

Doral Yoongarillup Mine Closure Obligations Checklist

Source	Section Reference	Closure Obligation	Evidence of Conformance
<i>Aboriginal Heritage Act 1978.</i>	Part IV	Heritage sites are not to be altered, excavated, damaged, concealed or any portion of the site removed in anyway, unless granted via Section 16 or 18 under the Aboriginal Heritage Act 1978.	
<i>Agriculture and Related Resources Protection Act 1976</i>	Part V, Division IV (47)	The occupier of any private land shall control declared plants and declared animals on and in relation to that land.	
<i>Contaminated Sites Act 2003.</i> <i>Contaminated Sites Regulations 2006.</i>	Part I, Section 11 Part II (6)	The proponent or individuals are to report known or suspected areas of contaminated sites.	
<i>Contaminated Sites Act 2003.</i>	Part III, (23)	Sites classified as Contaminated - Remediation Required as described under the Contaminated Sites Act 2003 are to be remediated.	
<i>Environmental Protection (Controlled Waste)</i>		Disposal of asbestos is to be separated, wrapped and labelled and disposed in accordance with Part III,(6)(44)	
<i>Environmental Protection (Controlled Waste)</i>		The proponent is to treat all products listed in schedule 1 of the Environmental Protection (Controlled Waste) Regulations 2004 as a controlled waste.	
<i>Environmental Protection Act 1986.</i>	Part V, (49)	Proponent shall not cause pollution or an unreasonable emission of noise, odour or electromagnetic radiation.	
<i>Environmental Protection Act 1986.</i>	Part V, (51)	The proponent shall not clear native vegetation without the relevant approval (e.g. clearing permit) in place.	
<i>Health Act 1911.</i>	Part IV (2) (87)	The proponent shall ensure (stagnant) pools, ponds, open ditches, and drains do not become offensive to the public or allow these areas to become prejudicial to human health.	

Source	Section Reference	Closure Obligation	Evidence of Conformance
<i>Health Act 1911. Environmental Protection (Controlled Waste)</i>	Part IV (3) (95) Part III	Removal of sewerage systems is to be conducted in accordance with Local Government Law and by a licensed contractor in accordance with the Environmental Protection (Controlled Waste) Regulations 2004.	
<i>Mines Safety and Inspection Regulations 1995.</i>	Part III, (2)(3.11)	Notification of suspension of mining operations must be in writing and include the requirements specified in Section 3.14 of the regulations.	
<i>Mines Safety and Inspection Regulations 1995.</i>	Part III, (2)(3.16)	At notification of abandonment the proponent is required to notify the department how the following has been achieved: <ul style="list-style-type: none"> • Secure the site against inadvertent public access. • Prevent and mitigate mine subsidence. • Plant and equipment removed or secured and left in a safe condition. • Hazardous substances removed or properly disposed. 	
<i>Mines Safety and Inspection Regulations 1995.</i>	Part XVI, (2)(16.35)	The proponent shall submit a plan with the notification which shows: (a) the specific locations in which radioactive waste has been buried; and (b) the absorbed dose rates in air one metre above the final surface.	
<i>Mines Safety and Inspection Regulations 1995.</i>	Part XVI, (2)(16.35)	After the mine is abandoned, rehabilitation sites are to be inspected and monitored at such intervals and in such a way as is approved by the State mining engineer.	
<i>Mines Safety and Inspection Regulations 1995.</i>	Part XIII, (13.8)	The principal employer at, and the manager of, a mine must ensure that geotechnical aspects are adequately considered in relation to the design, operation and abandonment of quarry operations.	
<i>Mining Act 1978</i>	Part IV (84AA)	A mine closure plan is required to be approved by the Department and reviewed every 3 years, or as specified by the Department.	
<i>Mining Act 1978.</i>	Part III (1)(20)(3a)	Make safe all holes, pits, trenches and other disturbances on the surface of the land which are likely to endanger the safety of any person or animal.	
<i>Mining Act 1978.</i>	Part III (1)(20)(3b)	Take all necessary steps to prevent fire and damage to trees or other property.	

Source	Section Reference	Closure Obligation	Evidence of Conformance
<i>Mining Regulations 1981.</i>	Part V, (6)(97)	Avoid activity that obstructs any public thoroughfare or undermines any road, railway, dam or building in such manner as to endanger the public safety.	
<i>Mining Regulations 1981.</i>	Part V, (6)(98)	The proponent shall not allow detritus, dirt, sludge, refuse, garbage, mine water or pollutant from the tenement to become an inconvenience to the holder of any other mining tenement or to the public, or in any way injure or obstruct any road or thoroughfare or any land used for agricultural purposes.	
<i>Soil and Land Conservation Act 1945.</i>	Part V (32)	The proponent shall take adequate precautions to prevent or control soil erosion, salinity or flooding; or the destruction, cutting down or injuring of any tree, shrub, grass or any other plant on land where land degradation is occurring or likely to occur.	
<i>Wildlife Conservation Act 1950</i>	(16 and 23F)	A person may not take for any purpose protected fauna or flora without a licence, or rare and endangered flora without the written consent of the Minister.	



YOONGARILLUP Mineral Sands Project

Public Environmental Review

Revision B - May 2014



Submitted for OEPA Review

EPA Assessment No: 1938

EPBC Reference: 2012/6521

Doral Reference: DMS-ENVIRO-216

AMENDMENT REGISTER

[illegible]

INVITATION TO MAKE A SUBMISSION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. Both electronic and hard copy submissions are most welcome.

Doral Mineral Sands Pty Ltd proposes to extract ore from the strand of heavy mineral deposit known as the Yoongarillup Mineral Sands Deposit, located approximately 17km southeast of Busselton, Western Australia. In accordance with the *Environmental Protection Act 1986* (EP Act), a Public Environmental Review (PER) has been prepared which describes this proposal and its likely effects on the environment. The PER is available for a public review period of [4] weeks from 7 July 2014 closing on 4 August 2014 {Dates to be updated upon approval to release PER}

Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government.

HOW TO OBTAIN A COPY OF THIS DOCUMENT?

The Public Environmental Review document will be made available for viewing in person at the following locations:

Environmental Protection Authority

Library / Reading Room
The Atrium
168 St Georges Terrace
PERTH WA 6000

Shire of Busselton Library

Stanley St
BUSSELTON WA 6280

J S Battye Library / WA State Library

Perth Cultural Centre
25 Francis Street
NORTHBRIDGE WA 6003

Doral Mineral Sands Pty Ltd

Lot 7 Harris Road
PICTON WA 6229

The document will be available online at the Doral website - www.doral.com.au

The document may be purchased in hardcopy format from Doral Mineral Sands for a fee of \$ 10.00 (includes postage and packaging). A CD version is also available upon request. Please contact Doral Mineral Sands should you require a hardcopy version of the document.

Doral Mineral Sands Pty Ltd

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WHY WRITE A SUBMISSION?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992* (FOI Act), and may be quoted in full or in part in the EPA's report.

WHY NOT JOIN A GROUP?

If you prefer not to write your own comments, it may be worthwhile joining a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

DEVELOPING A SUBMISSION

You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposal. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements of the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

POINTS TO KEEP IN MIND

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether you want your submission to be confidential and the reasons why you wish to keep your submission confidential.

Information in submissions will be deemed public information unless a request for confidentiality of the submission is made in writing and accepted by the EPA. As a result, a copy of each submission will be provided to the proponent but the identity of private individuals will remain confidential to the EPA.

The closing date for submissions is: 4 August 2014 {To be updated upon approval to release PER}.

The EPA prefers submissions on PER documents to be made electronically on its consultation hub at <https://consultation.epa.wa.gov.au>.

Alternatively, submissions can be:

Posted To:

Chairman, Environmental Protection Authority
Attention: EPA Assessment Officer - Tim Gentle
Locked Bag 33
CLOISTERS SQUARE WA 6850

Delivered To:

Environmental Protection Authority
Attention: EPA Assessment Officer - Tim Gentle
Level 4, The Atrium,
168 St Georges Terrace
PERTH WA 6000

Faxed To:

Environmental Protection Authority
Fax Number: 08 6467 5562

If you have any questions on how to make a submission, please ring the EPA assessment officer, Tim Gentle on 6145 0809.

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LIST OF ABBREVIATIONS

\$A	Australian Dollars
AB, AW	Abba
ACMC	Aboriginal Cultural Materials Committee
ASS	Acid sulfate soils
BCGA	Busselton - Capel Groundwater Area
BCM	Bulk Cubic Metres
BOM	Bureau of Meteorology
°C	Degrees Celsius
CAMBA	China-Australia Migratory Bird Agreements
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CE	Critically endangered
CL	Cleared Pasture
CMP	Conservation Management Plan
CR	Critically Endangered
CTRC	Conservation Through Reserves Committee
DAFWA	Department of Agriculture and Food Western Australia
DAWA	Department of Agriculture Western Australia
dB	Decibels
DBH	Diameter at Breast Height
DER	Department of Environment Regulation
DoE	[Commonwealth] Department of Environment
DHIMS	Doral's Hazard and Incident Management System
DMAs	Decision Making Authorities
DMP	Department of Mines and Petroleum
DSEWPaC	[Commonwealth] Department of Sustainability, Environment, Water, Population and Communities
DoW	Department of Water
DPaW	Department of Parks and Wildlife
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EMP	Environmental Management Plan
EN	Endangered
EPBC	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPA	Environmental Protection Authority
EP Act	<i>Environmental Protection Act 1986</i>
ESA	Environmentally Sensitive Area

ESD	Environmental Scoping Document
FCT	Floristic Community Type
GL	Gigalitres
GPS	Global Positioning System
ha	Hectare
HMC	Heavy Mineral Concentrate
IBRA	International Biogeographic Region Australia
JAMBA	Japan-Australia Migratory Bird Agreements
JF2	Southern Jarrah Forest
Km	Kilometre
LTV	Long-term Irrigation Value
m	Metre
m/d	Metre(s)/day
mbgl	Metres below ground level
mg/L	Milligrams per litre
mm	Millimetre
ML	Megalitres
MNES	Matters of National Environmental Significance
NES	National Environmental Significance
NW/SW	North West/South West
OEPA	Office of the Environmental Protection Authority
P	Priority
PEC	Priority Ecological Community
PER	Public Environmental Review
PD	Presumed totally destroyed
pH _F	Field pH
pH _{FOX}	Field Oxidised pH
PWP	Process Water Pond
ROKAMBA	Republic of Korea- Australia Migratory Bird Agreements
RFA	Regional Forest Agreement
RIWI Act	<i>Rights in Water and Irrigation Act 1914</i>
SCP	Swan Coastal Plain
SEPs	Solar Evaporation Ponds

EXECUTIVE SUMMARY

INTRODUCTION

Doral Mineral Sands Pty Ltd (Doral) proposes to extract ore from the strand of heavy mineral deposit, known as the Yoongarillup Mineral Sands Deposit located within Mining Tenements M70/458 and M70/459. The Proposal was referred to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986* (EP Act) on 22 March 2012. On the 27 August 2012 the EPA determined the level of assessment for the Proposal as Public Environmental Review (PER) with a four week public review period (Assessment No. 1938). The EPA prepared and issued the Environmental Scoping Document in January 2013 (Appendix 2-A).

The Proposal was referred to the Commonwealth Department of the Environment (DoE) on 24 August 2012 for consideration under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). On 26 September 2012, the DoE determined that the Proposal is a controlled action and requires assessment and decision on approval under the EPBC Act (EPBC Reference: 2012/6521).

The Proposal is being assessed under the intergovernmental bilateral agreement between the Commonwealth of Australia and the State of Western Australia under Section 47 of the EPBC Act. The bilateral agreement allows the Commonwealth Minister for the Environment to rely on the State environmental impact assessment (EIA) process in assessing this action under the EPBC Act so long as the State process considers and addresses those matters protected under the EPBC Act.

The purpose of this PER is to outline the Proposal, undertake an EIA of the Proposal and to demonstrate that following the implementation of the environmental management measures that the Proposal could be implemented in a manner that is environmentally acceptable.

This PER has been prepared in accordance with the ESD, the *Generic Guidelines for Preparing a Public Environmental Review* (OEPA, 2012) and *Environmental Assessment Guideline No. 8 Environmental Assessment Guidelines for Environmental factors and objectives* (EPA, 2013).

OVERVIEW AND KEY CHARACTERISTICS OF PROPOSAL

The Yoongarillup Mineral Sands Project (the Proposal) is to allow mining of the Yoongarillup Mineral Sands Deposit, a strand of heavy mineral deposit located adjacent to the Whicher Scarp, 17km southeast of Busselton, Western Australia. Approximately 4,000,000t will be extracted from the deposit to produce 256,000t of heavy mineral concentrate (HMC). HMC product to be generated from mining the deposit includes zircon, ilmenite and rutile.

Ore from the deposit will be mined progressively via a series of open-cut pits using dry mining techniques. Dewatering of groundwater inflows into the pit will be required to enable dry mining to occur. Mining will be staged in order to minimise the area of disturbance at any one time.

Processing of ore will commence in-pit and then slurry will be pumped from the feed preparation plant to the wet concentration plant for further processing. Waste clay and sand materials from processing of this ore will be combined and backfilled into the mine voids using co-flocculation (co-disposal system) where possible. Some material will be initially placed in Solar Evaporation Ponds (SEPs), to allow drying of the clay and recycling of water back to the process water pond (PWP) (return water), prior to being co-disposed into mine voids. The mined area will be rehabilitated back to pasture and / or native vegetation, consistent with the post-mine land use requirements.

HMC resulting from the wet concentrator plant processing will be stockpiled on site prior to transport to Doral's Picton Dry Separation Plant, located approximately 63km north-east of the mine, for separation using electrostatic processes. Processing activities at the Picton Dry Separation Plant and exporting of HMC product are not part of this Proposal and are not further described in this PER.

The Proposal has a total ground disturbance area of 95.71ha within a Development Envelopment of 151.97ha. 8.90ha of the disturbance area is located in an area of State Forest No. 33 which has previously undergone partial clearing and has since revegetated, excluding an area of 0.22ha which remains cleared. A total of 86.81ha of the disturbance area is located on previously cleared land currently used for farming activities.

Key characteristics for the Proposal are summarised in Table ES - 1. It should be noted that areas stated in the table have been rounded to the nearest whole number as requested by the Office of the EPA (OEPA).

TABLE ES - 1 KEY PROPOSAL CHARACTERISTICS TABLE

SUMMARY OF THE PROPOSAL	
Proposal Title	Yoongarillup Mineral Sands Project
Proponent Name	Doral Mineral Sands Pty Ltd
Short Description	The proposal is to extract ore from the Yoongarillup Mineral Sands Deposit, 17km southeast of Busselton, including the construction of associated mine infrastructure (offices, workshops, laydown area, roads, ore processing facilities and solar evaporation ponds).

PHYSICAL ELEMENTS		
ELEMENT	LOCATION	PROPOSED EXTENT AUTHORISED
Mine Pits	Figure 1-1 – Locality Plan Figure 1-2 – Proposed Site Layout	Clearing no more than 9ha of native vegetation and 32ha of pasture within a 152ha development envelope
Associated Infrastructure	Figure 1-2– Proposed Site Layout	Clearing of no more than 27ha of pasture within a 152ha development envelope.
Solar Evaporation Ponds (i.e. Tailings Storage Facility)	Figure 1-2– Proposed Site Layout	Clearing no more than 29ha of pasture within a 152ha development envelope.

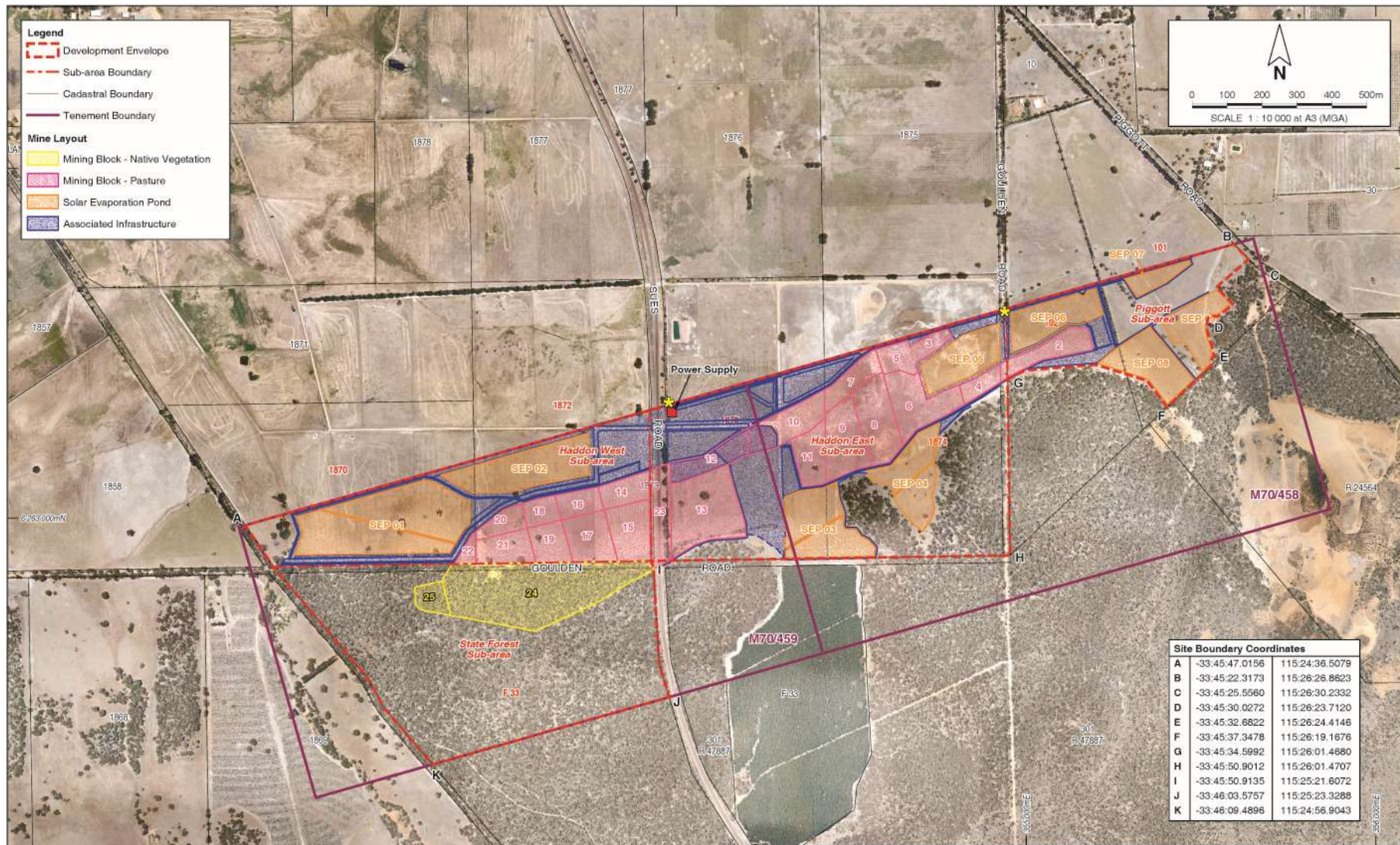
OPERATIONAL ELEMENTS		
ELEMENT	LOCATION	PROPOSED EXTENT AUTHORISED
Ore Processing (waste)	Solar Evaporation Ponds Figure 1-2– Proposed Site Layout	No more than 250,000 tonnes per annum
Dewatering	-	Extraction of no more than 1.6 Gigalitres per annum

PLATE ES - 1 LOCALITY PLAN



*This image is an extract from Figure 1-1

PLATE ES - 2 PROPOSED SITE LAYOUT



*This image is an extract from Figure 1-2

STAKEHOLDER CONSULTATION

Stakeholder consultation for the Proposal commenced in early 2011 with discussions with landowners directly affected by the Proposal and key Government agencies. Doral engaged stakeholders early in the planning process to achieve a collaborative approach and to ensure local knowledge is considered in the design and management of the Proposal.

Stakeholder consultation has included the following:

- Written communications to affected landowners discussing details of the following:
 - Overview and regular updates of the Proposal;
 - Exploration drilling programs;
 - Scope and purpose of environmental technical studies;
 - Landowner access arrangements;
 - Notification of submission of the EP Act referral for the Proposal;
 - The EPA determination of a PER level of assessment for the Proposal.
- Telephone and email discussions with landowners to discuss upcoming studies/work and organise access arrangements for relevant staff/contractors;
- Meetings and presentation with City of Busselton councilors to present an overview of Doral and details of the Proposal;
- Meetings, telephone and email discussions with key Government agencies to discuss various aspects of the Proposal. These include:
 - Office of the Environmental Protection Authority (OEPA);
 - Department of Parks and Wildlife (DPaW);
 - Department of Environment Regulation (DER);
 - Department of Mines and Petroleum (DMP);
 - Department of Water (DoW);
 - Department of Environment (DoE);
 - Mains Road Western Australia;
 - City of Busselton.
- Consultation with the South West Aboriginal Land and Sea Council (SWALSC) as part of the ethnographic and archaeology surveys and the selection of Aboriginal consultants from the South West Boojarah (SWB) claim. This included interviews and site inspections with the South West Boojarah consultants and consultation regarding the findings of the surveys.

A summary of the stakeholder consultation that has occurred to date, including a summary of discussion points, primary issues raised and Doral's response to these is provided in Section 4 of the PER.

KEY ENVIRONMENTAL FACTORS

As detailed in the ESD (Appendix 1) and in accordance with EPA (2013), the key environmental factors relevant to the Proposal are:

- Flora and Vegetation;
- Terrestrial Fauna;
- Hydrological Processes;
- Rehabilitation and Closure;
- Residual Risk Management (Offsets).

In accordance with EPA (2013), 'Rehabilitation and Closure' and 'Offsets' are now considered to be 'integrating factors'. As the ESD identified Rehabilitation and Mine Closure (i.e. Rehabilitation and Closure) and Residual Risk Management (i.e. Offsets) as key environmental factors, Doral has continued to address these aspects in accordance with the ESD.

Other Environmental Matters listed in the ESD as requiring consideration as part of the environmental review of the Proposal are:

- Water resources;
- The impact of groundwater drawdown on the Vasse-Wonnerup System;
- Dieback mapping and management;
- Dust;
- Noise.

Prior to the release of EPA (2013), these other environmental matters were previously identified as 'other environmental factors'. Although the ESD referred to these as 'other environmental factors', Doral has updated this terminology to be consistent with EPA (2013).

In addition to the above environmental/integrating factors and other environmental matters, page 2 of the ESD requests a separate section to be included in the PER document to identify and discuss Matters of National Environmental Significance (MNES).

Table ES - 2 summarises relevant information for each environmental/integrating factor including management objectives, existing environment, potential impacts, management strategies/proponent commitments and predicted outcomes. Table ES - 3 provides a summary of the relevant information relating to MNES.

TABLE ES - 2 EXECUTIVE SUMMARY OF THE IMPACTS AND PROPOSED MANAGEMENT COMMITMENTS FOR ENVIRONMENTAL / INTEGRATING FACTORS

ENVIRONMENTAL /INTEGRATING FACTOR	Flora and Vegetation	Table ES-2 (1)
MANAGEMENT OBJECTIVES	To maintain representation, diversity, viability and ecological function at the species, population and community level.	
EXISTING ENVIRONMENT		
<p>The Development Envelope varies extensively in its current condition from grazed and previously cleared agricultural holdings to grazed remnant bushland areas to more intact State Forest areas. The Development Envelope has been divided into four sub-areas:</p> <ul style="list-style-type: none">State Forest sub-area;Haddon West sub-area;Haddon East sub-area;Piggott’s sub-area. <p>The Haddon West and Piggott sub-areas are essentially clear of native vegetation (i.e. cleared pasture with scattered trees/shrubs), with the Haddon’s East sub-area having only a small amount of native vegetation. The remainder of the Haddon East sub-area contains no native vegetation, with the exception of some scattered trees/shrubs. The State Forest sub-area is relatively undisturbed with the m ajority of the vegetation (97%) rated by Ecoedge Environmental (2013) as Very Good or Excellent condition, with only a small area on the northern boundary previously used as a sand pit being rated as Completely Degraded.</p> <p>Ecoedge Environmental (2013) mapped three plant communities (A, B and C). Two of these communities were divided into three sub-communities. No Threatened or Priority Ecological Communities were identified within the State Forest sub-area.</p> <p>Two Threatened flora species, <i>Daviesia elongata</i> subsp. <i>elongata</i> and <i>Verticordia densiflora</i> var. <i>pedunculata</i> were recorded within the State Forest sub-area. Both of these species are listed as Threatened pursuant to subsection (2) of Section 23F of the WC Act. <i>Daviesia elongata</i> subsp. <i>elongata</i> is listed as Vulnerable and <i>Verticordia densiflora</i> var. <i>pedunculata</i> is listed as Endangered pursuant to Section 179 of the EPBC Act. Two Priority listed species pursuant to subsection (2) of Section 23F of the WC Act; <i>Conospermum paniculatum</i> (P3) and <i>Acacia semitrullata</i> (P4) were also recorded within the State Forest sub-area.</p>		
POTENTIAL IMPACTS		
<p>Clearing of 8.68ha of native vegetation for the Proposal will reduce the extent of the Whicher Scarp soil-landscape system, the Yelverton (Y) vegetation complex, vegetation communities and disturb Threatened, Priority and regionally significant flora.</p> <p>Numerical groundwater flow modelling by PB (2014a) has shown that no adverse impacts to groundwater-dependant vegetation (therefore fauna habitats) within the State Forest sub-area or Whicher National Park are expected from groundwater drawdown during short-term dewatering of the mine pit.</p> <p>Mining activities and vehicle movement have the potential to result in the spread of weeds and pathogens including dieback within and outside of the Development Envelope.</p> <p>Mining activities and vehicle movement has the potential to generate dust which may directly affect adjacent vegetation.</p> <p>Changes to fire regime from introduced ignition sources.</p>		
ENVIRONMENTAL MANAGEMENT / MANAGEMENT STRATEGIES / PROPONENT COMMITMENTS		
<p>Doral will develop and implement a Flora and Vegetation Management Plan to address potential impacts to flora and vegetation. The Flora and Vegetation Management Plan will include the following key management actions:</p> <ul style="list-style-type: none">Development and implementation of specific clearing procedures to minimise impacts to flora and vegetation. This will include demarcation of cleared areas and authorisation requirements;Establishment of specific stockpile locations and procedures to store and manage crushed vegetation, topsoil, subsoil and overburden from within dieback infested and non-dieback infested areas of the State Forest and Haddon East sub-areas;Any Threatened flora which will not be cleared will be marked using flagging tape and a 50m buffer will be established around the plant and considered an Environmentally Sensitive Area (ESA);Any Priority flora which will not be cleared will be marked using flagging tape and avoided;Impacts to regionally significant flora will be minimised where possible;Locations of the Declared Plant <i>Zantedeschia aethiopica</i> will be marked with flagging tape and managed in accordance with Control Code Requirements P1 and P4 (Department of Agriculture and Food, 2011);Weed management measures will be incorporated into the ongoing management of flora and vegetation for the Proposal. <p>Doral will also implement the following management plans to manage impacts to flora and vegetation values:</p> <ul style="list-style-type: none">Rehabilitation Management Plan;Dieback Management Plan;Dust Management Plan;Fire Management Plan.		
PREDICTED OUTCOMES		
<p>The Proposal will require clearing of up to 8.68ha of native vegetation and 87.03ha of cleared pasture/area (includes 0.22ha of cleared area within the State Forest sub-area). Disturbance to the cleared pasture will also result in the loss of approximately 31 scattered trees/shrubs.</p> <p>Clearing for the Proposal represents 0.09% of the area remaining of the Whicher Scarp soil-landscape system and does not significantly reduce the regional extent of this soil-landscape system.</p> <p>Clearing for the Proposal represents 0.25% of the area remaining of the Yelverton (Y) vegetation complex and does not significantly reduce the extent of this vegetation complex and is in keeping with the target’s set in the EPA’s Position Statement No. 2 (EPA, 2000) (i.e. 30% or more).</p> <p>No PEC or TEC will be impacted by the Proposal.</p> <p>Approximately 52% of vegetation community A (predominantly the A2 sub-community) will be lost as a result of clearing for the Proposal.</p> <p>Impacts to the Threatened flora <i>Daviesia elongata subsp. elongata</i> are not considered to be significant as only six individuals (0.59%) of the known population of 1,016 mature plants (DEC, 2007), will be impacted. This species is known from seven locations of which one is located within a nature reserve which is managed for conservation of flora and fauna. The other subpopulations are located with State forests, with the exception of subpopulations 1 and 2 which occur in Shire reserves (DEC, 2007). Known populations are healthy and not immediately threatened (DEC, 2007).</p> <p>The population of the Threatened flora <i>Verticordia densiflora</i> var. <i>pedunculata</i> within the State-Forest sub-area will not be impacted by the Proposal.</p> <p>Populations of the Priority flora <i>Conospermum paniculatum</i> (P3) and <i>Acacia semitrullata</i> (P4) will be reduced, however these species are known from several locations outside of the Development Envelope. It is considered that the conservation status of these species is unlikely to change.</p> <p>No significant impacts to regionally significant flora will occur as a result of the Proposal.</p> <p>Although Doral considers the impacts to flora and vegetation to not be significant, Doral recognises the value of the Whicher Scarp and is committed to providing a suitable offset to secure a positive environmental outcome for the State on a ‘like for like’ principle (or as near to as practicable). Doral is currently negotiating with DPaW regarding a suitable land acquisition.</p>		

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ENVIRONMENTAL /INTEGRATING FACTOR	Terrestrial Fauna	Table ES-2 (2)
MANAGEMENT OBJECTIVES	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.	
EXISTING ENVIRONMENT		
<p>The majority of the Development Envelope is cleared of native vegetation and is used for livestock grazing, providing very little habitat value for native fauna. However, native vegetation occurs within the State Forest sub-area adjacent to the Whicher Scarp National Park and within the Haddon East sub-area. Fauna habitat within the State Forest and Haddon East sub-areas is dominated by woodlands or forests of Jarrah and/or Marri with variations occurring with respect to the numbers and types of subdominant mid and lower storey species (e.g. Mountain Marri, Banksia, Sheoak, Woody Pear and various shrubs). Twelve fauna habitats were mapped within the Development Envelope. These fauna habitats were based on the vegetation units of Ecoedge Environmental (2013) and Mattiske (2012a). Fallen logs (some hollow) and trees with hollows are relatively common within this area providing further habitat.</p> <p>Evidence of 95 species of native vertebrate fauna was obtained during the level 2 survey (captured, sighted, heard, recorded, signs) comprising of 52 native bird species, 14 native mammal species, 25 reptile species and 4 amphibian species. This is approximately 53% of the total number of potential native species (based on previous fauna surveys in the area and desktop investigations). The following species of conservation significance are likely or known to occur within the Development Envelope:</p> <div><div><ul style="list-style-type: none">Western Brush Wallaby (<i>Macropus Irma</i>);Quenda (<i>Isoodon obesulus fusciventer</i>);Rainbow Bee-eater (<i>Merops ornatus</i>);Cattle Egret (<i>Ardea ibis</i>);Great Egret (<i>Ardea alba</i>).</div><div><ul style="list-style-type: none">Forest Red-tailed Black-Cockatoo (<i>Calyptorhynchus banksii naso</i>);Carnaby’s Black-Cockatoo (<i>Calyptorhynchus latirostris</i>);Baudin’s Black-Cockatoo (<i>Calyptorhynchus baudinii</i>;Coastal Plains Ctenotus (<i>Ctenotus ora</i>);</div></div>		
POTENTIAL IMPACTS		
<div><ul style="list-style-type: none">Vegetation clearing for the Proposal will directly remove fauna habitat and consequential displacement of fauna. In total 8.68ha of remnant vegetation (known to support conservation significant fauna) will be cleared for the Proposal. The majority of disturbance for the Proposal (91%) will occur within cleared areas.Trenching for drains and presence of artificial water bodies may result in the loss/injury of individual fauna.The redistribution of surface water flows around the mine and its infrastructure may alter fauna habitat.Changes to fire regime from introduced ignition sources.Potential increase in the number of predatory introduced species.Light and noise emissions.Potential spread of dieback and weeds which could lead to the degradation or alteration of fauna habitat.Vehicle movements during construction and operation may result in the loss of individual fauna, especially less-mobile species, from vehicle strikes.</div> <p>Numerical groundwater flow modelling by PB (2014) has shown that no adverse impacts to groundwater-dependant vegetation (therefore fauna habitats) within the State Forest sub-area or Whicher National Park are expected from groundwater drawdown during short-term dewatering of the mine pit.</p>		
ENVIRONMENTAL MANAGEMENT / MANAGEMENT STRATEGIES / PROPONENT COMMITMENTS		
<p>Doral will develop and implement a Fauna Management Plan to address potential impacts to fauna of conservation significance and their associated habitat. The Fauna Management Plan will include the following key management actions:</p> <div><ul style="list-style-type: none">Development and implementation of specific clearing procedures to minimise impacts to fauna and fauna habitats. This will include demarcation of cleared areas, pre-clearing surveys (see above) and authorisation requirements;Staged clearing where practical. This involves the initial clearing of vegetation excluding habitat trees and any significant habitat areas identified in the pre-clearing surveys. These areas are left overnight allowing tree—dwelling fauna and /or fauna occurring in habitat areas to escape overnight to surrounding bushland;Clearing activities will be conducted between January and May to avoid the breeding season of fauna of conservation significance, particularly Black Cockatoos;A suitably qualified fauna spotter/carer will be on site during clearing operations to conduct daily checks of vegetation to be cleared and retrieve fauna if necessary. The fauna spotter will be responsible for all activities related to the protection and welfare of individual fauna;Vehicle speeds on site will be restricted. All collisions with fauna are to be reported and recorded through Doral’s Hazard and Incident Management System (DHIMS);Native fauna injured during clearing or normal site operations should be taken to a designated veterinary clinic or a DPaW nominated wildlife carer;No dead, standing or fallen timber will be removed from site unnecessarily. Logs and other debris resulting from land clearing will be used to enhance fauna habitat in untouched and rehabilitated areas;All staff working on site will be educated with regards to protected fauna;Weapons and pets will not be permitted on site;Wastes will be managed appropriately to ensure that fauna have no access to scraps or rubbish;Lights at night will be directed towards construction and operation activities and will be in accordance with <i>AS4282-1997 Control of the obtrusive effects of outdoor lighting</i>; andTo minimise the potential impacts of artificial water bodies and drains on fauna Doral will:<div><ul style="list-style-type: none">Design the site as to reduce accessibility to most artificial water sources and drains;If artificial ponds or drains are directly adjacent to native vegetation then use fencing to exclude larger animals;Prevent overflow of artificial waterbodies and drains in dry conditions;Use fauna deterrent devices such as high visibility material flapping over water bodies;Non-slippery sides to ponds/drains and/or egress points so that any animals that enter the artificial waterbody may escape;Any trenching required for services or drains should be kept open only for as long as necessary and suitable escape ramps provided.</div></div> <p>Environmental targets and performance indicators will be developed to ensure fauna management can be monitored and audited.</p>		
PREDICTED OUTCOMES		
<div><ul style="list-style-type: none">Approximately 95.71ha of terrestrial fauna habitat will be disturbed by the Proposal of which 87.03ha is cleared and considered of little value to fauna and 8.68ha is considered of value to several species of conservation significance.It is likely that the Proposal will result in a temporary reduction in the availability of foraging, breeding and roosting habitat for three conservation significant Black-Cockatoo species. However, there is predicted to be an overall net gain in Black-Cockatoo foraging, breeding and roosting habitat as a consequence of rehabilitation of mined areas in combination with proposed long-term conservation offsets (land acquisition).It is likely that the Proposal will result in a temporary reduction in the availability of fauna habitat for the Coastal Plains Ctenotus. The impacts to this species are however, unlikely to be significant given small impact area and the large areas of adjoining habitat, and the site rehabilitation and ecological offsets proposed resulting in a long-term overall net increase in habitat for this species.It is likely that the Proposal will result in a temporary reduction in the availability of fauna habitat for mammals such as the conservation significant Western Brush Wallaby and Southern Brush-tailed Phascogale on a local scale. Given the site rehabilitation and ecological offsets proposed, significant impacts to these species are unlikely and an overall net increase in habitat is predicted.It is likely that the Proposal will result in a temporary reduction in the availability of fauna habitat for those species that live in the area and have specific habitat requirements. However these impacts are considered to be at a local scale and of a temporary nature as site rehabilitation and ecological offsets will result in a long-term overall net increase in fauna habitat and fauna habitat values.Impacts to short–range endemic species is not expected to occur as a result of the Proposal, as it is unlikely that any of the invertebrate taxa encountered would be restricted to the locality of the Development Envelope. This is due to the absence of geomorphological boundaries or subdivisions that may represent isolating mechanisms for potential short–range endemic invertebrate species.No fauna of conservation significance (listed under the WC Act or EPBC Act) will cease to exist or have its conservation status affected as a result of the Proposal.No priority species as listed by the DPaW will cease to exist or have its priority status affected as a result of the proposal.</div> <p>Significant regional impact to fauna is unlikely as only a small proportion of similar woodland and forest habitat will be impacted. Similar habitat occurs extensively outside the Development Envelope.</p>		

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ENVIRONMENTAL /INTEGRATING FACTOR	Hydrological Processes	Table ES-2 (3)
MANAGEMENT OBJECTIVES	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.	
EXISTING ENVIRONMENT		
<p>Three aquifers are recognised locally, which are hosted within the local stratigraphy; the Superficial aquifer, the Leederville aquifer and the deeper Yarragadee aquifer. Based on background data, groundwater water quality is similar to the values associated with a ‘slightly to moderately disturbed’ ecosystem (ANZECC & ARMCANZ, 2000). The Proposal is located within the Busselton - Capel Groundwater Area (Superficial and Leederville aquifers) and the Busselton-Yarragadee Groundwater Area (Yarragadee aquifer).</p> <p>The Proposal is located within the catchment of the Vasse River and the Busselton Coast surface water management area. The majority of the catchment (80%) is cleared for agricultural use, and many drainage lines have previously been created across the landscape (PB, 2013c).</p>		
POTENTIAL IMPACTS		
<ul style="list-style-type: none">Short-term dewatering of mine pits and associated drawdown of the water table, have been modelled by PB (2014a) to show no expected impacts on:<ul style="list-style-type: none">Water availability at privately-owned bores; andNative vegetation within the State Forest sub-area and Whicher National Park.Short-term abstraction of water from the Yarragadee aquifer is not expected to impact other users of the Yarragadee aquifer or overlying aquifers as there are no known bores located within the drawdown cone generated by abstraction of water (PB, 2014a).Discharge of water in emergency situations will enter local paddock drains which are separate to major diversion drains in the region. Therefore there is no pathway for the discharged water to enter the Vasse River and/or move into the Vasse-Wonnerup System Ramsar wetland.A reduction in surface water yield in the Vasse River sub-catchment is not considered to be significant as the mine pits occupy only 1% of the Vasse River sub-catchment, and intercepts rainfall runoff from 2.76% of the sub-catchment (up-gradient of the mine pits and the mine pits).Hydrological and physico-chemical impacts on the Vasse-Wonnerup System Ramsar Wetland are unlikely given that the Ramsar wetland is located over 14km away (to the north) and the maximum extent of drawdown north is predicted to be approximately 350m (PB, 2014a).		
ENVIRONMENTAL MANAGEMENT / MANAGEMENT STRATEGIES / PROPONENT COMMITMENTS		
<ul style="list-style-type: none">Doral’s EMS will be updated to include the Yoongarillup Mineral Sands Mine, which will include plans and procedures to manage impacts to hydrological processes. These plans and procedures will be implemented to manage groundwater and surface water impacts.Supply affected bore owners with supplementary water as required.Pits will be backfilled as soon as possible following the cessation of mining.Following the first six months of dewatering, the groundwater model will be calibrated with the available groundwater monitoring data to verify the accuracy of the model and provide greater confidence in model predictions. If re-calibration of the model indicates drawdown will extend further than the initial extents predicted, then Doral will reassess the potential impacts of the drawdown, in consultation with relevant stakeholders and adapt management of the dewatering accordingly.Groundwater monitoring bores will be installed around SEPs screened within the Superficial aquifer to monitor any leakage.Volumes and quality of water discharged from the mine site will be recorded during emergency discharge events.Production bores will be placed in locations to avoid impacts to other Yarragadee aquifer users.Volumes of water abstracted from the Yarragadee aquifer will be recorded monthly.Reporting in accordance with conditions of the approvals documents (Ministerial Statement, RIWI Act licences, DER Licence to Operate etc.).		
PREDICTED OUTCOMES		
<ul style="list-style-type: none">Three privately-owned bores may be affected by drawdown of up to 4.5m (20005669) and by up to 1m (20005670 and 20005671) during the life of mine. Impacts will be mitigated by the supply of supplementary water to meet the needs of the bore owners.No adverse impacts to groundwater-dependent vegetation within the State Forest sub-area or Whicher National Park are expected from groundwater drawdown during short-term dewatering of mine pits.No adverse impacts to other users of the Yarragadee aquifer are expected from abstraction of water from the Yarragadee aquifer.No adverse impacts to water quality within paddock drains from the emergency discharge of water.No adverse impacts to the Vasse—Wonnerup System Ramsar Wetland.		

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ENVIRONMENTAL /INTEGRATING FACTOR	Rehabilitation and Closure	Table ES-2 (4)
MANAGEMENT OBJECTIVES	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.	
EXISTING ENVIRONMENT		
<p>The Proposal has a total ground disturbance area of 95.71ha. 8.90ha of the disturbance area is located in an area of State Forest No. 33 which has previously undergone partial clearing and has since revegetated, excluding an area of 0.22ha which remains cleared. A total of 86.81ha of the disturbance area is located on previously cleared land currently used for farming activities (beef cattle, dairy cattle and pasture).</p> <p>State Forest No. 33, also known as Millbrook State Forest, is managed by the DPaW and lies within the Whicher Scarp soil-landscape system (DAFWA, 2007), immediately adjacent to the Whicher National Park. A Floristic Survey of the Whicher Scarp (Keighery <i>et al.</i>, 2008) places the project area in the Central Whicher Scarp. This is described as having moderate north facing slopes with areas of laterite capped rises and soils ranging from deep sands to sand, gravel, silt, clay and ironstone combinations.</p> <p>Ecoedge Environmental (2013) rated the vegetation within the State Forest sub-area as Very Good or Excellent condition, with only a small area (0.08 ha) on the northern boundary previously being used as a sand pit being rated as 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, Ecoedge Environmental (2013) estimates the clearing was probably conducted during the period 1950-1965, perhaps in readiness for pine planting that did not eventuate.</p> <p>Parts of the previously cleared area are relatively species poor and there is evidence of heavy kangaroo grazing through the State Forest sub-area. A strip around the east and north sides of the State Forest sub-area shows no signs of previous clearing which resulted in the vegetation being classified as excellent condition. <i>Phytophthora</i> disease is present along the eastern boundary and part of the western boundary, evidenced by scattered deaths of <i>Eucalyptus marginata</i> and <i>Xanthorrhoea</i> species (Moore Mapping, 2014). Scattered deaths of <i>Banksia grandis</i>, particularly near the southern boundary of the State Forest sub-area are a result of drought. Dumping of domestic and farm refuse has been carried out in various places along the tracks in the northern and western parts. (Ecoedge Environmental, 2013). The proportion and cover of introduced species is generally low throughout.</p> <p>The disturbed areas post mining, will be progressively rehabilitated back to pasture and native vegetation, as agreed with the land owners and consistent with pre-mining land use.</p>		
POTENTIAL IMPACTS		
<p>After review of the international and national body of relevant literature for mine rehabilitation (refer to Appendix 12), the issues listed below were considered to be of importance for rehabilitation of surface mining in southwest Western Australia:</p> <ul style="list-style-type: none">Characterization and reconstruction of soil profiles including:<ul style="list-style-type: none">Pre-mining characterisation of natural soil profiles and landforms;Removal and management of vegetation and topsoil; andSoil profile reconstruction to support post mining land use objectives.Species selection and seed management including:<ul style="list-style-type: none">Plant species selection; andSeed collection.Plant establishment including:<ul style="list-style-type: none">Plant establishment techniques;Controlling threats to rehabilitation success; and completion criteria and monitoring. <p>The potential impacts of not successfully addressing these issues will result in poor rehabilitation and closure procedures which will result in a number of undesirable impacts to the receiving environment. These may include:</p> <ul style="list-style-type: none">Loss or change in species biodiversity;Loss or change in species composition;Compaction of soil layers resulting in poor infiltration;Loss or change in pasture productivity;Depletion of topsoil resources; andIntroduction of <i>Phytophthora</i> dieback or weeds to rehabilitated areas.		
ENVIRONMENTAL MANAGEMENT / MANAGEMENT STRATEGIES / PROPONENT COMMITMENTS		
<p>Doral will implement a Rehabilitation Management Plan for the Proposal which will include the following key aspects:</p> <ul style="list-style-type: none">A surface profile reconstruction plan;A topsoil management plan; andA seed bank management plan. <p>In addition Doral will implement a Mine Closure Plan (Appendix 12) which has been developed in accordance with EPA/DMP (2011) and EPA (2006b) guidance and a Dieback Management Plan.</p>		
PREDICTED OUTCOMES		
<p>Doral considers that by implementing the requirements of the rehabilitation management plan and the Mine Closure Plan which has been developed using best practice techniques, successful mine rehabilitation will be achieved that will meet the EPA’s objective of ensuring that a planning process is in place so that the mine can be decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed post-mining outcomes and land-uses and without unacceptable liability to the State.</p>		

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ENVIRONMENTAL /INTEGRATING FACTOR	Residual Risk Management - Offsets	Table ES-2 (5)
MANAGEMENT OBJECTIVES	To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.	
EXISTING ENVIRONMENT		
<p>Clearing 8.68ha of native vegetation within the Whicher Scarp soil-landscape system that contains Threatened and Priority flora species.</p> <p>Temporary reduction in the availability of foraging, breeding and roosting habitat for three conservation significant Black-Cockatoo species. No fauna of conservation significance (listed under the WC Act or EPBC Act) will cease to exist or have its conservation status affected as a result of the Proposal.</p>		
POTENTIAL IMPACTS		
<ul style="list-style-type: none">Clearing of 8.68ha of Excellent to Very Good quality Yelverton vegetation within the Whicher Scarp soil-landscape system containing one Threatened and two Priority listed flora species.Loss of foraging, breeding and roosting opportunities will occur as a result of the proposal. The Proposal will result in clearing 8.68ha of Black-Cockatoo foraging and breeding habitat. This habitat is known to contain 110 identified black cockatoo habitat trees (i.e. DBH >50cm), of which 56 trees contain small hollows not suitable for a Black-Cockatoo, 10 trees containing large hollows possibly suitable for a Black-Cockatoo and one night roosting sites.		
ENVIRONMENTAL MANAGEMENT / MANAGEMENT STRATEGIES / PROPONENT COMMITMENTS		
<p>Doral is committed to delivering an offset strategy that addresses the requirements of both the State and Commonwealth Offset Policies. This will be achieved through the provision of both direct and contributing or compensatory offsets.</p> <p>Doral intend to use land acquisition as its primary method for providing a direct offset for the proposal. Doral have commenced discussions with DPaW to identify a suitable site or sites with conservation values that address the residual impacts of the proposal. Further consultation with the DoE will also be undertaken to ensure all the Commonwealth offset requirements are addressed.</p> <p>In identifying suitable offset sites, Doral will achieve the following:</p> <ul style="list-style-type: none">Secure, for conservation purposes, parcels of land within the Whicher Scarp that have conservation values that, in their present condition, are acceptable to the relevant government agencies; and/orSecure, for conservation purposes, parcels of land within the Whicher Scarp that have conservation values that, through the implementation of a rehabilitation program, will be acceptable to the relevant government agencies within an agreed timeframe; <p>Doral will also undertake post-mining rehabilitation and revegetation of the 8.68ha of State Forest No. 33 to be cleared as a result of this proposal. This will, over time, reduce the long-term impact of the proposal on the environment.</p> <p>Supplementing the direct offsets, and in consultation with the relevant agencies, Doral will develop a package of contributing/compensatory offset activities that complement the direct offsets provided for the proposal. These contributing offsets will include, but not be limited to:</p> <ul style="list-style-type: none">Control of weedsControl of feral animalsMaintaining the existing diversity of native flora and fauna (post rehabilitation) through the use of visual monitoring and photopoints.		
PREDICTED OUTCOMES		
<p>Through the provision of environmental offsets, a net environmental benefit can be gained as a result of the Proposal.</p> <p><u>Offset for the State:</u></p> <p>Whilst the impacts to vegetation and flora are not considered significant, given less than 1% of the Whicher Scarp soil-landscape system, Yelverton vegetation complex and known Threatened species population may be affected, Doral recognises the value of the Whicher Scarp and is committed to providing a suitable offset to secure a positive environmental outcome for the State on a ‘like for like’ principle (or as near to as practical) through land acquisition.</p> <p><u>Offset for the Commonwealth:</u></p> <p>Impacts to Matters of NES are considered to be at a local scale and of a temporary nature as site rehabilitation and the proposed offsets package will result in a long-term overall net increase in fauna habitat and fauna habitat values.</p>		

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TABLE ES - 3 SUMMARY OF MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

ENVIRONMENTAL /INTEGRATING FACTOR	Matters of National Environmental Significance (NES)	Table ES-3 (1)
MANAGEMENT OBJECTIVES	Provide for the protection of the environment, especially Matters of National Environmental Significance.	
EXISTING ENVIRONMENT		
<p>Two Threatened flora (Long-leaved Daviesia - Daviesia elongata subsp. elongata and Long-stalked Featherflower - Verticordia densiflora var. pedunculata), three Threatened fauna species (Forest Red-tailed Black-Cockatoo, Baudin’s Black-Cockatoo and Carnaby’s Black-Cockatoo) and one Migratory bird species (Rainbow Bee-eater) listed under the EPBC Act are known to occur within the Development Envelope.</p> <p>The Vasse-Wonnerup System is listed as a Wetland of international Importance (under the Ramsar Convention) and is located approximately 14km north of the Development Envelope.</p>		
POTENTIAL IMPACTS		
<p>Activities or aspects of the Proposal that may potentially affect Matters of NES, not considering mitigation efforts, include:</p> <ul style="list-style-type: none">• Vegetation clearing could potentially impact Threatened fauna habitat. In total 8.68ha of remnant vegetation (known to support three Threatened Black-Cockatoo species and the Rainbow Bee-eater) will be cleared for the Proposal;• Vegetation clearing could potentially impact Threatened flora. Six individuals of Daviesia elongata subsp. elongata will be removed through clearing of vegetation. No Verticordia densiflora var. pedunculata individuals will be removed through clearing;• Spread of dieback and weeds may negatively affect vegetation health and therefore the condition of Threatened fauna habitat and/or nearby populations of Threatened flora;• Changes to fire regime from introduced ignition sources may affect nearby populations of Threatened flora; and• Vehicle strikes from vehicle movement during construction and operation may result in the loss of individual threatened fauna. <p>Numerical groundwater flow modelling by PB (2014a) has shown that no adverse impacts to groundwater dependant vegetation (therefore fauna habitats) within the State Forest sub-area or Whicher National Park are expected from groundwater drawdown during short-term dewatering of the mine pit.</p> <p>No adverse impacts to the Vasse-Wonnerup System Ramsar wetland is expected from groundwater drawdown or emergency water discharge as:</p> <ul style="list-style-type: none">• The maximum extent of groundwater drawdown to the north of the Development Envelope is predicted to be 350m (the Ramsar wetland is located 14km north); and• Paddock drains are separate to major diversion drains in the region therefore there is no pathway for the discharged water to move into the Vasse-Wonnerup System Ramsar wetland		
ENVIRONMENTAL MANAGEMENT / MANAGEMENT STRATEGIES / PROPONENT COMMITMENTS		
<p>Doral’s overall principles for managing the impacts to matters of NES for the Proposal are to:</p> <ul style="list-style-type: none">• Minimise native vegetation clearing and land disturbance;• Meet the Commonwealth laws governing flora and fauna conservation as contained in the EPBC Act;• Conduct pre-clearing fauna surveys;• Implementation of specific clearing procedures including the demarcation of cleared areas and authorisation requirements;• Monitor vegetation health in adjacent undisturbed vegetation located with the State Forest sub-area; and• Minimise the timeframe between disturbance and rehabilitation. <p>The potential impacts to matters of NES will be managed through the development and implementation of several management plans. Those plans specific to the protection and management of Matters of NES include:</p> <ul style="list-style-type: none">• A Fire Management Plan;• A Dieback Management Plan;• A Flora and Vegetation Management Plan; and• A Fauna Management Plan. <p>Residual Impacts will be managed through the provision of offsets as summarised in Table ES-2 (5) – Offsets.</p>		
PREDICTED OUTCOMES		
<p>After mitigation measures have been applied, the Proposal is expected to result in the following outcomes in relation to matters of NES:</p> <ul style="list-style-type: none">• No Impacts to the Vasse-Wonnerup Wetland System are expected;• Six individuals (representing 0.59% of the population) of Daviesia elongata subsp. elongata will be removed as a result of clearing. However this is not considered to constitute a significant impact to this species under the EPBC Act;• No impacts to the Verticordia densiflora var. pedunculata are expected;• Given the widespread occurrence of the species and the range of habitats available throughout the region and Australia it is considered that the Rainbow Bee-eater will not be significantly affected by the Proposal;• It is likely that the Proposal will result in a temporary reduction in the availability of foraging, breeding and roosting habitat (8.68ha) for three conservation significant Black-Cockatoo species. However, there is predicted to be an overall net gain in Black-Cockatoo foraging, breeding and roosting habitat as a result of rehabilitation of mined areas in combination with long-term conservation offsets; and• No fauna or flora of conservation significance listed under the EPBC Act will cease to exist or have its conservation status affected as a result of the Proposal.		

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1 INTRODUCTION

1.1 PROPOSAL OVERVIEW

1.1.1 Location

The Yoongarillup Mineral Sands Project (the Proposal) is located approximately 17km southeast of Busselton and 250km south of Perth, Western Australia, in the City of Busselton (Figure 1-1).

Consistent with the approach outlined in *Environmental Assessment Guideline No. 1* (EPA, 2012) the Proposal is defined within a Development Envelope, within Mining Tenements M70/458 and M70/459. The Development Envelope, mining tenement boundaries and the proposed mine layout are shown on Figure 1-2. The Proposal is located on private land and within a portion of State Forest No. 33.

1.1.2 Proponent

The proponent of the Proposal is Doral Mineral Sands Pty Ltd (Doral).

Doral is a wholly owned subsidiary of Perth-based Doral Proprietary Limited, which itself is an unlisted public company owned by Iwatani International Corporation of Japan.

The registered office for Doral is:

Doral Mineral Sands Pty Ltd
Lot 7 Harris Road
PICTON WA 6229

The contact for the proposal is:

Mr. Andrew Templeman – General Manager
Phone: (08) 9725 5444
Fax: (08) 9725 4757

1.1.3 Description

Doral proposes to extract ore from the strand of heavy mineral deposit, known as the Yoongarillup Mineral Sands Deposit (the deposit). Approximately 4,000,000t will be extracted from the deposit to produce 256,000t of heavy mineral concentrate (HMC). HMC product to be generated from mining the deposit includes zircon, ilmenite and rutile.

The life of mine is expected to be three years, including an initial pre-mine establishment phase and three mining phases. Rehabilitation and mine closure will be implemented at the cessation of mining; this phase is likely to take up to five years. The Proposal has a total ground disturbance area of 95.71ha within a Development Envelopment of 151.97ha. 8.90ha of the disturbance area is located in an area of State Forest No. 33 which has previously undergone partial clearing and has since revegetated, excluding an area of 0.22ha which remains cleared. A total of 86.81ha of the disturbance area is located on previously cleared land currently used for farming activities (currently used for farming beef cattle, dairy cattle and pasture).

1.2 LEGAL FRAMEWORK

1.2.1 Land Ownership and Access Agreement

There are three individual landowners and two gazetted roads within the Development Envelope (Figure 1-4). Access to landowner's properties will be made available via compensation agreements. In-principal consent forms to mine private land and gazetted roads are included in Appendix 4. Approximately 8.90ha of the proposed disturbance area is located within State Forest No. 33 (including 0.22ha of cleared area),

which is managed by the Department of Parks and Wildlife (DPaW). The lot numbers, landowners and land tenure that will be affected by this Proposal are summarised in Table 1-1 below.

TABLE 1-1: LAND TENURE AND LANDOWNER STATUS FOR THE PROPOSAL

LOT NUMBER	LANDOWNER	LAND TENURE
101	Private Ownership	Freehold
102	Private Ownership	Freehold
1870	Private Ownership	Freehold
1872	Private Ownership	Freehold
1873	Private Ownership	Freehold
1874	Private Ownership	Freehold
F33	State Forest	Crown land
Goulden Road	City of Busselton	Gazetted Road
Sues Road	Main Roads	Gazetted Road

1.2.2 Planning

The City of Busselton's Town Planning Scheme (TPS) No. 20 (TPS 20) shows the Development Envelope as being mostly zoned as 'Agriculture' with the portion contained in State Forest No. 33 being reserved for 'Recreation'.

1.2.3 Western Australia Environmental Impact Assessment Process

The Proposal was referred to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986* (EP Act) on 22 March 2012. On the 27 August 2012 the EPA determined the level of assessment for the Proposal as Public Environmental Review (PER) with a four week public review period. The EPA prepared and issued the Environmental Scoping Document (ESD) in January 2013 for the Proposal (Appendix 2-A).

Following a four week public review, the EPA will provide the Proponent with a summary of, and copies of any submissions received. The Proponent will be required to respond to the matters raised in the submissions to the satisfaction of the EPA.

The EPA will assess the PER document, submissions, Proponent response to submissions, obtain advice from any other persons it considers appropriate and then submit its assessment report to the Minister for the Environment.

The Minister for the Environment will subsequently publish the EPA report. As provided for under section 100(1) (d) of the EP Act, any person may lodge an appeal to the Minister against the findings or recommendations of the EPA assessment report within 14 days of publication of the report. Following determination of any appeals and consultation with decision-making authorities, the Minister will determine whether the Proposal should be implemented and if so, under what conditions.

1.2.4 Other Western Australian Environmental Approvals

Following the Environmental Impact Assessment (EIA) process the Proposal is required to gain environmental approval under the following state Acts, prior to it proceeding:

- *Aboriginal Heritage Act 1972*;
- *Mining Act 1978*;
- Part V of the EP Act;
- *Rights in Water and Irrigation Act 1914* (RIWI Act).

1.2.5 Australian Government Environmental Impact Assessment Process

The Proposal has the potential to affect Matters of National Environmental Significance (MNES) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act provides that actions that have or are likely to have a significant impact on MNES require approval from the Commonwealth Minister for the Environment. The Proposal was referred to the Commonwealth Department of the Environment (DoE) (formerly known as the Department of Sustainability, Environment, Water, Population and Communities (DSEWPac)) on 24 August 2012 for consideration under the EPBC Act.

On the 26 September 2012, the DoE determined that the Proposal is a controlled action and requires assessment and decision on approval under the EPBC Act (EPBC Reference: 2012/6521) (Appendix 3). The Proposal may have a significant impact on the following matters protected by the EPBC Act:

- Listed threatened species and communities (Sections 18 and 18A);
- Wetlands of international importance (Sections 16 and 17B).

The Proposal is being assessed under the intergovernmental bilateral agreement between the Commonwealth of Australia and the State of Western Australia under Section 47 of the EPBC Act. The bilateral agreement allows the Commonwealth Minister for the Environment to rely on the State EIA process in assessing this action under the EPBC Act so long as the State process considers and addresses those matters protected under the EPBC Act.

1.2.6 Decision Making Authorities and Agencies

In the ESD the EPA identified decision making authorities (DMAs) that are constrained from making any decision that could have the effect of causing or allowing the Proposal to be implemented (Table 1-2). Throughout the assessment process further DMAs may be identified by the EPA.

TABLE 1-2: NOMINATED DECISION MAKING AUTHORITIES

DECISION MAKING AUTHORITY	RELEVANT LEGISLATION
Department of Environment Regulation (DER)	Part V of the EP Act
Minister for Water	<i>RIWI Act 1914</i>
Minister for Mines and Petroleum	<i>Mining Act 1978</i>
Department of Mines and Petroleum (DMP)	<i>Mining Act 1978</i>
Minister for Aboriginal Affairs	<i>Aboriginal Heritage Act 1972</i>
City of Busselton	Planning approvals

Note: DMAs are not prevented from parallel processing, up to the point of their decision, so that their views can inform the ministerial consultation process.

1.3 CURRENT OPERATIONS

Doral currently operates the Dardanup Mineral Sands Project in Henty, approximately 20km east of Bunbury, Western Australia. For over a decade Doral have operated the Dardanup Mineral Sands Project, which includes:

- One operating mine (Dardanup Mine) which extracts ore from the Dardanup and Burekup mineral sands deposits;
- A dry separation plant at Picton, 10km east of Bunbury, which receives HMC from the Dardanup mine.

The Dardanup mine and dry separation plant are operated in accordance with the conditions of Ministerial Statement's 484 and 789. Doral has no other operational mines in Western Australia.

1.4 PURPOSE AND SCOPE OF THIS DOCUMENT

The purpose of this PER is to outline the Proposal, undertake an environmental impact assessment of the Proposal and to demonstrate that following the implementation of the environmental management measures, that the Proposal could be implemented in a manner that is environmentally acceptable.

This PER has been prepared in accordance with the ESD (Appendix 2-A), the *Generic Guidelines for Preparing a Public Environmental Review* (OEPA, 2012) and *Environmental Assessment Guideline No. 8 Environmental Assessment Guidelines for Environmental Factors and Objectives* (EPA, 2013).

The main text of the PER has been structured as follows:

[Section 1:](#) This section provides a brief introduction to the Proposal and its context.

[Section 2:](#) This section provides an overview of the receiving environment, specifically the biophysical and socio-economic setting.

[Section 3:](#) This section provides an overall description of the Proposal, including the:

- Mineral resource;
- Overview of the Proposal and key characteristics table;
- Phases of mining;
- Description of mining and ore processing;
- Infrastructure required to support mining;
- Workforce to service the mine.

[Section 4:](#) A description of the stakeholder engagement and consultation process undertaken for the Proposal, including the key issues raised and the proponent's response to these issues.

[Section 5:](#) Presents the EIA framework, the key environmental and integrated factors, other environmental matters to be addressed in the PER as stated in the ESD, the environmental principles considered in designing the Proposal, and the EPA's expectations in conducting an EIA, and how these expectations have been met.

[Sections 6 to 8:](#) The EIA for each key environmental factor in accordance with the requirements specified within the ESD.

- [Section 9:](#) Discussion of the management of the integrated factor, 'Rehabilitation and Closure', as defined in the ESD and EPA (2013) guidance.
- [Section 10:](#) Consideration of other environmental matters as requested in the ESD.
- [Section 11:](#) The EIA for Matters of National Environmental Significance (MNES).
- [Section 12:](#) Presents Doral's proposed Offset Strategy (integrated factor) to enable a net environmental benefit to be achieved on implementation of the Proposal.
- [Section 13:](#) Describes the environmental management framework through which Doral enforces and implements environmental management at the Dardanup Mine, and how environmental management will be implemented at the Yoongarillup Mine.
- [Section 14:](#) This section details the supporting information such as the EIA checklist, electronic database information and spatial data files.
- [Section 15:](#) This section is the conclusion which outlines Doral's opinion on the environmental acceptability of the Proposal.



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Doral

**Public Environmental Review
Proposed Yoongarillup Mineral Sands Project**

Regional Location

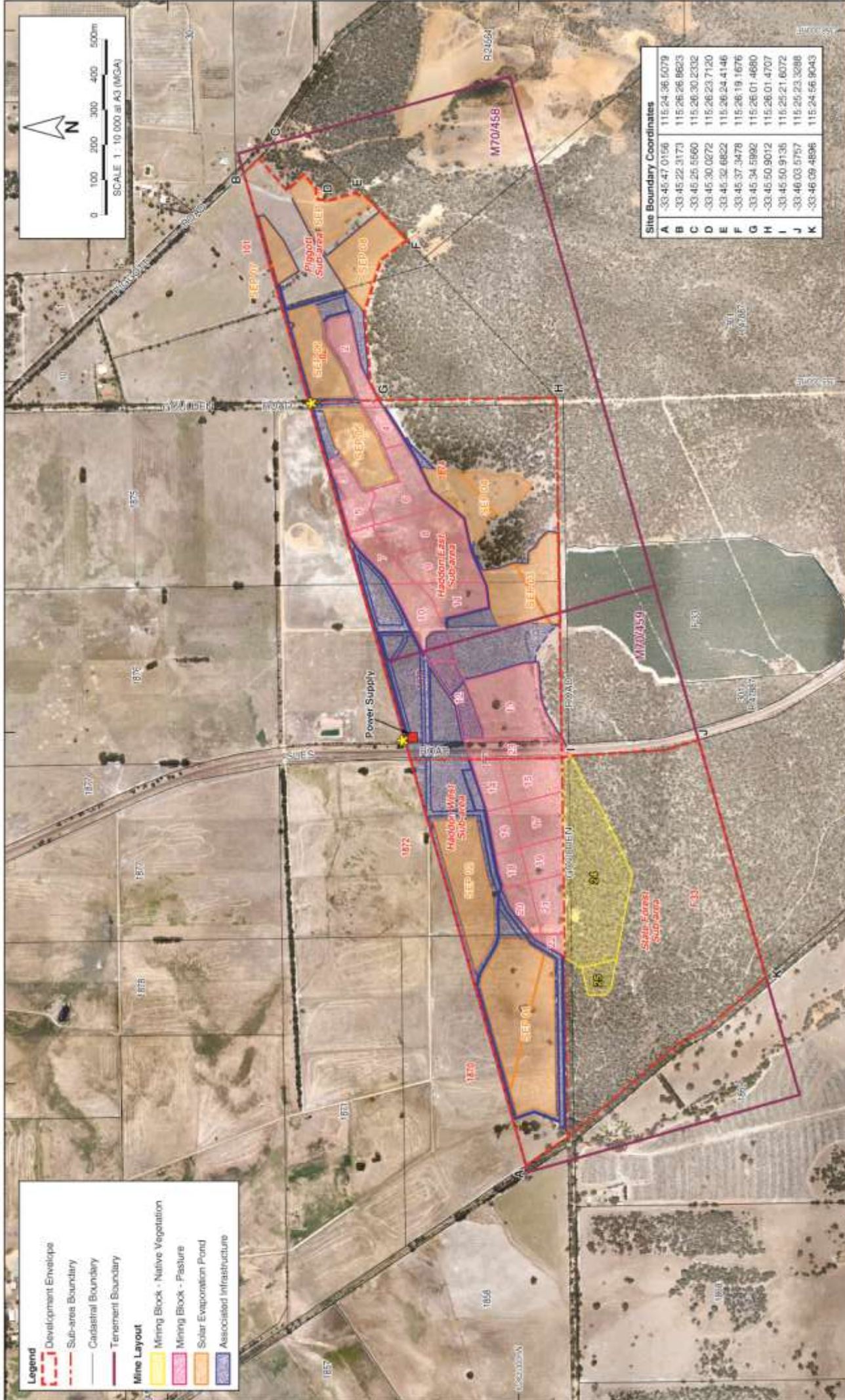
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Projection:
Australia MGA94 (50)

Sheet Size:
A4

Figure 1-1

Date: 28/04/2014



Legend

- Development Envelope
- Sub-area Boundary
- Cadastral Boundary
- Tenement Boundary

Mine Layout

- Mining Block - Native Vegetation
- Mining Block - Pasture
- Solar Evaporation Pond
- Associated Infrastructure



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Proposed Yoongarillup Mineral Sands Project

Site Layout

Scale: 1:10 000	Projection: Australia MG494 (50)	Sheet Size: A3
Figure 1-2		Date: 28/04/2014

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2 OVERVIEW OF RECEIVING ENVIRONMENT

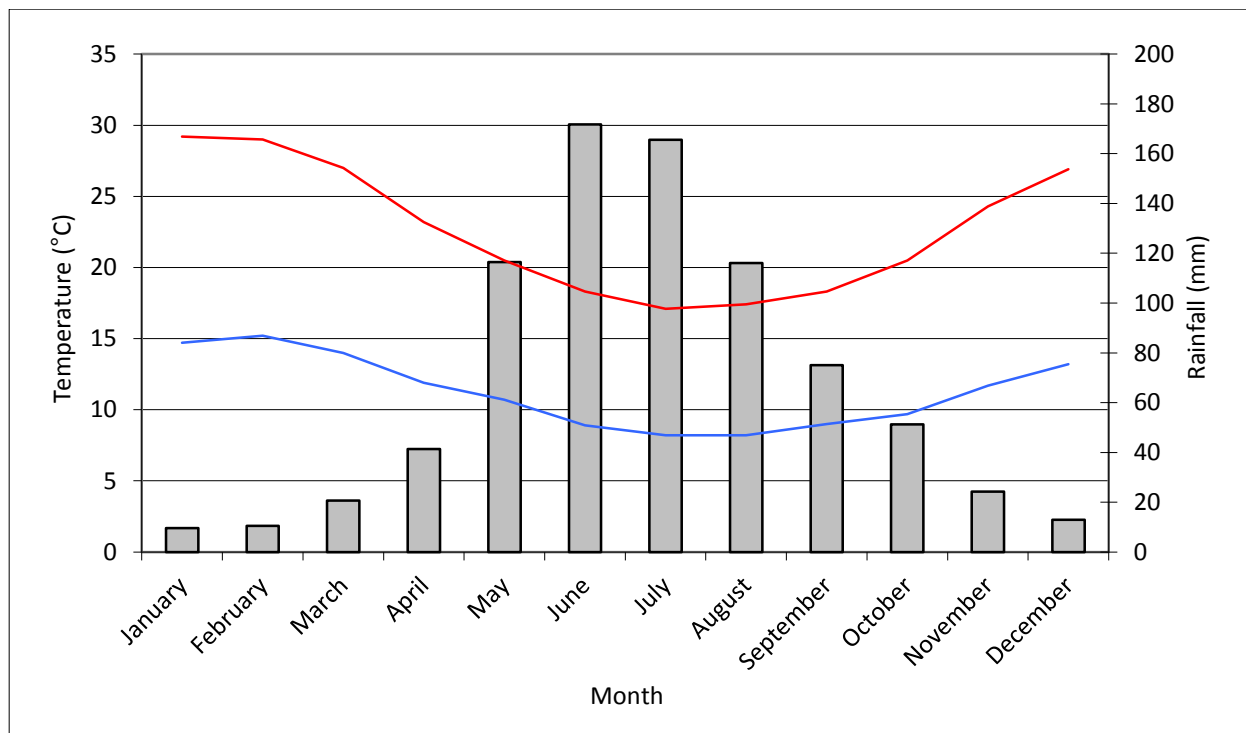
2.1 BIO-PHYSICAL SETTING

2.1.1 Climate

The Geographe-Naturaliste coastline experiences a Mediterranean climate with warm to hot dry summers, and mild wet winters. High pressure cells dominate climatic patterns during summer and the passage of cold fronts and associated low pressure cells dominate during winter. Strong sea breezes occur from late November to early March.

The annual rainfall generally falls within the 800mm and 1000mm range, peaking in June and July, as shown in Chart 2-1. In summer the average maximum temperature is 28°C with an average minimum temperature of 12°C. In winter the average maximum temperature is 16°C with an average minimum temperature of 5°C (Bureau of Meteorology, 2013).

CHART 2-1: ANNUAL AVERAGE CLIMATE DATA



Source: Bureau of Meteorology Busselton Station (Weather Station 009515).

2.1.2 Bioregion

The Proposal is located on the lower/mid slopes of the Whicher Scarp which is an arcuate north facing scarp formed during the late Tertiary and early Pleistocene by marine erosion of underlying sedimentary rocks and in this area marks the southern limit of the Swan Coastal Plain.

The Whicher Scarp is referred to as being entirely within the Southern Jarrah Forest (JAF02) Biogeographic Sub-region of the Jarrah Forest Bioregion as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Australian Government, 2013) and reported in EPA (2009a).

It should also be noted that the Whicher Scarp has been mapped by the EPA (EPA, 2004a, Map 1) as occurring over the boundary of the Swan Coastal Plain (Perth Sub-region SWA02) and the Southern Jarrah Forest (JAF02) Biogeographic Sub-regions. Given that the location of the Proposal is situated on the foothills of the Whicher Scarp, it could be considered that the Development Envelope is part of the Swan

Coastal Plain (SWA02) Biogeographic Sub-region. This is consistent with the Department of Parks and Wildlife (DPaW) assessment (Mitchell *et al.*, 2002), EPA Guidance Statement 10 (EPA, 2003), accepted geological interpretations by Baxter (1977) (i.e. the targeted mineral sand deposits are units of the Swan Coastal Plain) and soil mapping by DAWA (2003).

2.1.3 Geology

The Proposal is located in the southern part of the Perth Basin (Figure 2-1). The Perth Basin is a deep linear trough containing sedimentary rocks (Permian to Quaternary) extending north-south for some 1,000km in the southwest of Western Australia and covers an area of 45,000km² onshore and 55,000km² offshore (GSWA, 1976). The Perth Basin is essentially a half-graben structure bounded on the east by north-trending Darling Fault, 1,000km long, which separates the Basin from the Archean rocks of the Yilgarn Block (GSWA, 1976).

The regional geology associated with the Proposal is dominated by a sedimentary sequence deposited within the graben in the southern Perth Basin (Schafer *et al.*, 2008). This part of the Basin comprises two main geological structures: the Bunbury trough and the Vasse Shelf. The major north-south trending Busselton Fault subdivides the graben structure into two major structural units: the deep Bunbury Trough to the east and a relatively shallow fault block, known as the Vasse Shelf, to the west (Schafer *et al.*, 2008). The Development Envelope is situated on the eastern side of the graben structure, entirely within the Bunbury Trough (Figure 2-1).

The geological setting of the area comprises:

- The Yarragadee Formation;
- The Leederville Formation;
 - Vasse Member;
 - Mowen Member.
- The Superficial Deposits.
 - Yoganup Formation;
 - Guildford Clay;
 - Bassendean Sand.

The Yarragadee Formation comprises Jurassic aged laterally discontinuous interbedded feldspathic sandstone, siltstone and shale deposits that are up to two km in thickness (Varma, 2009).

The Cretaceous aged Leederville Formation unconformably overlies the Yarragadee Formation and comprises discontinuous interbedded sandstone and shales. The sediments are essentially flat-lying with a gentle slope to the north and have a weathering profile, up to 150m thick, where outcropping occurs mainly along the Whicher Scarp and the Blackwood Plateau (Schafer *et al.*, 2008). Based on the studies east of the Development Envelope, the Leederville Formation has been divided into Vasse and Mowen Members (Schafer *et al.*, 2008).

The Pliocene-Quaternary aged superficial deposits overlie the Leederville Formation and collectively comprise the Yoganup Formation, Guildford Formation and the Bassendean Sand (Schafer *et al.*, 2008). The maximum thickness of Quaternary deposits in the Perth Basin amounts to about 150m, but in most areas they are less than 20m thick (GSWA, 1976). The superficial deposits form a relatively thin cover sequence over most of the coastal plain. The oldest superficial deposit is the

Yoganup Formation, which occurs along the base of the Whicher Scarp. It comprises leached and ferruginous beach sand with localised concentrations of heavy minerals (Schafer *et al.*, 2008) and consists of white coarse sand rich in heavy minerals and sandy silt and clay respectively. The Guildford Clay covers much of the coastal plain and is a composite unit of interfingering alluvial clay and sand. The Bassendean Sand consists of quartz-rich dunal sand that generally overlies or abuts the Guildford Clay.

The Yoganup Formation dominates the study area, whilst the Guildford Clay is observed mainly towards the northern boundaries. In these superficial deposits, a lateritic hardpan has developed due to water table fluctuation in many areas (Schafer *et al.*, 2008).

2.1.4 Conceptual Hydrogeology

Groundwater investigations conducted by Parsons Brinckerhoff (PB, 2014a) indicate three aquifers are recognised locally, which are hosted within the local stratigraphy; the Superficial aquifer, the Leederville aquifer and the deeper Yarragadee aquifer. A generalised lithostratigraphical and hydrostratigraphical description of the Development Envelope is provided in Table 2-1 and shown on Figure 2-2.

TABLE 2-1: GENERALISED STRATIGRAPHY AND ASSOCIATED AQUIFERS OF THE DEVELOPMENT ENVELOPE

AGE	STRATIGRAPHY	MAXIMUM THICKNESS (M)	LITHOLOGY	AQUIFER SYSTEM
Quaternary – late Tertiary	Superficial Formation:			
	Bassendean Sand	80*	Fine to medium sub-rounded quartz sand.	Superficial aquifer
	Guildford Formation	35*	Brown to dark grey clays with isolated lenses of silt and sand towards the base.	Local aquitard
	Yoganup Formation	10*	White to yellowish-brown unconsolidated, poorly sorted sand, gravel and pebbles with local subordinate clay, ferruginised grains and heavy minerals.	Superficial aquifer
Cretaceous	Leederville Formation	600*	Interbedded units of sand and shales. Generally divided in to upper, predominantly shaly section (Mowen Member) and lower sandy section (Vasse Member).	Leederville aquifer
Mid to Late Jurassic	Yarragadee Formation	2000*	Weakly consolidated sandstone, siltstone and shales.	Yarragadee aquifer
Early Jurassic	Cockleshell Gully Formation		Angular to sub angular, weakly cemented quartz sandstone containing accessory pyrite and garnet, and weakly consolidated siltstone and shale.	

Source: PB (2014a) *Davidson (1995)

The following description of the hydrogeology has been taken from PB (2014a).

The Superficial Aquifer is an unconfined aquifer comprising Bassendean Sand towards the top and Yoganup Sand towards the base. The Guildford Clay is locally present between the two aquifers. The hydraulic conductivity of the Superficial Aquifer is likely to be variable.

The Leederville Aquifer is a multi-layered aquifer system comprising discontinuous interbedded sequences of sandstone and clay. The horizontal hydraulic conductivity of sandstone beds in the Leederville aquifer, derived from pumping tests (Davidson, 1995), is about 10 metres per day (m/d), and that of the siltstone and shale beds is assumed to be about 1×10^{-6} m/d. If the interbedded sandstones, siltstones and shales are laterally extensive, the average horizontal hydraulic conductivity of the aquifer will approach 5m/d (as the sandstones constitute approximately half the aquifer thickness). Sandy beds that comprise the Vasse Member constitute the main aquifer. The sandy beds underlie the Mowen Member which comprises an aquitard. The Mowen Member is assumed to be present in the entire modelled area. The Leederville Aquifer becomes more consolidated with depth resulting in permeability decrease with depth. The Leederville Aquifer extensively outcrops throughout the Blackwood Plateau (Schafer *et al.*, 2008).

The Yarragadee Aquifer is composed primarily of non-marine fluvial feldspathic, poorly sorted sandstones which are porous and poorly cemented and, hence, allow for considerable groundwater reserves. It grades from a shale-siltstone dominated base to a cleaner sandstone in the upper portions of the Formation, probably representing increased subsidence or filling of the basin during the late Jurassic (Varma, 2009). The Yarragadee Formation is divided into four units. Unit 3, which underlays the Vasse Member in the mining area is reported to be the most transmissive unit (Baddock *et al.*, 2005). However, isotopic dating of groundwater indicates an average hydraulic conductivity of 8m/d.

2.1.5 Water Quality

Doral recognise the importance of the collection of background or 'pre-mine' water quality data given the wider Busselton area has previously been modified by agricultural uses since the 1830s (DoW, 2010) and has the potential to be further impacted by mining. Background data collected will be used for comparison with data collected during mining and post-mining to monitor and identify any impacts.

Nine bores (six screened within the Mowen Member, two screened within the Superficial and Mowen Member, and one screened in the Mowen and Vasse Members) have been monitored for water quality parameters since 2012. Up to six groundwater monitoring events have been conducted on certain bores, with at least two events conducted on all bores. Bores will continue to be monitored regularly until the mine is approved and commences pre-mine construction and operation, to expand the background dataset. Pending approval of the Proposal further groundwater monitoring bores will be installed into the Superficial aquifer for collection of data during mining.

Background data provided as an average of results and as a range or maximum for some parameters, is tabulated in Appendix 8-A. Based on the collected data, the pre-mine water quality across the area is characterised as:

- Slightly acidic, pH ranges between 4.17 and 6.85;
- Salinity ranges between 110 and 320mg/L, which is at the lower end of the scale for the Leederville aquifer within the Busselton-Capel groundwater area (DoW, 2009a) and is more similar to the salinity found in the Donnybrook groundwater area, which is generally <500mg/L (DoW, 2009a);

- Generally suitable for irrigation, as the majority of metal concentrations are lower than long-term irrigation trigger values (LTV)¹ (ANZECC & ARMCANZ 2000). The exceptions are:
 - All bores have higher concentrations of iron than the LTV;
 - Bore YMB2 has higher nickel concentrations than the LTV;
 - Bores YMB1, YMB3, YMB4 and YMB5 have higher nitrogen concentrations than the LTV;
 - Bores YMB1, YMB6D and YMB7 have higher phosphorus concentrations than the LTV.

Generally the background data describes the values associated with a 'slightly to moderately disturbed' ecosystem (ANZECC & ARMCANZ, 2000). These values include freshwater systems with slightly to moderately cleared catchments and rural streams receiving runoff from land disturbed to varying degrees by grazing or pastoralism.

2.1.6 Water Management Areas

Superficial and Leederville Aquifers

The Proposal is within the Busselton-Capel Groundwater Area (BCGA). The majority of the mining operation will be conducted within the Busselton-Capel subarea of the BCGA. However a small portion of the mine pit located within the State Forest sub-area is within the Blackwood Plateau North sub-area of the BCGA (Figure 2-3).

The Busselton-Capel sub-area covers 757.3km² and is predominantly used by the service sector, mining and industry, and horticulture. Currently the Superficial and Leederville aquifers in the subarea are fully allocated. The Blackwood Plateau North subarea covers 1,056.9km² and is used for stock, domestic and garden supply (DoW, 2009a).

Yarragadee Aquifer

The Proposal is within the Busselton-Yarragadee Groundwater Area (Yarragadee aquifer). The Busselton-Yarragadee subarea covers 2,021.4km² and is fully allocated (Figure 2-3). The predominant use of this aquifer is for public water supply, mining and industry (DoW, 2009a).

Surface Water

The Proposal is within the Busselton Coast surface water management area, within the Vasse Diversion subarea. Part of the Vasse Diversion subarea is a proclaimed surface water area known as the 'Geographe Bay Rivers'. A portion of the proclaimed surface water area overlaps the Development Envelope (Figure 2-3) (DoW, 2009b).

2.1.7 Hydrology

The Proposal is within the catchment of the Vasse River (Figure 2-3). The majority of the catchment (80%) is cleared for agricultural use, and many drainage lines have previously been created across the landscape (PB, 2014b).

The Vasse River begins at the northern edge of the Blackwood Plateau in the Whicher Ranges, 149m above sea level, and traverses north for approximately 24 km, across mixed farming and horticulture land uses on the Swan Coastal Plain before discharging into the Vasse-Wonnerup Estuary or the Vasse Diversion

¹ The long-term trigger value is the maximum concentration (mg/L) of contaminant in the irrigation water which can be tolerated assuming 100 years of irrigation, based on the irrigation loading assumptions described in Volume 3, Section 9.2.5 (ANZECC & ARMCANZ, 2000).

Drain, which subsequently discharges into Geographe Bay (Paper Daisy Environmental Services, 2000). The Vasse River is located approximately 6km northwest of the western boundary of M70/459.

The Vasse River's only tributary is the Sabina River which similarly flows into the Vasse-Wonnerup Estuary (PB, 2014b). The Sabina River, located 590m east of M70/458, flows northerly for approximately 18 km into the Vasse-Wonnerup Estuary (Figure 2-3 and Figure 1-1). Both rivers are seasonal, flowing in winter and dry in summer (DoW, 2010).

The Vasse Diversion Drain was constructed to divert water from the Vasse River. It accepts water from 65% of the Sabina River Catchment and 90% of the Vasse River catchment, diverting it away from the Vasse-Wonnerup Estuary (Paper Daisy Environmental Services, 2000). The Vasse Diversion Drain begins just north of the Busselton Golf Course, approximately 9km north of the Proposal.

There are no local waterways within the Development Envelope. Sheet flow or flow in small gullies is likely to occur seasonally based on aerial observations (PB, 2014b).

Based on local rain gauge stations (9771 and 9971) operated by the Bureau of Meteorology (BOM) average annual rainfall for the proposed mining operation is likely to be in the order of 700mm per year (PB, 2014b).

2.1.8 Soil and Landforms

Soils and landforms of the region have been described and mapped by Churchward and McArthur (1980), Tille and Lantzke (1990) and most recently by the Department of Agriculture Western Australia (DAWA, 2003). The above mapping shows the Development Envelope lies within two soil landscape systems:

- Whicher Scarp System (214Ws);
- Abba System (213Ab).

Within these two systems, four Soil Mapping Units occur within the Development Envelope as shown in Table 2-2 and Figure 2-4.

TABLE 2-2: SOIL MAPPING UNITS OCCURRING WITHIN THE DEVELOPMENT ENVELOPE

SOIL MAPPING UNIT	DESCRIPTION	SUPPORTS REMNANT VEGETATION (YES/NO)
213AbAbw	Winter wet flats and slight depressions with sandy grey brown duplex (Abba) and gradational (Busselton) soils	No
213AbAB1	Flats and low rises with sandy grey brown duplex (Abba) and gradational (Busselton) soils	No
214WsYLV	Narrow v-shaped minor valleys cutting through the shelf. Soils are brown deep sands and brown loamy earths.	No
214WsYL1	Raised flats. Duplex sandy gravels, semi-wet soils, yellow deep sands and sandy earths and loamy gravels.	Yes

Landloch (2014) (Appendix 5-A) undertook a baseline soil assessment of mining tenements M70/458 and M70/459 (targeted to within the mine pits) to provide information on the properties of the undisturbed soil resource for the Proposal.

Results of this assessment indicate that wind-blown and reworked sands make up most of the parent material for the soils within the Development Envelope, associated with Bassendean Sands (S₁₀). The entire proposed mine pit area consists of this one soil type. There are smaller areas of shallow gravels on the laterite geology to the south of the proposed mined pits. In the eastern sections of the assessment area are zones of disturbed soil from previous sand mining. Consequently, three soil types were identified and mapped by Landloch (2014) as listed below and shown on Figure 2-5:

- Deep Pale Sands;
- Shallow Gravels;
- Disturbed soils.

2.1.9 Vegetation

The Proposal is located adjacent to the Whicher National Park (Figure 1-1). Vegetation within the Development Envelope varies extensively in its current condition from grazed and previously cleared agricultural holdings to plantations to grazed remnant bushland areas to more intact State Forest areas. The Development Envelope is subdivided into four main sub-areas as detailed in Table 2-3.

TABLE 2-3: VEGETATION WITHIN THE DEVELOPMENT ENVELOPE

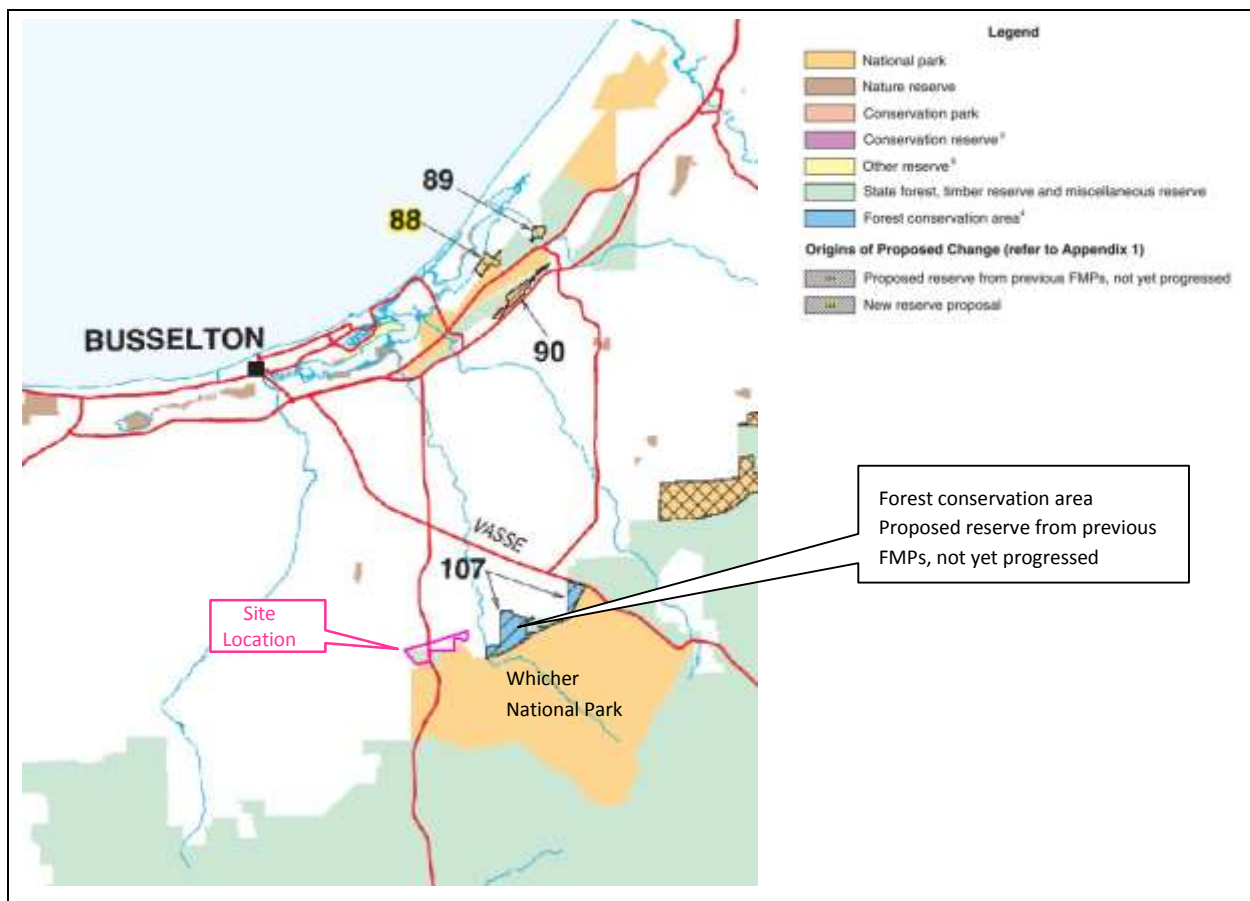
SUB-AREAS	LOT NUMBER	TOTAL AREA (ha)	AREA OF VEGETATION (ha)	NUMBER OF SCATTERED TREES/SHRUBS
Haddon West sub-area	1870	31.52	0	22
	1872			5
Haddon East sub-area	1873	58.28	11.65	26
	1874			
Piggott sub-area	101	17.22	0	24
	102			
State Forest sub-area	SF33	44.95	44.73	n/a

Of the areas provided in Table 2-3, the Haddon West and Piggott sub-area's contain no native vegetation (i.e. cleared pasture with scattered trees/shrubs), with the Haddon East sub-area having only a small amount (11.65ha). The remainder of the Haddon East sub-area contains no native vegetation, with the exception of some scattered trees/shrubs. The State Forest sub-area is relatively undisturbed with the majority of the vegetation (97%) rated by Ecoedge Environmental (2013) as Very Good or Excellent condition using the vegetation condition ratings according to Keighery (1994), with a small area on the northern boundary (0.08ha) previously used as a sand pit by others being rated as Completely Degraded and the Goulden Road track (0.14ha) 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 Environmental, 2013).

The State Forest sub-area was previously included as a 'proposed National Park' in the Forest Management Plan 2004-2013, but has since been excluded as a 'proposed National Park' in the recent Forest Management Plan 2014-2023 (Plate 2-1).

PLATE 2-1: EXTRACT FROM MAP 2 – FOREST MANAGEMENT PLAN 2014-2023



2.1.10 Fauna

The majority of the Development Envelope is clear of native vegetation and is used for livestock grazing, providing very little habitat value for native fauna. However, the State Forest sub-area (adjacent to the Whicher Scarp National Park, Figure 1-1) contains intact native vegetation providing habitat for a diversity of fauna. Fauna habitat within the State Forest sub-area is dominated by woodlands or forests of Jarrah and/or Marri with variations occurring with respect to the numbers and types of subdominant mid and lower storey species (e.g. Mountain Marri, Banksia, Sheoak, Woody Pear and various shrubs). Fallen logs (some hollow) and trees with hollows are relatively common within this area providing further habitat.

The EPA (2009a) state that while the Whicher Scarp has not been comprehensively surveyed for fauna, existing site based information indicates a high diversity of vertebrates including Threatened and Priority fauna species. The results of the fauna investigation conducted by Harewood (2014) for the Development Envelope are consistent with this report in particular the utilisation of the area by a number of Threatened, Priority and habitat specialist fauna species less common on the adjoining coastal plain

including three threatened Black-Cockatoo species *Calyptorhynchus baudinii* (Baudin's Black Cockatoo - S1 (WC Act), Vulnerable (EPBC Act)), *Calyptorhynchus latirostris* (Carnaby's Black Cockatoo - S1 (WC Act), Endangered (EPBC Act)) and *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo - S1 (WC Act), Vulnerable (EPBC Act)), *Merops ornatus* (Rainbow Bee-eater - Migratory (EPBC Act)), *Ctenotus ora* (Coastal Plains Ctenotus – P1 (DPaW Priority species)) and *Isodon obesulus fusciventer* (Quenda - P5 (DPaW Priority species)).

A small, highly degraded, seasonally inundated drainage line enters the Development Envelope near the south western corner of Lot 1870 (Haddon West sub-area) and this may, during very wet years, represent very marginal but temporary habitat for some aquatic species if downstream habitat exists (i.e. species can move upstream).

2.2 KEY CONSERVATION VALUES

Environmental Protection Bulletin No. 6 *The Values of the Whicher Scarp* (EPA, 2009a) and *A Floristic Survey of the Whicher Scarp* (Keighery *et al.*, 2008) state that the Whicher Scarp is a naturally restricted landform with diverse flora containing local 'biodiversity hotspots'. These encompass distinctive and unique vegetation complexes including restricted and rare wetland communities (EPA, 2009a: Keighery *et al.*, 2008). The landform which is approximately 21,000ha in size is just 0.7% of the Southern Jarrah Forest Biogeographic region of which around 46% (approximately 9,200ha) remains naturally vegetated leading to unusual relictual habitats of plant communities and flora (EPA, 2009a). Consequently this remnant vegetation meets the six criteria for regionally significant natural areas (EPA, 2006). Of this remaining area, 64% (approximately 5,800ha) is on public lands. The majority of the public lands are managed by DPaW and are located in nine forest areas.

The Whicher Scarp forms a regional ecological linkage between the Darling Plateau and the Leeuwin-Naturaliste Ridge with contiguous habitats facilitating seasonal movements of fauna and changing habitat requirements (EPA, 2009a). The area supports a high diversity of vertebrate fauna, some of which are listed as threatened under state and/or federal legislation. Conservation significant fauna known to occur within the Scarp include all three threatened Black-Cockatoos, the Chuditch, the Western Ringtail Possum, the Brush-tailed Phascogale and a high number of Priority Fauna species including the Quenda, Carpet Python and Western False Pipstrelle (EPA, 2009a). The area is a known breeding area for species that feed on the Swan Coastal Plain (SCP) and many species survival on the SCP is dependent on recruitment and recolonisation through ecological linkages with larger populations in the Whicher Scarp (EPA, 2009a). The Whicher Scarp supports a variety of habitat specialist species that have declined or disappeared on the SCP and the area is likely to support significant populations of short range endemic (SRE) fauna species (EPA, 2009a).

The State Forest and the site of the proposed mine, was identified in the Conservation Through Reserves Committee (CRTC) *Draft System 1 Report* (CTRC, 1974) as being of high conservation value and lies within the Whicher Scarp System (DAFWA, 2007). This system includes the DPaW managed land of the Whicher Forest block and Whicher Reference Area (Keighery *et al.*, 2008) and is immediately adjacent to the Whicher National Park. The proposed mine pits within the State Forest sub-area are within the Central Whicher Scarp described by Keighery *et al.*, (2008) and shown on Figure 2-6. This is described as having moderate north facing slopes with areas of laterite capped rises and soils ranging from deep sands to sand, gravel, silt, clay and ironstone combinations.

2.3 SOCIO-ECONOMIC SETTING

2.3.1 Ethnographic Survey

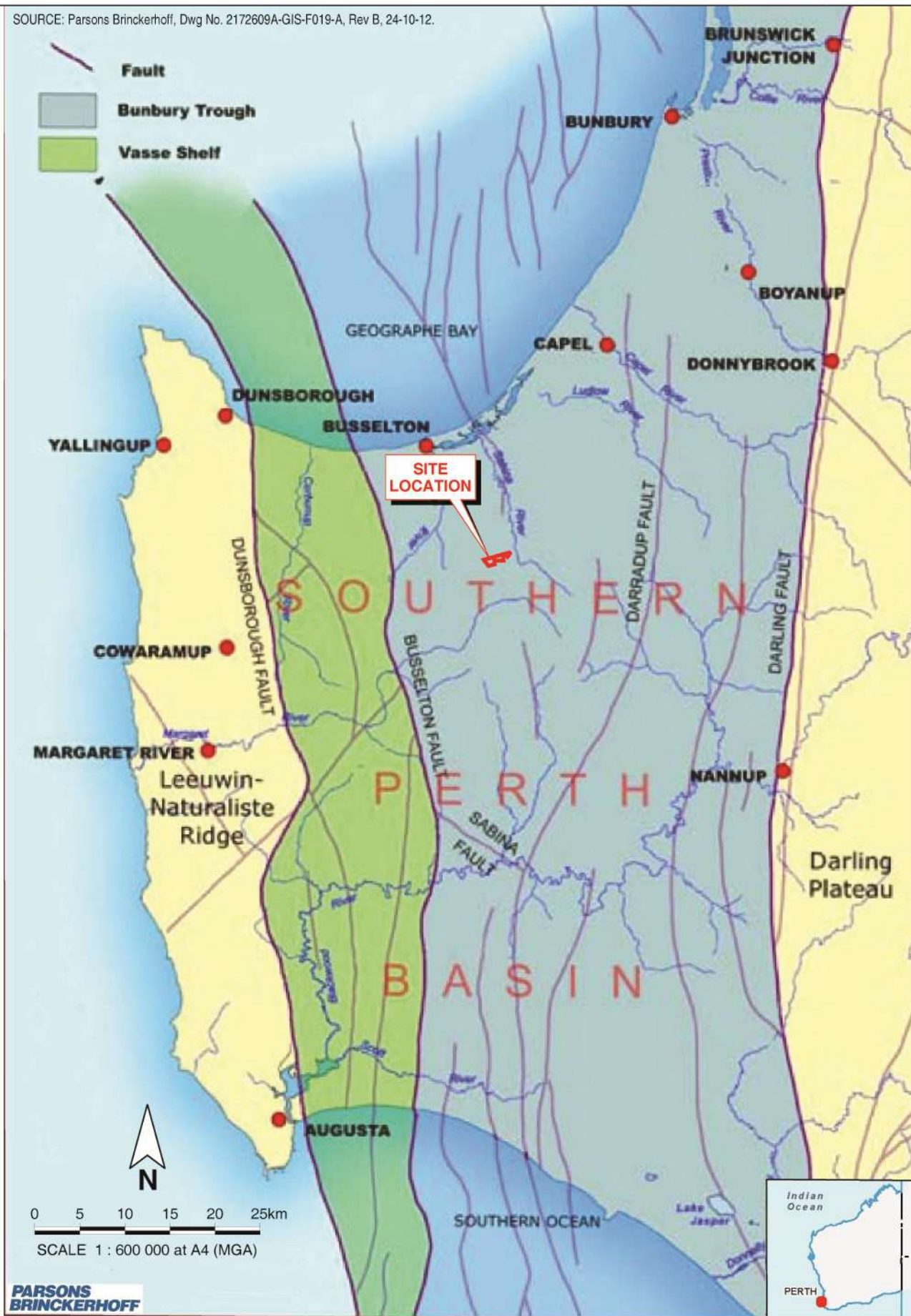
The survey area is wholly located within the South West Boojarah (SWB) # 2 (WC06/4 NT Claim which is represented by the South West Aboriginal Land and Sea Council (SWALSC).

Ethnoscience (2012) undertook an ethnographic survey within a sub-section of the Development Envelope that included the State Forest, Haddon West and Haddon East sub-areas (Appendix 9-B). The survey included a desktop investigation, consultation with the SWALSC regarding the survey and the selection of Aboriginal consultants from the SWB claim, interviews and site inspections with the SWB consultants and consultation regarding the results of the archaeological survey.

No other ethnographic Aboriginal sites or 'Other Heritage Places' were identified through desktop searches or by consultation with relevant Native Title groups.

2.3.2 Archaeological Survey

The newly recorded artefact cluster and isolated finds of stone artefacts have been assessed by Tempus Archaeology (2012) and in their opinion, the finds do not constitute Aboriginal sites under the meaning of Section 5 of the *Aboriginal Heritage Act 1972*. To confirm this determination, Doral has commenced consultation with the Department of Aboriginal Affairs (DAA) with regard to presenting the finds to the Aboriginal Cultural Material Committee (ACMC). Should the ACMC determine that the newly recorded Aboriginal cluster and isolated finds identified within the Development Envelope constitute Aboriginal sites (as defined under the *Aboriginal Heritage Act 1972*), and disturbance of the sites cannot be avoided, Doral will seek Section 18 consent from the Minister for Aboriginal Affairs.



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Public Environmental Review
Proposed Yoongarillup Mineral Sands Project

Structural Geology

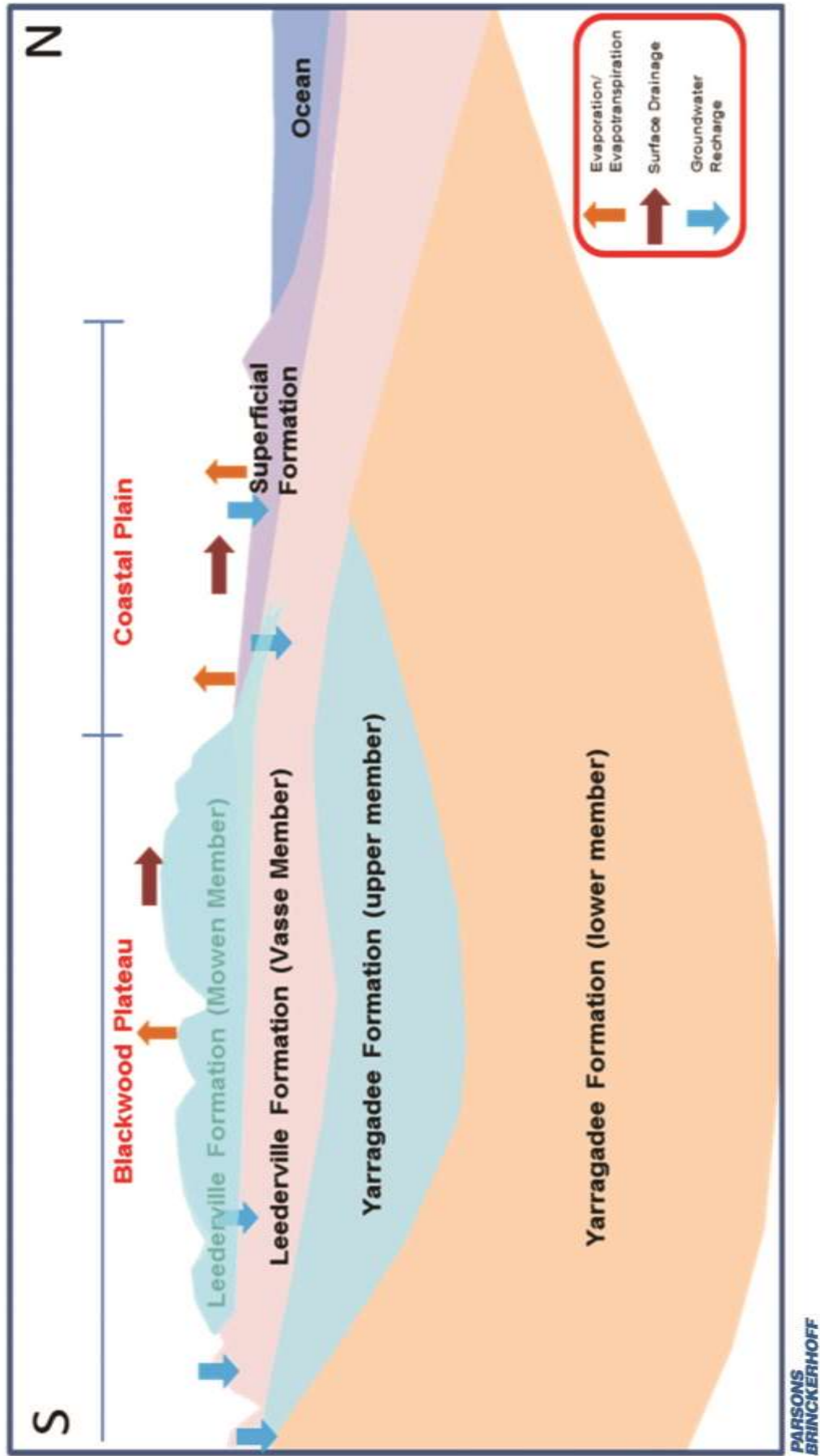
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Figure 2-1

Date: 05/02/2014



Doral

Public Environmental Review
Proposed Yoongarillup Mineral Sands Project

Hydrogeological Cross Section

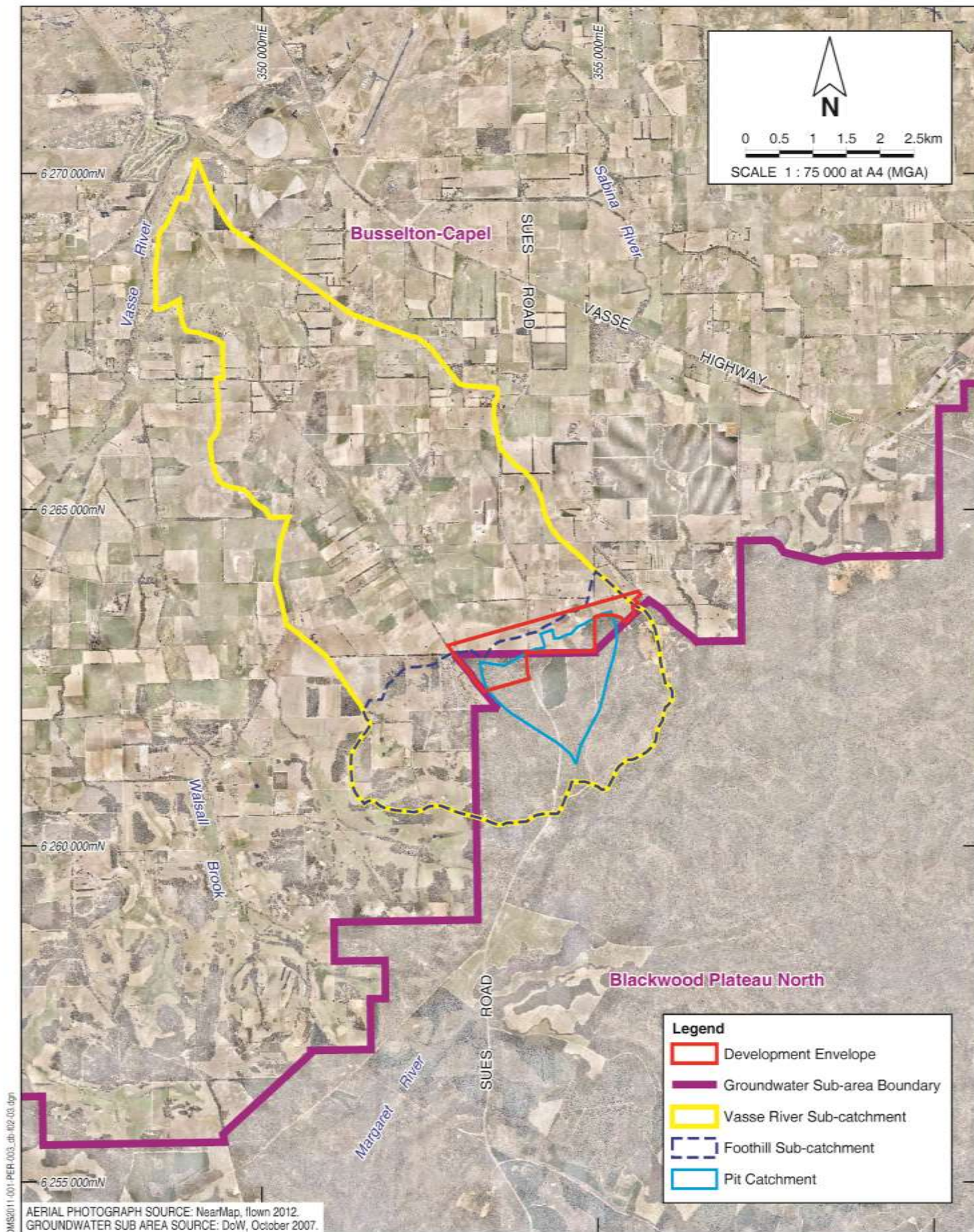
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Figure 2-2

Date: 05/02/2014



Doral

**Public Environmental Review
Proposed Yoongarillup Mineral Sands Project**

Water Management Areas

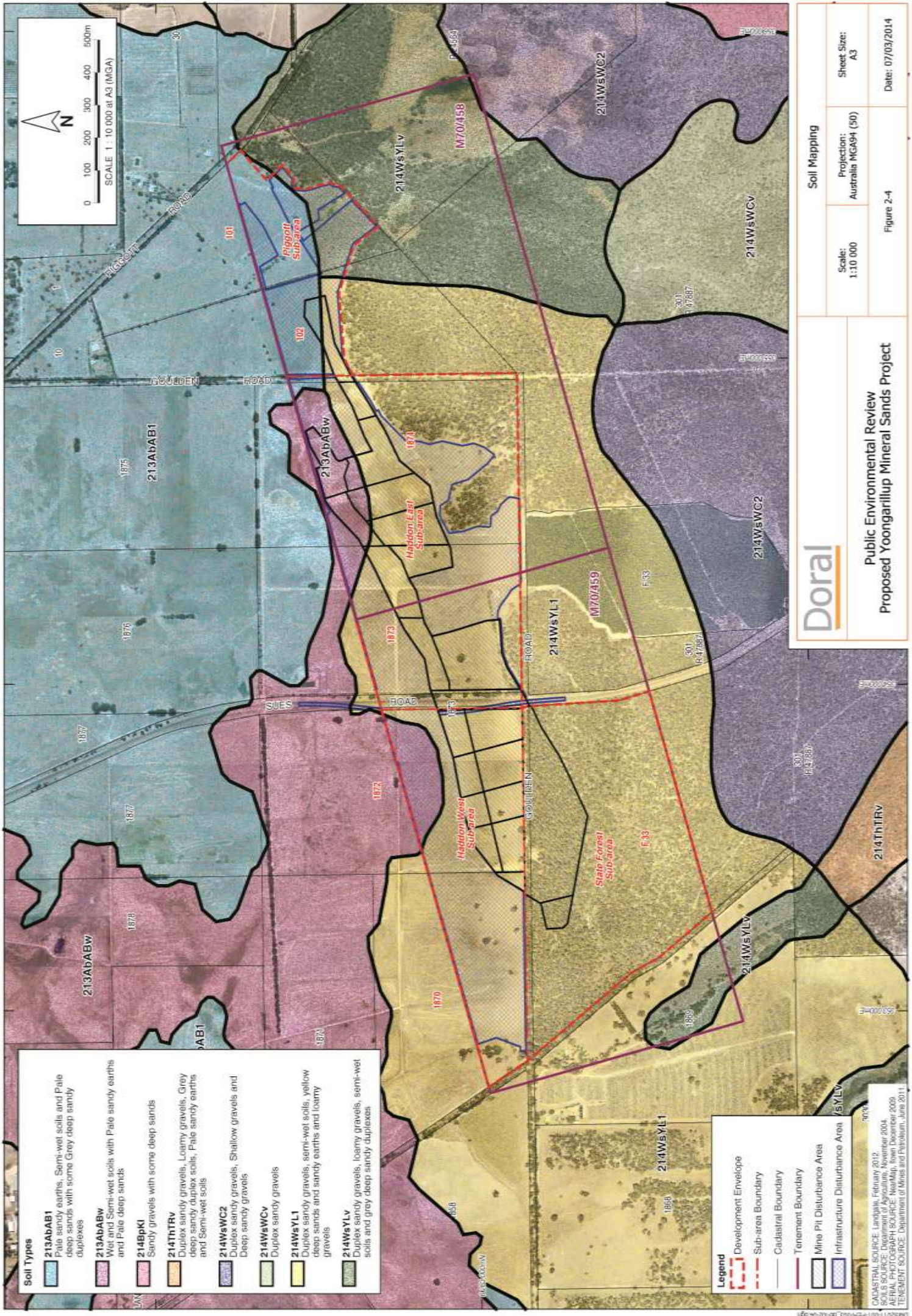
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Australia MGA94 (50)

Sheet Size:
A4

Figure 2-3

Date: 05/02/2014



- Soil Types**
- 213ABAB1**
Pale sandy earths, Semi-wet soils and Pale deep sands with some Grey deep sandy duplexes
 - 213ABABw**
Wet and Semi-wet soils with Pale sandy earths and Pale deep sands
 - 214BpKI**
Sandy gravels with some deep sands
 - 214TnTRV**
Duplex sandy gravels, Loamy gravels, Grey deep sandy duplex soils, Pale sandy earths and Semi-wet soils
 - 214WsWC2**
Duplex sandy gravels, Shallow gravels and Deep sandy gravels
 - 214WsWCv**
Duplex sandy gravels
 - 214WsYL1**
Duplex sandy gravels, semi-wet soils, yellow deep sands and sandy earths and loamy gravels
 - 214WsYLV**
Duplex sandy gravels, loamy gravels, semi-wet soils and grey deep sandy duplexes

- Legend**
- Development Envelope
 - Sub-area Boundary
 - Cadastral Boundary
 - Tenement Boundary
 - Mine Pit Disturbance Area
 - Infrastructure Disturbance Area

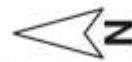
Public Environmental Review
Proposed Yoongarillup Mineral Sands Project

Scale: 1:10 000	Projection: Australia MGA94 (50)	Sheet Size: A3
Figure 2-4		Date: 07/03/2014

CADASTRAL SOURCE: Landgate, February 2012
SOILS SOURCE: Department of Agriculture, November 2004
AERIAL PHOTOGRAPH SOURCE: NearMap, Town December 2009
TENEMENT SOURCE: Department of Mines and Petroleum, June 2011



Soil_Type
Deep Pale Sands
Disturbed
Shallow Gravels



0 100 200 300 400 500m
SCALE 1 : 15 000 at A4 (MGA)

Doral

**Public Environmental Review
Proposed Yoongarillup Mineral Sands Project**

Soil Mapping of the Proposal Area

Scale:
1:15 000

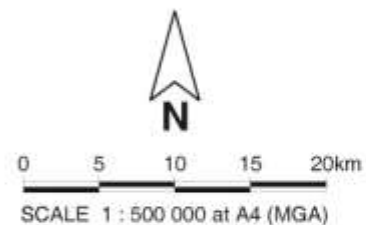
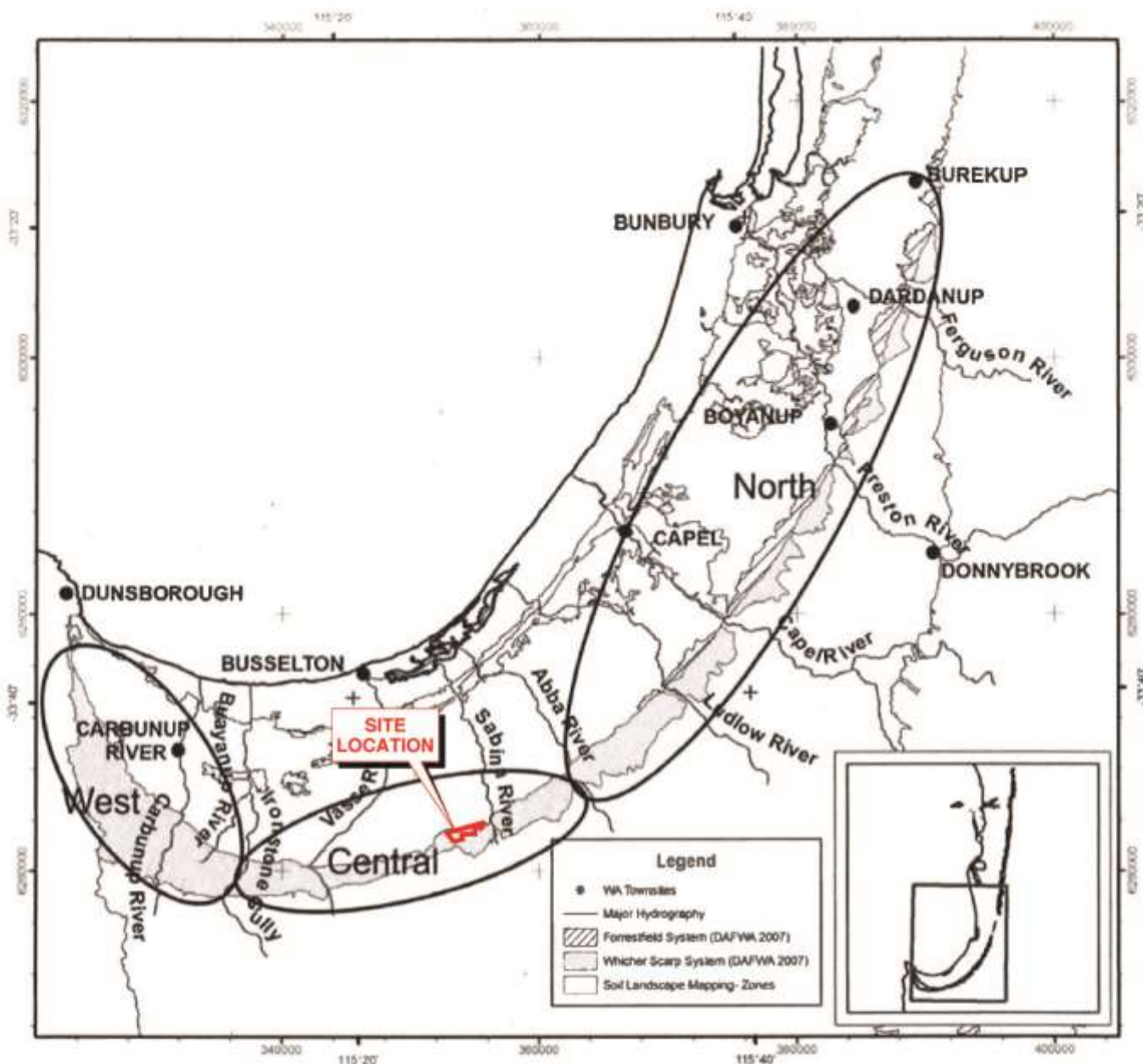
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A4

SOURCE: Landtech, Figure 6.

Figure 2-5

Date: 05/02/2014



SOURCE: Department of Agriculture and Food WA.

Doral

Public Environmental Review
Proposed Yoongarillup Mineral Sands Project

Whicher Scarp Soil-Landscape System

Scale:
1:500 000

Projection:
Australia MGA94 (50)

Sheet Size:
A4

Figure 2-6

Date: 05/02/2014

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3 DESCRIPTION OF PROPOSAL

3.1 JUSTIFICATIONS AND OBJECTIVES

Australia is considered the largest producer of rutile and zircon, and the second largest producer of ilmenite in the world (Geoscience Australia, 2012). In 2012/13, the value of Western Australian mineral sands sales was \$756 million (Department of Mines and Petroleum, 2014). Doral is one of four mineral sands producers in the southwest region of Western Australia that contribute to Western Australia's mineral sands exports. The continued production of mineral sands is important globally to meet market demand and for the West Australian economy, which receives royalties from Doral's business.

Doral have operated in the southwest region for over a decade, from one operating mine (Dardanup Mine) which extracts ore from the Dardanup and Burekup mineral sands deposits, located approximately 20km east of Bunbury. Doral also operates a Dry Separation Plant at Picton, 10km east of Bunbury, which receives HMC from Doral's mine.

Employing approximately 100 people, Doral's business is a source of employment locally and provides business for suppliers, distributors and local services (e.g. mechanics, contractors). Doral contributes financial support to local schools, sporting groups, various volunteer groups, and annual local festivals and is considered a valuable member of the local community.

Mining operations at Doral's Dardanup Mine are scheduled to be completed in March 2015. Commencement of mining operations at the Yoongarillup Mineral Sands Project in mid-2015 will enable Doral to continue operating in the southwest of Western Australia. The Proposal will ensure employees are retained in the southwest and local support to communities continues.

3.2 ALTERNATIVES CONSIDERED

In accordance with OEPA (2012) Doral have analysed the alternatives to mining the Yoongarillup Mineral Sands Deposit. A discussion of the consideration of each stage in the hierarchy of alternatives is outlined below.

Need/meeting needs – is this development needed? Consider no-action alternative.

Doral is a global supplier of the products of mineral sands mining (ilmenite, rutile and zircon). Continuation of mining is core to Doral's business and crucial to continue to deliver to a global market.

Ilmenite, rutile, leucoxene (an alteration product of ilmenite) and high grade titanium (which is a blend of ilmenite and leucoxene) are mainly used to make pure white, highly light refractive and ultra-violet light absorbing, Titanium Dioxide pigment for use in protective house and car paints; paper; plastics; ink; rubber; textiles; cosmetics; sun screens; leather and ceramics. Because titanium dioxide is non-toxic and biologically inert, it can be safely used in foodstuffs and pharmaceuticals. Super strong, lightweight and corrosion resistant titanium metals are also used in the construction of aircraft, spacecraft and motor vehicles, and for medical implants. Again, its non-reactive properties make titanium one of the few materials the human body will not reject; consequently it is widely used in such medical operations as hip replacements and the installation of heart pacemakers. This super metal is also being increasingly used in the manufacture of strong, lightweight sports equipment, jewellery and other advanced engineering applications.

Zircon is used in ceramics, specialty castings and various refractory applications, where its resistance to high temperature and abrasion make it extremely valuable in the manufacturing processes as well as ceramics such as glazes for tiles and sanitary wear. In industry, it is mainly used as a raw material in making refractory bricks, furnace linings and producing pigments in the ceramic industry; where its opacity and

hardness gives a whiteness and durability to tiles, sanitary ware and tableware. It is also utilized in a range of other high-tech industrial and chemical applications.

Doral's operations meet a global need for ilmenite, rutile and zircon and provide West Australian people with employment. Doral currently sources ore to produce these products from its Dardanup mine, which is scheduled for closure in 2015. An alternative ore source is required to continue to meet global demand and to ensure the continued employment of Doral's employees.

**Mode/meeting general goals – is this development proposal the best way to meet the general goal?
Consider alternative technologies or options.**

Open cut mining of mineral sands is standard practise in Western Australia due to the shallow nature of the deposits, which generally occur between 5 to 10m deep in the region. Deposits are usually strand-like and occur at the location of ancient shorelines. Disturbance occurs only on the surface layers and not at depth, compared to other forms of mining (e.g. iron ore mining can have pit depths of greater than 60m deep). The use of alternative technologies can be more expensive (e.g. horizontal drilling) and have their own associated impacts and may not result in fewer disturbances to the environment.

Location/meeting project objectives spatially – what is the best location for the project. Consider alternative locations with a view to minimising environmental impacts.

Doral are constrained spatially, as the location of mineral sands deposits are the targeted location, and in the southwest region these are largely associated with the foothills of the Whicher Scarp. The grade of HMC discovered through exploration drilling largely determines the areas that are viable and can be extracted for sale.

In this case Doral have conducted extensive exploration drilling, and the results of core testing indicate the area beneath the State Forest contains approximately 30% of the mineral resource and the highest grade of ore within the Yoongarillup Mineral Sands Deposit. Whilst the initial drilling results indicated a 20ha area beneath the State Forest contains viable mineral (as initially referred to the EPA), Doral have reconsidered this area during mine planning, given the significance of the vegetation within the State Forest, and have reduced the area to be mined to 8.90ha (includes 8.68ha of vegetation and 0.22ha of cleared area in the State forest).

Doral hold other tenements in the southwest however economic resources have yet to be defined for these. As such no environmental or technical studies have been undertaken on these tenements.

Timing/meeting project objectives temporally – what is the best sequence of development for components of the project?

The mine schedule has been planned by the Mine Manager of the Dardanup Mine based on many years of practical experience in mineral sands mining. Scheduling of mining has taken into account; the volumes of materials required to be shifted, the space within the mining tenements available for placement of infrastructure (e.g. Solar Evaporation Ponds (SEPs), stockpiles, etc.) throughout the mine life, depths of mine pits, simultaneous operation of the overburden fleet and mining fleet, personnel and contractor resources to be drawn on, budgets, viability of ore, water availability, rehabilitation requirements and minimising environmental impacts.

Implementation mechanisms/designing the project – what is the best way to optimise the project so as to minimise environmental impacts? Consider detailed site design, layout, technologies and mitigation strategies.

The design of the Proposal and placement of mine pits is continually evaluated through exploration drilling. Exploration drilling was commenced in 2011 and since that time Doral have designed a series of mine pit configurations, resulting in the layout presented in this PER.

Optimisations that have been incorporated in the layout are:

- Approximately half of the area covered by the mining tenements is vegetated. The mine infrastructure is proposed to be located on already cleared areas (i.e. within paddocks) to minimise the need to clear vegetation;
- A reduction in pit area within the State Forest to reduce environmental impacts, as such the majority of vegetation within the mine tenement boundaries will not be cleared;
- Utilising mine voids where possible for ponds and location of mine infrastructure to reduce the total area disturbed;
- Location of processing equipment in-pit (e.g. hopper) to minimise noise emissions to sensitive receptors;
- Incorporation of noise bunds to minimise potential noise impacts under certain wind conditions on nearby residences;
- Incorporation of several options for emergency discharge of water in the event of heavy rainfall.

On conclusion of the consideration of alternatives Doral consider that there are no alternatives to the Proposal presented in this PER.

3.3 MINERAL RESOURCE

Doral's most recent resource modelling indicates that 256,000t of HMC is located within the Yoongarillup Mineral Sands Deposit. HMC product to be generated from mining the Deposit includes zircon, ilmenite and leucoxene.

3.4 OVERVIEW AND KEY CHARACTERISTICS OF THE PROPOSAL

The Proposal is to allow mining of the Yoongarillup Mineral Sands Deposit, a strand of heavy mineral deposit located adjacent to the Whicher Scarp, 17km southeast of Busselton, Western Australia.

Ore from the deposit will be mined progressively via a series of open-cut pits using dry mining techniques. Dewatering of groundwater inflows into the pit will be required to enable dry mining to occur. Mining will be staged (refer to Section 2) in order to minimise the area of disturbance (at any one time) with the aim of achieving focussed and effective management of the environmental factors at each pit location, prior to moving onto the next pit location.

Processing of ore will commence in-pit and then slurry will be pumped from the feed preparation plant to the wet concentration plant for further processing. Waste clay and sand materials from processing of this ore will be combined and backfilled into the mine voids using co-flocculation (co-disposal system) where possible. Some material will be initially placed in a Tailing Storage Facility, herein referred to as SEPs, to allow drying of the clay and recycling of water back to the process water pond (PWP) (return water), prior to being co-disposed into mine voids. The mined area will be

rehabilitated back to pasture and / or native vegetation, depending on pre-mining conditions, consistent with the post-mine land use requirements (refer to Appendix 12).

HMC produced at the wet concentrator plant will be stockpiled on site prior to transport to Doral's Picton Dry Separation Plant, located approximately 63km northeast of the mine, for separation using electrostatic processes. The Picton Dry Separation Plant has a licence to process 250,000t of HMC sourced from Doral's Dardanup Mine. Processing of HMC into products of zircon, ilmenite, and leucoxene has occurred since the Picton Dry Separation Plant was approved by Ministerial Statement 484 in 1998. Once processed, HMC products are hauled by truck to either the Bunbury Port or Fremantle Port for export. Processing activities at the Picton Dry Separation Plant and exporting of product are not part of this Proposal and are not further described in this PER.

Key characteristics for the Proposal are summarised in Table 3-1. It should be noted that areas have been rounded to the nearest whole number as requested by the OEPA.

TABLE 3-1: KEY PROPOSAL CHARACTERISTICS TABLE

SUMMARY OF THE PROPOSAL		
Proposal Title	Yoongarillup Mineral Sands Project	
Proponent Name	Doral Mineral Sands Pty Ltd	
Short Description	The proposal is to extract ore from the Yoongarillup Mineral Sands Deposit, 17km southeast of Busselton, including the construction of associated mine infrastructure (offices, workshops, laydown area, roads, ore processing facilities and solar evaporation ponds).	

PHYSICAL ELEMENTS		
ELEMENT	LOCATION	PROPOSED EXTENT AUTHORISED
Mine Pits	Figure 1-2 – Proposed Site Layout	Clearing no more than 9ha of native vegetation and 32ha of pasture within a 152ha development envelope
Associated Infrastructure	Figure 1-2– Proposed Site Layout	Clearing of no more than 27ha of pasture within a 152ha development envelope.
Solar Evaporation Ponds (i.e. Tailings Storage Facility)	Figure 1-2– Proposed Site Layout	Clearing no more than 29ha of pasture within a 152ha development envelope.

OPERATIONAL ELEMENTS		
ELEMENT	LOCATION	PROPOSED EXTENT AUTHORISED
Ore Processing (waste)	Solar Evaporation Ponds Figure 1-2– Proposed Site Layout	No more than 250,000 tonnes per annum
Dewatering	-	Extraction of no more than 1.6 Gigalitres per annum

TABLE 3-2: PROPOSAL SUMMARY

ELEMENT	PROPOSAL
Proponent	Doral Mineral Sands Pty Ltd, Lot 7 Harris Road, Picton WA 6229
Life of mine	3 years
Total disturbance area	95.71 ha (mine pits and all infrastructure)
Mineable reserve	4,000,000 tonnes
Overburden volume	478,000 Bank Cubic Metres (BCM)
Rates of extraction (overburden and ore)	6,400,000 tonnes per annum (tpa)
Processing rate/mining rate	200 tonnes per hour (TPH)
HMC production	256,000 tonnes
Extraction method	Dry Mining
Water supply sources	1.6 gigalitres (GL) per annum abstracted from the Yarragadee aquifer Pit dewater and rainfall catchment will supplement the abstracted water where possible
HMC transport to Picton Dry Separation Plant	Six round trips (12 movements) per day

3.5 LIFE OF MINE

The operational mine life is three years which includes:

- Pre-mine establishment phase where the mine infrastructure and support facilities are constructed as described in Section 3.6. The duration of the phase is expected to be four months.
- Mining phase (Table 3-3, Section 3.6):
 - Haddon West sub-area – mining of blocks 14 to 23 and the realignment of Sues Road, (subject to approval from Main Roads – See Section 4);
 - State Forest sub-area – mining of blocks 24 and 25;
 - Haddon East sub-area – mining of blocks 2, and 4 to 13.

Following the operational phase of mining (three years), the mine closure phase will commence where rehabilitation and closure of mining domains will be undertaken in accordance with the Mine Closure Plan (Appendix 12). Doral expects mine closure to occur for up to five years, however this will depend on the success of rehabilitation.

A description of the activities conducted at each stage of the mine life is described after Table 3-3.

TABLE 3-3: MINING SCHEDULE**PROPOSED MINING SCHEDULE
YOONGARILLUP PROJECT**

Source: Budget Yoongarillup Current.xlsm

Dated: Worksheet Updated 23/12/2013 from Mining Schedule 20/09/2013

LEGEND

	Construction		Realign Sues Rd
	Overburden		Ore
	Ore & Overburden		

	2014/15				2015/16												2016/17												2017/18													
Pit	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18		
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SEP's (West)																																										

3.6 PRE-MINE ESTABLISHMENT WORKS

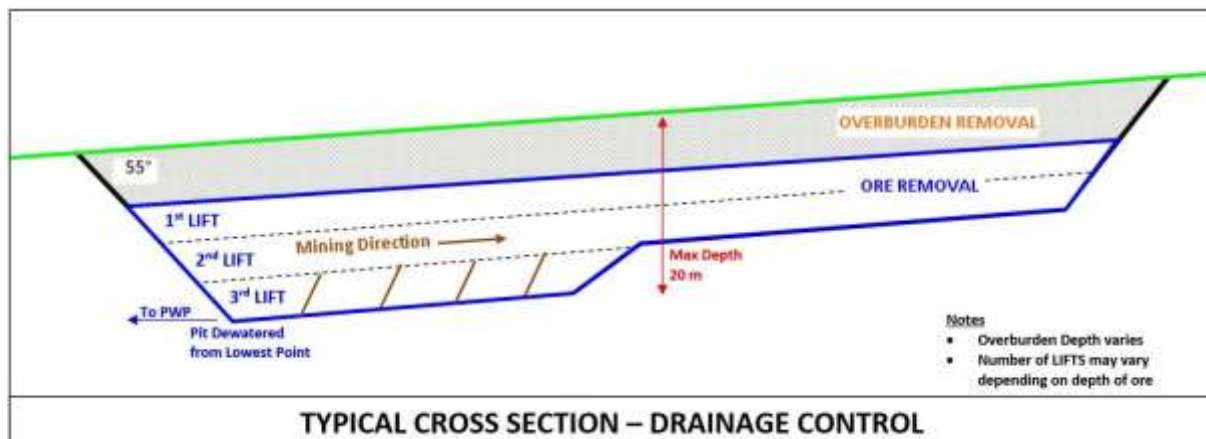
Pre-mine establishment activities will be undertaken between the hours of 7am to 7pm Monday to Saturday (excluding public holidays). The pre-mine establishment works will occur for a period of four months as shown in Table 3-3. Activities to be conducted are:

- Sub-soil drainage of paddocks;
- Clearing of remnant paddock trees;
- Construction of the PWP and drop out pond on mine blocks 10 and 12;
- Stripping of topsoil and subsoil on blocks 14 and 15 using scrapers and trucks;
- Construction of SEPs;
- Construction of internal haul roads;
- Installation of production bores and associated water infrastructure (e.g. pipeline);
- Construction of two amenities buildings; one containing offices and lunchroom and a second for ablution facilities. A local government approved septic tank and leach drain system will be established for effluent disposal;
- Construction of feed preparation plant, wet concentration plant and associated infrastructure;
- Construction of workshop and hardstand areas;
- Fencing where required (e.g. between SEPs and native vegetation);
- Erection of signage (e.g. State Forest sub-area);
- Ongoing monitoring of groundwater bore network;
- Pre-mine surveys.

3.7 MINING PHASE

3.7.1 Mining of Haddon West, Haddon East and Piggott Sub-Areas

Ore from the Yoongarillup Mineral Sands Deposit will be mined progressively via a series of open-cut pits using dry mining techniques. Once the topsoil and subsoil is stripped and stockpiled, overburden will be removed via scrapers or excavators. Removed overburden will be stockpiled or immediately used in progressive rehabilitation of previously mined areas. Exact depths of ore and overburden will vary for each pit, but will not exceed 20m below ground level (mbgl). Ore will be mined in a series of lifts, to a maximum depth of 20mbgl. Pits will be mined on a slight incline from the deepest point and then mined moving up-gradient in order to retain pit water within a sump at the deepest point on the pit floor (Plate 3-1). 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 (i.e. below 20m) is highly unlikely to occur. Mine pit dewater is pumped from the sump to the PWP for reuse.

PLATE 3-1: TYPICAL CROSS SECTION OF DRAINAGE CONTROL IN MINE PITS

Mining of ore and overburden within blocks 14 to 23 (Haddon West sub-area) is likely to occur over an eight month period. In order to mine block 23, Doral are planning on realigning a 300m section of Sues Road temporarily before reinstating the road at the completion of mining activities to its original alignment. The concept temporary road alignment is shown on Figure 3-1. Preliminary discussions have been held with Main Roads WA, whom have provided agreement to temporarily realign Sues Road, subject to a formal agreement being established and all Main Roads WA requirements being met. These agreements will be finalized prior to the commencement of mining.

Mining of ore and overburden within blocks 2, 4 to 13 (Haddon East sub-area) is likely to occur over a 14 month period following mining of the State Forest sub-area. Ore will be processed as described in Section 3.7.3.

3.7.2 Mining of State Forest Sub-Area

As mining nears completion in the Haddon West sub-area (block 22), stripping of dieback free vegetation from the State Forest sub-area will commence within block 25 and block 24 from west to east. Salvaged vegetation, topsoil and subsoil from the dieback free areas will be segregated separately and stockpiled onto backfilled areas in block 19 and 21 while observing hygiene protocols. Mining will then continue using the same techniques as the Haddon West and Haddon East sub-areas, with progressive backfilling occurring as mining progresses towards the east. Clearing will then commence in the dieback infested area (eastern end of block 24), with salvaged vegetation, topsoil and sub-soil segregated and stockpiled separately onto backfilled areas (block 15). Hygiene measures will be established to prevent cross-contamination of dieback free areas and stockpiles (refer to Section 10.3.4 for Dieback Management).

PLATE 3-2: PROPOSED MINING METHOD FOR MINE BLOCKS WEST OF SUES ROAD, INC.STATE FOREST

1. Completion of mining within Haddon West sub-area (block 22) with tailings backfill occurring progressively behind mining in a westerly direction.



2. Clearing commences within the State Forest sub-area (blocks 24 and 25) in an easterly direction.



3. Cleared vegetation, topsoil and subsoil from the dieback free areas will be segregated and stockpiled separately on backfilled areas (blocks 19 and 21).



4. Clearing of block 24 commences and progresses to the east, with cleared vegetation, topsoil and subsoil continuing to be segregated and stockpiled on backfilled areas (blocks 19 and 21).



5. Clearing of block 24 continues to the east, with block 25 and the western end of block 24 being progressively backfilled with tailings from the west.



6. Clearing of block 24 continues to the east, with block 24 continuing to be backfilled with tailings from the west.



7. Clearing commences in dieback infested area (eastern end of block 24). Vegetation, topsoil and subsoil is segregated and stockpiled separately on backfilled areas (block 15). Dieback hygiene management is established to prevent cross-contamination with uninfested stockpiles on blocks 19 and 21.



8. Mining commences in the dieback infested area (eastern end of Block 24) and tailings backfill continues in block 24.



9. Overburden backfill placement commences in blocks 25 and western end of block 24. Overburden material sourced from western side of Sues Road.



10. Overburden placement continues, progressing towards the east. Subsoil placement commences on block 25 and western end of block 24, sourced from stockpiles located on block 19 and 21.



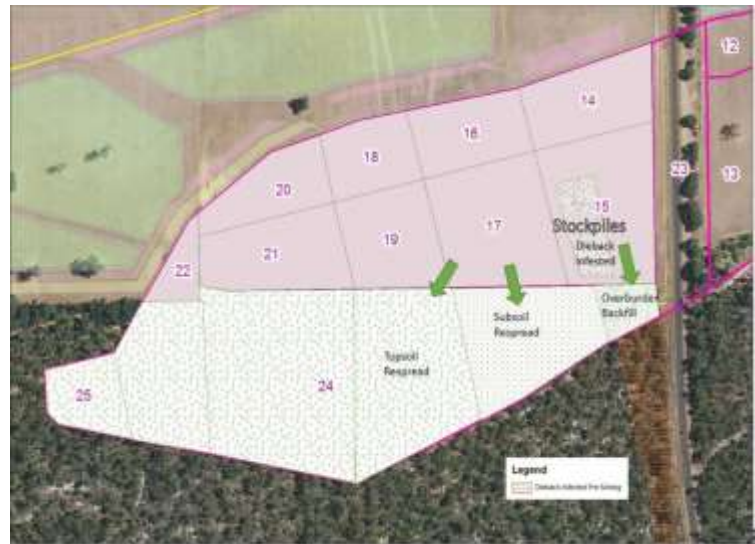
11. Overburden backfill placement continues towards the east of block 24. Subsoil respread continues and topsoil placement commences in block 25 and western end of block 24 from stockpiles located on block 19 and 21.



12. Overburden backfill placement continues towards the east of block 24. Subsoil and topsoil respread continues in an easterly direction along block 24 from stockpiles located in block 17.



13. Overburden placement in dieback infested area on the eastern end of block 24 commences. Subsoil and topsoil respread continues in dieback free areas of block 24 from stockpiles located in block 17.



14. Subsoil from dieback infested stockpiles located in block 15 is respread over dieback infested area of block 24. Subsoil respread of dieback free areas of block 24 is completed.



15. Topsoil respread for block 24 is complete in dieback and dieback free areas.



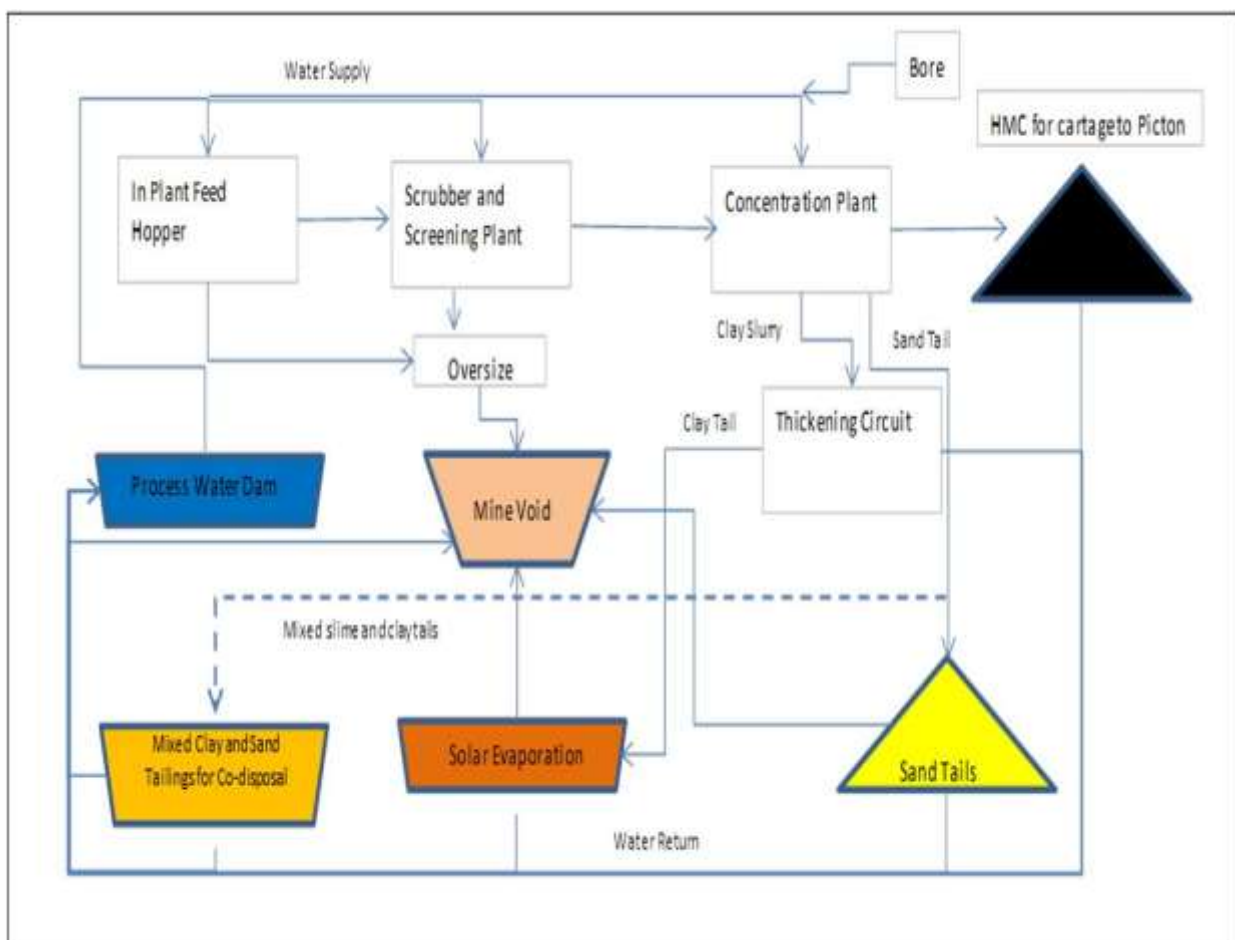
3.7.3 Ore Processing

Ore will be mined from the face using a Front End Loader in a series of lifts, and fed into the in-pit hopper, and screened and slurried using a mobile in-pit screening unit. The screened slurry will then be pumped to the feed preparation plant where it will move through a trommel and scrubber for removal of material greater than 3mm. Oversize materials (i.e. > 3mm) will be returned to the pit void or used to sheet internal minesite roads.

From the feed preparation plant, the ore will be transported via pumps and pipelines to the wet concentration plant where the process requires all particles >2.4mm to be removed from the ore. It is anticipated the wet concentrator plant will operate at a nominal throughput rate of 200TPH to produce 256,000t of HMC over the life of mining the Yoongarillup Mineral Sands Deposit. The HMC is stockpiled on site, and remains saturated, prior to transportation to the Picton Dry Separation Plant (see Section 3.11).

Two waste streams will be produced from the wet concentration plant; sand tails and clay slurry (Chart 3-1). The clay slurry is directed to the thickening circuit, where flocculent agglomerates clay fines, producing clay tails.

CHART 3-1: FLOW CHART OF MINING OPERATIONS



Clay tails are pumped into SEPs to allow settlement and drying. Dried clay tails is then removed from the SEPs (during dry months) and placed in mine voids. The co-disposal of clay tails with the sand tails into pit voids is also conducted.

Clay tails will be piped to SEPs to allow settlement and drying. Dried clay tails will then be removed from the ponds (during the dry months) and placed in-pit with sand tails. Where possible co-disposal of tailings will be undertaken during mining whereby the clay tails is disposed with the sand tails into the pit voids. This provides a more heterogeneous distribution of soil particle sizing and improves the hydraulic conductivity and permeability of the returned soil profile. The majority of the water will be decanted from the SEPs and pumped or gravity fed back to the PWP for use as process water. A Site Water Balance has been included as Appendix 8-D.

3.8 MINE CLOSURE PHASE

Full details of the mine closure phase of the proposal are documented in Section 9. A summary of the treatments that will be undertaken in each area is provided below.

3.8.1 Haddon West, Haddon East and Piggott Sub-Areas

Mine pits within the Haddon West, Haddon East and Piggott sub-areas will be progressively backfilled via co-disposal of sand tailings, dried clay tailings, oversize and overburden. A depth of 300mm of subsoil and 150mm of topsoil will then be replaced in order to promote the establishment of pasture grasses. Following replacement of subsoil/topsoil, the surface will be contoured to provide drainage and then ripped to 300mm.

3.8.2 State Forest Sub-Area

Mine pits within the State Forest sub-area will be progressively back filled via co-disposal of sand tailings and dried clay tailings at various depths, prior to backfill with 2,500mm of overburden material. An average depth of 300mm of subsoil and 150mm of topsoil will be replaced in two 75mm layers, in reverse order of stripping so as to ensure the original seed bearing layer is put back as the final surface layer, to promote the establishment and survival of native vegetation. To alleviate any compaction caused by the movement of heavy machinery, all mined areas will be ripped. Ripping requirements will be tailored to suit specific rehabilitation areas. In native rehabilitation areas, deep ripping may be required.

Prior to planting, rip lines will be furrowed along contours to collect water, directing it to the root-zone and also assist to remove hydrophobic soils, if present. Furrow spoil will be hilled on the down-slope side to better trap and retain water and to minimise erosion.

3.9 ANCILLARY INFRASTRUCTURE

3.9.1 Infrastructure

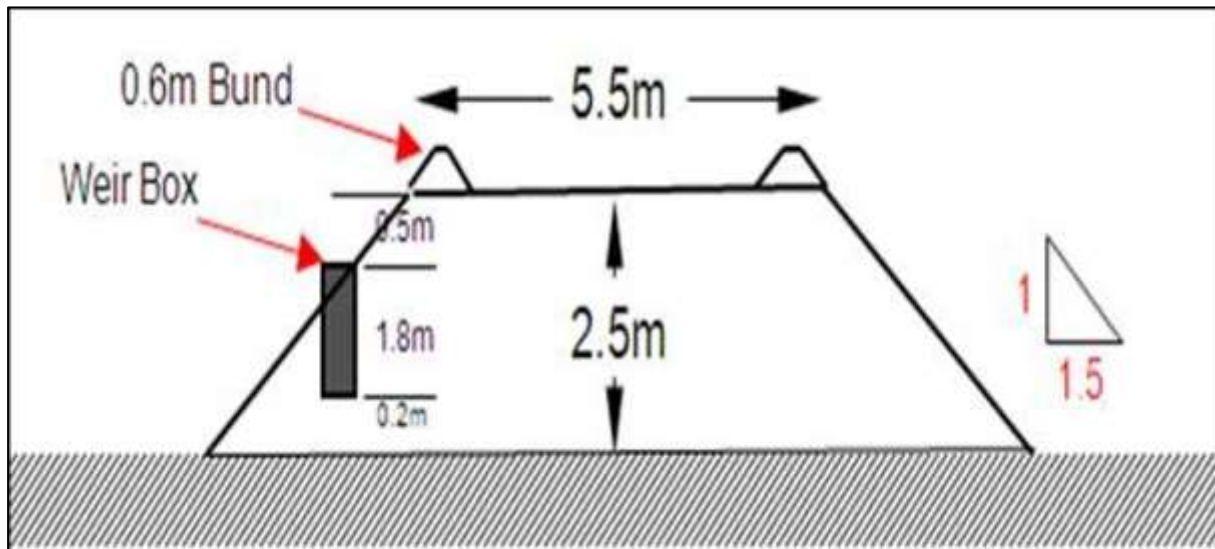
Infrastructure to support mining will include:

- Mobile in-pit screening plant, comprising feed hopper and screens and conveyors;
- Feed preparation plant, comprising a scrubbing unit to remove rock and clay from the ore;
- Wet concentration plant, comprising gravity separation spirals for heavy mineral separation, a thickening unit and other ancillary equipment;
- Mine offices, workshops and associated hardstand area;
- Internal haul roads and access roads.

3.9.2 Solar Evaporation Ponds

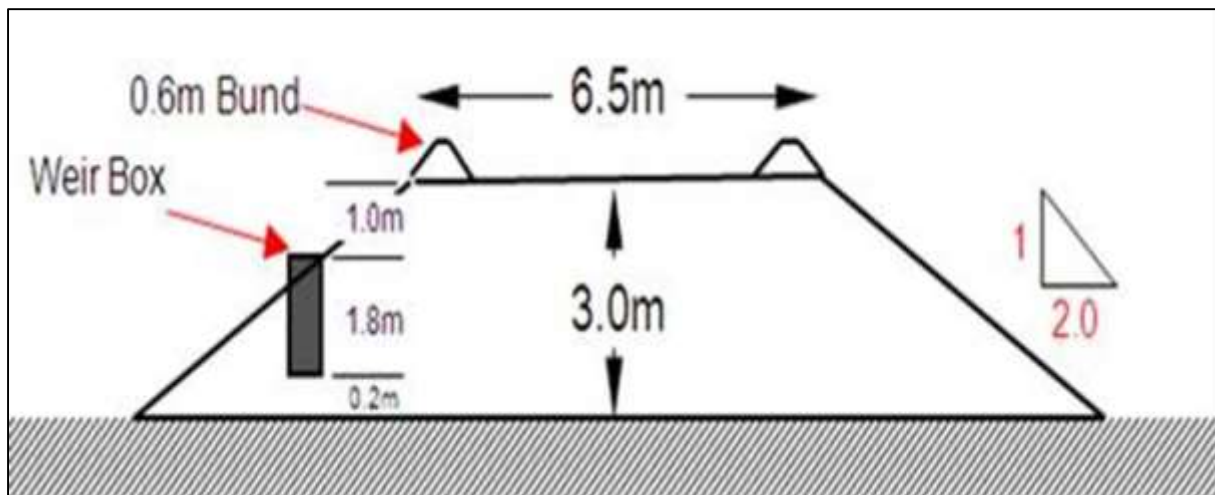
Doral propose to construct nine SEPs (28.23ha) as shown on Figure 1-2, to receive tailings during mining. SEPs will be constructed in accordance with best practice as outlined within *Code of Practice: Tailings Storage Facilities in Western Australia* (DMP, 2013) and shown in Plate 3-3 and Plate 3-4.

PLATE 3-3: SOLAR EVAPORATION POND DESIGN CLAY AND OVERBURDEN STRUCTURES



(Note: NOT TO SCALE)

PLATE 3-4: SOLAR EVAPORATION POND DESIGN TAILINGS SAND STRUCTURES



(Note: NOT TO SCALE)

The following standard design and operating practices for the management of SEPs will be implemented over the life of the mine in order to maintain the structural integrity of the embankment walls and to prevent over topping:

- All SEP floors are constructed to design slope using laser levels or GPS prior to pouring. The SEP floors are designed with a slope of 1:300 to 1:400 to assist with even and homogenous fills and to prevent water ponding prior to reaching the weir box;

- SEP wall height shall be at least 2.5m above the floor for clay and overburden structures and at least 3.0m above the floor for tailing sand structures;
- SEPs constructed with dry clay material or overburden are track rolled using a D7 dozer. The angle of repose for the outer pond wall is 1.0 vertical:1.5 horizontal;
- Only light vehicles have access to standard pond walls following construction. If SEP walls are to be modified as haul roads the running width must be at least 6.5m for one-way traffic and 14m for two-way traffic.

3.9.3 Process Water Pond

A 1.08ha pond will be constructed in mine voids created from the removal of overburden and ore from blocks 10 and 12 (Figure 1-2). The PWP will be unlined and will supply water to the plant for processing of ore. The capacity of the PWP will be 113ML.

3.9.4 Drop Out Pond

The drop out pond of 0.76ha will be constructed adjacent to the PWP. The purpose of this pond is to receive all return water from the site and act as a settling pond to settle out suspended solids from water prior to it entering the PWP.

3.10 WATER AND POWER SUPPLY

Water required for the wet concentrator plant process will be sourced entirely from the PWP. Water for the PWP will be sourced from two production bores screened within the Yarragadee aquifer and supplemented with rainfall runoff, mine dewater and return water from the SEPs. The process to apply for an abstraction licence from the Yarragadee aquifer has been initiated by Doral in consultation with the DoW (refer to Section 4). A simple site water balance for the Proposal (PB, 2013c) is described in Section 8.2.1.

Power requirements will be sourced from the Western Power grid via a 2MVA 22kV power line. Consultation with Western Power has indicated that Western Power will utilise existing infrastructure and upgrade where required to provide a three phase power supply to the processing plant. The power demands of the Proposal are estimated at 1,819kW with the major consumption areas being:

- 534kW: Feed Preparation Plant;
- 794kW: Wet Concentration Plant;
- 61kW: Clay tailings disposal system;
- 430kW: Mine Services.

3.11 TRANSPORT OF HMC TO PICTON

Trucks will transport HMC to Picton by road, travelling from the mine north along Sues Road and Bussell Highway, north-east along Boyanup-Capel Road (comprising Capel Drive, Gavins Road, Railway Road and Trigwell Road), north onto South Western Highway, north-east onto Bunbury Outer Ring Road, north along Willinge Drive (Port Access Road), then onto Boyanup Picton Road and Harris Road to the Picton Dry Separation Plant (Figure 1-3). There will be approximately six round trips per day using Class 10 or 11 vehicles. All roads on this route are part of Restricted Access Vehicle (RAV) network 4.

3.12 WORKFORCE

Workforce requirements will fluctuate between summer months when clay tails are removed from SEPs and winter where the workforce will generally be focused on mining activities.

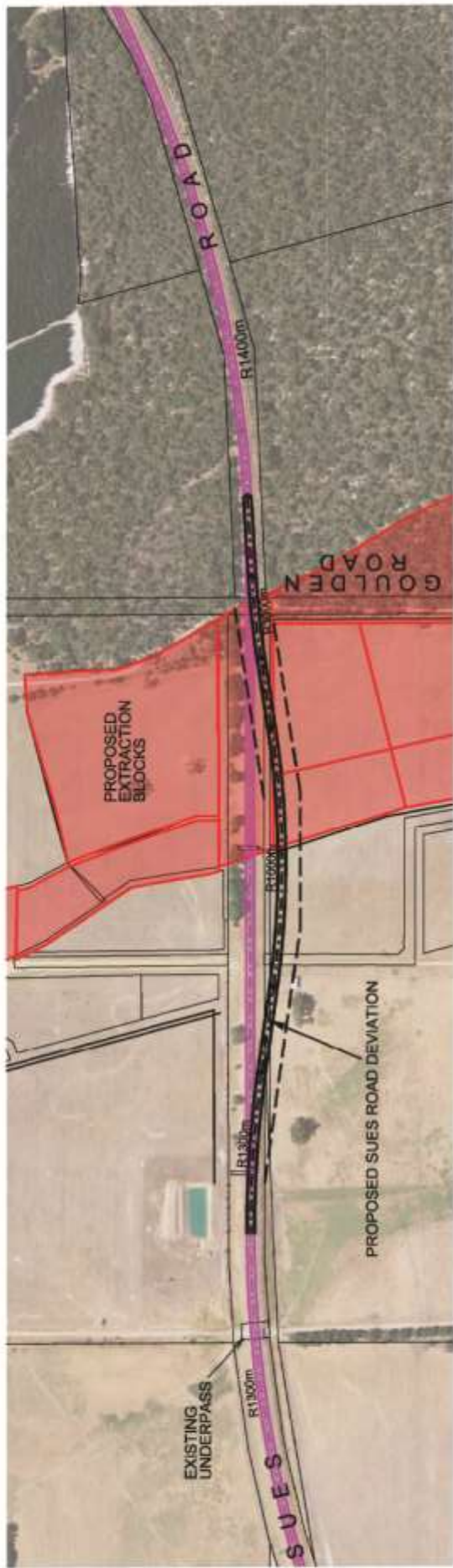
The permanent workforce levels are expected to be:

- Summer - 32 people;
- Winter - 25 people.

This includes:

- A Mine Coordinator;
- Mine Engineer;
- Surveyor;
- Environmental Officer;
- Operators;
- Maintenance staff.

Sub-contractors will be utilised for specific task as required. Specific workforce induction and training commitments will be implemented for the Proposal as outlined in the Environmental Management System and Safety Manual. Mining of this mineral resource will provide direct and indirect employment opportunities for the local community.



0 50 100 150 200 250m

SCALE 1 : 7 000 at A4 (MGA)

Doral

Public Environmental Review
Proposed Yoongarillup Mineral Sands Project

Proposed Sues Road Deviation
Preliminary Concept Alignment

Scale:
1:7 000

Projection:
Australia MGA94 (50)

Sheet Size:
A4

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4 STAKEHOLDER CONSULTATION

4.1 CONSULTATION PROCESS

Stakeholder consultation for the Proposal commenced in early 2011 with discussions with landowners directly affected by the Proposal and key Government agencies. Doral engaged stakeholders early in the planning process to achieve a collaborative approach and to ensure local knowledge is considered in the design and management of the Proposal.

Stakeholder consultation has included the following:

- Written communications to affected landowners discussing details of the following:
 - Overview and regular updates of the Proposal;
 - Exploration drilling programs;
 - Scope and purpose of environmental technical studies;
 - Landowner access arrangements;
 - Notification of submission of the EP Act referral for the Proposal;
 - The EPA determination of a PER level of assessment for the Proposal.
- Telephone and email discussions with landowners to discuss upcoming studies/work and organise access arrangements for relevant staff/contractors;
- Meetings and presentation with City of Busselton councillors to present an overview of Doral and details of the Proposal;
- Meetings, telephone and email discussions with key Government agencies to discuss various aspects of the Proposal. These include:
 - Office of the Environmental Protection Authority OEPA);
 - Department of Parks and Wildlife (DPaW);
 - DER;
 - DMP;
 - DoW;
 - DoE;
 - Mains Road Western Australia;
 - City of Busselton.
- Consultation with the SWALSC as part of the ethnographic and archaeology surveys and the selection of Aboriginal consultants from the SWB claim. This included interviews and site inspections with the SWB consultants and consultation regarding the findings of the surveys.

Table 4-1 provides a summary of the stakeholder consultation that has occurred to date, including a summary of discussion points, primary issues raised and Doral's response to these. It should be noted that Table 4-1 excludes any matter that does not relate directly to the Proposal or information of a financial or commercially sensitive nature.

TABLE 4-1: STAKEHOLDER CONSULTATION

STAKEHOLDER	DATE	TOPIC	DISCUSSION POINTS/ISSUES RAISED	RESPONSE
Office of the Environmental Protection Authority (OEPA) <ul style="list-style-type: none"> • P Tapsell • M Jeffries 	21 Sep 2011	Project Briefing	<p>Flora and vegetation survey to be undertaken as per EPA Guidance Statement No. 51 <i>Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia</i> (EPA, 2004a).</p> <p>OEPA requested that the Yoongarillup Project be referred under section 38 of the EP Act as a single Proposal, rather than separate areas (i.e. State Forest and paddock areas).</p>	<p>Flora and vegetation survey conducted by Mattiske (2012a) was undertaken in accordance with EPA (2004a).</p> <p>Proposal for the Yoongarillup Minerals Sands Project was referred under section 38 the EP Act on 22 March 2012 as a single Proposal.</p>
	16 Mar 2012	Project Update	Doral were requested to submit a referral under section 38 of the EP Act by 22 March 2012 containing all available critical information (current at the time) to assist the OEPA in determining the level of assessment. Formal level of assessment was to be provided by the OEPA following the assessment of critical information (particularly flora and vegetation, dieback, and fauna).	<p>Timelines agreed.</p> <p>Doral submitted referral on 22 March 2012.</p>
	15 May 2012	Discussion of floristic issues related to the Yoongarillup referral	<p>The importance of the Floristic Community Type (FCT) C1: Central Whicher Scarp Jarrah woodlands was discussed with Doral in relation to the percentage that occurred within the Proposal.</p> <p>Proposed National Park issue would not affect the Proposal.</p> <p>Dieback mapping issues discussed and OEPA requested a groundwater runoff map to be supplied.</p> <p>OEPA agreed Doral would receive an indication of the level of assessment by end of May.</p>	<p>The importance of FCT C1 was noted and all efforts to reduce the disturbance area within the State Forest were made.</p> <p>The Proposal was not located in an area identified as a Proposed National Park in the current Forest Management Plan 2014-2023.</p> <p>Doral engaged Moore Mapping (2012) to conduct further dieback mapping within the State Forest.</p>

STAKEHOLDER	DATE	TOPIC	DISCUSSION POINTS/ISSUES RAISED	RESPONSE
				Groundwater runoff map supplied to OEPA 17 May 2012. A PER level of assessment was set by the EPA on 27 August 2012, with a four week public review period (Assessment No. 1938).
Office of the Environmental Protection Authority (OEPA) <ul style="list-style-type: none">• P Tapsell• K Taylor	26 Jul 2012	Meeting to outline OEPA recommendations to the EPA	The OEPA advised Doral that they will be recommending the Proposal be assessed as a streamlined PER with a 4 week public response period. The OEPA advised Doral that offsets will be critical to the approval process. Due to the need to provide offsets to satisfy the EPA and DoE, PER considered most timely assessment level. OEPA indicated that they did not believe a further flora and vegetation survey was required. EPA would consider recommendation on 2 August 2012	A PER level of assessment was set by the EPA on 27 August 2012, with a four week public review period (Assessment No. 1938). Discussions with DPaW regarding a suitable offset via land acquisition has commenced.
Department of Minerals and Petroleum (DMP) <ul style="list-style-type: none">• E Bouwhuis• T Sudovic	21 Jul 2011	Project Briefing	DMP advised Doral that they will be required to prepare a Mining Proposal in accordance with DMP guidelines.	Noted
Department of Parks and Wildlife (DPaW) <ul style="list-style-type: none">• C Bishop• K Williams• A Webb	15 Apr 2011	Project Briefing	DPaW advised Doral that the fauna survey should focus on Black-Cockatoo breeding sites, nesting hollows and ringtail possums.	Doral provided DPaW's advice to the relevant consultant (Mattiske, 2012a, Ecoedge Environmental, 2013 and Harewood, 2014).

STAKEHOLDER	DATE	TOPIC	DISCUSSION POINTS/ISSUES RAISED	RESPONSE
			<p>DPaW advised Doral that flora and vegetation surveys should identify Mountain Marri and Whicher Scarp FCT's within the state forest area of the proposal.</p> <p>DPaW advised that there is a requirement for a Conservation Management Plan (CMP) to be submitted to DPaW prior to submitting a Program of Works (POW) to the DMP for the exploration drilling within the State Forest.</p>	Doral prepared and submitted a Draft CMP on 2 March 2012.
	1 Mar 2012	Pre-submission scoping meeting for Conservation Management Plan (CMP) for exploratory drilling	<p>Doral to submit CMP to support the POW.</p> <p>Doral committed to undertaking targeted surveys of all drill lines for Threatened flora as detailed in the CMP.</p> <p>Doral to supply DPaW with results of the flora and vegetation survey (Mattiske, 2012a) for immediate review.</p>	<p>Doral submitted a Draft CMP on 2 March 2012.</p> <p>Doral supplied DPaW with relevant flora and vegetation surveys.</p>
	26 Mar 2012	Update on CMP Progress and EPA Referral	<p>Doral advised DPaW that a dieback assessment was to be undertaken on 27 March 2012.</p> <p>Doral to provide DPaW with the outcome of the targeted drill line survey and EPA referral when available.</p>	<p>Dieback assessment not available until the end of April 2012.</p> <p>Revised CMP will be provided to DPaW (communicated on the 12 April 2012).</p>
<p>Department of Parks and Wildlife (DPaW)</p> <ul style="list-style-type: none"> A Errington 	31 Oct 2013	Offsets – land acquisition	<p>Doral discussed acquiring a suitable piece of land as a direct offset for the residual impacts of the Proposal to meet the State and Commonwealth offset policies with DPaW.</p> <p>DPaW advised Doral that potential offset land was currently available.</p> <p>DPaW discussed the expectations and processes involved in acquiring land.</p>	Discussion with DPaW ongoing.

STAKEHOLDER	DATE	TOPIC	DISCUSSION POINTS/ISSUES RAISED	RESPONSE
			<p>DPaW advised Doral how other proponents have included land acquisition in their environmental approval documentation (i.e. PER) and what should be included in the Yoongarillup Proposal (on-going consultation with DPaW)</p> <p>Doral advised DPaW that they cannot commit to providing funds to DPaW to acquire a suitable piece of land until the Proposal received conditional approval.</p>	
<p>Department of Parks and Wildlife (DPaW)</p> <ul style="list-style-type: none"> • N Woolfrey • A Errington • D Coffey <p>Office of the Environmental Protection Authority (OEPA)</p> <ul style="list-style-type: none"> • T Gentle 	2 May 2014	Offsets – land acquisition	<p>Doral reiterated its commitment to acquiring suitable parcel(s) of land to use as direct offsets for the residual impacts of the Proposal, as required by the State and Commonwealth offset policies.</p> <p>DPaW acknowledged Doral's position of not being able to purchase specific land packages for the purpose of offsets until EPA approval had been obtained for the Proposal.</p> <p>EPA advised that the offset package will need to meet the requirements of the Commonwealth Offset Policy (including the "Commonwealth Offsets Calculator") and the EPA Offset Policy.</p> <p>DPaW acknowledged the amount of privately held native vegetation available on the Whicher Scarp for purchase was limited. Doral advised that they had a number of possible sites they were investigating, however further investigation, discussions with DPAW, DER and EPA, and landholders were required prior to finalising an offset package for the project.</p>	<p>Doral will continue to have on-going discussions with DPAW, the EPA and DER.</p> <p>Doral will undertake additional investigative studies on the sites that they have identified as potential offset sites. The information collected from these studies will be included in the final offset package submitted to the regulatory bodies for review and consideration.</p>

STAKEHOLDER	DATE	TOPIC	DISCUSSION POINTS/ISSUES RAISED	RESPONSE
Department of Environment Regulation (DER) <ul style="list-style-type: none"> S Wong 	16 May 2011	Proposed Acid Sulfate Soil Assessment	DER provided the following items that needed to be included in the Acid Sulfate Soil assessment: <ul style="list-style-type: none"> Use a 0.005 detection limit for inorganic sulfur. Undertake appropriate soil classification work when describing each of the soil profiles that occur onsite. Test the groundwater which collects in each of the bore holes for pH and electrical conductivity (EC). Include an extra line of monitoring bores to the west of the proposed Haddon Pit to account for the potential dewatering zone. Correctly log and conduct acid sulfate soil assessment for the bore holes which will be used as long term environmental monitoring bores. 	Information provided to Soil Water Consultants who are undertaking the ASS assessment.
Department of Water (DoW) <ul style="list-style-type: none"> R Watson 	18 May 2011	Project Briefing	DoW advised Doral that the Yarragadee aquifer is fully allocated. Doral advised to procure water from businesses/ private allocation holders if possible. Doral advised DoW that approximately 1.5GL of water is required for the Proposal. If Doral are unable to procure a water allocation, a short term allocation can be requested. Once allocation has been traded Doral will still need to apply for a licence to take water.	Doral has contacted Iluka Resources Ltd and Cristal Mining Australia Ltd in an attempt to purchase/lease some unused portions of their water allocations. Doral unsuccessfully tendered on the Challenge Dairy water allocation.
	11 Dec 2013	Project Update	Project update was provided to DoW and new project manager introduced. The requirement of 1.6 GL/year for the proposal was confirmed with DoW.	An application to abstract water from the Yarragadee aquifer has been applied for.

STAKEHOLDER	DATE	TOPIC	DISCUSSION POINTS/ISSUES RAISED	RESPONSE
			Doral had been unsuccessful in obtaining an existing allocation to date (through lease/purchase) but efforts were still being made in this area. Alternative allocations were discussed, including applying to access the “reserve” allocation as the Proposal is of a short term nature.	Doral will continue to seek water allocation via purchase/lease from existing allocations.
	21 Jan 2014	Water Allocations	Email discussion seeking advice on process for submitting a 5C licence to take water. Advice was provided that application could be submitted, but would not be approved until all approvals for the Proposal were obtained.	Doral has submitted an application for a 5C licence to take groundwater.
Main Roads WA <ul style="list-style-type: none"> • P Bromley • P Davies • L Palandri 	18 Dec 2013	Project Briefing Sues Road	<p>Provided overview of the Proposal and discussed that a portion of the mineral reserve is located under Sues Road.</p> <p>Doral discussed the proposed road re-alignment of Sues Road and requested in-principle consent to mine Sues Road should the road re-alignment meet Main Roads requirements.</p>	<p>Doral are continuing discussions with Main Roads WA to finalise the re-alignment requirements.</p> <p>Main Roads provided in-principle consent to mine and temporarily re-align Sues Road.</p>
Forest Products Commission <ul style="list-style-type: none"> • S Sawyer • T Sawyer • J Mak 	23 Dec 2013	Project Briefing	<p>Provided overview of the proposal. The Forest Products Commission manages a pine plantation east of Sues Road (south of the Proposal). Forest Products Commission advised that this plantation was to be thinned in 2014, and possibly again 5 years later. Concern was raised as to minesite dewatering operations and the stress this may place on the plantation.</p> <p>Forest Products Commission requested that Doral advise them when the PER was released for public comment.</p>	<p>Doral advised Forest products Commission that a detailed groundwater model (PB, 2014a) indicated that no drawdown outside of the mine pits will occur. And that this groundwater modelling would be available as part of the PER.</p> <p>Doral noted.</p>

STAKEHOLDER	DATE	TOPIC	DISCUSSION POINTS/ISSUES RAISED	RESPONSE
Landowner Lots 1872, 1873 and 1874 • N and E Haddon	9 Mar 2011	Project Briefing	<p>Doral advised the Haddon's of upcoming drilling program. Discussions were held on what the mining operation may look like if the Project went ahead.</p> <p>The Haddon's advised that parts of adjoining State Forest have been cleared previously and in places has had sand and gravel excavated.</p>	<p>Regular update meetings and minutes provided to the Haddon's.</p> <p>As much timing information as possible supplied to minimise impact on farming operations.</p> <p>Paddock access requirements under development.</p>
	23 Mar 2011	Project Update Exploratory Drilling Agreement	<p>Doral discussed water sources for mining operations.</p> <p>Section 29 consent provided for exploratory drilling. The Haddon's requested as much timing information as possible be supplied to minimise impact on farming operations.</p>	<p>Meeting minutes forwarded to the Haddon's.</p> <p>Section 29 consent for exploratory drilling provided 23 March 2011.</p>
	23 Jan 2012	Project Updates	<p>Discussion of proposed compensation arrangements</p> <p>Timing impacts discussed – herding/cropping.</p> <p>Requirements for paddock access agreed – closing gates/ double gee inspection in areas.</p> <p>Changes to project staffing discussed as it occurred</p>	<p>Meeting minutes forwarded to the Haddon's.</p>
	6 Aug 2012	Project Update	<p>Doral provided advice that the Proposal was likely to be formally assessed as a PER by the OEPA which would delay the timing of implementing the Proposal.</p> <p>Doral discussed possible road relocation (Sues Road) to facilitate mining of existing road reserve, power supply for</p>	<p>Doral would continue liaising with the Haddon's and providing them with project updates.</p>

STAKEHOLDER	DATE	TOPIC	DISCUSSION POINTS/ISSUES RAISED	RESPONSE
			<p>minesite, and engagement of consultant to undertake pasture monitoring and compensation arrangements.</p> <p>Doral discussed water requirements and protection of dam located east of Sues Rd (not located within Development Envelopment)</p> <p>Requested approval to undertake soil analysis in paddocks both sides of Sues Road to gain understanding of soil profile in pasture areas.</p>	
	14 Feb 2013	Project Update	Discussion of proposed compensation arrangements. The Haddon's requested data on groundwater modelling.	Noted – Report to be forwarded when available.
	28 Feb 2013	Technical Studies	<p>New Doral project staff introduced.</p> <p>Doral provided overview of the technical studies required to be undertaken to support the PER (noise, dust monitoring, flora and vegetation, fauna, hydrology, archaeology etc.).</p>	Minutes of meeting forwarded to the Haddon's.
	28 Mar 2013	Discussed Upcoming Drilling Program	Section 29 consent provided for exploratory drilling.	Section 29 consent for exploratory drilling signed 4 April 2013.
	25 Oct 2013	Project Update	<p>Advised that Doral had received board approval for the project.</p> <p>Advised that Doral were currently preparing the PER.</p> <p>Provided an update on the proposed project timing.</p>	Minutes of meeting forwarded to the Haddon's.
	19 Dec 2013	Project Update	A Project Status update was provided.	Minutes of meeting forwarded to the Haddon's.

STAKEHOLDER	DATE	TOPIC	DISCUSSION POINTS/ISSUES RAISED	RESPONSE
Landowner Lot 1870 <ul style="list-style-type: none"> J and S Mildwaters 	9 Mar 2011	Project Briefing	Susan Mildwaters attended the meeting with the Haddon's. The upcoming drilling program was discussed and information was provided on what the minesite operations may look like should the Proposal be implemented.	Regular update meetings and minutes to be provided. Susan Mildwaters provided advice to Doral that project update information and meeting minutes were able to be passed on to her via her parents, Neville and Elaine Haddon.
	23 Mar 2011	Project Update Upcoming Drilling Program	Doral discussed water sources for mining operations. Section 29 consent provided for exploratory drilling.	Section 29 consent for exploratory drilling signed 25 March 2011.
	29 Jan 2014	Phone Discussion to provide Project Update	Introduced new project staff. Discussed project status and PER process.	Provided minutes from previous meeting with the Haddon's.
Landowner Lots 101 and 102 <ul style="list-style-type: none"> B and F Piggott 	17 Mar 2011	Project Briefing	Doral provided advice of upcoming drilling program. Discussions were held on what any future mining operation may look like.	Section 29 consent for exploratory drilling signed 24 March 2011.
	10 Sep 2012	Project Update	Doral representatives provided update on Proposal. The Piggott's advised that they would prefer that Goulden Rd would not be used as a mine access road. Discussed environmental/technical studies that were required for the PER.	Minutes of meeting forwarded to the Piggott's. Doral advised that there is no current plan to utilise Goulden Road for this purpose.

STAKEHOLDER	DATE	TOPIC	DISCUSSION POINTS/ISSUES RAISED	RESPONSE
	28 Mar 2013	Exploratory Drilling	Meeting to discuss upcoming drilling program. Section 29 consent provided for exploratory drilling. The Piggott's requested that survey stakes are removed after drilling. Requested information on drill hole water levels.	Section 29 consent for exploratory drilling signed 29 March 2013.
	19 Dec 2013	Project Update	A Project Status update was provided.	Minutes of meeting forwarded to Piggott's.
Landowners Lot 1869 <ul style="list-style-type: none"> E and S Chidgey J and J George 	28 Mar 2012	Project Briefing	Doral representatives provided a brief overview of the Proposal. Concern was shown by the landholders with regard to mining operations generating noise and dust. Concern was also expressed as to the potential impacts on their water supply, which was sourced from rainwater and groundwater and that mining operations would impact the groundwater table.	Doral noted concerns and advised that noise modelling would be undertaken as part of the environmental approval process.
	24 Apr 2013	Project Update	Doral representatives provided a Project Status update. Concern was again raised about noise and dust and the impact of the mining operations on their water supply. Doral advised landowner of PER process which would provide an opportunity for them to comment on the Proposal. Discussed upcoming exploratory drilling programs.	Committed to providing advice to landholders when the PER is released for public comment. Section 29 consent for exploratory drilling signed 16 May 2013.

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5 FRAMEWORK FOR ENVIRONMENTAL IMPACT ASSESSMENT OF PROPOSAL

5.1 IDENTIFICATION OF KEY FACTORS AND THEIR SIGNIFICANCE

Key environmental factors were identified through the scoping process including:

- Submission of Referral Documentation outlining the results of preliminary environmental investigations;
- Agency consultation;
- Preparation of an ESD by the EPA.

As detailed in the ESD (Appendix 2-A) and in accordance with EPA (2013), the key environmental factors relevant to the Proposal are:

- Flora and Vegetation;
- Terrestrial Fauna;
- Hydrological Processes;
- Rehabilitation and Closure ;
- Offsets.

In accordance with EPA (2013), 'Rehabilitation and Closure' and 'Offsets' are now considered to be 'integrating factors'. As the ESD identified Rehabilitation and Mine Closure (i.e. Rehabilitation and Closure) and Residual Risk Management (i.e. Offsets) as key environmental factors, Doral has continued to address these aspects in accordance with the ESD.

In addition to the above environmental/integrating factors, page 2 of the ESD (Appendix 2-A) requests a separate section to be included in the PER document to identify and discuss MNES.

5.2 OTHER ENVIRONMENTAL MATTERS

Other Environmental Matters warranting attention as part of the environmental review of the Proposal are:

- Water resources;
- The impact of groundwater drawdown on the Vasse-Wonnerup System;
- Dieback mapping and management;
- Dust;
- Noise.

Prior to the release of EPA (2013), these other environmental matters were previously identified as 'other environmental factors'. Although the ESD referred to these as 'other environmental factors', Doral has updated this terminology to be consistent with EPA (2013).

The potential impacts and their proposed management on the relevant environmental/integrating factors, MNES and other environmental matters are assessed in Sections 0 to 12.

5.3 CONSIDERATION OF ENVIRONMENTAL PRINCIPLES

The EP Act sets out five principles by which protection of the environment is to be achieved in Western Australia. These principles, and the manner in which Doral has sought to apply them in the design and planned implementation of the Proposal, are outlined in Table 5-1.

TABLE 5-1: PRINCIPLES OF ENVIRONMENTAL PROTECTION, AS THEY APPLY TO THE PROPOSAL

PRINCIPLE	CONSIDERATION GIVEN IN PROPOSAL	RELEVANT SECTIONS IN DOCUMENT
<p>1. Precautionary Principle</p> <p>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</p> <p>In the application of the precautionary principle, decisions should be guided by:</p> <ul style="list-style-type: none"> Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment An assessment of the risk weighted consequences of various options. 	<p>The precautionary principle has been applied where lack of full scientific certainty of the impacts of the Proposal are known to prevent environmental degradation.</p>	<p>Examples of sections in the PER where the precautionary principle has been applied:</p> <p>7.4.7 Light, Noise and Dust Emissions</p> <p>Light, dust and noise emissions are all likely to increase as a result of mining activities. The impacts of these emissions on fauna are difficult to predict and therefore a precautionary approach will be adopted and emissions will be reduced as far as practicable.</p> <p>8.4.5 Discharge of Water during Emergency Situations</p> <p>Discharge water quality is unknown and cannot be measured prior to the implementation of the Proposal. To manage the potential for pollution of the receiving environment, Doral will test excess water prior to discharge and adhere to acceptable water quality criteria.</p> <p>10.3 Dieback</p> <p>Doral considers the paddocks within the Haddon West and Haddon East sub-areas are uninterpretable as there is no vegetation present through which the disease can be confirmed. Pasture topsoil particularly those adjacent to water flows from the infested area of the State Forest sub-area are likely to harbour <i>Phytophthora</i> dieback. Therefore for the purposes of management paddocks are deemed 'infested'.</p>

PRINCIPLE	CONSIDERATION GIVEN IN PROPOSAL	RELEVANT SECTIONS IN DOCUMENT
<p>2. Intergenerational Equity</p> <p>The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.</p>	<p>Doral recognises the importance of intergenerational equity and throughout the management measures sections of this PER we present measures to appropriately manage potential impacts to ensure health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.</p>	<p>Section 6.5 Management Measures and Performance Standards</p> <p>Section 7.5 Management Measures and Performance Standards</p> <p>Section 8.5 Management Measures and Performance Standards</p> <p>Section 10.3.4 Management Measures and Performance Standards</p> <p>Section 10.4.4 Management Measures and Performance Standards</p> <p>Section 10.5.6 Management Measures and Performance Standards</p> <p>Section 11.5 Management Measures and Performance Standards</p>
<p>3. Conservation of biological diversity and ecological integrity</p> <p>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</p>	<p>Doral recognises the natural values of the Whicher Scarp are of significance to Western Australia.</p> <p>Doral considered it was important to retain as much of the State Forest within the Whicher Scarp as practically possible, whilst still achieving an economically viable Proposal.</p>	<p>Section 2.2 Key Conservation Values</p> <p>Section 3.2 Alternatives Considered</p> <p>Section 0 Flora and Vegetation</p> <p>Section 12 Residual Risk Management (Offsets)</p>

PRINCIPLE	CONSIDERATION GIVEN IN PROPOSAL	RELEVANT SECTIONS IN DOCUMENT
<p>4. Improved valuation, pricing and incentives mechanisms</p> <p>(i) Environmental factors should be included in the valuation of assets and services.</p> <p>(ii) The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement.</p> <p>(iii) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes.</p> <p>(iv) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentives structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.</p>	<p>Doral have factored in the costs of implementing environmental management measures into annual budgets for the Yoongarillup Mineral Sands Project.</p> <p>Costs of rehabilitation have been considered and included in the Mine Closure Plan.</p>	Appendix 12 - Mine Closure Plan
<p>5. Waste minimisation</p> <p>All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge.</p>	<p>Doral's EMS includes waste management plans, waste management procedures and incident reporting procedures which will be communicated to staff in inductions and regular meetings to ensure best practise management of wastes is implemented at the Yoongarillup mine.</p>	Section 13 Environmental Management Framework

5.4 CONSIDERATION OF EPA'S EXPECTATION FOR ENVIRONMENTAL IMPACT ASSESSMENT

Table 5-2 sets out the EPA expectations for environmental impact assessment of proposals, with a summary of how these matters are considered in this environmental impact assessment, together with a cross reference to the relevant sections.

TABLE 5-2: STATEMENT OF EXPECTATION FOR ENVIRONMENTAL IMPACT ASSESSMENT

EXPECTATIONS	CONSIDERATION GIVEN IN PROPOSAL	RELEVANT SECTIONS IN DOCUMENT
a) Proponents will use best practicable measures and genuine evaluation of options or alternatives in siting, planning and designing their proposals to avoid, and where this is not possible, to minimise impacts on the environment.	Doral have considered all alternatives to mining the Yoongarillup Mineral Sands Deposit.	Section 3.2 Alternatives Considered
b) The onus is with the proponents to describe the environmental impacts of their proposals, and to use their best endeavours to demonstrate that the unavoidable impacts are environmentally acceptable, taking into account cumulative impacts in the region.	Environmental impacts of the Proposal have been described under each key environmental factor. This includes discussion of the source of potential impacts, the assessment of these impacts and incorporation of management measures to ensure residual impacts or 'predicted outcomes' are environmentally acceptable. A consideration of cumulative impacts is presented for key environmental factors.	Section 6.4 Assessment of Likely Impacts Section 7.4 Assessment of Likely Impacts Section 8.4 Assessment of Likely Impacts Section 11.4 Assessment of Likely Impacts
c) Proponents will use best practicable measures and mitigation to manage adverse environmental impacts.	In preparing the PER the emphasis has been placed on including practical management and mitigation measures for each key environmental factor. These measures have been compared with the current measures implemented at the Dardanup Mine, and where appropriate improved on for this Proposal.	Section 6.5 Management Measures and Performance Standards Section 7.5 Management Measures and Performance Standards Section 8.5 Management Measures and Performance Standards Section 11.5 Management Measures and Performance Standards

EXPECTATIONS	CONSIDERATION GIVEN IN PROPOSAL	RELEVANT SECTIONS IN DOCUMENT
d) Proposals will meet relevant environmental objectives and standards.	Each section of the PER that discusses a key environmental factor has a 'Predicted Outcome against environmental objectives, policies, guidelines, standards and procedures' section. In these sections we state if the relevant EPA objectives will be met.	<p>Section 6.6 Predicted Environmental Outcomes against environmental objectives, policies, guidelines, standards and procedures.</p> <p>Section 7.6 Predicted Environmental Outcomes against environmental objectives, policies, guidelines, standards and procedures.</p> <p>Section 8.6 Predicted Environmental Outcomes against environmental objectives, policies, guidelines, standards and procedures.</p> <p>Section 11.6 Predicted Environmental Outcomes against environmental objectives, policies, guidelines, standards and procedures.</p>
e) In all EIA, there will be opportunities for effective stakeholder consultation, including engagement with the local community during the assessment of the proposal. Proponents should adequately engage in consultation with stakeholders who may be interested in, or affected by their proposals, early in the EIA process.	Doral have conducted stakeholder consultation prior to and during the preparation of the PER. Doral will continue to discuss the Proposal with interested parties.	Section 4 Stakeholder Consultation.
f) Assessment will be based on sound science and documented information. It is essential that proponents allow adequate time and resources to carry out the necessary surveys and investigations as part of the EIA.	Assessment of potential impacts has been based on environmental technical studies undertaken for the Proposal. This has included modelling of potential impacts based on the proposed mining schedule and conducting site specific environmental investigation to appropriately document the existing environment in order to understand the nature of the impacts on the environment from the Proposal.	Environmental technical studies are included in the appendices to this PER.

EXPECTATIONS	CONSIDERATION GIVEN IN PROPOSAL	RELEVANT SECTIONS IN DOCUMENT
g) Proponents will identify management measures for all key environmental factors during the assessment, to demonstrate whether the proposal can be implemented to meet the EPA's environmental objectives.	Management measures have been proposed for all key environmental factors.	Section 6.5 Management Measures and Performance Standards Section 7.5 Management Measures and Performance Standards Section 8.5 Management Measures and Performance Standards Section 11.5 Management Measures and Performance Standards
h) In all EIA, performance standards will be established, communicated and agreed at the beginning of the EIA process, and these will be monitored, reviewed and reported against.	Performance standards are listed under the 'Management Measures and Performance Standards' section of each key environmental factor.	Section 6.5 Management Measures and Performance Standards Section 7.5 Management Measures and Performance Standards Section 8.5 Management Measures and Performance Standards Section 11.5 Management Measures and Performance Standards
i) Proponents will implement continuous improvement in environmental performance and will apply best practicable measures for environmental management in implementing their proposals.	Doral enforce this principle through our Environmental Policy and EMS. Continually reporting of environmental performance annually allows Doral to recognise gaps and areas for improvement in environmental management.	Section 13 Environmental Management Framework

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6 FLORA AND VEGETATION

6.1 RELEVANT ENVIRONMENTAL OBJECTIVES, LEGISLATION, POLICIES, GUIDELINES, STANDARDS & PROCEDURES

6.1.1 EPA Objectives

To maintain representation, diversity, viability and ecological function at the species, population and community level.

6.1.2 Legislation, Policy and Guidelines

Legislation

In a legislative context, the preservation and conservation of flora and ecological communities is covered primarily by the following legislation:

- *Wildlife Conservation Act 1950* (WC Act);
- *Conservation and Land Management Act 1984* (CALM Act);
- EP Act;
- EPBC Act.

Policies and Guidelines

Relevant policy and guidelines for flora and vegetation include the following:

EPA Position Statement No. 2

EPA Position Statement No. 2 *Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation, with Particular Reference to the Agricultural Area* (EPA, 2000) provides an overview of the EPA position on the clearing of native vegetation in Western Australia. In assessing a proposal, the EPA consideration of biological diversity will include the following basic elements:

- Comparison of project scenarios, or options, to evaluate biodiversity protection at the species and ecosystems levels, and demonstration that all reasonable steps have been taken to avoid disturbing native vegetation;
- No known species of plant or animal is caused to become extinct as a consequence of the project and the risks to threatened species are considered to be acceptable;
- No association or community of indigenous plants or animals ceases to exist as a result of the project;
- There is a comprehensive, adequate and secure representation of scarce or endangered habitats within and/or in areas biologically comparable to the project area, protected in secure reserves;
- If the proposal is large (in the order of 10–100ha or more, depending on where in the State) the project area itself should include a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity are secure and protected;
- The on-site and off-site impacts of the project are identified and the proponent demonstrates that these impacts can be managed.

EPA Position Statement No. 3

EPA Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA, 2002) discusses the range of International, National and State agreements and policies currently influencing the future protection of biodiversity in Western Australia and the need to review and improve

the quality and quantity of information required for environmental impact assessment. In these regards, the EPA has set the following positions and expectations:

- The EPA will adopt the definition of Biological Diversity and the Principles as defined in the National Strategy for the Conservation of Australia's Biological Diversity (Commonwealth of Australia, 1996);
- The quality of information and scope of field surveys should meet standards, requirements and protocols as determined and published by the EPA;
- The IBRA should be used as the largest unit for EIA decision-making in relation to the conservation of biodiversity;
- Terrestrial biological surveys should provide sufficient information to address both biodiversity conservation and ecological function values within the context of Proposals;
- The results of surveys should be publicly available.

EPA Guidance Statement No. 51

EPA Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004b), provides guidance on standards and protocols for terrestrial flora and vegetation surveys, particularly those undertaken for the EIA of proposals.

EPA Environmental Protection Bulletin No. 6

EPA Environmental Protection Bulletin No. 6 *The Natural Values of the Whicher Scarp* (EPA, 2009a) recognises the significance of the natural values of the Whicher Scarp across a range of biodiversity characteristics at the genetic, species and community levels, and the small overall extent of the Whicher Scarp environments. The EPA will, as required under EP Act, continue to consider proposed developments for this area on an individual basis. Where the EPA considers a proposal is likely to pose significant risk to the outstanding natural values of the Whicher Scarp, it will be formally assessed, and/or may be considered environmentally unacceptable.

A Floristic Survey of the Whicher Scarp

A survey of the Whicher Scarp (Keighery *et al.*, 2008) was undertaken by the Departments of Environmental Protection and Conservation and Land Management together with the Wildflower Society of Western Australia (Inc.) over a period of more than 10 years. This work was completed as part of the Swan Bioplan Project to provide a more detailed knowledge of the conservation status of species and communities that occur in this area.

6.2 EXISTING ENVIRONMENT

6.2.1 Flora and Vegetation Surveys Undertaken for the Proposal

Flora and vegetation surveys specifically undertaken for the Proposal are provided as Appendix 6 and include the following:

Appendix 6-A	<i>Level 2 Flora and Vegetation Survey at Yoongarillup</i> (Ecoedge Environmental, 2013)
Appendix 6-B	<i>Flora and Vegetation Survey of Yoongarillup Resource Zone Survey Area</i> (Mattiske, 2012a);
Appendix 6-C	<i>Threatened and Priority Species Survey of Drill Lines within the Millbrook State Forest</i> (Mattiske, 2012b).

During the feasibility stage of the Proposal, Doral conducted an exploration drilling program in the State Forest sub-area. As required by tenement conditions, a Conservation Management Plan (CMP) was prepared to address the conservation impacts of the proposed drilling activities within the State Forest sub-area. To assist in preparing the CMP, findings of the flora and vegetation survey conducted by Mattiske (2012a) and a subsequent Threatened and Priority species survey of the proposed drill lines (Mattiske, 2012b) were utilised. During the review of the CMP by the Environmental Management Branch and South West Region of the Department of Environment and Conservation (now DPaW), it was identified that several items relating to the Mattiske (2012a) survey required further response. These responses were incorporated into the final CMP (Aurora Environmental, 2012) and approved by DPaW on 19 September 2012.

DPaW's review of the draft CMP and the Mattiske (2012a) survey, also identified differences in the survey effort in comparison with Keighery *et al.*, (2008) and it was recommended by DPaW that:

'Should exploration or any future proposal require soil disturbance, further quadrat based floristic surveys will be carried out to DPaW standards to address current deficiencies'.

Subsequently Doral engaged Ecoedge Environmental (2013) to conduct an additional flora and vegetation survey in accordance with EPA Guidance Statement No. 51 (EPA, 2004b), for the State Forest sub-area. Findings of this survey (Ecoedge Environmental, 2013) have been used as the primary document to conduct the environmental impact assessment of flora and vegetation within the State Forest sub-area, however data collected during the previous surveys by Mattiske (2012a and 2012b) has also been considered.

Findings of Mattiske (2012a) have been used to assess impacts to flora and vegetation within the Haddon West and Haddon East sub-areas. No vegetation surveys were undertaken for the Piggott sub-area, as this area does not contain any native vegetation, with the exception of scattered trees/shrubs. Table 6-1 summarises the relevant flora and vegetation survey used for the environmental impact assessment for each corresponding sub-area of the Development Envelope.

TABLE 6-1: SUB-AREA'S AND CORRESPONDING FLORA AND VEGETATION SURVEYS

SUB-AREA	FLORA AND VEGETATION SURVEY
State Forest	Ecoedge Environmental (2013) Mattiske (2012a) Mattiske (2012b)
Haddon West	Mattiske (2012a)
Haddon East	Mattiske (2012a)
Piggott	Not assessed

6.2.2 Whicher Scarp Soil-Landscape System

The Development Envelope is located within the Whicher Scarp soil-landscape system (unit 214Ws) which includes the DPaW managed lands of the Whicher Forest Block and Whicher Reference Area (Keighery *et al.*, 2008) and is immediately adjacent to the Whicher National Park. The soil-landscape system covers an area of 20,709ha (Maps 1 and 2 after DAFWA, 2007) and is 0.7% of the Southern Jarrah Forest Biogeographic region of which around 46% (approximately 9,200ha) remains naturally vegetated leading to unusual relictual habitats of plant communities and flora (EPA, 2009a) (refer to Table 6-2, Figure 2-6). Consequently this remnant vegetation meets the six criteria for regionally significant natural areas (EPA, 2006a). Of this remaining area, 64% (approximately 5,800ha) is found on public lands. The majority of the public lands are DPaW managed lands located in nine forest areas. Only 3.4% of the Whicher Scarp soil-landscape system is protected in formal reserves.

The Development Envelope contains a total of 56.38ha of native vegetation that occurs within the Whicher Scarp soil-landscape system (Figure 2-4).

TABLE 6-2: WHICHER SCARP SOIL LANDSCAPE SYSTEM

Soil Landscape System	Whicher Scarp
Pre-European Extent of Soil Landscape System	20,709 ha
Current Area Remaining of Soil Landscape System	9,200 ha
Area of Development Envelope within Soil Landscape System	56.38 ha
Current % of Remaining of Soil Landscape System	46 %
% of Development Envelope within Soil Landscape System	0.61 %

6.2.3 Vegetation Complexes within the Development Envelope

Utilising the Regional Forest Agreement (RFA) vegetation complex mapping (Mattiske and Havel, 1998), the Swan Coastal Plain (SCP) mapping (Hedde *et al.*, 1980) and the South West Biodiversity Project (SWBP) Mapping and Information Instalment 2 (Molloy *et al.*, 2007), the native vegetation within the Development Envelope (56.38ha) is mapped as Yelverton vegetation complex. Vegetation complexes occurring within the Development Envelope are described in Table 6-3 and shown on Figure 6-1.

TABLE 6-3: VEGETATION COMPLEXES WITHIN THE DEVELOPMENT ENVELOPE

VEGETATION COMPLEX	VEGETATION COMPLEX CODE	DESCRIPTION	PRE-EUROPEAN VEGETATION EXTENT (ha)	CURRENT AREA REMAINING (ha)	PERCENTAGE OF PRE-EUROPEAN COMPLEX REMAINING (%)	AREA OF DEVELOPMENT ENVELOPE WITHIN VEGETATION COMPLEX (ha)
Abba	AB	Woodland and open forest of <i>Corymbia calophylla</i> on flats and low rises in the humid zone.	12,450	578	5%	0
Abba	Aw	Mosaic of tall Shrubland of <i>Melaleuca viminea</i> and woodland of <i>Eucalyptus rudis-Melaleuca raphiophylla</i> with occasional <i>Corymbia calophylla</i> on broad depressions in the humid zone.	15,863	508	3%	0
Yelverton	Y	Woodland of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> - <i>Corymbia calophylla</i> - <i>Allocasuarina fraseriana</i> - <i>Agonis flexuosa</i> and open woodland of <i>Corymbia calophylla</i> on low undulating uplands in the humid zone	9,046	3477	38%	55.87
Yelverton	Yw	Woodland of <i>Allocasuarina fraseriana</i> - <i>Nuytsia floribunda</i> - <i>Agonis flexuosa</i> - <i>Banksia attenuata</i> on slopes and open forest of <i>Corymbia calophylla</i> - <i>Eucalyptus patens</i> - <i>Eucalyptus marginata</i> subsp. <i>marginata</i> on the lower slopes and woodland of <i>Eucalyptus rudis</i> - <i>Melaleuca raphiophylla</i> on valley floors in the humid zone.	4,216	1,116	26%	0.51

6.2.4 Vegetation Communities within the Development Envelope

Vegetation communities within the Development Envelope have been mapped by Ecoedge Environmental (2013) and Mattiske (2012a) as shown on Figure 6-2. Table 6-1 (refer to Section 6.2.1) shows the corresponding flora and vegetation survey used to map vegetation communities for each sub-area within the Development Envelope.

The Development Envelope (total area of 151.97) comprises predominantly cleared pasture (95.59ha), with native vegetation (56.38ha) being confined to the following areas:

- State Forest sub-area : The portion of Mining Tenement M70/459 that is located within State Forest No. 33 (excludes the 0.22ha of previously cleared area);
- Haddon East sub area: The southwest corner of Lot 1873 and the southeast corner of Lot 1874.

The following sections describe the vegetation communities that occur within each of the sub-areas of the Development Envelope.

State Forest Sub-Area

The following sections have been sourced from Ecoedge Environmental (2013), unless otherwise stated.

Ecoedge Environmental (2013) mapped the vegetation within the State Forest sub-area by placing nineteen 10m x 10m quadrats in areas not previously sampled by Mattiske (2012a). A quadrat installed during the previous survey by Mattiske (2012a) (F 5-2) and a quadrat installed during the Whicher Scarp Survey (Keighery *et al.*, 2008) were also re-surveyed. Quadrats were sighted in relatively undisturbed vegetation and were surveyed twice on 19-25 September 2012 and 11-12 October 2012. In addition, 18 quadrats from the previous survey (Mattiske, 2012a) and two quadrats (GOUL1, GOUL2) from Keighery *et al.*, (2008) were used to assist in mapping vegetation communities. Locations of quadrats are shown on Figure 6-3.

Plant communities were defined and mapped primarily on a floristic basis, derived from the clustering of quadrats following multivariate analysis of quadrat data drawn from Ecoedge Environmental (2013), two quadrats from Keighery *et al.*, (2008) (GOUL01, GOUL02), and 18 quadrats from Mattiske (2012a). There was, however, some interpretation and re-arrangement of the groups produced by the clustering, based on field observations of the vegetation and soil characteristics. As a likely result of survey effect (season), the Mattiske (2012a) quadrats clustered separately in the dendrogram. The Mattiske (2012a) quadrats were installed and recorded in late spring 2011 (21 and 23 November 2011) and therefore a number of early flowering species, particularly annuals and annually-regenerating taxa were no longer identifiable at the time of their survey, but were identified in the Ecoedge Environmental (2013) survey, which commenced two months earlier.

Ecoedge Environmental (2013) mapped three plant communities (A, B and C). Two of these communities were further divided into three sub-communities. The communities were defined primarily on a floristic basis. Communities A and C were quite clearly delineated into sub-communities by the quadrat clustering dendrogram following multivariate analysis (Ecoedge Environmental, 2013) however some quadrats in Community B were assigned to a sub-community based on their location rather than strictly according to their position on the dendrogram.

Community B was difficult to separate geographically even though there was quite substantial floristic diversity within it, apart from the small area on the southern boundary represented by two quadrats and mapped as B3 (Ecoedge Environmental, 2013). Through further investigation Ecoedge Environmental (2013) identified that quadrats containing the small eucalypt *Corymbia haematoxylon* were more or less confined to the western part of the area mapped as Community B, and on this basis the remainder of the area was mapped as communities B1 and B2.

The communities and sub-communities are summarised below. Their characteristics and common species are shown in Table 6-4 and their distribution is mapped in Figure 6-2.

- **A1:** *Eucalyptus marginata*, *Corymbia haematoxylon* open forest/woodland over *Banksia grandis* (*Banksia attenuata*, *Persoonia elliptica*) low open woodland over *Dasypogon hookeri*, *D. bromeliifolius*, *Hibbertia hypericoides*, *Kennedia coccinea*, *Podocarpus drouynianus*, *Stirlingia latifolia*, *Xanthorrhoea gracilis* and *X. preissii* shrubland/low shrubland and *Anarthria prolifera*, *Desmocladius fasciculatus* open sedgeland and *Patersonia occidentalis* scattered herbs on grey-brown loamy sand.
- **A2:** *Eucalyptus marginata*, *Corymbia calophylla* open forest/woodland over *Banksia grandis* low open woodland over *Acacia pulchella*, *Adenanthos barbiger*, *Boronia crenulata*, *Dasypogon hookeri*, *Hakea amplexicaulis*, *H. ruscifolia*, *Hibbertia hypericoides*, *Hypocalymma robustum*, *Melaleuca thymoides*, *Podocarpus drouynianus*, *Xanthorrhoea gracilis*, shrubland/low shrubland over *Tetraria* sp. Jarrah Forest, *Mesomelaena tetragona* open sedgeland and *Patersonia occidentalis* open herbs on yellow or yellow-brown loamy sand.
- **A3:** *Eucalyptus marginata*, *Corymbia calophylla* open forest/woodland over *Banksia grandis*, (*Persoonia longifolia*) low woodland over *Acacia extensa*, *Adenanthos barbiger*, *Boronia crenulata*, *Daviesia cordata*, *Grevillea trifida*, *Hakea ruscifolia*, *Hibbertia hypericoides*, *Hypocalymma robustum*, *Macrozamia riedlei*, *Mirbelia dilatata*, *Podocarpus drouynianus*, *Xanthorrhoea gracilis*, *X. preissii* shrubland/low shrubland over *Hypolaena exsulca*, *Loxocarya cinerea* open sedgeland and *Patersonia umbrosa* var. *xanthina* scattered herbs on red-brown loam.
- **B1:** *Eucalyptus marginata*, (*Corymbia calophylla*) woodland over *Banksia grandis* (*Xylomelum occidentale*) open low woodland over *Acacia pulchella*, *Adenanthos barbiger*, *D. bromeliifolius*, *D. Hookeri*, *Hibbertia hypericoides*, *Hypocalymma robustum*, *Melaleuca thymoides*, *Podocarpus drouynianus*, *Stirlingia latifolia*, *Xanthorrhoea gracilis*, *X. preissii* Shrubland/low Shrubland over *Anarthria prolifera*, *Desmocladius fasciculatus* open sedgeland on grey-brown loamy sand.
- **B2:** *Corymbia haematoxylon*, *Eucalyptus marginata* woodland over *Xylomelum occidentale*, *Banksia grandis* open low woodland over *Acacia extensa*, *A. pulchella*, *Dasypogon bromeliifolius*, *Hibbertia hypericoides*, *Hypocalymma robustum*, *Jacksonia horrida*, *Stirlingia latifolia* shrubland, low shrubland over *Anarthria prolifera*, *Desmocladius fasciculatus*, *Mesomelaena tetragona* open sedgeland on light grey sand.
- **B3:** *Eucalyptus marginata*, *Corymbia haematoxylon*, *Allocasuarina fraseriana* open forest over *Banksia grandis*, (*Persoonia elliptica*) open low woodland over *Dasypogon hookeri*, *D. bromeliifolius*, *Hibbertia hypericoides*, *H. glomerata*, *Labichea punctata*, *Stirlingia latifolia*,

Xanthorrhoea preissii, *X. gracilis* shrubland/low shrubland over *Patersonia umbrosa* var. *xanthina* open herbland on grey-brown or yellow-brown loamy sand and sandy loam.

- **C:** *Eucalyptus marginata*, *Corymbia calophylla* open forest over *Banksia dallanneyi*, *Hakea amplexicaulis*, *Hibbertia amplexicaulis*, *H. hypericoides*, *Hypocalymma robustum* shrubland/low shrubland over *Desmocladius fasciculatus*, *Tetraria* sp. Jarrah Forest open sedgeland and *Conostylis aculeata*, *Opercularia apiciflora*, *Patersonia umbrosa* var. *xanthina* open herbland on gravelly sand or grey brown loamy sand.

TABLE 6-4: CHARACTERISTICS AND COMMON SPECIES IN THE STATE FOREST SUB-AREA PLANT COMMUNITIES

* Shaded cells (>75%) considered to be characteristic to the community.

SPECIES	A1	A2	A3	B1	B2	B3	C
	PERCENTAGE OCCURENCE WITHIN QUADRATS (%)						
<i>Acacia extensa</i>			75		71		
<i>Acacia pulchella</i>		69	100	91	71		
<i>Adenanthos barbiger</i>		85	100	82	57		
<i>Allocasuarina fraseriana</i>						83	
<i>Anarthria prolifera</i>	50	62		82	71		
<i>Banksia dallanneyi</i>	50	62	100	82	57		71
<i>Banksia grandis</i>	100	62	100	82	71	67	
<i>Boronia crenulata</i>		69	100				57
<i>Bossiaea ornata</i>			50				
<i>Burchardia congesta</i>		54	50	55	57		
<i>Cassytha racemosa</i>					57		
<i>Comesperma calymega</i>			50				
<i>Conostephium pendulum</i>					57		
<i>Conostyllis setigera</i>		54					100
<i>Corymbia calophylla</i>		69	75	55			71
<i>Corymbia haematoxylon</i>	75				86	100	
<i>Dampiera linearis</i>		69		55	57		
<i>Dasypogon bromeliifolius</i>	75			100	86	83	

SPECIES	A1	A2	A3	B1	B2	B3	C
	PERCENTAGE OCCURENCE WITHIN QUADRATS (%)						
<i>Dasypogon hookeri</i>	75	62	50	64	57	100	
<i>Daviesia cordata</i>			75				
<i>Daviesia preissii</i>							57
<i>Desmocladus fasciculatus</i>	50			91	86		86
<i>Eucalyptus marginata</i>	100	100	100	73	71	100	100
<i>Gompholobium knightianum</i>		92	75	55			71
<i>Gompholobium polymorphum</i>			50				
<i>Gompholobium preissii</i>		62	75				
<i>Grevillea trifida</i>			100				
<i>Hakea amplexicaulis</i>		77	100				71
<i>Hakea ruscifolia</i>		77	75				
<i>Hibbertia amplexicaulis</i>	50						100
<i>Hibbertia glomerata</i>		54		55		67	57
<i>Hibbertia hypericoides</i>	100	100	75	100	86	50	100
<i>Hovea chorizemifolia</i>		54	75				71
<i>Hypocalymma angustifolium</i>							57
<i>Hypocalymma robustum</i>	50	77	100	82	100		71
<i>Hypolaena exsulca</i>		54	50	91	57		
<i>Isopogon sphaerocephalus</i>			50				
<i>Kennedia coccinea</i>	75		50				
<i>Labichea punctata</i>						67	57
<i>Lechenaultia biloba</i>							71
<i>Leucopogon propinquus</i>			50				
<i>Leucopogon pulchellus</i>					57		
<i>Loxocarya cinerea</i>		54	50				
<i>Macrozamia riedlei</i>			100				

SPECIES	A1	A2	A3	B1	B2	B3	C
	PERCENTAGE OCCURENCE WITHIN QUADRATS (%)						
<i>Melaleuca thymoides</i>		69		73	71		
<i>Mesomelaena tetragona</i>		62			71		
<i>Opercularia apiciflora</i>		54	50		57		100
<i>Patersonia occidentalis</i>		62					
<i>Patersonia umbrosa</i> var. <i>xanthina</i>		54	50	55		67	71
<i>Penyapeltis peltigera</i>		54	50				
<i>Persoonia elliptica</i>	50					50	
<i>Persoonia longifolia</i>			75				
<i>Podocarpus drouynianus</i>	100	62	75	73	57		
<i>Synaphea whicherensis</i>			50				
<i>Tetraria octandra</i>		54					57
<i>Tetraria</i> sp. Jarrah Forest (R.Davies 7391)		69	50				100
<i>Xanthorrhoea gracillis</i>	75	100	100	73	100	50	100
<i>Xanthorrhoea preissii</i>	75		75	100	57	83	100
<i>Xylomelum occidentale</i>	50				86		

The area of each vegetation community occurring within the State Forest sub-area as mapped by Ecoedge Environmental (2013) is shown in Table 6-5. Ecoedge Environmental (2013) included the (0.22ha) cleared area (sand pit and Goulden Road track) within the A2 and A3 sub-communities. This area has been subtracted from the total area of A2 and A3.

TABLE 6-5: VEGETATION COMMUNITIES WITHIN STATE FOREST SUB-AREA

VEGETATION COMMUNITY	TOTAL AREA (ha)
A1	1.98
A2	13.59
A3	1.17
B1	9.86
B2	9.31
B3	1.46
C	7.36
TOTAL	44.73

Haddon West Sub-Area

Mattiske (2012a) mapped the Haddon West sub-area as Cleared (CL) as shown on Figure 6-2. Within the CL area approximately 22 scattered trees/shrubs also occur.

Haddon East Sub-Area

Mattiske (2012a) mapped the Haddon East sub-area based on the *Structural Forms of Australian Vegetation* (Beard, 1990), cluster analysis of recording sites, permanent plots and interpretation of aerials. Approximately 46.63ha of the Haddon East sub-area was mapped as CL. The CL area contains approximately 26 scattered trees/shrubs. Vegetation communities occurring in the Haddon East sub-area are summarised below and shown on Figure 6-2:

- **W1:** Open Woodland of *Eucalyptus marginata* – *Corymbia calophylla* – *Corymbia haematoxylon* – *Allocasuarina fraseriana* over introduced herbs and grasses on disturbed flats and lower slopes with leached or brown sandy-loams and sandy-gravels.
- **F1:** Open Forest of *Eucalyptus marginata* – *Corymbia calophylla* – *Banksia grandis* - *Corymbia haematoxylon* – *Xylomelum occidentale* over *Xanthorrhoea preissii*, *Podocarpus drouynianus*, *Hakea amplexicaulis*, *Hakea ruscifolia*, *Hibbertia hypericoides*, *Dasypogon hookeri*, *Dasypogon bromeliifolius* and *Kingia australis* over low herbs and grasses on lower and mid slopes with leached grey/brown sandy to sandy-loam soils.
- **F2:** Open Forest of *Eucalyptus marginata* – *Allocasuarina fraseriana* – *Corymbia calophylla* – *Corymbia haematoxylon* – *Xylomelum occidentale* over *Podocarpus drouynianus*, *Hibbertia hypericoides*, *Xanthorrhoea gracilis*, *Hypocalymma robustum* and *Hakea amplexicaulis* over *Hypolaena exsulca* and *Loxocarya striata* low subshrubs and herbs on slopes with leached grey sands to sandy-gravels.
- **F3:** Open Forest of *Corymbia calophylla* - *Eucalyptus marginata* – *Banksia grandis* - *Allocasuarina fraseriana* over *Hibbertia hypericoides*, *Xanthorrhoea preissii*, *Xanthorrhoea gracilis*, *Dasypogon hookeri*, *Dasypogon bromeliifolius*, *Kunzea recurva* and *Podocarpus drouynianus* on flats with leached grey and brown sands and sandy loams.
- **CL:** Cleared

Table 6-6 shows the area of each vegetation community mapped by Mattiske (2012a) that occurs within the Haddon East sub-area.

TABLE 6-6: VEGETATION COMMUNITIES WITHIN THE HADDON EAST SUB-AREA

VEGETATION COMMUNITY	TOTAL AREA (ha)
W1	5.83
F1	0.39
F2	5.16
F3	0.27
TOTAL	11.65

Piggott Sub-area

The Piggott sub-area contains no native vegetation and is considered to be CL, with the exception of 24 scattered trees/shrubs.

6.2.5 Vegetation Condition within the Development Envelope

State Forest Sub-Area

Vegetation condition within the State Forest sub-area was mapped by Ecoedge Environmental (2013) using the vegetation condition ratings according to Keighery (1994) as shown on Figure 6-4. The Keighery (1994) condition ratings are shown in Table 6-7.

TABLE 6-7: VEGETATION CONDITION RATINGS (KEIGHERY, 1994)

SCORE	DESCRIPTION
Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good (3)	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good (4)	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded (5)	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded (6)	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Vegetation within the State Forest sub-area (44.73ha) was rated as Very Good (32.66ha) or Excellent (12.07ha) condition by Ecoedge Environmental (2013) using the condition ratings of Keighery (1994). A small totally cleared area (0.08ha) on the northern boundary of the State Forest sub-area previously used as a sand pit is rated as Completely Degraded by Ecoedge Environmental (2013). In addition the Goulden Road track (0.14ha) is also considered to be Completely Degraded. The portion classified as

Very Good rather than Excellent (approximately 73% of the State Forest sub-area), has been partly cleared as evidenced by old windrows of fallen trees scattered throughout (Ecoedge Environmental, 2013). Based on the size of the regrowth eucalypts, Ecoedge Environmental (2013) estimates that the clearing was probably conducted during the period 1950-1965, perhaps in readiness for pine planting that did not eventuate.

Parts of the previously cleared area are relatively species poor and there is evidence of heavy kangaroo grazing through the State Forest sub-area. A strip around the east and north sides of the State Forest sub-area shows no signs of previous clearing which resulted in the vegetation being classified as Excellent condition. *Phytophthora* disease is present along the eastern boundary (1.24ha) and in the western part of the State Forest sub-area (3.58ha), evidenced by scattered deaths of *Eucalyptus marginata* and *Xanthorrhoea* species (Moore Mapping, 2014). Scattered deaths of *Banksia grandis*, particularly near the southern boundary of the State Forest sub-area are a result of drought, and dumping of domestic and farm refuse has been carried out in various places along the tracks in the northern and western parts (Ecoedge Environmental, 2013). The proportion and cover of introduced species is generally low throughout.

Haddon West Sub-area

Mattiske (2012a) mapped the Haddon West sub-area as Completely Degraded using the vegetation condition ratings according to Keighery (1994) as shown on Figure 6-4.

Haddon East Sub-area

The Haddon East sub-area was also mapped by Mattiske (2012a) as predominantly Completely Degraded due to the absence of native vegetation. The small area of native vegetation in the southeast corner of Lot 1874 was mapped as a combination of Degraded, Good and Very Good condition (Figure 6-4).

Piggott Sub-area

The Piggott sub-area contains no native vegetation and is considered to be all CL, with the exception of 26 scattered trees/shrubs. The condition of the Piggott sub-area is therefore considered to be Completely Degraded (Figure 6-4).

6.2.6 Vegetation of Conservation Significance

Threatened and Priority Ecological Communities

An ecological community is defined by the DPaW as:

- “Naturally occurring biological assemblages that occur in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole, they provide many of the processes which support specific ecosystems and provide ecological services.” (DEC, 2010).

At the state level, ecological communities may be considered as Threatened once they have been identified as such by the Western Australian Threatened Ecological Communities Scientific Advisory Committee. A threatened ecological community (TEC) is defined, under the EP Act, as an ecological community listed, designated or declared under a written law or a law of the Commonwealth as threatened, endangered or vulnerable. There are four State categories of TECs:

- Presumed totally destroyed (PD);
- Critically endangered (CR);
- Endangered (EN);
- Vulnerable (VU).

A description of each of these categories of TECs is presented in Appendix A3 of Matiske (2012a) (Appendix 6-B).

At the Commonwealth level, some Western Australian TECs are listed as Threatened, under the EPBC Act. Under the EPBC Act, a person must not take an action that has or will have a significant impact on a listed TEC without approval from the Commonwealth Minister for the Department of Environment, unless those actions are not prohibited under the Act. A description of each of these categories of TECs is presented in Appendix A4 of Matiske (2012a) (refer to Appendix 6-B).

Ecological communities identified as potentially threatened, but not listed as TECs, are classified as priority ecological communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. The DPaW categorises PECs according to their conservation priority, using five categories, P1 to P5, to denote the conservation priority status of such ecological communities, with P1 communities being the most threatened and P5 the least. Appendix A5 of Matiske (2012a) (refer to Appendix 6-B) sets out definitions of PECs.

Ecoedge Environmental (2013) undertook a DPaW database search for threatened or priority ecological communities known to occur within a 5km radius of the Development Envelope (DEC, 2013a). A Protected Matters Search was undertaken for communities listed under the EPBC Act occurring within a 10km radius of the Development Envelope. Results of these searches are presented in Table 6-8. The complete Protected Matters Search results are included as Appendix 1 of Ecoedge Environmental (2013) (Appendix 6-A).

TABLE 6-8: THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES DATA SEARCH RESULTS

COMMUNITY NAME	COMMUNITY DESCRIPTION	CONSERVATION STATUS (WC ACT)	CONSERVATION STATUS (EPBC ACT)
Shrublands on dry clay flats SCP10a	Rapidly drying clay flats that generally have shallower microtopography than other clay pan community types or else have thin skeletal soils.	EN	CR
Herb rich saline shrublands in clay pans SCP07	Community occurs on heavy clay soils that are generally inundated from winter into mid-summer. This community is dominated by either <i>Melaleuca viminea</i> , <i>Melaleuca uncinata</i> , <i>Melaleuca cuticularis</i> or <i>Casuarina obesa</i> or a mixture of these species.	VU	CR

COMMUNITY NAME	COMMUNITY DESCRIPTION	CONSERVATION STATUS (WC ACT)	CONSERVATION STATUS (EPBC ACT)
Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) SCP10b	Rapidly drying clay flats, occurring on small areas of ironstone with thin skeletal soils in the Busselton area.	CR	EN
Southern wet shrublands, Swan Coastal Plain SCP02	Shrublands or open low woodlands restricted to small remnants of Busselton. These occur on seasonally inundated sandy clay soils.	EN	-
<i>Eucalyptus calophylla</i> woodlands on heavy soils of the southern Swan Coastal Plain SCP1b	Consists largely of <i>Eucalyptus</i> (<i>Corymbia</i>) <i>calophylla</i> forests and woodlands of bushland remnants on the plain south of Capel.	VU	-
<i>Eucalyptus haematoxylon</i> - <i>E. marginata</i> woodlands on Whicher foothills ('community type 1a')	Community occurs along the northern edge of State Forest along the base of the Whicher Range and is composed of <i>Eucalyptus</i> (<i>Corymbia</i>) <i>haematoxylon</i> – <i>Corymbia calophylla</i> - <i>Eucalyptus marginata</i> forests and woodlands. Taxa virtually restricted to the type include <i>Acacia varia</i> subsp. <i>varia</i> , <i>Agonis grandiflora</i> and <i>Xanthosia pusilla</i> .	P3	-
Central Whicher Scarp Mountain Marri woodland (Whicher Scarp woodlands of grey/white sands community A1)	Located on Whicher Scarp mid slopes. The taxa that identify the group include: <i>Ricinocarpos</i> aff. <i>cyanescens</i> , <i>Hibbertia ferruginea</i> , <i>Platysace filiformis</i> , <i>Conospermum capitatum</i> subsp. <i>glabratum</i> , <i>Thysanotus arbuscula</i> , <i>Schoenus brevisetis</i> , <i>Phlebocarya filifolia</i> , <i>Leucopogon glabellus</i> , <i>Pimelea rosea</i> subsp. <i>rosea</i> , <i>Adenanthos obovatus</i> , <i>Stylidium carnosum</i> and <i>Gompholobium capitatum</i> .	P1	-
Central Whicher Scarp Jarrah woodland (Whicher Scarp woodlands of coloured sands and laterites community C1)	Occurs on coloured sands on moderate to gentle slopes of the Central Whicher Scarp. The community has strong representation of a less common group of southern taxa including: <i>Podocarpus drouynianus</i> , <i>Loxocarya cinerea</i> , <i>Allocasuarina fraseriana</i> , <i>-Drosera stolonifera</i> , <i>Amperea ericoides</i> ,	P1*	-

COMMUNITY NAME	COMMUNITY DESCRIPTION	CONSERVATION STATUS (WC ACT)	CONSERVATION STATUS (EPBC ACT)
	<i>Thysanotus triandrus</i> , <i>Cyathochaeta equitans</i> , <i>Hibbertia quadricolor</i> , <i>Comesperma calymega</i> , <i>Lepidosperma pubisquameum</i> , <i>Conospermum paniculatum</i> , <i>Acacia preissiana</i> and <i>Hybanthus debilissimus</i> .		
Sabina River Jarrah and Marri woodland (Whicher Scarp community F1)	Community in Sabina River alluvial fan where the Sabina River meets the Swan Coastal Plain. It is characterised by a suite of wetland taxa of restricted occurrence in the Whicher Scarp: <i>Mirbelia dilatata</i> , <i>Lomandra pauciflora</i> , <i>Tremandra diffusa</i> , <i>Tremandra stelligera</i> , <i>Trymalium floribundum</i> subsp. <i>trifidum</i> and <i>Clematis aristata</i> var. <i>occidentalis</i> . Other significant taxa in the community are: <i>Hovea elliptica</i> , <i>Leucopogon verticillatus</i> , and <i>Darwinia citriodora</i> .	P1*	-
Swan Coastal Plain Paluslope Wetlands	These wetlands are very wet all year round and are associated with areas of groundwater seepage from the sandy low hills at the base of the Whicher Scarp. At times these wetlands are contiguous with areas of Pinjarra Plain wetlands, and the wetlands of the two landforms merge. Combinations of the following species are typically found in the type: <i>Melaleuca preissiana</i> , <i>Taxandria linearifolia</i> , <i>Taxandria fragrans</i> , <i>Melaleuca incana</i> , and <i>Cyathochaeta teretifolia</i> . Other species include: <i>Eucalyptus patens</i> , <i>Homalospermum firmum</i> , <i>Gahnia decomposita</i> , <i>Callistachys lanceolata</i> , <i>Hakea linearis</i> , <i>Melanostachya ustulata</i> , <i>Evandra aristata</i> , <i>Beaufortia sparsa</i> , <i>Callistemon glaucus</i> and <i>Pultenaea pinifolia</i> .	P1*	-

* Indicates Whicher Scarp Floristic Community Types (Keighery *et al.*, 2008).

Comparison of Quadrats from State Forest Sub-area with Whicher Scarp Survey Quadrats

A multivariate analysis was carried out by Mattiske (2012a) whereby 35 quadrats drawn from the Keighery *et al.*, (2008) were compared with forty quadrats and releves from the State Forest and Haddon East sub-areas (i.e. areas of native vegetation within the Development Envelope). This

analysis showed a high degree of ‘clumping’ (clustering) of the sub-areas, and little similarity with the quadrats drawn from Keighery *et al.*, (2008), even though some of these quadrats were located close to, or actually inside the State Forest sub-area (WH03, GOUL01, GOUL02) (Figure 6-3). Clumping of quadrats surveyed as part of an assessment of relatively small areas of vegetation can make it difficult to assign Floristic Community Types (FCTs) to new quadrats using multivariate analysis (Griffin, 2008).

Ecoedge Environmental (2013) states that one way to address the ‘clumping’ of quadrats into discrete groups where they are added to an existing classification (where they cluster with other quadrats from the same survey), is to compare sub-sets of quadrats from a new survey rather than all of the quadrats at once. This approach was applied by comparing quadrats from the State Forest sub-area grouped according to the plant community following the initial multivariate analysis. Thus, quadrats assigned to communities A, B and C were compared with the Keighery *et al.*, (2008) datasets in three separate analyses. Comparisons were undertaken using the software program PATN.

Community A

Community A (*Eucalyptus marginata*-*Corymbia haematoxylon* and *E. marginata*-*C. calophylla* woodlands) in the northern part of the State-Forest sub-area, particularly the area where sub-communities A2 and A3 occur, is associated with ‘orange’ (yellow, yellow-brown and red-brown) soil. A multivariate comparison between the quadrats located in Community A and the regional dataset showed that the quadrat from sub-community A3, which is situated on red-brown loam, clustered closely with three Keighery *et al.*, (2008) quadrats assigned to the Whicher Scarp/Blackwood Plateau Jarrah and Marri woodland FCT C4. The remainder of the Community A grouped with one Whicher Scarp Survey quadrat that is assigned to the Central Whicher Scarp Jarrah woodland FCT C1, which is a PEC. However, the remainder of the FCT C1 quadrats used in the analysis were grouped quite separately in the dendrogram.

Based on the Ecoedge Environmental (2013) multivariate analysis, the vegetation mapped as sub-communities A1 and A2 in the State Forest sub-area is shown to be closest in floristic composition to Whicher Scarp FCT C1 (Central Whicher Scarp Jarrah woodland). However, only one quadrat designated as FCT C1 (kemp01) clusters with the State Forest sub-area quadrats; the remainder of the FCT C1 quadrats used in the analysis are grouped separately (Ecoedge Environmental, 2013). This suggests that kemp01 was a marginal inclusion in FCT C1. This is illustrated by the fact that the level of dissimilarity (Bray-Curtis) between kemp01 and the other FCT C1 quadrats is mostly between 0.55 and 0.60, whereas most of the FCT C1 quadrats have levels of dissimilarity with other C1 quadrats (except kemp01) between 0.40 and 0.50 – with a lower quotient indicating greater floristic similarity. The level of dissimilarity between the State Forest sub-area quadrats (Ecoedge Environmental 2013) and all FCT C1 quadrats used in the analysis was 0.63, with kemp01, ACTN02 and GOUL01 (which is within the State Forest sub-area) being the least dissimilar.

Of the thirty taxa occurring in 70% or more of quadrats classified as FCT C1 (Keighery *et al.*, 2008), nine were present in 60% or more of the 14 Ecoedge Environmental (2013) quadrats (excluding YOONG25, which is closest to FCT C4) used in the comparison analysis. However, 12 of these frequent FCT C1 taxa were present in 40% or less of the Ecoedge Environmental (2013) quadrats, including two that were

not present at all. Nevertheless, Ecoedge Environmental (2013) notes that almost all of the frequent and other common taxa identified for FCT C1 are present within sub-communities A1 and A2 in the State Forest sub-area. The separation of the sub-community A1 and A2 quadrats, the Ecoedge Environmental (2013) quadrats and the bulk of the Keighery *et al.*, (2008) FCT C1 quadrats by the multivariate classification appears to be mainly because of less common species that occur in the latter quadrats but infrequently or not all in the former (Ecoedge Environmental, 2013).

Ecoedge Environmental (2013) concluded that while Community A within the State Forest sub-area (in particular sub-community A2) is similar to FCT C1 (which is a PEC) in that it shares many of the characteristic species of that FCT and also occurs on coloured sands, it perhaps represents a variant of that community that was under-sampled during Keighery *et al.*, (2008).

Community B

Community B, which is represented by three sub-communities (woodlands dominated mainly by *Eucalyptus marginata*, *Corymbia haematoxylon* and *Allocasuarina fraseriana* on light grey or grey-brown loamy sand), is the most widespread of the three communities in the State Forest sub-area covering just under 50% of its area. The multivariate analysis separated the six quadrats from Community B from the bulk of the comparison quadrats at the first level of division along with four quadrats from Keighery *et al.*, (2008). All of the latter quadrats were assigned to different FCTs, although three of them were from Floristic group A: 'Whicher Scarp woodlands of grey/white sands' of Keighery *et al.*, (2008).

Ecoedge Environmental (2013) concluded that Community B from the State-Forest sub-area represents a variant FCT within Whicher Scarp Floristic group A that was only lightly sampled during Keighery *et al.*, (2008). In addition, Community B is quite diverse, as indicated by the degree of dissimilarity (Bray-Curtis) between quadrats from the community that ranges from 0.48 and 0.79, with a mean of 0.56.

Community C

Community C (*Eucalyptus marginata*-*Corymbia calophylla* open forest on gravel or grey-brown loamy sand) had the most unambiguous relationship of the State-Forest sub-area plant communities with a FCT from Keighery *et al.*, (2008); all four of the Community C quadrats clustered at the third level of division on the dendrogram with FCT C4 (Whicher Scarp/Blackwood Plateau Jarrah and Marri woodland).

6.2.7 Flora within the Development Envelope

A total of 353 species of vascular flora from 49 plant families, including 34 introduced species were recorded within the Development Envelope (Ecoedge Environmental, 2013; Mattiske 2012a).

6.2.8 Flora of Conservation Significance

Desktop Assessment

Flora within Western Australia that is considered to be under threat may be classed as either Threatened flora or Priority flora. Where flora has been gazetted as declared Threatened flora under the WC Act, it is an offence "to take" such flora without the written consent of the Minister. The WC

Act states that “to take” flora includes to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means.

Priority flora constitute species which are considered to be under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. Such species are considered to potentially be under threat, but do not have legislative protection afforded under the WC Act. The DPaW categorises priority flora according to their conservation priority, using four categories, P1 to P4, to denote the conservation priority status of such species, with P1 listed species being the most threatened, and P4 the least. Priority flora species are regularly reviewed, and may have their priority status changed when more information on the species becomes available. Table 6-9 sets out the categories and definitions of both Threatened and Priority flora species (DEC, 2011).

TABLE 6-9: CATEGORIES OF DECLARED RARE & PRIORITY FLORA LISTED UNDER THE WC ACT
(DEC, 2011)

CONSERVATION CODE	CATEGORY
T	<p>Threatened Flora (Declared Rare Flora – Extant)</p> <p>Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the Wildlife Conservation Act 1950).</p> <p>Threatened Flora (Schedule 1) are further ranked by the DPaW according to their level of threat using IUCN Red List criteria:</p> <ul style="list-style-type: none"> • CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild; • EN: Endangered – considered to be facing a very high risk of extinction in the wild; or • VU: Vulnerable – considered to be facing a high risk of extinction in the wild.
P1	<p>Priority One – Poorly Known Species</p> <p>Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.</p>

CONSERVATION CODE	CATEGORY
P2	<p>Priority Two – Poorly Known Species</p> <p>Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.</p>
P3	<p>Priority Three – Poorly Known Species</p> <p>Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.</p>
P4	<p>Priority Four – Rare Threatened and other species in need of monitoring</p> <ul style="list-style-type: none"> a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands; b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable; or c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	<p>Priority Five – Conservation Dependent Species</p> <p>Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.</p>

At the Commonwealth level, under the EPBC Act Threatened species can be listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent, by the Commonwealth Minister for the DoE. Table 6-10 provides a description of each of these categories of threatened species. Under the EPBC Act, a person must not take an action that has or will have a significant impact on a listed Threatened species without approval from the Commonwealth Minister for the DoE, unless those actions are not prohibited under the Act.

TABLE 6-10: DEFINITION OF THREATENED FLORA SPECIES UNDER THE EPBC ACT

CATEGORY CODE	CATEGORY
Ex	Extinct Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	Extinct in the Wild Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	Critically Endangered Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	Endangered Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	Vulnerable Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	Conservation Dependent Taxa which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Ecoedge Environmental (2013) conducted a DPaW database search for Threatened and Priority flora pursuant to subsection (2) of Section 23F of the WC Act occurring within 5km of the State Forest sub-area (DEC, 2013b) and a Protected Matters Search for flora listed as Threatened pursuant to Schedule 1 of the EPBC Act occurring within 10km of the State Forest sub-area. Mattiske (2012a) also undertook a DPaW database search and Protected Matters Search for flora within or adjacent to the State Forest sub-area. Results of these searches are summarised below in Table 6-11.

TABLE 6-11: THREATENED AND PRIORITY FLORA POTENTIALLY OCCURRING WITHIN OR ADJACENT TO, THE DEVELOPMENT

FAMILY	SPECIES	CONSERVATION STATUS (WC ACT)	CONSERVATION STATUS (EPBC ACT)
Ericaceae	<i>Andersonia gracilis</i>	-	E
Proteaceae	<i>Banksia mimica</i>	T	E
Proteaceae	<i>Banksia nivea</i> subsp. <i>uliginosa</i>	-	E
Proteaceae	<i>Banksia squarrosa</i> subsp. <i>argillacea</i>	T	V
Apiaceae	<i>Brachyscias verecundus</i>	-	CE
Orchidaceae	<i>Caladenia hoffmanii</i>	-	E
Orchidaceae	<i>Caladenia procera</i>	-	CE
Orchidaceae	<i>Caladenia winfieldii</i>	-	E
Centrolepidaceae	<i>Centrolepis caespitosa</i>	-	E
Myrtaceae	<i>Chamelaucium</i> sp. C Coastal Plain (R.D. Royce 4872)	T	V
Myrtaceae	<i>Darwinia foetida</i>	-	CE
Myrtaceae	<i>Darwinia whicherensis</i>	-	E
Fabaceae	<i>Daviesia elongata</i> subsp. <i>elongata</i>	T	V
Orchidaceae	<i>Diuris micrantha</i>	-	V
Orchidaceae	<i>Drakaea elastica</i>	-	E
Droseraceae	<i>Drosera fimbriata</i>	-	V
Myrtaceae	<i>Eucalyptus phylacis</i>	-	E
Fabaceae	<i>Gastrolobium papilio</i>	-	E
Proteaceae	<i>Lambertia echinata</i> subsp. <i>occidentalis</i>	-	E
Proteaceae	<i>Petrophile</i> sp. <i>Whicher Range</i> (G.J.Keighery 11790) WA Herbarium	-	E

FAMILY	SPECIES	CONSERVATION STATUS (WC ACT)	CONSERVATION STATUS (EPBC ACT)
Epacridaceae	<i>Sphenotoma drummondii</i>	-	E
Proteaceae	<i>Synaphea stenoloba</i>	-	E
Myrtaceae	<i>Verticordia plumosa</i> var. <i>vassensis</i>	T	E
Orchidaceae	<i>Caladenia busselliana</i>	T	-
Orchidaceae	<i>Diuris drummondii</i>	T	-
Cyperaceae	<i>Eleocharis keigheryi</i>	T	-
Cyperaceae	<i>Bolboschoenus medianus</i>	P1	-
Rutaceae	<i>Boronia humifusa</i>	P1	-
Fabaceae	<i>Gastrolobium</i> sp. <i>Yoongarillup</i> (S.Dilkes s.n. 1/9/1969)	P1	-
Loganiaceae	<i>Logania wendyae</i>	P1	-
Apiaceae	<i>Actinotus whicheranus</i>	P2	-
Euphorbiaceae	<i>Amperea micrantha</i>	P2	-
Rutaceae	<i>Boronia capitata</i> subsp. <i>gracilis</i>	P2	-
Myrtaceae	<i>Eucalyptus relictia</i>	P2	-
Ericaceae	<i>Leucopogon</i> sp. Busselton (D. Cooper 243) PN	P2	-
Elaeocarpaceae	<i>Platytheca anasima</i>	P2	-
Proteaceae	<i>Synaphea petiolaris</i> subsp. <i>simplex</i>	P2	-
Asteraceae	<i>Blennospora doliiformis</i>	P3	-
Rutaceae	<i>Boronia tetragona</i>	P3	-
Cyperaceae	<i>Caustis</i> sp. Boyanup (G.S. McCutcheon 1706)	P3	-
Asparagaceae	<i>Chamaescilla gibsonii</i>	P3	-
Restionaceae	<i>Chordifex gracilior</i>	P3	-

FAMILY	SPECIES	CONSERVATION STATUS (WC ACT)	CONSERVATION STATUS (EPBC ACT)
Proteaceae	<i>Conospermum paniculatum</i>	P3	-
Apiaceae	<i>Eryngium</i> sp. Ferox (G.J. Keighery 16034)	P3	-
Apiaceae	<i>Eryngium subdecumbens</i>	P3	-
Proteaceae	<i>Grevillea brachystylis</i> subsp. <i>brachystylis</i>	P3	-
Proteaceae	<i>Isopogon formosus</i> subsp. <i>dasylepis</i>	P3	-
Fabaceae	<i>Jacksonia gracillima</i>	P3	-
	<i>Lasiopetalum membranaceum</i>	P3	-
Restionaceae	<i>Lepyrodia heleocharoides</i>	P3	-
Restionaceae	<i>Meeboldina decipiens</i> subsp. <i>decipiens</i>	P3	-
Loganiaceae	<i>Mitreola minima</i>	P3	-
Haloragaceae	<i>Myriophyllum echinatum</i>	P3	-
Cyperaceae	<i>Schoenus benthamii</i>	P3	-
Proteaceae	<i>Synaphea hians</i>	P3	-
Proteaceae	<i>Synaphea polypodioides</i>	P3	-
Elaeocarpaceae	<i>Tetratheca parvifolia</i>	P3	-
Orchidaceae	<i>Thelymitra variegata</i>	P3	-
Malvaceae	<i>Thomasia laxiflora</i>	P3	-
Myrtaceae	<i>Verticordia attenuata</i>	P3	-
Fabaceae	<i>Acacia flagelliformis</i>	P4	-
Fabaceae	<i>Acacia semitrullata</i>	P4	-
Myrtaceae	<i>Aponogeton hexatepalus</i>	P4	-
Orchidaceae	<i>Caladenia speciosa</i>	P4	-
Myrtaceae	<i>Calothamnus quadrifidus</i> subsp. <i>teretifolius</i>	P4	-

FAMILY	SPECIES	CONSERVATION STATUS (WC ACT)	CONSERVATION STATUS (EPBC ACT)
Myrtaceae	<i>Chamelaucium</i> sp. Yoongarillup (G.J. Keighery 3635)	P4	-
Proteaceae	<i>Franklandia triaristata</i>	P4	-
Proteaceae	<i>Lambertia rariflora</i> subsp. <i>rariflora</i>	P4	-
Asparagaceae	<i>Laxmannia jamesii</i>	P4	-
Menyanthaceae	<i>Ornduffia submerse</i>	P4	-
Myrtaceae	<i>Verticordia lehmannii</i>	P4	-

Results of Threatened and Priority Flora Surveys

Threatened and Priority flora species were recorded within the Development Envelope during surveys undertaken by Matiske (2012a), Matiske (2012b) and Ecoedge Environmental (2013). Details of each survey are provided in Table 6-12.

TABLE 6-12: DETAILS OF THREATENED & PRIORITY FLORA SURVEY'S CONDUCTED WITHIN THE DEVELOPMENT ENVELOPE

SURVEY	SUB-AREA	METHODOLOGY/SEARCH AREA	TIMING
Matiske (2012a)	State Forest Haddon West Haddon East	100m x 100m grid pattern with 75 sites being surveyed in total. Nine 10m x 10m quadrats within less disturbed vegetation.	November 2011
Matiske (2012b)	State-Forest	Nine drill lines approximately 6m wide and 100m long.	March 2012
Ecoedge Environmental (2013)	State Forest	Grid pattern along transects 30m-40m apart. Previous locations of Threatened and Priority species recorded by Matiske (2012a and 2012b)	September/October 2012

Two Threatened flora species, *Daviesia elongata* subsp. *elongata* and *Verticordia densiflora* var. *pedunculata* were recorded within the State Forest sub-area. Both of these species are listed as Threatened pursuant to subsection (2) of Section 23F of the WC Act. *D. elongata* subsp. *elongata* is

listed as vulnerable and *V. densiflora* var. *pedunculata* is listed as endangered pursuant to section 179 of the EPBC Act.

Two Priority listed species pursuant to subsection (2) of section 23F of the WC Act; *Conospermum paniculatum* (P3) and *Acacia semitrullata* (P4) were also recorded within the State Forest sub-area. A species previously recorded by Matiske (2012a and 2012b) as potentially the Priority 3 species *Jacksonia gracillima* was subsequently identified by Ecoedge Environmental (2013) to be a Whicher Scarp form of the common species *Jacksonia horrida*.

In addition to the identification of Threatened and Priority flora, Ecoedge Environmental (2013) recorded three taxa within the State Forest sub-area which are considered to be regionally significant. These include the Whicher variant *Crowea angustifolia* var. *angustifolia* and populations of *Hemiphora bartlingii* and *Petrophile serruriae*, which are geographical outlier. Matiske (2012a) also recorded *Hemiphora bartlingii* and *Petrophile serruriae* as well as *Hibbertia lasiopus*. These species however are not protected under the WC Act

The locations of Threatened, Priority and regionally significant flora are shown on Figure 6-5.

6.2.9 Plant Pathogens

The plant disease known as 'dieback' is caused by infestation of an introduced pathogen *Phytophthora* species, with the most common (and perhaps the most devastating) species being *P. cinnamomi*. It affects a vast and diverse range of plant species in the southwest region of Western Australia. The disease enters through the plant roots, eventually causing them to rot, affecting the plants ability to transport water and nutrients throughout the plant. Some species which are susceptible to dieback (such as Jarrah) may show some resistance to the disease and appear to gradually die back (hence the name).

The ESD identified dieback as an 'other environmental factor' to be addressed as part of this PER. As such, dieback impacts and management are discussed in full in Section 10.3.

6.2.10 Introduced Species

A total of 34 introduced species were recorded within the Development Envelope (Matiske, 2012a; Ecoedge Environmental, 2013). Of these taxa, *Zantedeschia aethiopica* (Arum Lilly) is a Declared Plant species pursuant to section 37 of the *Agriculture and Related Resources Protection Act 1976*. This species is listed as a Priority 1 (P1) and Priority 4 (P4) for all of Western Australia. Locations of this Declared Plant are shown on Figure 6-6.

6.3 POTENTIAL IMPACTS

The following aspects of the Proposal may affect flora and vegetation values:

- Clearing of native vegetation for the development of the mining area will reduce the extent of soil-landscape systems, vegetation complexes, vegetation communities and disturb Threatened, Priority and regionally significant flora;
- Dewatering activities may affect groundwater-dependent vegetation by lowering local groundwater levels;

- Mining activities and vehicle movement have the potential to spread weeds and pathogens including dieback within and outside of the Development Envelope;
- Mining activities and vehicle movement has the potential to deposit dust on vegetation within the Development Area and offsite;
- Potential for fires to start as a result of the mining operations.

6.4 ASSESSMENT OF POTENTIAL IMPACTS

6.4.1 Clearing of Native Vegetation

The Proposal will clear 8.68ha of native vegetation. This will reduce the regional and local extent of the Whicher Scarp soil-landscape system, vegetation complexes and communities and also disturb Threatened and Priority flora species.

The impact of native vegetation clearing has considered in terms of soil-landscape systems, vegetation complexes and vegetation communities. Soil-landscape systems are mapped on a regional scale and assist in determining regional scale impacts of native vegetation clearing for a particular system such as the Whicher Scarp soil-landscape system. Vegetation complexes are a relatively broad vegetation mapping system and are also used to describe the regional scale of impacts associated with native vegetation clearing, as it considers the pre-European vegetation extent. Vegetation communities are used to describe the impacts of native vegetation clearing at a local scale. Vegetation communities represent site-specific vegetation mapping defined and mapped primarily on a floristic basis, derived from the clustering of quadrats following multivariate analysis of quadrat data drawn from Ecoedge Environmental (2013), two quadrats from the Whicher Scarp Survey (GOUL01, GOUL02), and 18 quadrats from Matiske (2012a).

Impacts to Soil-Landscape System

The Proposal will clear 8.68ha of native vegetation that occurs wholly within the Whicher Scarp soil-landscape system. Table 6-13 shows the relevant area and percentage of the Whicher Scarp soil-landscape system that will be directly affected by the Proposal.

TABLE 6-13: AREA AND PERCENTAGE OF SOIL-LANDSCAPE SYSTEMS TO BE CLEARED

Soil Landscape System	Whicher Scarp
Pre-European Extent of Soil Landscape System	20,709 ha
Current Area Remaining of Soil Landscape System	9,200 ha
Area of Development Envelope within Soil Landscape System	56.38 ha
Total Clearing for Proposal	8.68 ha
% of Pre-European Extent Directly Affected by Proposal	0.04 %
% of Area Remaining Directly Affected by Proposal	0.09 %

Table 6-13 shows that the Proposal will directly affect 8.68ha of native vegetation that occurs within the Whicher Scarp soil-landscape system as mapped by DAFWA (2007). The pre-European extent of the Whicher Scarp soil-landscape system is 20,709ha, with 9,200ha remaining (46%) and 3.7% protected in formal reserves. The area proposed to be cleared to facilitate the Proposal represents only 0.09% of the area remaining of the Whicher Scarp soil-landscape system and does not significantly reduce its extent.

Impacts to Vegetation Complexes

Clearing of native vegetation will only occur within the Yelverton (Y) vegetation complex. No clearing will occur in the Yelverton (Yw) or Abba (AB, Aw) vegetation complexes. Table 6-14 shows the area and percentage of each vegetation complex to be cleared for the Proposal.

TABLE 6-14: AREA AND PERCENTAGE OF VEGETATION COMPLEXES TO BE CLEARED

VEGETATION COMPLEX CODE	AB	Aw	Y	Yw
Pre-European Vegetation Extent (ha)	12450	15863	9046	4216
Current Area Remaining (ha)	578	508	3477	1116
Area of Development Envelope within Vegetation Complex (ha)	0	0	56.38	0.51
Total Clearing for Proposal (ha)	0	0	8.68	0
Percentage of Pre-European Vegetation Extent Directly Affected by Proposal (%)	0	0	0.1	0
Percentage of Area Remaining Directly Affected by Proposal (%)	0	0	0.25	0

As shown in Table 6-14, the Proposal will require clearing of 8.68ha of Yelverton (Y) vegetation as mapped by the Mattiske and Havel (1998) (RFA), Heddlé *et al.*, (1980) (SCP) and Molloy *et al.*, (2007) (SWBP). The pre-European vegetation extent and percentage of the Yelverton (Y) vegetation complex remaining is approximately 3,477ha or 38% (Keighery *et al.*, 2008). The area proposed to be cleared to facilitate the Proposal represents 0.25% of the area remaining of the Yelverton (Y) vegetation complex and therefore does not significantly reduce the extent of this vegetation complex (i.e. less than 1%).

In 2001, the Commonwealth of Australia stated National Targets and Objectives for Biodiversity Conservation, which recognized that the retention of 30% or more, of the pre-European vegetation of each ecological community was necessary if Australia's biological diversity were to be protected (Ecoedge Environmental, 2013). This level of recognition is in keeping with the targets set in the EPA's

Position Statement No. 2 (EPA, 2000). Currently 38% of the Yelverton (Y) vegetation complex is remaining. The remaining vegetation complexes mapped as occurring within the Development Envelope; Yelverton (Yw) and Abba (AB, Aw), will not be affected by the Proposal.

Impacts to Vegetation Communities

The majority of the native vegetation to be cleared for the Proposal (i.e. 7.83ha) will be within the A2 sub-community mapped by Ecoedge Environmental (2013) as *Eucalyptus marginata-Corymbia calophylla* open forest on yellow or yellow-brown loamy sand. In addition 0.39ha of sub-community A3 - *Eucalyptus marginata- Corymbia calophylla* open forest on red-brown loam and 0.46ha of sub-community B1 - *Eucalyptus marginata- Corymbia calophylla* woodland on grey-brown loamy sand will be cleared. The remainder of the disturbance area (87.03ha) will occur in cleared areas (this includes 0.22ha within the State Forest sub-area). According to Ecoedge Environmental (2013) the vegetation communities are not considered to be PECs as discussed in Section 6.2.5 (Appendix 6-A).

Table 6-15 shows the areas and percentages of each vegetation community and sub-community that will be directly impacted by the Proposal.

TABLE 6-15: AREA AND PERCENTAGE OF VEGETATION COMMUNITIES AND SUB-COMMUNITIES TO BE CLEARED BY THE PROPOSAL

VEGETATION COMMUNITY	TOTAL AREA OF COMMUNITY (ha)	TOTAL AREA OF CLEARING (ha)	CLEARING AS A PERCENTAGE OF TOTAL COMMUNITY (%)
A1	1.98	0	0
A2	13.59	7.83	57.62
A3	1.17	0.39	33.33
B1	9.86	0.46	4.67
B2	9.31	0	0
B3	1.46	0	0
C	7.36	0	0
W1	5.82	0	0
F1	0.39	0	0
F2	5.16	0	0
F3	0.27	0	0

Of the 8.68ha of vegetation to be cleared for the Proposal, 5.48ha has been mapped as Excellent and 3.20ha mapped as Very Good (Ecoedge Environmental, 2013).

In addition to the vegetation communities to be cleared for the Proposal, Table 6-16 shows the number of scattered trees/shrubs located in areas mapped as CL and the number of those that will be cleared.

TABLE 6-16: SCATTERED TREES TO BE CLEARED

SUB-AREA	TOTAL SCATTERED TREES	SCATTERED TREES/SHRUBS TO BE CLEARED
Haddon West	22	12
Haddon East	26	11
Piggott	26	8
TOTAL	87	31

Impacts to Threatened and Priority Ecological Communities

As discussed in Section 6.2.5, no TECs or PECs were mapped by Ecoedge Environmental (2013) as occurring within the Development Envelope, therefore no impacts will occur.

Impacts to Conservation Significant Flora

Four flora of conservation significance were recorded within the State-Forest sub-area comprising two Threatened flora; *Daviesia elongata* subsp. *elongata* and *Verticordia densiflora* var. *pedunculata*, one P3 flora *Conospermum paniculatum* and one P4 flora *Acacia semitrullata* as shown on Figure 6-5. In addition four species of regionally significant flora were identified as occurring within the State-Forest sub-area. Table 6-17 shows the extent of clearing for each of the conservation and regionally significant flora species.

Additional information regarding species listed as Threatened under the EPBC Act (i.e. Matters of National Environmental Significance) can be found in Section 11.

TABLE 6-17: NUMBER OF CONSERVATION SIGNIFICANT FLORA TO BE CLEARED

SPECIES	CONSERVATION STATUS (WC ACT)	CONSERVATION STATUS (EPBC ACT)	KNOWN POPULATION NUMBERS	NUMBER WITHIN DEVELOPMENT ENVELOPE	NUMBER TO BE CLEARED	PROPORTION OF KNOWN POPULATION TO BE CLEARED (%)
<i>Daviesia elongata</i> subsp. <i>elongata</i>	T	V	1016*	7	6	0.59
<i>Verticordia densiflora</i> var. <i>pedunculata</i>	T	E	522*	9	0	0
<i>Conospermum paniculatum</i>	P3	-	Unknown	20	16	Unknown
<i>Acacia semitrullata</i>	P4	0	Unknown	3	2	Unknown
<i>Crowea angustifolia</i> var. <i>angustifoli</i>	-	-	Unknown	1	0	Unknown
<i>Hibbertia lasiopus</i>	-	-	Unknown	6	0	Unknown
<i>Hemiphora bartlingii</i>	-	-	Unknown	4	2	Unknown
<i>Petrophile serruriae</i>	-	-	Unknown	10	1	Unknown

***Source: DEC (2007)**

The proposed clearing of *Daviesia elongata* subsp. *elongata* is unlikely to have a significant impact on this species. Only six individuals (0.59%) of the estimated population of 1016 mature plants (DEC, 2007) will be impacted by the Proposal. Of the seven known populations (DEC, 2007), one population occurs in a nature reserve which is managed for conservation of flora and fauna, although not specifically for this species. The remaining six subpopulations occur within State Forest, with the exception of subpopulations 1 and 2 which occur in Shire reserves (DEC, 2007). Known populations are healthy and not immediately threatened (DEC, 2007). No *Verticordia densiflora* var. *pedunculata* will be cleared for the Proposal.

Impacts to the P3 listed flora *Conospermum paniculatum* are unlikely to be significant. This species is known to occur outside of the Development Envelope. On the Whicher Scarp this species occurs in a series of scattered localities at the north of its range; as well as in the Treeton and Whicher forests (along Kemp Road) and at Carburnup River Bushland (Keighery *et al.*, 2008). There is a significantly disjunct population near Darkan (Keighery *et al.*, 2008). Keighery *et al.*, (2008) also state that this species occurs in the Yarloop, Donnybrook and Yallingup areas on sandy soils.

The P4 listed species *Acacia semitrullata* is unlikely to be significantly impacted by the Proposal. This species is known from populations outside of the Development Envelope, within the Dardanup, Argyle and Whicher forests (Keighery *et al.*, 2008). A study into the flora and vegetation of the Dardanup Forest Block by Keighery *et al.*, (2008) (Map 2g of Keighery *et al.*, 2008) identified high flora diversity, populations of new endemic species and further populations of disjunct and/or range ends of flora. This included the P4 taxa *Acacia semitrullata* (reported as a P3 within Keighery *et al.*, 2008).

Impacts to regionally significant flora are not considered to be significant as these species are not protected under the WC Act or EPBC Act. In addition only one *Petrophile serruriae* and two *Hemiphora bartlingii* individuals will be impacted.

6.4.2 Impacts from Dewatering Activities

Groundwater flow modelling by PB (2014a) indicates that no drawdown will occur in the Superficial Aquifer south of the proposed mine pits (i.e. within State Forest sub-area). Drawdown of the Mowen Member will be less than 1m within the State Forest sub-area and does not extend beyond the boundary of the mine pits. Vegetation outside of the proposed mine pits will therefore not be impacted by dewatering activities.

The potential indirect impacts of dewatering activities on groundwater-dependent vegetation are discussed in detail in Section 8.3.

6.4.3 Impacts from Spread of Dieback and Weeds

Mining activities and vehicle movement have the potential to result in the introduction and spread of weeds and pathogens including dieback and death of trees within and outside of the Development Envelope.

There is a risk that dieback could spread from potentially infested paddock areas (mapped as dieback uninterpretable) and/or infested bush areas in the State Forest sub-area to un-infested areas within the State Forest sub-area. Following the precautionary principle, the paddock areas which are uninterpretable, are assumed to be infested. To manage the risk of dieback spreading into the disease

free areas of the State Forest sub-area, Doral will prepare a Dieback Management Plan (detailed in Section 10.3.4).

Further detail of the potential impacts of the spread of dieback is discussed in Section 10.3.

Strict weed hygiene measures will be implemented to reduce the risk of weed introduction into adjacent uncleared areas and areas that are largely weed-free. Measures will be implemented to target the control of the Declared Plant Arum Lily *Zantedeschia aethiopica*. Weed management will be implemented as per Doral's Flora and Vegetation Management Plan.

6.4.4 Impacts from Dust

Mining activities and vehicle movement has the potential to generate dust which may directly affect vegetation within the Development Envelope and also offsite through deposition of dust on the plants. Dust deposition on the surface of vegetation can adversely impact upon the plant's function and ability to transpire. With controls in place, dust generation can be minimised to the extent that adverse impacts are managed at an acceptable level. Doral will implement a Dust Management Plan to minimise these impacts where possible (refer to Section 10.4.4).

6.4.5 Impacts from Changes to Fire Regime from Introduced Ignition Sources

Construction and operation of the Proposal may increase the risk of accidental fire attributable to site activities. The consequences of fire to vegetation will be likely result in the death of some species. Fire risk will be managed through the implementation of a Fire Management Plan which will include a fire response procedure.

6.4.6 Cumulative Impacts

For the purposes of the impact assessment Doral have defined cumulative impact as 'a permanent irreversible impact that occurs simultaneously with other local mineral sands projects and their associated impacts'.

Doral have considered the cumulative impacts to flora and vegetation, based on available public data and in the context of the local and regional environment. Doral are limited in the assessment of cumulative impacts given the lack of data available publicly.

No cumulative impacts are predicted to occur given:

- No other projects are known to be located nearby in the Whicher Scarp soil-landscape system;
- The regional cumulative impacts of clearing 8.68ha of the Whicher Scarp soil-landscape system represents only 0.09% of the area remaining of the Whicher Scarp soil-landscape system and does not significantly reduce its extent;
- Clearing for the Proposal represents disturbance to 0.25% of the vegetation remaining for the Yelverton (Y) vegetation complex and does not significantly reduce the extent of this vegetation complex;
- No other projects are known to be occurring within other state forests or council reserves where known populations of the Threatened flora *Daviesia elongata subsp. elongata* are known to occur. The Proposal represents disturbance to only 0.59% of the estimated population of 1016 mature plants (DEC, 2007); and

- Doral will rehabilitate mined areas within the State Forest sub-area back to native vegetation and also provide conservation offset resulting in a net environmental benefit for the Proposal.

6.5 MANAGEMENT MEASURES AND PERFORMANCE STANDARDS

Doral's overall principles for managing potential impacts to flora and vegetation are to:

- Minimise native vegetation clearing and land disturbance;
- Implement specific clearing procedures including the demarcation of cleared areas and authorisation requirements;
- Monitor vegetation health in adjacent undisturbed vegetation located with the State Forest sub-area;
- Minimise the timeframe between disturbance and rehabilitation.

Doral has an existing Environmental Management System (EMS) which it implements at its Dardanup Mine (including extensions to the mine). The EMS will be updated to include the Yoongarillup Mineral Sands Project (i.e. the Proposal), which will include the following management plans and procedures detailed below to manage the impacts to flora and vegetation. Additional details on Doral's Environmental Management System are provided in Section 13.

6.5.1 Flora and Vegetation Management Plan

Doral will develop and implement a Flora and Vegetation Management Plan to address potential impacts to flora and vegetation. The Flora and Vegetation Management Plan will include the following key management actions:

- Development and implementation of specific clearing procedures to minimise impacts to flora and vegetation. This will include demarcation of cleared areas and authorisation requirements;
- Establishment of specific stockpile locations and procedures to store and manage crushed vegetation, topsoil, subsoil and overburden from within dieback infested and non-dieback infested areas of the State Forest sub-area;
- Any Threatened flora which will not be cleared will be marked using flagging tape and a 50 m buffer will be established around the plant and considered an Environmentally Sensitive Area (ESA);
- Any Priority flora which will not be cleared will be marked using flagging tape and avoided;
- Impacts to regionally significant flora will be minimised where possible;
- Locations of the Declared Plant *Zantedeschia aethiopica* will be marked with flagging tape and managed in accordance with Control Code Requirements P1 and P4 (Department of Agriculture and Food, 2011);
- Weed management measures will be incorporated into the ongoing management of flora and vegetation for the Proposal.

6.5.2 Rehabilitation Management Plan

Doral will develop and implement a Rehabilitation Management Plan for disturbed areas. Details of rehabilitation for the Proposal are provided in detail in the Mine Closure Plan (Appendix 12).

6.5.3 Dieback Management Plan

Doral will develop and implement a Dieback Management Plan as detailed in Section 10.3.4.

6.5.4 Dust Management Plan

Doral will develop and implement a Dust Management Plan as detailed in Section 10.4.4.

6.5.5 Fire Management Plan

A Fire Management Plan will be prepared to manage the risk of unplanned fires and provide contingency measures to minimise any associated impacts. The plan will include a fire response procedure in the event of any bushfires that commence as a result of the works on site.

6.6 PREDICTED ENVIRONMENTAL OUTCOMES

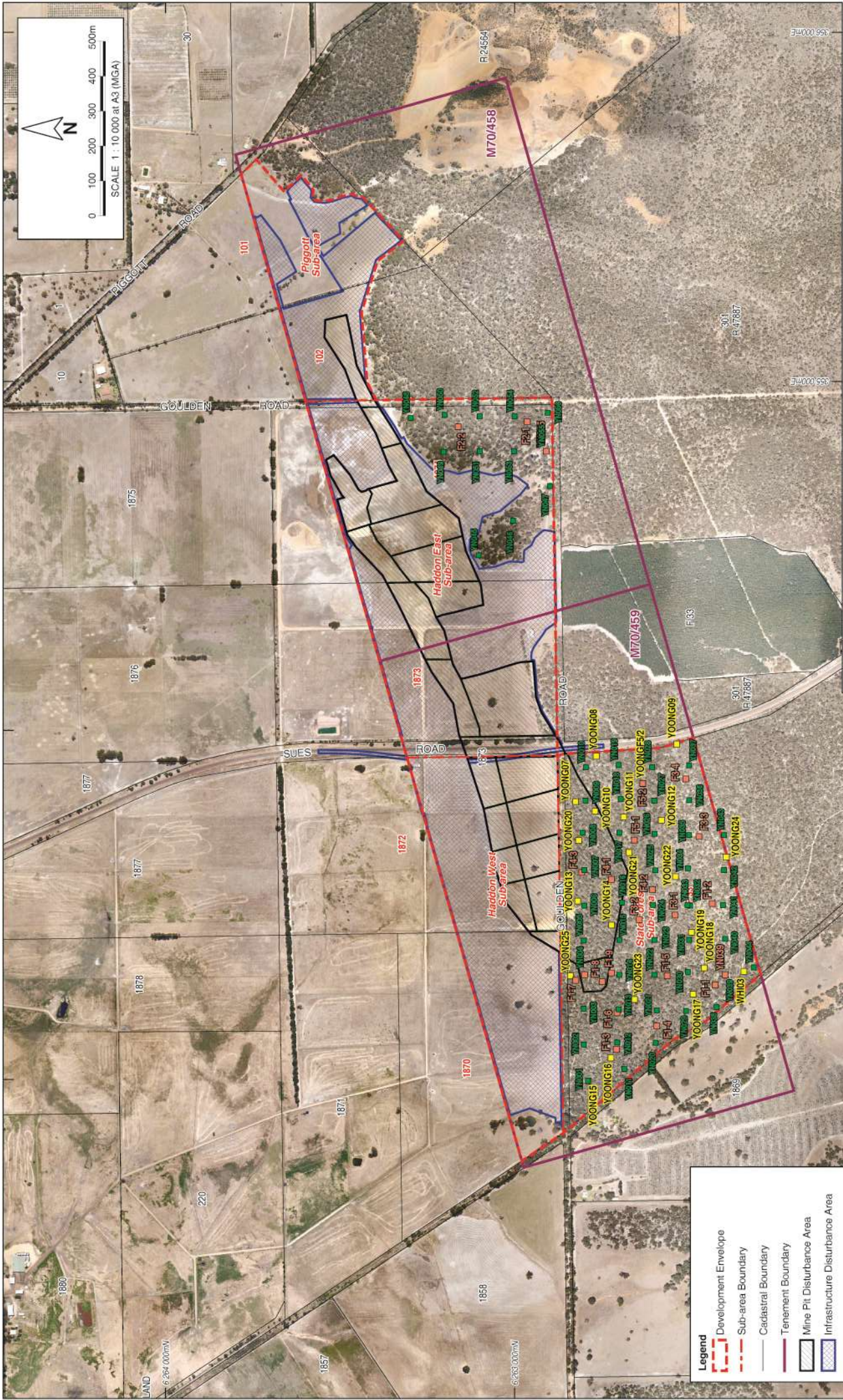
After the application of mitigation measures described above, the Proposal will result in the following outcomes in relation to flora and vegetation:

- The Proposal will clear up to 8.68ha of native vegetation and approximately 31 scattered trees/shrubs;
- Clearing for the Proposal represents disturbance to 0.04% of the pre-European vegetation extent and 0.09% of the area remaining of the Whicher Scarp soil-landscape system and does not significantly reduce the regional extent of this soil-landscape system;
- Clearing for the Proposal represents disturbance to 0.10% of the pre-European vegetation and 0.25% of the area remaining for the Yelverton (Y) vegetation complex and does not significantly reduce the extent of this vegetation complex and is in keeping with the target's set in the EPA's Position Statement No. 2 (EPA, 2000) (i.e. 30% or more);
- No PEC or TEC will be impacted by the Proposal;
- Approximately 52% of vegetation community A (predominantly the A2 sub-community) will be lost as a result of clearing for the Proposal;
- Impacts to the Threatened flora *Daviesia elongata subsp. elongata* are not considered to be significant as only 0.59% (six individuals) of the estimated population of 1016 mature plants (DEC, 2007), will be impacted. This species is known from seven locations of which one is located within a nature reserve that is managed for the conservation of flora and fauna. The other subpopulations are located within State forests, with the exception of subpopulations 1 and 2 which occur in Shire reserves (DEC, 2007). Known populations are healthy and not immediately threatened (DEC, 2007).
- The population of the Threatened flora *Verticordia densiflora var. pedunculata* within the State-Forest sub-area will not be impacted by the Proposal and as such no impacts on the known population will occur;

- Populations of the Priority flora *Conospermum paniculatum* (P3) and *Acacia semitrullata* (P4) will be reduced, however these species are known from several locations outside of the Development Envelope. It is considered that the conservation status of these species is unlikely to change as a result of the clearing;
- No significant impacts to regionally significant flora will occur as a result of the Proposal.

The Proposal will not result in a significant change to the Whicher Scarp soil-landscape system, the Yelverton vegetation complex, the regional distribution of flora and vegetation and is unlikely to change the status of flora of conservation significance. Although Doral considers the impacts to flora and vegetation to not be significant, Doral recognises the value of the Whicher Scarp and is committed to providing a suitable offset to secure a positive environmental outcome for the State on a 'like for like' principle (or as near to as practical). Section 12 describes further the offset strategy that Doral will implement for this proposal.

Doral considers that with the implementation of the proposed management listed above, and the acquisition of land via an offsets package, the EPA's objective to maintain representation, diversity, viability and ecological function at the species, population and community level can be achieved.



Legend

- Development Envelope
- Sub-area Boundary
- Cadastral Boundary
- Tenement Boundary
- Mine Pit Disturbance Area
- Infrastructure Disturbance Area
- Vegetation Mapping Site - Matiske 2012a
- Quadrat Location - Matiske 2012a
- Quadrat Location - Ecoedge Environmental, 2013



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Quadrat Locations		
Scale:	Projection:	Sheet Size:
1:10 000	Australia MGA94 (50)	A3
Figure 6-3		Date: 07/03/2014

CADASTRAL SOURCE: Landgate, February 2012.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown December 2009.
TENEMENT SOURCE: Department of Mines and Petroleum, June 2011.

7 TERRESTRIAL FAUNA

7.1 RELEVANT ENVIRONMENTAL OBJECTIVES, LEGISLATION, POLICIES, GUIDELINES, STANDARDS AND PROCEDURES

7.1.1 EPA Objectives

To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.

7.1.2 Legislation, Policy and Guidelines

State Legislation

In a legislative context, the preservation and conservation of fauna is covered primarily by the following Western Australian legislation:

- WC Act;
- CALM Act;
- EP Act.

In WA, rare or endangered species are protected by the Wildlife Conservation (Specially Protected Fauna) Notice 2008, under the WC Act. Schedules 1 and 4 in this notice are relevant to this assessment, providing a listing of the species protected by this Notice. Fauna are also listed by DPaW as Priority species if they are potentially threatened but for which there is insufficient evidence to properly evaluate their conservation significance. They range from Priority 1 (P1) to Priority 4 (P4) species.

Note that the Priority status does not have statutory standing. The Priority fauna classifications are employed by the DPaW to manage and classify their database of species considered potentially to be at risk, but these categories have no legislative status for protection in addition to the native vegetation clearing legislation.

Commonwealth Legislation

The EPBC Act protects species listed under Schedule 1 of the Act. In 1974, Australia became a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). An official list of these endangered species is prepared and is regularly updated by DoE. The current list differs from the various State lists; however some species are common to both. Threatened fauna and flora may be listed in any one of the following categories as defined in Section 179 of the EPBC Act:

- Critically endangered (CE);
- Endangered (E);
- Vulnerable (V).

Policies and Guidelines

To comply with regulatory requirements fauna investigations were undertaken in accordance with the following EPA statements and guidelines.

- Guidance Statement No. 56 *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia June 2004* (EPA, 2004a);
- EPA Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA, 2002);

- EPA Guidance Statement No. 20 *Sampling of Short-range Endemic Fauna for Environmental Impact Assessment in Western Australia* (EPA, 2009b);
- *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. Technical report of the Environmental Protection Authority and the Department of Environment and Conservation (Hyder *et al.*, 2010)

7.1.3 International Agreements

Australia is party to the Japan-Australia (JAMBA), Republic of Korea-Australia (ROKAMBA), China-Australia (CAMBA) and the Bonn Convention 1979 Migratory Bird Agreements. All migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as matters of NES under the EPBC Act.

7.2 EXISTING ENVIRONMENT

7.2.1 Studies Undertaken

A detailed fauna investigation was undertaken by Harewood (2014) to quantify the fauna values of the Development Envelope (Figure 7-1) and identify the potential presence, distribution and abundance of specific fauna species of conservation significance. The fauna survey was undertaken within the Development Envelope and included Lots 1870, 1871, 1872, 1873, 1874 and State Forest No. 33. The fauna assessment included the following:

- Level 1 fauna assessment;
- Level 2 seasonal Fauna Survey undertaken in December 2011 and March 2012;
- Chuditch Trapping Program;
- Western Ringtail Possum Targeted Surveys;
- Black-Cockatoo Habitat Survey;
- Terrestrial Invertebrate Survey for SRE taxa (Phoenix Environmental Services, 2012).

Field survey techniques included opportunistic surveys, trapping, call playback, habitat surveys, acoustic bat recordings, infrared cameras and bird surveys. Previous Fauna surveys in the area were consulted prior to field investigations and used to determine the potential fauna assemblage for the general area. The methodology and full results of the fauna survey are provided in 0.

The following description of fauna and fauna habitats within the Development Envelope is adapted from Harewood (2014) unless otherwise stated.

7.2.2 Terrestrial Fauna Habitats

Twelve Fauna Habitats were mapped within the Development Envelope (Figure 7-1). These fauna habitats were based on the vegetation units of Ecoedge Environmental (2013) and Mattiske (2012a) and are described in Table 7-1. Most of the Development Envelope is cleared of native vegetation and is used for livestock grazing. Remnant native vegetation is dominated by woodlands or forests of Jarrah and/or Marri with variation occurring with respect to the subdominant mid and lower storey species.

Most of the vegetation within the State Forest sub-area is rated by Ecoedge Environmental (2013) as Very Good to Excellent condition despite appearing to have regenerated after past historical disturbances. Adjacent vegetation within the Whicher National Park is generally in better condition with a higher density of groundcover vegetation.

Fallen logs (some hollow) and trees with hollows were relatively common within the (vegetated) areas of the Development Envelope. The location of trees containing hollows is shown in Figure 7-2.

TABLE 7-1: FAUNA HABITATS WITHIN THE DEVELOPMENT ENVELOPE

BROAD FAUNA HABITAT TYPE	FAUNA HABITAT MAPPING (Harewood, 2014)	SOURCE	DESCRIPTION
Open Forest	Jarrah/Mountain Marri open forest on grey-brown loamy sand	Ecoedge Environmental (2013)	A1. <i>Eucalyptus marginata</i> , <i>Corymbia haematoxylon</i> open forest/woodland over <i>Banksia grandis</i> (<i>Banksia attenuata</i> , <i>Persoonia elliptica</i>) low open woodland over <i>Dasypogon hookeri</i> , <i>D. bromeliifolius</i> , <i>Hibbertia hypericoides</i> , <i>Kennedia coccinea</i> , <i>Podocarpus drouynianus</i> , <i>Stirlingia latifolia</i> , <i>Xanthorrhoea gracilis</i> and <i>X. preissii</i> shrubland/low shrubland and <i>Anarthria prolifera</i> , <i>Desmocladius fasciculatus</i> open sedgeland and <i>Patersonia occidentalis</i> scattered herbs on grey-brown loamy sand.

BROAD FAUNA HABITAT TYPE	FAUNA HABITAT MAPPING (Harewood, 2014)	SOURCE	DESCRIPTION
Open Forest	Jarrah/Marri open forest on yellow or yellow-brown loamy sand	Ecoedge Environmental (2013)	A2. <i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> open forest/woodland over <i>Banksia grandis</i> low open woodland over <i>Acacia pulchella</i> , <i>Adenanthos barbiger</i> , <i>Boronia crenulata</i> , <i>Dasypogon hookeri</i> , <i>Hakea amplexicaulis</i> , <i>H. ruscifolia</i> , <i>Hibbertia hypericoides</i> , <i>Hypocalymma robustum</i> , <i>Melaleuca thymoides</i> , <i>Podocarpus drouynianus</i> , <i>Xanthorrhoea gracilis</i> , shrubland/low shrubland over <i>Tetraria</i> sp. Jarrah Forest, <i>Mesomelaena tetragona</i> open sedgeland and <i>Patersonia occidentalis</i> open herbs on yellow or yellow-brown loamy sand.
Open Forest	Jarrah/Marri open forest on red-brown loam	Ecoedge Environmental (2013)	A3. <i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> open forest/woodland over <i>Banksia grandis</i> , <i>Persoonia longifolia</i> low woodland over <i>Acacia extensa</i> , <i>Adenanthos barbiger</i> , <i>Boronia crenulata</i> , <i>Daviesia cordata</i> , <i>Grevillea trifida</i> , <i>Hakea ruscifolia</i> , <i>Hibbertia hypericoides</i> , <i>Hypocalymma robustum</i> , <i>Macrozamia riedlei</i> , <i>Mirbelia dilatata</i> , <i>Podocarpus drouynianus</i> , <i>Xanthorrhoea gracilis</i> , <i>X. preissii</i> shrubland/low shrubland over <i>Hypolaena exsulca</i> , <i>Loxocarya cinerea</i> open sedgeland and <i>Patersonia umbrosa</i> var. <i>xanthina</i> scattered herbs on red-brown loam.
Woodland	Jarrah/Marri woodland on grey-brown loamy sand	Ecoedge Environmental (2013)	B1. <i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> woodland over <i>Banksia grandis</i> , <i>Xylomelum occidentale</i> open low woodland over <i>Acacia pulchella</i> , <i>Adenanthos barbiger</i> , <i>Dasypogon bromeliifolius</i> , <i>D. hookeri</i> , <i>Hibbertia hypericoides</i> , <i>Hypocalymma robustum</i> , <i>Melaleuca thymoides</i> , <i>Podocarpus drouynianus</i> , <i>Stirlingia latifolia</i> , <i>Xanthorrhoea gracilis</i> , <i>X. preissii</i> shrubland/low shrubland over <i>Anarthria prolifera</i> , <i>Desmocladius fasciculatus</i> open sedgeland on grey-brown loamy sand.

BROAD FAUNA HABITAT TYPE	FAUNA HABITAT MAPPING (Harewood, 2014)	SOURCE	DESCRIPTION
Woodland	Mountain Marri/Jarrah woodland on light grey sand	Ecoedge Environmental (2013)	B2. <i>Corymbia haematoxylon</i> , <i>Eucalyptus marginata</i> woodland over <i>Xylomelum occidentale</i> , <i>Banksia grandis</i> open low woodland over <i>Acacia extensa</i> , <i>A. pulchella</i> , <i>Dasypogon bromeliifolius</i> , <i>Hibbertia hypericoides</i> , <i>Hypocalymma robustum</i> , <i>Jacksonia horrida</i> , <i>Stirlingia latifolia</i> shrubland, low shrubland over <i>Anarthria prolifera</i> , <i>Desmocladius fasciculatus</i> , <i>Mesomelaena tetragona</i> open sedgeland on light grey sand.
Open Forest	Jarrah/Mountain Marri/Sheoak open forest on grey-brown or yellow-brown loamy sand and sandy loam	Ecoedge Environmental (2013)	B3. <i>Eucalyptus marginata</i> , <i>Corymbia haematoxylon</i> , <i>Allocasuarina fraseriana</i> open forest over <i>Banksia grandis</i> , <i>Persoonia elliptica</i> open low woodland over <i>Dasypogon hookeri</i> , <i>D. bromeliifolius</i> , <i>Hibbertia hypericoides</i> , <i>H. glomerata</i> , <i>Labichea punctata</i> , <i>Stirlingia latifolia</i> , <i>Xanthorrhoea preissii</i> , <i>X. gracilis</i> shrubland/low shrubland over <i>Patersonia umbrosa</i> var. <i>xanthina</i> open herbland on grey-brown or yellow-brown loamy sand and sandy loam.
Open Forest	Jarrah/Marri open forest on gravelly sand or grey brown loamy sand	Ecoedge Environmental (2013)	C. <i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> open forest over <i>Banksia dallanneyi</i> , <i>Hakea amplexicaulis</i> , <i>Hibbertia amplexicaulis</i> , <i>H. hypericoides</i> , <i>Hypocalymma robustum</i> shrubland/low shrubland over <i>Desmocladius fasciculatus</i> , <i>Tetraria</i> sp. Jarrah Forest open sedgeland and <i>Conostylis aculeata</i> , <i>Opercularia apiciflora</i> , <i>Patersonia umbrosa</i> var. <i>xanthina</i> open herbland on gravelly sand or grey brown loamy sand.
Open Woodland	Jarrah/Marri/Mountain Marri/Sheoak Open Woodlands over weeds	Mattiske (2012a)	W1. Open Woodland of <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> - <i>Corymbia haematoxylon</i> - <i>Allocasuarina fraseriana</i> over introduced herbs and grasses on disturbed flats and lower slopes with leached or brown sandy-loams and sandy-gravels.

BROAD FAUNA HABITAT TYPE	FAUNA HABITAT MAPPING (Harewood, 2014)	SOURCE	DESCRIPTION
Open Forest	Jarrah/Marri/Banksia/Mountain Marri/Woody Pear open forest over Shrubland over low herbs and grasses on leached grey/brown sandy to sandy-loam soils	Mattiske (2012a)	F1. Open Forest of <i>Eucalyptus marginata</i> <i>Corymbia calophylla</i> <i>Banksia grandis</i> - <i>Corymbia haematoxylon</i> <i>Xylomelum occidentale</i> over <i>Xanthorrhoea preissii</i> , <i>Podocarpus drouynianus</i> , <i>Hakea amplexicaulis</i> , <i>Hakea ruscifolia</i> , <i>Hibbertia hypericoides</i> , <i>Dasypogon hookeri</i> , <i>Dasypogon bromeliifolius</i> and <i>Kingia australis</i> over low herbs and grasses on lower and mid slopes with leached grey/brown sandy to sandy-loam soils.
Open Forest	Marri/Mountain Marri/Banksia/Woody Pear open forest over shrubland	Mattiske (2012a)	F2. Open Forest of <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> - <i>Banksia grandis</i> - <i>Corymbia haematoxylon</i> - <i>Xylomelum occidentale</i> over <i>Xanthorrhoea preissii</i> , <i>Podocarpus drouynianus</i> , <i>Hakea amplexicaulis</i> , <i>Hakea ruscifolia</i> , <i>Hibbertia hypericoides</i> , <i>Dasypogon hookeri</i> .
Open Forest	Marri/Jarrah/Banksia/Sheoak open forest over Shrubland on leached grey and brown sands and sandy loams	Mattiske (2012a)	F3. Open Forest of <i>Corymbia calophylla</i> - <i>Eucalyptus marginata</i> <i>Banksia grandis</i> - <i>Allocasuarina fraseriana</i> over <i>Hibbertia hypericoides</i> , <i>Xanthorrhoea preissii</i> , <i>Xanthorrhoea gracilis</i> , <i>Dasypogon hookeri</i> , <i>Dasypogon bromeliifolius</i> , <i>Kunzea recurva</i> and <i>Podocarpus drouynianus</i> on flats with leached grey and brown sands and sandy loams.
Cleared	Cleared paddocks	Mattiske (2012a)	CL. The majority of the Development Envelope is cleared farmland. Some of the cleared areas are low lying and subject to seasonal inundation/waterlogging in the winter months. Some sections contain various densities of scattered individual and groups of trees, principally Marri (<i>C. calophylla</i>) and Jarrah (<i>E. marginata</i>) over a mixture of introduced pasture grasses, clovers, weeds and degraded sedgeland. A variety of non-endemic trees and shrubs have been planted in some locations as windbreaks and screens.

7.2.3 Occurrence of Vertebrate Fauna

In total, evidence of 95 species of native vertebrate fauna was obtained during the level 2 survey (captured, sighted, heard, recorded, signs) comprising of 52 native bird species, 14 native mammal species, 25 reptile species and 4 amphibian species. This is approximately 53% of the total number of potential native species (based on previous fauna surveys in the area and desktop investigations).

Fish

No freshwater fish were recorded.

No listed Threatened or Priority native fish species are likely to occur in the area.

Native Non-Volant Mammals

Eight native non-flying mammals were captured and/or observed during the field surveys. Based on desktop study results another six species may occur in the general area. Three species of conservation significance were observed or noted as utilising the Development Envelope:

- Quenda (*Isodon obesulus fusciventer*) listed as a P5 (DPaW Priority Species);
- Southern Brush-tailed Phascogale (*Phascogale tapoatafa* spp) listed as Schedule 1 under the WC Act;
- Western Brush Wallaby (*Macropus irma*) listed as P4 (DPaW Priority Species).

Other specially protected/priority species that may utilise the Yoongarillup area at times but which were not sighted are the Chuditch (*Dasyurus geoffroii*) and the Western Ringtail Possum (*Pseudocheirus occidentalis*) which are both listed as Schedule 1 under the WC Act and Vulnerable under the EPBC Act. Although some areas of suitable habitat occur within the Development Envelope, these species were absent during the survey.

Bats

Six bat species were recorded during all stages of the fauna survey. Based on the desktop study results another three species of bat may occur in the general area.

No bat species recorded are listed as conservation significant species. The Western false pipistrelle (*Falsistrellus mackenziei*) is listed as P4 and has been recorded nearby and may utilise habitat within the Development Envelope despite its apparent absence during the survey period.

Introduced Mammals

Six introduced mammals were observed during the field survey; the House Mouse (*Mus musculus*), Black Rat (*Rattus rattus*), Red Fox (*Vulpes vulpes*), Rabbit (*Oryctolagus cuniculus*), Pig (*Sus scrofa*) and European Cattle (*Bos taurus*).

Birds

A total of 53 bird species (one introduced) were recorded. A comprehensive list of these species is provided in 0. Another 55 species may occur in the general area. The higher number of potential bird species (based on fauna surveys at Gwindinup/Happy Valley (Bancroft and Bamford, 2008), Tutunup (Biota, 2009), Yoganup (Biota, 2007a) and Tutunup South (Biota, 2007b) compared to the Development

Envelope can in part be explained by the larger size of the survey area, a wider range of habitats and in the case of Gwindinup/Happy Valley repeated surveys over several years.

Four species of avifauna assigned conservation significance were recorded within the Development Envelope;

- Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) listed as Schedule 1 under the WC Act and Vulnerable under the EPBC Act;
- Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) listed as Schedule 1 under the WC Act and Endangered under the EPBC Act;
- Forest Red Tailed Black-Cockatoo (*Calyptorhynchus banksia naso*) listed as Schedule 1 under the WC Act and Vulnerable under the EPBC Act;
- Rainbow Bee-eater (*Merops ornatus*) listed as Schedule 3 under the WC Act and Migratory under the EPBC Act;

These species are discussed in detail in Section 11.

Other specially protected/migratory/priority species that may utilise habitats within the development envelope at times but which were not sighted are the Peregrine Falcon (*Falco peregrinus*) listed as Schedule 4 of the WC Act, the Masked Owl (*Tyto n. novaehollandiae*) listed as P3, the Great Egret (*Ardea alba*) and the Cattle Egret (*Ardea ibis*) both listed as Migratory under the EPBC Act.

Reptiles

A total of 25 species of reptile were captured and/or observed during the field surveys. Based on the desktop study results another 11 species may occur in the general area. These results are comparable with those recorded elsewhere on the Whicher Scarp. Bancroft and Bamford (2008) recorded a combined total of 25 reptile species from Gwindinup and Happy Valley. Biota recorded 19 species at Tutanup (Biota, 2009) and 20 species at Yoganup and at Tutanup South (Biota 2007a, 2007b). Hart *et al.*, (1997) recorded 21 species further out on the coastal plain within vegetation bordering Tutanup Road. One species of conservation significance was recorded, the Coastal Plains Skink (*Ctenotus ora*) which is a P1 species. The only other likely species of conservation significance that may occur within the Development Envelope and its surrounds is the Southern Carpet Python (*Morelia spilota imbricata*) which is listed as Schedule 4 under the WC Act.

Amphibians

Four species of frog were captured and/or observed during the field survey. Desktop study results indicate that another seven species may occur in the general area. None of the identified or potential amphibian species that may occur in the area are listed as Threatened or Priority species.

7.2.4 Vertebrate Species of Conservation Significance

Based on previous surveys, database and literature searches from within 20km of the Development Envelope, there is the potential for 29 species of conservation significance to occur in the area (Table 7-2). Seven of these species have been recorded within the Development Envelope (either directly or through secondary evidence).

TABLE 7-2: POTENTIALLY OCCURRING CONSERVATION SIGNIFICANT VETERBRATE FAUNA SPECIES

* Descriptions of the Conservation Category Codes can be found in Appendix A of Appendix 7 – Fauna Survey Reports

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Carter's Freshwater Mussel <i>Westralunio carteri</i>	-	P4	Occurs in greatest abundance in slower flowing streams with stable sediments that are soft enough for burrowing amongst woody debris and exposed tree roots. Salinity tolerance quite low (Morgan <i>et al.</i> , 2011)	Unlikely.	No suitable habitat.
Margaret River (Hairy) Marron <i>Cherax tenuimanus</i>	CR	S1	Information on the current distribution of the hairy marron indicates that the species requires relatively good quality water and a diversity of habitat structure and may struggle to persist in disturbed habitats.	Unlikely.	No suitable habitat.
Mud Minnow <i>Galaxiella munda</i>	-	S1	Typically found in small flowing streams near submerged vegetation, occasionally in still water of ponds, swamps and roadside drains. Water is usually darkly tannin stained and acidic (pH 3.0-6.0) (Allen <i>et al.</i> , 2003).	Unlikely.	No suitable habitat.

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Balston's Pygmy Perch <i>Nannatherina balstoni</i>	VU	S1	Acidic, tannin stained freshwater pools, streams and lakes within 30 km of the coast, typically situated amongst peat flats. Prefers shallow water and is commonly found in association with tall sedge thickets (Allen <i>et al.</i> , 2003). Morgan (1996) found them most common in shallow pools and creeks that often dry up in summer. Lower numbers were observed in the permanent major rivers surveyed.	Unlikely	No suitable habitat.
Perth Lined Lerista <i>Lerista lineata</i>	-	P3	This small species of skink inhabits white sands (Storr <i>et al.</i> , 1999) under areas of shrubs and heath where it inhabits loose soil and leaf litter (Nevill, 2005) particularly in association with Banksias (Bush <i>et al.</i> , 2002).	Unlikely	This species has not been found south of Bunbury in recent times. The single documented record south of Bunbury (West Busselton) is considered erroneous).

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Coastal Plains Skink <i>Ctenotus ora</i>	-	P1	Sandy substrates with low vegetation (including heath) in open <i>Eucalyptus/Corymbia</i> woodland over <i>Banksia</i> (Kay and Keogh, 2012). Individuals have been found sheltering under <i>Banksia</i> logs on white sand, and trapped in eucalypt woodland with <i>Banksia</i> or peppermint mid-storey, or heath (Bamford <i>et al.</i> , 2010). Habitat also includes open eucalypt woodland over <i>Banksia</i> and low vegetation on sandy coastal plain and coastal dunes (Wilson and Swan, 2013)	Known to Occur	Twenty eight specimens of what is assumed to be <i>Ctenotus ora</i> were collected during the survey period.
Southern Carpet Python <i>Morelia spilota imbricata</i>	-	S4, P4	This species has been recorded from semi-arid coastal and inland habitats, <i>Banksia</i> woodland, Eucalypt woodlands, and grasslands. Most often found utilising hollow logs in addition to the burrows of other animals for shelter. Often arboreal and will also use tree hollows for refuge.	Possible	Status on-site is difficult to determine. Habitat appears suitable with areas of dense groundcover and hollow logs/trees. Typically only occurs in low densities.

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Short-nosed Snake <i>Elapognathus minor</i>	-	P2	Restricted to the humid coastal plains of the deep south west (Storr <i>et al.</i> , 2002). Inhabits heaths edging swamps though also known to inhabit wet sclerophyll forest. Shelters in low dense vegetation such as tussocks and sedges (Wilson and Swan, 2013).	Unlikely	Just outside of documented range. No suitable habitat.
Great Egret <i>Ardea alba</i>	Migratory	S3	Wetlands, flooded pasture, dams, estuarine mudflats, mangroves and reefs (Morcombe, 2004).	Possible	Likely to utilise the manmade dams and possibly paddocks for foraging at times, in small numbers. This species would be an infrequent, temporary visitor only. No potential for breeding on-site. Would not utilise forested areas for any purpose.
Cattle Egret <i>Ardea ibis</i>	Migratory	S3	Moist pastures with tall grasses, shallow open wetlands and margins, mudflats (Morcombe, 2004).	Possible	Likely to utilise the manmade dams and possibly paddocks for foraging at times, in small numbers. This species would be an infrequent, temporary visitor only. No potential for breeding on-site. Would not utilise forested areas for any purpose.
Malleefowl <i>Leipoa ocellata</i>	VU	S1	Mainly scrubs and thickets of mallee <i>Eucalyptus</i> sp., boree <i>Melaleuca lanceolata</i> and bowgada <i>Acacia linophylla</i> , also dense litter forming shrublands.	Unlikely	This species is locally and regionally extinct.

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Australasian Bittern <i>Botaurus poiciloptilus</i>	EN	S1	Freshwater wetlands, occasionally estuarine; prefers heavy vegetation (Morcombe, 2004) such as beds of tall dense <i>Typha</i> , <i>Baumea</i> and sedges in freshwater swamps (Johnstone and Storr, 1998).	Unlikely	No suitable habitat
White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i>	Migratory	S3	They nest and forage usually near the coast over islands, reefs, headlands, beaches, bays, estuaries, mangroves, but will also live near seasonally flooded inland swamps, lagoons and floodplains, often far inland on large pools of major rivers. Established pairs usually sedentary, immatures dispersive (Morcombe, 2004). White-bellied Sea-Eagles build a large stick nest, which is used for many seasons in succession.	Unlikely	No suitable habitat

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Peregrine Falcon <i>Falco peregrinus</i>	-	S4	Diverse from rainforest to arid shrublands, from coastal heath to alpine (Morcombe, 2004). Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes (Johnstone and Storr, 1998). The species utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It will also occasionally use the abandoned nests of other birds of prey.	Possible	The species potentially utilises some sections of the Development Envelope as part of a much larger home range. No actual nest sites observed.
Carnaby's Black Cockatoo <i>Calyptrorhynchus latirostris</i>	EN	S1	Forests, woodlands, heathlands, farms; feeds on <i>Banksia</i> , <i>Hakea</i> and Marri. Carnaby's Black-Cockatoo has specific nesting site requirements. Nests are mostly in smoothed-barked eucalypts with the nest hollows ranging from 2.5 to 12m above the ground, an entrance from 23-30cm diameter and a depth of 0.1-2.5m (Johnstone and Storr, 1998).	Known to Occur	Small flocks of this species observed flying over the Development Envelope on occasions and foraging evidence attributed to this species found within Development Envelope (chewed marri and jarrah fruits). All marri, mountain marri, jarrah, <i>banksia</i> trees and a range of other plant species within the development envelope represents potential foraging habitat for this species. Larger trees (>50cm Diameter at Breast Height (DBH)) are considered potential breeding habitat by DoE (DSEWPac, 2012a). This species may also roost on site on occasions. Several trees with evidence of roosting activity were observed within the Development Envelope.

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Baudin's Black Cockatoo <i>Calyptorhynchus baudinii</i>	VU	S1	Mainly eucalypt forests where it feeds primarily on Marri seeds, (Morcombe, 2004), <i>Banksia</i> , <i>Hakea</i> and <i>Erodium</i> sp. Also strips bark from trees in search of beetle larvae (Johnstone and Storr, 1998). This species of cockatoo nests in large tree hollows, 30–40cm in diameter and more than 30cm deep (Saunders, 1974).	Possible	Foraging evidence attributed to this species found within the Development Envelope (chewed marri fruits). All marri, mountain marri, banksia trees and a range of other plant species within the Development Envelope represents potential foraging habitat for this species. Larger trees (>50cm DBH) are considered potential breeding habitat by DoE (DSEWPac, 2012a). This species may also roost on site on occasions. Several trees with evidence of roosting activity were observed within the Development Envelope.
Forest Red-tailed Black Cockatoo <i>Calyptorhynchus banksii naso</i>	VU	S1	Eucalypt forests, feeds on marri, jarrah, blackbutt, karri, sheoak and snottygobble. The Forest Red-tailed Black-Cockatoo nests in the large hollows of marri, Jarrah and Karri (Johnstone and Kirkby, 1999). In Marri, the nest hollows of the Forest Red-tailed Black Cockatoo range from 8-14m above ground, the entrance is 12 – 41cm in diameter and the depth is one to five metres (Johnstone and Storr, 1998).	Known to Occur	Heard calling on several occasions and foraging evidence attributed to this species found within the Development Envelope (chewed jarrah fruits). All marri, mountain marri and jarrah trees and a range of other plant species within the Development Envelope represents potential foraging habitat for this species. Larger trees (>50cm DBH) are considered potential breeding habitat by DoE (DSEWPac, 2012a). This species may also roost on site on occasions. Several trees with evidence of roosting activity were observed within the Development Envelope.

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Masked Owl (SW population) <i>Tyto n. novaehollandia</i>	-	P3	Roosts and nests in heavy forest, hunts over open woodlands and farmlands (Morcombe, 2004). Probably breeding in forested deep south west with some autumn–winter wanderings northwards (Johnstone and Storr, 1998).	Possible	May occasionally reside in general area though status uncertain. May utilise forested areas for roosting and hunt over cleared paddocks.
Fork-tailed Swift <i>Apus pacificus</i>	Migratory	S3	Low to very high airspace over varied habitat from rainforest to semi desert (Morcombe, 2004).	Flyover Only	It is potentially a very occasional summer visitor to air space above the development envelope but is entirely aerial and largely independent of terrestrial habitats. Not listed as a potential species as it is only likely to occur in the general area on very rare occasions.
Rainbow Bee-eater <i>Merops ornatus</i>	Migratory	S3	Open country, of woodlands, open forest, semi-arid scrub, grasslands, clearings in heavier forest, farmlands (Morcombe, 2004). Breeds underground in areas of suitable soft soil firm enough to support tunnel building.	Known to Occur	Heard calling during field survey work in December 2011. May breed in some sections of the Development Envelope where ground conditions permit.

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Chuditch <i>Dasyurus geoffroii</i>	VU	S1	Chuditch are known to have occupied a wide range of habitats from woodlands, dry sclerophyll (leafy) forests, riparian vegetation, beaches and deserts. Riparian vegetation appears to support higher densities of Chuditch, possibly because food supply is better or more reliable and better cover is offered by dense vegetation. Chuditch appear to utilise native vegetation along road sides in the wheatbelt (CALM, 1994). The estimated home range of a male Chuditch is over 15km ² whilst that for females is 3-4km ² (Sorena and Soderquist, 1995). This species is rarely recorded on the coastal plain (Dell, 2000).	Possible	No evidence of this species found during the survey period. This species may however occur on some occasions as it has previously been recorded in state forest areas of the south west.

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Southern Brush-tailed Phascogale <i>Phascogale tapoatafa</i> ssp	-	S1	This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. A nocturnal carnivore relying on tree hollows as nest sites. The home range for a female Brush-tailed Phascogale is estimated at between 20ha and 70ha, whilst that for males is given as twice that of females. In addition, they tend to utilise a large number of different nest sites (~ 20) throughout their range (Soderquist, 1995). Rhind's 1998 study indicated a preference for hollows in older and senescent or dead trees and small hollow entrances (Rhind, 1998).	Known to Occur	This species was recorded within the state forest area during the field survey (Camera site 1).

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Quenda <i>Isoodon obesulus fusciventer</i>	-	P5	Dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting jarrah and wandoo forests are usually associated with watercourses. Quendas can thrive in more open habitat subject to exotic predator control (DPaW information pamphlet).	Known to Occur	This species was recorded within the national park area (Trap Site 3) during the field survey. Appears to be favouring areas with the densest groundcover as it was not captured or observed in areas with relatively sparse groundcover.
Bilby <i>Macrotis lagotis</i>	VU	S1	Current habitat included <i>Acacia</i> shrublands, spinifex and hummock grassland (Menkhorst and Knight, 2011).	Unlikely	Regionally extinct.
Western Ringtail Possum <i>Pseudocheirus occidentalis</i>	VU	S1	The western ringtail possum was once located in a variety of habitats including coastal peppermint, coastal peppermint-tuart, jarrah-marri associations, sheoak woodland, and eucalypt woodland and mallee. Coastal populations mostly inhabit peppermint-tuart associations with highest densities in habitats with dense, relatively lush vegetation. In these areas the main determinants of	Possible	No evidence of this species was found within the bounds of the Development Envelope despite two repeat night surveys and extensive daytime transects across the site. Based on this information it is concluded to be absent from the site despite the presence of some areas of suitable habitat.

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
			<p>suitable habitat for WRPs appears to be the presence of <i>Agonis flexuosa</i> either as the dominant tree or as an understorey component of eucalypt forest or woodland (Jones <i>et al.</i>, 1994a). Inland, the largest known populations occur in the upper Warren area east of Manjimup (Wayne <i>et al.</i>, 2005). In this area the peppermint tree is naturally absent and jarrah-marri associations constitute the species refuge and foraging habitat. In areas where peppermint is absent or rare WRPs have been observed feeding predominately on young jarrah, <i>Nuytsia floribunda</i> and <i>Allocasuarina fraseriana</i> (G Harewood pers. obs.).</p>		
<p>Western Brush Wallaby <i>Macropus irma</i></p>	-	P4	<p>The species optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (DPaW information pamphlet).</p>	Known to Occur	<p>A single individual of this species was seen within the national park area during the December 2011 survey period.</p>

SPECIES	CONSERVATION CATEGORY CODE		HABITAT	LIKELIHOOD OF OCCURRENCE	OCCURRENCE DISCUSSION
	EPBC ACT	WC Act			
Quokka <i>Setonix brachyurus</i>	VU	S1	Mainland populations of this species are currently restricted to densely vegetated coastal heaths, swamps, riverine habitats including tea-tree thickets on sandy soils along creek systems where they are less vulnerable to predation. The species is nocturnal.	Unlikely	A population of this species could not persist within the habitats present with the Development Envelope.
Western False Pipistrelle <i>Falsistrellus mackenziei</i>	-	P4	This species of bat occurs in high forest and coastal woodlands. It roosts in small colonies in tree hollows and forages at canopy level and in the cathedral-like spaces between trees.	Possible	This species was not recorded during the two field survey periods and it appears based on this information to be currently absent from the area.
Water Rat <i>Hydromys chrysogaster</i>	-	P4	The water rat occupies habitat in the vicinity of permanent water, fresh, brackish or marine. Likely to occur in all major rivers and most of the larger streams as well as bodies of permanent water in the lower south west (Christensen <i>et al.</i> , 1985).	Unlikely	No suitable habitat.

In summary the following species of conservation significance are likely or known to occur within the Development Envelope:

- Western Brush Wallaby (*Macropus irma*);
- Quenda (*Isodon obesulus fusciventer*);
- Rainbow Bee-eater (*Merops ornatus*);
- Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*);
- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*);
- Coastal Plains Ctenotus (*Ctenotus ora*);
- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*);
- Cattle Egret (*Ardea ibis*);
- Great Egret (*Ardea alba*).

Possibly occurring due to suitable habitat, however little evidence to suggest the presence of these species:

- Western False Pipstrelle (*Falsistrellus mackenziei*);
- Western Ringtail Possum *Pseudocheirus occidentalis*);
- Chuditch (*Dasyurus geoffroii*);
- Fork tailed Swift (*Apus pacificus*);
- Masked Owl (*Tyto n. novaehollandia*);
- Peregrine Falcon (*Falco peregrinus*);
- Southern Carpet Python (*Morelia spilota imbricate*).

7.2.5 Occurrence of Short-Range Endemic Invertebrate Fauna

SRE fauna (also known as narrow-range taxa) are defined as animals that display restricted geographic distributions, nominally less than 10,000km², that also may be disjunct and highly localised (Harvey 2002; Ponder and Colgan, 2002).

One species of scorpion and three species of mygalomorph spiders were recorded during the field survey. None of these invertebrate species are considered to represent SRE's (Phoenix Environmental Services, 2012).

Biota (2009) conducted invertebrate field surveys nearby at Tutunup and Tutanup South and concluded that it was unlikely that any of the invertebrate taxa encountered would be restricted to the locality of the Development Envelope due to the absence of geomorphological boundaries or subdivisions that may represent isolating mechanisms for potential SRE invertebrate species. Given the similar habitat types for the Development Envelope (Jarrah/Marri Woodland on sand and/or laterite) these conclusions may also be applied.

7.3 POTENTIAL IMPACTS

The Proposal may result in the following impacts to fauna and fauna habitats:

- Vegetation clearing for the Proposal will directly remove or possibly fragment fauna habitat leading to displacement of fauna;
- Trenching for drains and presence of artificial water bodies may result in the loss/injury of individual fauna;
- Redistribution of surface water flows around the mine pits and infrastructure may alter fauna habitat;
- Dewatering activities may affect groundwater-dependent vegetation and affect the value of fauna habitat;
- Changes to fire regime from introduced ignition sources;
- Increase in the number of predatory introduced species;
- Light and noise emissions could disrupt fauna behaviour;
- Spread of dieback and weeds could degrade fauna habitat;
- Vehicle movements during construction and operation may result in the loss of individual fauna, especially less-mobile species, from vehicle strikes.

7.4 ASSESSMENT OF POTENTIAL IMPACTS

7.4.1 Vegetation Clearing

Soil-Landscape System

It is difficult to determine the regional impacts to fauna habitats as most fauna would not be confined to a certain vegetation complex or soil-landscape system. However, in order to provide some regional context on the significance of habitat clearing, impacts to the Whicher Scarp soil-landscape system have been assessed. The area proposed to be cleared to facilitate the Proposal (i.e. 8.68ha) represents only 0.04% of the pre-European extent and 0.09% of the area remaining of the Whicher Scarp soil-landscape system and does not significantly reduce its extent.

Fauna Habitats

Almost all native fauna rely on native vegetation to provide food, shelter and breeding sites. Clearing of native vegetation is likely to reduce the capacity of the habitat to support fauna resulting in the displacement of fauna. Fauna habitat areas within the Development Envelope to be cleared are outlined in Table 7-3. As most fauna would not be confined to a specific vegetation complex, Woodland and Forest habitats have been grouped for these calculations. In total 8.68ha of remnant vegetation (known to support conservation significant fauna) will be cleared for the Proposal. The majority of disturbance for the Proposal will occur within the CL areas (Cleared Pasture).

Molloy *et al.*, (2009) identified a regional ecological link axis line passing within 600m to the south east of the Development Envelope. As the proposed mine pit will not dissect any significant ecological corridor, fragmentation of fauna habitat will not occur.

TABLE 7-3: FAUNA HABITATS TO BE CLEARED WITHIN THE DEVELOPMENT ENVELOPE

HABITAT TYPE	TOTAL AREA WITHIN DEVELOPMENT ENVELOPE (ha)	AREA TO BE CLEARED FOR THE PROPOSAL (ha)	PERCENTAGE OF TOTAL HABITAT TO BE CLEARED (%)
Woodlands and Forests	56.38	8.68	15.40
Cleared Pasture	95.59	87.03	91.05

7.4.2 Trenching for Drains and the Presence of Artificial Water Bodies

The presence of drains (requiring trenches) and the other artificial water bodies on site (SEPs, drop out pond, PWP and open cut drains) may attract native fauna, entrapping animals, possibly resulting in death as a result of drowning. Artificial water bodies may also attract introduced fauna that rely on artificial water bodies for drinking.

As there are existing artificial water sources in the vicinity of the Proposal, including stock dams, some of the above impacts may already be occurring. The provision of artificial water bodies may increase these impacts. To minimise the potential impacts of artificial water bodies and drains on fauna Doral will:

- Design the site as to reduce accessibility to most artificial water sources and drains;
- If artificial ponds or drains are directly adjacent to native vegetation then use fencing to exclude larger animals;
- Prevent overflow of artificial waterbodies and drains in dry conditions;
- Use fauna deterrent devices such as high visibility material flapping over water bodies;
- Non-slippery sides to ponds/drains and/or egress points so that animals which enter the artificial waterbody may be able to escape.

7.4.3 Redistribution of Surface Water Flows

Redistribution of surface water flows around the mine and its infrastructure is unlikely to alter fauna habitat as all native fauna habitat is located upstream of the mine and associated infrastructure.

7.4.4 Dewatering Activities

Groundwater flow modelling by PB (2014a) indicates that no drawdown will occur in the superficial aquifer south of the proposed mine pits (i.e. within State Forest sub-area). Drawdown of the Mowen Member will be less than 1m within the State Forest sub-area and does not extend beyond the boundary of the mine pits. Vegetation outside of the proposed mine pits will therefore not be impacted by dewatering activities.

The potential indirect impacts of dewatering activities on groundwater-dependent vegetation are discussed in detail in Section 8.3.

7.4.5 Changes to Fire Regime from Introduced Ignition Sources

The construction and operation of the proposal may increase the risk of accidental fire. Fire will result in the loss fauna habitat and death to some individuals. Fire risk will be managed through the implementation of a Fire Management Plan which will include a fire response procedure.

7.4.6 Increased Predation

Some fauna species (particularly smaller mammals) are sensitive to predation by foxes and feral cats. Foxes and feral cats may increase in abundance around the proposed minesite from an increase in the abundance of rodents, access to waste/scraps and/or from feeding by personnel. Waste management procedures will be implemented by Doral to ensure that fauna have no access to scraps or rubbish.

7.4.7 Light and Noise Emissions

Light and noise emissions are all likely to increase as a result of mining activities. The impacts of these emissions on fauna are difficult to predict and therefore a precautionary approach will be adopted and emissions will be reduced as far as practicable. A Noise Management Plan will be developed and implemented to minimise noise emissions and impacts. Further details of noise management is provided

in Sections 10.5. Lighting will be directed onto construction and operational areas and will be in accordance with Australian Standard *AS4282-1997 Control of the obtrusive effects of outdoor lighting*.

7.4.8 Spread of Dieback and Weeds

Further detail of the potential impacts of the spread of dieback and weeds is discussed in Section 10.3.

7.4.9 Impacts of Vehicle Movements

Clearing of native vegetation within the State Forest sub-area by machinery prior to mining is likely to result in an almost unavoidable impact on resident fauna, particularly on less mobile species. The construction and operation of the Proposal will result in an increase in vehicle movement to and from the site. Vehicle movements may result in the loss of individual fauna, especially less-mobile species, from vehicle strikes.

Some loss of fauna may occur as a result of these activities, however mitigation measures will be implemented to ensure that impacts to fauna are minimised. Isolated deaths of individual fauna are not expected to affect the distribution or conservation status of any fauna species.

Mitigation measures will include:

- Pre-clearing Surveys;
- Redistricted speed limits on access roads;
- Education of contractors during inductions and regular toolbox meetings.

7.4.10 Impacts to Fauna of Conservation Significance

The potential impacts to fauna of conservation significance and their habitats known to occur or considered likely to occur within the Development Envelope (as identified in Table 7-2) is outlined in Table 7-4 below. Additional information regarding species listed as Threatened under the EPBC act can be found in Section 11.

TABLE 7-4: POTENTIAL IMPACT ON TERRESTRIAL FAUNA OF SIGNIFICANCE KNOWN OR LIKELY TO OCCUR WITHIN THE DEVELOPMENT ENVELOPE

SPECIES	HABITAT TO BE DISTURBED (ha)	POTENTIAL IMPACT
Mammals		
Western Brush Wallaby <i>Macropus irma</i>	8.68	As this species optimum habitat is open forest or woodland the Proposal will result in the loss of 8.68ha of Western Brush Wallaby habitat. The impacts to this species are however, unlikely to be significant given the small impact area and the large areas of adjoining habitat.
Quenda <i>Isodon obesulus fusciventer</i>	8.68	This species was not recorded in the area of main impact and is possibly absent from most of this area due to relatively sparse groundcover. However there is potential for the loss of some habitat and death of individuals within the State Forest sub-area.

SPECIES	HABITAT TO BE DISTURBED (ha)	POTENTIAL IMPACT
Southern Brush-tailed Phascogale <i>Phascogale tapoatafa</i> ssp	8.68	The Proposal will result in the loss of 8.68ha of potential Southern Brush-tailed Phascogale habitat. There is the potential for individuals to be killed or injured during clearing operations.
Reptiles		
Coastal Plains Ctenotus <i>Ctenotus ora</i>	8.68	The Proposal will result in the loss of 8.68ha of Coastal Plains Ctenotus habitat. The impacts to this species are however, unlikely to be significant given small impact area and the large areas of adjoining habitat.
Birds		
Black Cockatoos Given the similar habitat requirements the following species have been considered together: <ul style="list-style-type: none"> The Forest Red-tailed Black-Cockatoo (<i>Calyptorhynchus banksii naso</i>); Baudin's Black-Cockatoo (<i>Calyptorhynchus baudinii</i>); and Carnaby's Black-Cockatoo (<i>Calyptorhynchus latirostris</i>). 	8.68	Loss of foraging, breeding and roosting opportunities will occur as a result of the Proposal. The Proposal will result in clearing 8.68ha of Black-Cockatoo foraging and breeding habitat. This habitat is known to contain 110 identified Black-Cockatoo habitat trees (i.e. DBH >50cm) and one night roosting sites. As such the Proposal is regarded as having a "high risk of significant impact" using referral guidelines issued by DSEWPac (2012a).
Rainbow Bee-eater <i>Merops ornatus</i>	8.68	No significant impact on this species is anticipated as individuals' present at any one time are unlikely to represent a substantial proportion of the population. It can be expected to continue to utilise the area, if it does now, despite the Proposal going ahead.
Great Egret <i>Ardea ibis</i>	87.03	No significant impact on this species or its preferred habitat will occur. This species would be an infrequent, temporary visitor only, possibly utilising paddocks for foraging at times, in small numbers. There is no potential for breeding on-site and the Great Egret would not utilise forested areas for any purpose.
Cattle Egret <i>Ardea ibis</i>	87.03	No significant impact on this species or its preferred habitat will occur. This species would be an infrequent, temporary visitor only, potentially utilising the manmade dams and possibly paddocks for foraging at times, in small numbers. There is no potential for breeding on-site and the Great Egret would not utilise forested areas for any purpose.

7.4.11 Impacts on Short Range Endemic Species

It is considered unlikely that the Proposal will significantly impact SRE populations given that:

- No SRE species were found during the field survey;
- The absence of geomorphological boundaries or subdivisions that may represent isolating mechanisms for potential SRE invertebrate species.

7.4.12 Cumulative Impacts

For the purposes of the impact assessment Doral have defined cumulative impact as 'a permanent irreversible impact that occurs simultaneously with other local mineral sands projects and their associated impacts'.

Doral have considered the cumulative impacts to fauna and fauna habitats, based on available public data and in the context of the local and regional environment. Doral are limited in the assessment of cumulative impacts given the lack of data available publically.

No cumulative impacts are predicted to occur given:

- No other projects are known to be located nearby in the Whicher Scarp soil-landscape system;
- The Proposal will only result in the temporary reduction in the availability of foraging, breeding and roosting habitat for three conservation significant Black Cockatoo species;
- The regional cumulative impacts of clearing 8.68ha of the Whicher Scarp soil-landscape system represents only 0.09% of the area remaining of the Whicher Scarp soil-landscape system and does not significantly reduce its extent;
- Rehabilitation of mined areas and a proposed conservation offset will provide an overall net gain in Black-Cockatoo foraging, breeding and roosting habitat.

7.5 MANAGEMENT MEASURES AND PERFORMANCE STANDARDS

7.5.1 Pre-clearing Surveys

Pre-clearing fauna surveys will be conducted within the State Forest sub-area prior to any ground disturbance. Fauna present in the clearing area will be encouraged to move to nearby native vegetation, or captured and relocated in adjacent vegetation. The capture/relocation will be undertaken by a qualified fauna handler with the appropriate licences in place.

7.5.2 Fauna Management Plan

Doral will develop and implement a Fauna Management Plan to address potential impacts to fauna of conservation significance and their associated habitat. The Fauna Management Plan will include the following key management actions:

- Development and implementation of specific clearing procedures to minimise impacts to fauna and fauna habitats. This will include demarcation of cleared areas, pre-clearing surveys (see above) and authorisation requirements;
- Staged clearing where practical. This involves the initial clearing of vegetation excluding habitat trees and any significant habitat areas identified in the pre-clearing surveys. These areas are left overnight allowing tree—dwelling fauna and /or fauna occurring in habitat areas to escape overnight to surrounding bushland;

- Clearing activities will be conducted between January and May to avoid the breeding season of fauna of conservation significance, particularly Black-Cockatoos;
- A suitably qualified fauna spotter/carer will be on site during clearing operations to conduct daily checks of vegetation to be cleared and retrieve fauna if necessary. The fauna spotter will be responsible for all activities related to the protection and welfare of individual fauna;
- Vehicle speeds on site will be restricted. All collisions with fauna are to be reported and recorded through Doral's Hazard and Incident Management System (DHIMS);
- Native fauna injured during clearing or normal site operations should be taken to a designated veterinary clinic or a DPaW nominated wildlife carer;
- No dead, standing or fallen timber will be removed from site unnecessarily. Logs and other debris resulting from land clearing will be used to enhance fauna habitat in untouched and rehabilitated areas;
- To minimise the potential impacts of artificial water bodies and drains on fauna Doral will:
 - Design the site as to reduce accessibility to most artificial water sources and drains;
 - If artificial ponds or drains are directly adjacent to native vegetation then use fencing to exclude larger animals;
 - Prevent overflow of artificial waterbodies and drains in dry conditions;
 - Use fauna deterrent devices such as high visibility material flapping over water bodies;
 - Non-slippery sides to ponds/drains and/or egress points so that any animals that enter the artificial waterbody may escape; and
 - Any trenching required for services or drains should be kept open only for as long as necessary and suitable escape ramps provided.
- All staff working on site will be educated with regards to protected fauna;
- Weapons and pets will not be permitted on site;
- Wastes will be managed appropriately to ensure that fauna have no access to scraps or rubbish;
- Lights at night will be directed towards construction and operation activities and will be in accordance with *AS4282-1997 Control of the obtrusive effects of outdoor lighting*.

Environmental targets and performance indicators will be developed to ensure fauna management can be monitored and audited.

7.5.3 Rehabilitation Management Plan

Doral will develop and implement a Rehabilitation Management Plan to address rehabilitation of disturbed areas. Details of proposed rehabilitation are included in the Mine Closure Plan (Appendix 12).

7.5.4 Other Management Plans

Doral will also develop and implement the following management plans:

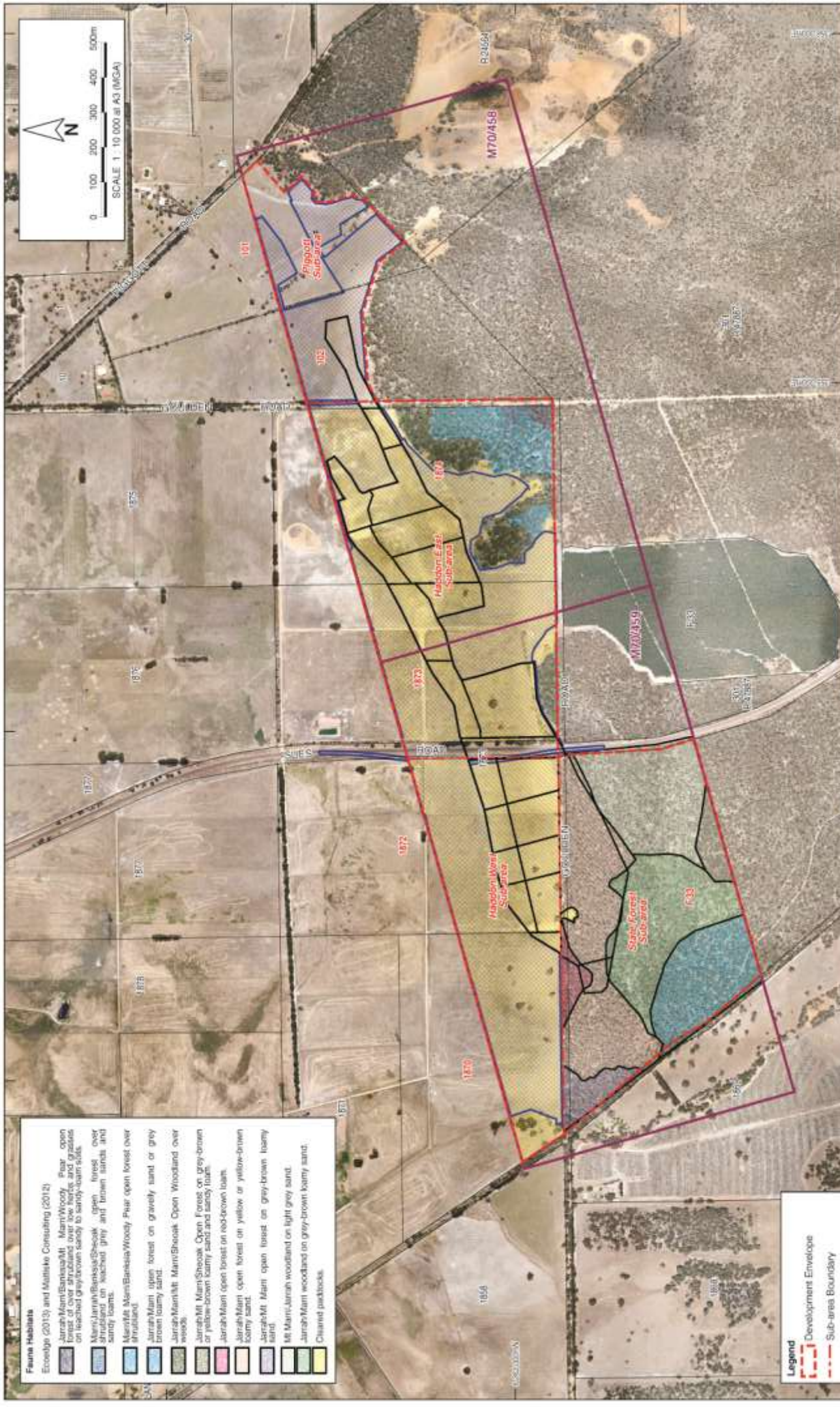
- A Fire Management Plan;
- A Dieback Management Plan (refer to Section 10.3.4);
- A Noise Management Plan (refer to Section 10.5.6).

7.6 PREDICTED ENVIRONMENTAL OUTCOMES

After mitigation measures have been applied, the Proposal is expected to result in the following outcomes in relation to terrestrial fauna and their habitats:

- Approximately 95.71ha of terrestrial fauna habitat will be disturbed by the Proposal of which 87.03ha is cleared and considered of little value to fauna and 8.68ha is considered of value to several species of conservation significance;
- It is likely that the Proposal will result in a temporary reduction in the availability of foraging, breeding and roosting habitat for three conservation significant Black-Cockatoo species. However, there is predicted to be an overall net gain in Black-Cockatoo foraging, breeding and roosting habitat as a consequence of rehabilitation of mined areas in combination with long-term conservation offsets proposed (refer to Section 12);
- It is likely that the Proposal will result in a temporary reduction in the availability of fauna habitat for the Coastal Plains Skink. The impacts to this species are however, unlikely to be significant given the small area impacted and the large areas of adjoining habitat. In addition, the site rehabilitation and ecological offsets proposed will result in a long-term overall net increase in habitat for this species’
- It is likely that the Proposal will result in a temporary reduction in the availability of fauna habitat for mammals such as the conservation significant Western Brush Wallaby and Southern Brush-tailed Phascogale on a local scale. Given the site rehabilitation and ecological offsets proposed, significant impacts to these species are unlikely and an overall net increase in habitat is predicted;
- It is likely that the Proposal will result in a temporary reduction in the availability of fauna habitat for those species that live in the area and have specific habitat requirements. However, these impacts are considered to be at a local scale and of a temporary nature as site rehabilitation and ecological offsets (refer to Section 12) will result in a long-term overall net increase in fauna habitat and fauna habitat values;
- Impact to SRE species is not expected to occur as a result of the Proposal as it is unlikely that any of the invertebrate taxa encountered would be restricted to the locality of the Development Envelope due to the absence of geomorphological boundaries or subdivisions that may represent isolating mechanisms for potential SRE invertebrate species;
- No fauna of conservation significance (listed under the WC Act or EPBC Act) will cease to exist or have its conservation status affected as a result of the Proposal;
- No Priority species as listed by DPaW will cease to exist or have its priority status affected as a result of the Proposal;
- Significant regional impact to fauna is unlikely as only a small proportion of similar woodland and forest habitat will be impacted. Similar habitat occurs extensively outside the Development Envelope.

Doral considers that the mitigation of impacts through the implementation of the above listed key management actions (via the Fauna Management Plan), the EPA’s objective to maintain representation, diversity, viability and ecological function at the species, population and community level will be met.

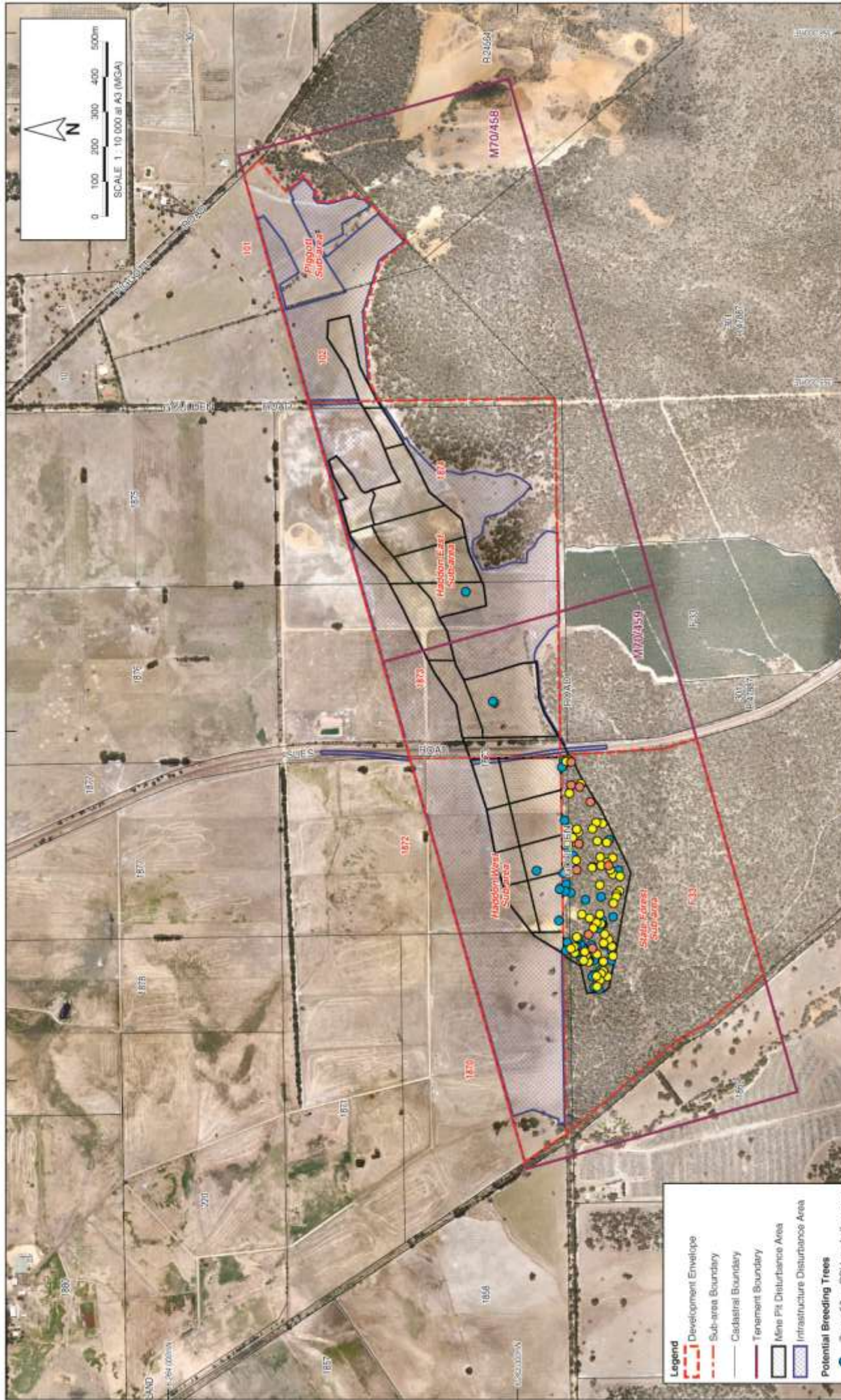


Doral		Public Environmental Review Proposed Yoongarillup Mineral Sands Project	
Fauna Habitats	Scale: 1:10 000	Projection: Australia MG494 (50)	Sheet Size: A3
Figure 7-1		Date: 07/03/2014	

- Fauna Habitats**
- EcoEdge (2013) and Matiske Consulting (2012)
- Jarrah/Marri/Banksia/Mt. Mann/Woody Pear open forest of over shrubland over low heath and grasses on leached grey-brown sandy to sandy-loam soils.
 - Mann/Jarrah/Banksia/Shoak open forest over shrubland on leached grey and brown sands and sandy loams.
 - Mann/Mt. Mann/Banksia/Woody Pear open forest over shrubland.
 - Jarrah/Mann open forest on gravelly sand or grey brown loamy sand.
 - Jarrah/Mann/Mt. Mann/Shoak Open Woodland over weeds.
 - Jarrah/Mt. Mann/Shoak Open Forest on grey-brown or yellow-brown loamy sand and sandy loam.
 - Jarrah/Mann open forest on red-brown loam.
 - Jarrah/Mann open forest on yellow or yellow-brown loamy sand.
 - Jarrah/Mt. Mann open forest on grey-brown loamy sand.
 - Mt. Mann/Jarrah woodland on light grey sand.
 - Jarrah/Mann woodland on grey-brown loamy sand.
 - Chained jackboots.

- Legend**
- Development Envelope
 - Sub-area Boundary
 - Cadastrial Boundary
 - Tenement Boundary
 - Mine Pit Disturbance Area
 - Infrastructure Disturbance Area

CADASTRIAL SOURCE: Landgate, February 2012
 TENEMENT SOURCE: Mineral Sands Project, from December 2008
 TENEMENT SOURCE: Department of Water and Fisheries, June 2011



Legend

- Development Envelope
- Sub-area Boundary
- Cadastral Boundary
- Tenement Boundary
- Mine Pit Disturbance Area
- Infrastructure Disturbance Area

Potential Breeding Trees

- Tree >50cm DBH, no hollow seen
- Tree >50cm DBH, one or more hollows seen
- Tree >50cm DBH, one or more hollows seen possibly suitable for a Black Cockatoo

Doral

Black Cockatoo Potential Breeding Trees

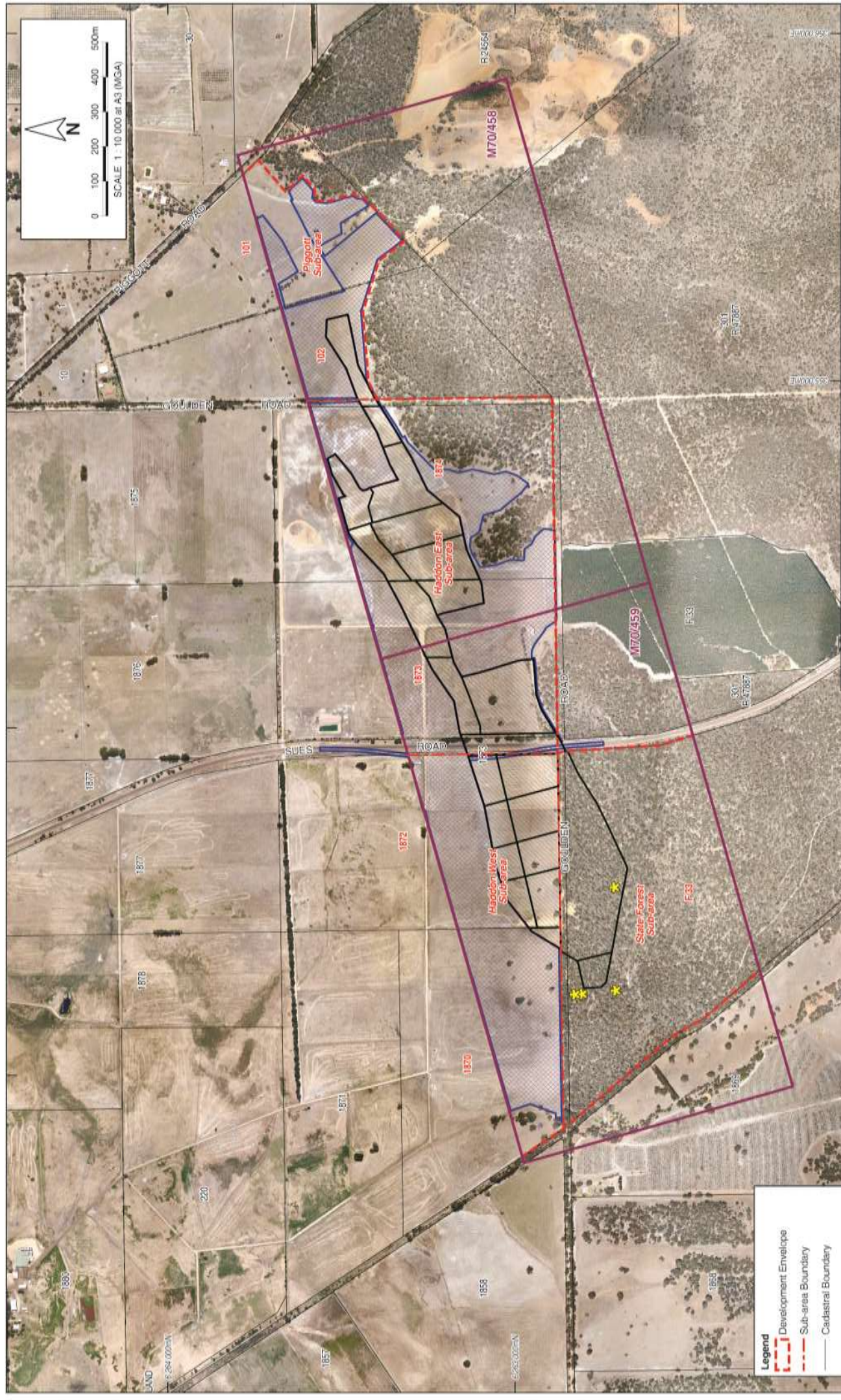
Scale: 1:10 000
Projection: Australia MGA94 (50)
Sheet Size: A3

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Figure 7-2

Date: 07/03/2014

CADASTRAL SOURCE: Landgate, February 2012
AERIAL PHOTOGRAPH SOURCE: NewMap, from December 2008
TENEMENT SOURCE: Department of Mines and Petroleum, June 2011



Legend

- Development Envelope
- Sub-area Boundary
- Cadastral Boundary
- Tenement Boundary
- Mine Pit Disturbance Area
- Infrastructure Disturbance Area
- Roosting Tree Location

CADASTRAL SOURCE: Landgate, February 2012
 AERIAL PHOTOGRAPHY SOURCE: GeoMap, 10th December 2009
 TENEMENT SOURCE: Department of Mines and Petroleum, June 2011

Public Environmental Review
Proposed Yoongarillup Mineral Sands Project

Black Cockatoo Roosting Trees

Scale: 1:10 000	Projection: Australia MGA94 (50)	Sheet Size: A3
Figure 7-3		Date: 07/03/2014

8 HYDROLOGICAL PROCESSES

8.1 RELEVANT ENVIRONMENTAL OBJECTIVES, LEGISLATION, POLICIES, GUIDELINES, STANDARDS AND PROCEDURES

8.1.1 EPA Objective

To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.

8.1.2 Legislation, Policy and Guidelines

The key legislation relating to the abstraction of groundwater for the Proposal is the RIWI Act. The key legislation to prevent the pollution of water is the EP Act. The Proposal will require environmental approval / licensing under both these Acts. Other legislation (including subsidiary legislation) relevant to the Proposal, but not requiring environmental approvals, includes:

- *Contaminated Sites Act 2003 (WA)*;
- *Country Areas Water Supply Act 1947 (WA)*;
- *Dangerous Goods Safety Act 2004 (WA)*

Policies, standards and guidelines relevant to the Proposal are:

National

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000);
- Australian Standard® Water Quality – Sampling – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples, (AS5667.1:1998), Standards Australia, Sydney, NSW;
- Guidelines for Groundwater Protection in Australia (ARMCANZ & ANZECC, 1995);
- Leading practice sustainable development program for the mining industry – Water management (DRET, 2008);
- Mining position statement (National Water Commission, 2010);
- National Water Quality Management Strategy (NHMRC, 1994);
- National Environment Protection (Assessment of Site Contamination) Measure (NEPC, 2013).

State

- State Water Quality Management Strategy (Government of Western Australia, 2004);
- Western Australian Water in Mining Guideline: Draft for Public Comment (DoW, 2012);
- Operational Policy 5.08 – Use of operating strategies in the water licensing process (DoW, 2011);
- Statewide Policy No. 5 – Environmental water provisions policy for Western Australia (DoW, 2000);
- Operational Policy 5.12 – Hydrogeological reporting associated with a groundwater well licence (DoW, 2009);
- Strategic Policy 2.09 – Use of mine dewatering surplus (DoW, 2013);

- Water Quality Protection Guidelines:
 - No.1. Water quality management in mining and mineral processing: An overview (DoW, 2003).
 - No.2. Mining and Mineral Processing – Tailings facilities (DoW 2003).
 - No.4. Mining and Mineral Processing – Installation of mine site groundwater monitoring wells (DoW, 2003).
 - No.5. Mining and Mineral Processing – Minesite water quality monitoring (DoW, 2003).
 - No.6. Mining and Mineral Processing – Minesite stormwater (DoW, 2003).
 - No.7. Mining and Mineral Processing – Mechanical servicing and workshop facilities (DoW, 2003).
 - No.10. Mining and Mineral Processing – Above ground fuel and chemical storage (DoW, 2002).
 - No.11. Mining and Mineral Processing – Mine dewatering (DoW 2002).
- Water Quality Protection Notes:
 - No.10 – Contaminant spills – emergency response (DoW 2006).
 - No.28 – Mechanical servicing and workshops (DoW 2013).
 - No.29 – Mobile mechanical servicing and cleaning (DoW 2013).
 - No.30 – Groundwater monitoring wells (DoW 2006).
 - No.51 – Industrial wastewater management and disposal (DoW 2009).
 - No.65 – Toxic and hazardous substances – storage and use (DoW 2006).
 - No.68 – Mechanical equipment washdown (DoW 2013).

8.2 EXISTING ENVIRONMENT

The following hydrogeological investigations and hydrology assessments were undertaken by Parsons Brinckerhoff Pty Ltd and provided in:

Appendix 8-B	<i>Yoongarillup hydrogeological investigations and groundwater modelling report</i> (PB, 2014a);
Appendix 8-C	<i>Surface water assessment for the proposed Yoongarillup Mineral Sands Project</i> (PB, 2014b);
Appendix 8-D	<i>Yoongarillup Site Water Balance</i> (PB ,2014c).

The findings of these reports are described in detail below.

8.2.1 Water Balance

The simple site water balance was developed to establish a monthly water balance for the life of mine (PB, 2014c). The wet concentration plant processing operations have the highest demand for water; based on an average mining rate of 200TPH, a net water demand of 180TPH per 200TPH of ore is required over

the life of mine. This equates to a water demand of 4.32 megalitres (ML) per day, approximately 131ML per month and approximately 1577ML (1.6GL/yr).

Water will be drawn directly from the PWP. The main inputs of water to the PWP will include:

- Recycled process water;
- Groundwater inflows pumped from the active mining cells (i.e. pit dewatering);
- Site runoff from impervious areas, including access road, building / structures and hardstands;
- Direct rain that falls over the surface of the PWP;
- Abstraction from production bores screened in the Yarragadee aquifer.

The outputs from the PWP are:

- Use of water in the wet concentration plant process;
- Evaporation.

The PWP will be constructed to hold a maximum of 113ML, but will operate at 80% capacity. This will allow 21 days of water demand to be held at any time during the life of mine, therefore water will be secure for this period at all times.

Based on the simple water balance (PB, 2014c)(Appendix 8-D) 2ML (1.5%) per month of the site water demand will be met from groundwater inflows and site runoff in a wet year. It is likely that in a dry year there will be little or no water available from site, as any rainfall that occurs will be lost to evaporation (PB, 2014c). Therefore production bores screened in the Yarragadee aquifer, will be relied upon to provide up to 100% of the site water demands over the life of mine. Doral propose to secure water for the Proposal through the legislative instruments of the RIWI Act. An application for a licence to abstract 1.6GL/yr from the Yarragadee aquifer has been submitted to the DoW.

8.2.2 Groundwater Modelling

Parsons Brinckerhoff prepared a numerical groundwater flow model (PB, 2014a) to assess the dewatering requirements and groundwater drawdown associated with the development of the Proposal. Drawdown predicted by modelling represents the 'worst case' expected (i.e. maximum drawdown at any time), based on the available water level data, predicted dewatering rates and the assumption that groundwater levels are passively dewatered to the base of mine pits. The predicted extent of drawdown is summarised below:

- No mining related drawdown is predicted in the Vasse Member (Leederville aquifer) and Yarragadee aquifer;
- Within the Superficial aquifer the predicted 1m drawdown contour is expected to extend to approximately 0.35km from the pit boundary in a northerly direction;
- Within the Mowen Member the predicted 1m drawdown contour is expected to extend to approximately 0.2km from pit boundary in a northerly direction;
- Predicted drawdown in both the Superficial aquifer and Mowen Member to the south of the mine is limited such that the 1m drawdown contour is not expected to extend beyond the pit boundary;
- Abstraction from the proposed Yarragadee production wells will cause localised groundwater drawdown in both the Yarragadee aquifer and the Vasse Member (Leederville aquifer). A maximum drawdown of 1.3m adjacent to the production wells is predicted with the 1m drawdown contour extending up to 90m from the production bores in the Yarragadee Aquifer and up to 80m in the Vasse Member.

Recovery to 90% of groundwater levels is expected to occur within 36 months of mine closure assuming progressive rehabilitation is undertaken.

8.2.3 Surface Water Assessment

A surface water assessment (PB, 2014b)(Appendix 8-C) was undertaken to assess how the proposed mine pits will impact on surface water flows, estimate the surface runoff yield of the local catchment in which the proposed mine pits will be located, and assess the reduction in flow volumes down gradient of the proposed mine pits. PB (2014b) have based the surface water assessment around the mine schedule, which assumes progressively backfilling to minimise the area of open pit, to minimise disruption to surface water flow.

Area of Surface Water Predicted to be Intercepted by Mine Pits

Based on the modelling, the pits will intercept 0.4km² (1%) of the Vasse River sub-catchment. Within the Vasse River sub-catchment (34.48km²) the southern section within the Whicher Range, reported as the 'Foothills sub-catchment' is 10.79km², herein referred to as the Foothills section. The 1% of area affected by the mine is within the Foothills section of the Vasse River sub-catchment. As the Foothills section is smaller, the pits and upstream catchment of the pits will intercept a surface water area of 2.76km² which is 3.7% of the Foothills section. Therefore 34.08km² (99%) of the Vasse sub-catchment and 10.39km² (96.3%) of the Foothills section will be unaffected by the Proposal.

Volume of Surface Water Predicted to be Intercepted by Mine Pits

The Foothills section is estimated to yield between 1.01 and 1.47 GL/yr and contributes between 57% and 82% of the total Vasse River sub-catchment volume (Table 8-1).

The volume of surface water yield of the Foothills section is estimated to be reduced by up to:

- 0.05GL/yr (3%) with diversions around pits reducing the contribution to the Vasse River sub-catchment to between 0.96 GL/yr (54%) and 1.42 GL/yr (79%);
- 0.36GL/yr (25%) without diversions around pits reducing the contribution to the Vasse River sub-catchment to between 0.741GL/yr (42%) and 1.11 GL/y (62%).

TABLE 8-1: YIELDS WITH AND WITHOUT DIVERSIONS AROUND MINE PITS

YIELD	VASSE RIVER SUB-CATCHMENT	FOOTHILLS SECTION OF THE VASSE RIVER SUB-CATCHMENT	
		ESTIMATE BASED ON AVERAGE RUNOFF COEFFICIENTS (1987 – 2012)	ESTIMATE BASED ON AVERAGE RUNOFF COEFFICIENTS (2006 – 2009)
Annual runoff yield (GL)	1.78	1.01	1.47
Yield of the Vasse River sub-catchment	100%	57 %	82 %
WITH PIT DIVERSIONS			
Predicted reduction in yield	1.89%	0.05 GL – 3%	0.05 GL – 3%
Predicted annual runoff yield (GL/yr)	1.78	0.96	1.42
Yield of the Vasse River sub-catchment	100%	54 %	79%
WITHOUT PIT DIVERSIONS			
Predicted reduction in yield	13.03%	0.36 GL – 25.55%	0.36 GL – 25.55%
Predicted annual runoff yield (GL/yr)	1.78	0.741	1.11
Yield of the Vasse River sub-catchment	100%	42%	62%

8.3 POTENTIAL IMPACTS

Potential impacts from the Proposal on hydrological processes are:

- Short-term dewatering of mine pits and associated drawdown of the water table, which may affect:
 - Water availability at privately-owned bores;
 - Native vegetation within the State Forest sub-area and Whicher National Park.
- Short-term abstraction of water from the Yarragadee aquifer, which may affect other users of the Yarragadee aquifer and the overlying Leederville Aquifer;
- Discharge of water in emergency situations, which may have a localised adverse effect on the receiving environment;
- A reduction in surface water yield in the Vasse River sub-catchment;
- Hydrological and physico-chemical impacts on the Vasse-Wonnerup System Ramsar Wetland.

8.4 ASSESSMENT OF POTENTIAL IMPACTS

8.4.1 Short-Term Dewatering of Mine Pits and Associated Drawdown of the Water Table

Dewatering of mine pits and associated drawdown of the water table will occur in a staged approach, with mine 'blocks' being dewatered as per the mining schedule (Table 3-3), subject to receipt of environmental approvals. Dewatering involves lowering the hydraulic head of the aquifer to the base of the open-cut mine pit, to allow dry mining techniques to be carried out within the pit.

Dewatering of mining areas occurs through the construction of a sump at the deepest point of the pit. The rest of the pit is then open drained to this sump with water is pumped from the sump to the drop out dam (either directly or via an open drain and then gravity fed). Water then flows from the drop out dam to the PWP, where it is utilised in processing operations.

The majority of blocks will be dewatered for between one and seven months, with the exception of block 24. This is a conservative estimate of the length of dewatering as in some blocks the removal of overburden and ore above the water table will not require dewatering. Pits will be progressively backfilled and complete recovery of the groundwater table is expected within 36 months of mine closure (PB, 2014a).

Mine pit dewatering will only affect the Superficial and Mowen Member as shown in Figure 8-1 and Figure 8-2. No dewatering of the Vasse Member (Figure 8-3), which hosts the Leederville Aquifer, or the Yarragadee Aquifer (Figure 8-4) will occur, and no mining related impacts to these aquifers are expected (PB, 2014a).

The predicted impacts to the surrounding environment from drawdown of the Superficial Aquifer and Mowen Member are described below.

8.4.2 Predicted Drawdown on Other Aquifer Users

Of the 48 registered private bores located within a 5km radius of the mine pits, three bores may experience temporary minor drawdown (< 1 m) during dewatering of the mine pits (PB, 2014a). The location of these bores (20005670, 20005669 and 20005671) is shown on Figure 8-1. Bores 20005670 and 20005671 will be removed to allow for mining, as agreed to by the owners during consultation for the Proposal. The remaining bore (20005669) will be supplied with make-up water if affected as agreed to with the bore owner. No impacts are expected to other aquifer users from drawdown of the water table during dewatering of the mine pits.

8.4.3 Predicted Impact to Native Vegetation

Groundwater dependent vegetation (i.e. phreatophytic plants) can be detrimentally impacted by changes in groundwater levels (Canham, 2011). Changes in the water table can sever the functional connection between phreatophytic plants and the water table, resulting in plants no longer being able to meet their water requirements (Mahoney and Rood, 1991; Naumburg *et al.*, 2005 as cited in Canham 2011). This may result in water stress, such as low predawn water potentials, reduced stomatal conductance, and eventually crown and plant death (Scott *et al.*, 1999; Sperry & Hacke 2002; Cooper *et al.*, 2003 as cited in Canham, 2011).

The risk of indirect impacts to native vegetation within the State Forest sub-area and the Whicher National Park has been assessed through detailed numerical groundwater flow modelling by PB (2014a). 'Worst-case scenario' groundwater flow modelling by PB (2014a) predicts that:

- A maximum drawdown of 1m will occur within the Superficial Aquifer (Figure 8-1);

- No drawdown of the superficial aquifer south of the mine (i.e. in the State Forest sub-area). The drawdown depends on the intersection of saturated material. The modelled steady state water table suggests that the Superficial aquifer south of the mine is mainly unsaturated, therefore, no drawdown will result;
- Drawdown of the Mowen Member will be less than 1m within the State Forest sub-area (Figure 8-5);
- Drawdown will not extend beyond the boundary of the mine pits (Figure 8-5);
- No drawdown of the Vasse Member (Figure 8-3).

No adverse impacts to groundwater dependent vegetation within the State Forest sub-area or Whicher National Park are expected from groundwater drawdown during short-term dewatering of mine pits as:

- The Whicher National Park is located 300 m from any drawdown impacts;
- Vegetation within the State Forest sub-area is likely to access water via the Leederville aquifer and not the superficial aquifer (Figure 2-2). The Leederville aquifer is predominantly hosted by the sandy beds of the Vasse Member which will not be affected by drawdown;
- Fluctuations of less than 1m in the water table as a result of mine dewatering are similar to the seasonal fluctuation the forest experiences naturally. Monitoring of groundwater levels within and adjacent to the State Forest sub-area show seasonal fluctuations between 0.6 m and 5.5 m (Appendix 8-B).

8.4.4 Short-Term Abstraction of Water from the Yarragadee Aquifer, Which May Affect Other Users of the Yarragadee Aquifer

No impacts are expected to other users of the Yarragadee aquifer or overlying aquifers as there are no known bores located within the drawdown cone generated by abstraction of water (PB 2014a). The predicted drawdown cone extends up to 90m from the production bores in the Yarragadee aquifer and up to 80m in the Vasse Member. The nearest known bore to the proposed location of the production bores is over 300m away.

8.4.5 Discharge of Water during Emergency Situations

Discharging water offsite may pollute the receiving environment. Several emergency discharge points have been designated for the Proposal (Figure 8-6). One of these points will be used in the event heavy rainfall and excess groundwater inflow into the PWP causes it to reach capacity. In this instance Doral will undertake a controlled discharge of water rather than have the PWP overflow in an uncontrolled manner. Descriptions of the three options being considered for emergency discharge include:

- a) Excess water will exit the PWP along the return water drain and flow into the cut-off drain north of the wet concentration plant. Water will then be discharged from the proposed location of the 'central emergency discharge' (Figure 8-6) and flow north along a constructed channel off the tenement. It will not be discharged into the paddock dam, rather it will cross under Sues Road (through the existing 600mm culvert) and into the existing paddock drain on the west of Sues Road on Lot 1872 before reaching the exiting roadside drain (Figure 8-6).
- b) Prior to mining block 24 and 25, a cut-off/diversion drain will be constructed in the paddock north of Goulden Road, preventing water entering the mining area. This drain is the proposed location of the 'western emergency discharge' (Figure 8-6). The western emergency discharge point will be used only when there is no capacity in the drop out pond and PWP and when it is not possible to

gravity feed water along the paddock cut-off drain north of blocks 20–14 to the PWP. In this case, water will be discharged from the western emergency discharge location, which will connect to an ephemeral drainage line and flow north into Lot 1870 before reaching the existing roadside drain (Figure 8-6).

- c) The 'eastern emergency discharge' location will discharge excess water into an ephemeral drainage line (Figure 8-6). The eastern emergency discharge will be located at a point between SEP 05 and SEP 06, or further to the east between SEP 06 and SEP 07. Discharged water from either point will flow into the creekline north of SEP 06, running until it intercepts Goulden Road (either from the north or the south depending on the discharge location). Water will flow west within a constructed channel north of Lot 1874 and Lot 1873, then into the paddock drainage network on the same lots before reaching the existing roadside drain (Figure 8-6).

To manage the potential pollution of the receiving environment, Doral will test excess water prior to discharge and adhere to acceptable water quality criteria (as per DER Licence conditions). If excess water does not meet water quality criteria, discharging will cease until measures are implemented to improve the water quality. The process of testing water prior to discharge will be documented in the Emergency Discharge Procedure prepared for the site as part of the update to Doral's EMS.

Should the Proposal receive environmental approval from the Minister for Environment, the mine will require an *Environmental Protection Act 1986* Licence, due to the mine being a prescribed premise under Schedule 1 of the EP Act. It is expected that the granted licence will contain water quality criteria to be met prior to water being discharged in an emergency situation. Evidence of compliance with water quality criteria for each emergency discharge event will be presented in the Annual Environmental Report, provided to the DER for each year of operation.

Consent to use the paddock drains discussed above has been provided by the landowners as part of the consultation process for this PER (Section 4 and Appendix 4).

8.4.6 Reduction in Surface Water Yield in the Vasse River Sub-Catchment

No local waterways (e.g. creeks or rivers) are located in the Development Envelope. No impacts to the Vasse River, Sabina River or Vasse–Wonnerup Estuary are expected. Sheet flow or flow within small gullies (e.g. low-lying ephemeral drainage lines) may occur during periods of heavy rainfall. A surface water assessment (PB, 2014b) (Appendix 8-C) predicted the reduction in yield to the Vasse River sub-catchment from the interception of rainfall runoff. With diversions around mine pits in place, 1.89% of the yield to the Vasse River sub-catchment will be affected by a reduced volume of 0.05GL/yr. The consequence of this surface water reduction is negligible as 98.11% of the yield will still be available in the catchment for use.

Rainfall runoff is generally highest in October, three months after the peak stream flows. The mine pits occupy 1% of the Vasse River sub-catchment, and intercept rainfall runoff from 2.76% of the sub-catchment (up-gradient of the mine pits and the mine pits) (see Figure 2 of PB 2014b). Rainfall falling directly over mine pits will be collected in the pit sump, along with mine pit dewater, and pumped to the PWP. The runoff up-gradient of the mine pits will be diverted using bunding to ephemeral drainage lines located at the proposed western and eastern emergency discharge locations (Figure 8-6) and continue to flow down-gradient within the Vasse sub-catchment.

8.4.7 Hydrological and physico-chemical impacts on the Vasse-Wonnerup System Ramsar Wetland

The ESD requested consideration of the impacts of groundwater drawdown on the Vasse-Wonnerup System Ramsar wetland. However given the Ramsar wetland is over 14km away from the Development Envelope (Figure 1-1) and the maximum extent of drawdown north is predicted to be approximately 350 m, the Vasse-Wonnerup System Ramsar wetland will not be affected by dewatering of mine pits.

The proposed locations for emergency discharge of water are shown on Figure 8-6. The volume of water will vary depending on the capacity of the PWP and return water lines at the time of the rainfall event, and depending on the amount of water required to be discharged at that time. Emergency discharge of water will not occur until strict water quality criteria are met (see Section 8.4.5). The volume of water discharged will be recorded. Once discharged, water will move through ephemeral drainage lines (paddock drains) north of the mine, where water is likely to sit until it evaporates. Paddock drains are separate to major diversion drains in the region therefore it is unlikely for the discharged water to move into the Vasse-Wonnerup System Ramsar Wetland (see Figure 8-6). Therefore no hydrological or physio-chemical impacts to the Vasse-Wonnerup System Ramsar Wetland are expected as a result of the Proposal.

8.4.8 Cumulative Impacts

For the purposes of the impact assessment Doral have defined cumulative impact as ‘a permanent irreversible impact that occurs simultaneously with other local mineral sands projects and their associated impacts’.

Doral have considered the cumulative impacts to hydrological processes, based on available public data and in the context of the local and regional environment. Doral are limited in the assessment of cumulative impacts given the lack of data available publically on the drawdown extents and timing of drawdown from existing and future mineral sands projects.

No cumulative impacts are predicted to occur given:

- Groundwater drawdown from the proposed mine pits is limited to within the mining tenements, and does not overlap any other mine sites;
- The hydrogeology is likely to be different locally and regionally (i.e. presence of aquatards and non-confined layers) and impacts to aquifers are likely to be different;
- Groundwater drawdown is not permanent (i.e. three years duration) and is reversible once mining ceases;
- No mineral sands mines are located within the Vasse River sub-catchment which could add to the reduction in yield of surface water in the sub-catchment;
- Management measures will be implemented to minimise potential impacts.

8.5 MANAGEMENT MEASURES AND PERFORMANCE

Doral has an existing EMS which is implemented for its Dardanup Mine (including extensions to the mine). The EMS will be updated to include the Yoongarillup Mineral Sands Mine, which will include the following management plans and procedures:

- Groundwater Operating Strategy;
- Surface Water Management Plan;

- Emergency Discharge – Pre-release of Discharge Procedure;
- Emergency Discharge –Discharge Monitoring Procedure;
- Groundwater Monitoring Procedure;
- SEP Construction and Operation Procedure;
- Hydrocarbon Management Procedure;
- Spill Management Procedure.

The key management measures to reduce impacts to hydrological processes are:

- Preparation and implementation of plans and procedures relevant to the management of groundwater and surface water (as listed above);
- Supply affected bore owners with supplementary water as required;
- Pits will be backfilled as soon as possible following cessation of mining;
- Following the first six months of dewatering, the groundwater model will be calibrated with the available groundwater monitoring data to verify the accuracy of the model and provide greater confidence in model predictions. If re-calibration of the model indicates drawdown will extend further than the initial extents predicted, than Doral will reassess the potential impacts of the drawdown, in consultation with relevant stakeholders and adapt management of the dewatering accordingly;
- Groundwater monitoring bores will be installed around SEPs, screened within the Superficial aquifer to monitor any leakage;
- Volumes of water discharged from the mine site will be recorded during emergency discharge events;
- Placement of production bores to avoid impacts to other Yarragadee aquifer users;
- Volumes of water abstracted from the Yarragadee aquifer will be recorded monthly; and
- Reporting in accordance with conditions of the approvals documents (Ministerial Statement, RIWI Act licences, DER Licence to Operate etc.).

Performance standards for the Yoongarillup Mineral Sands Mine include:

- Compliance with relevant plans and procedures (as listed above), and investigation into any non-compliance in accordance with Doral's corrective action procedures;
- Compliance with relevant licences;
- Groundwater Operating Strategy will be prepared in accordance with Operational policy 5.08 – Use of operating strategies in the water licensing process (DoW, 2011).

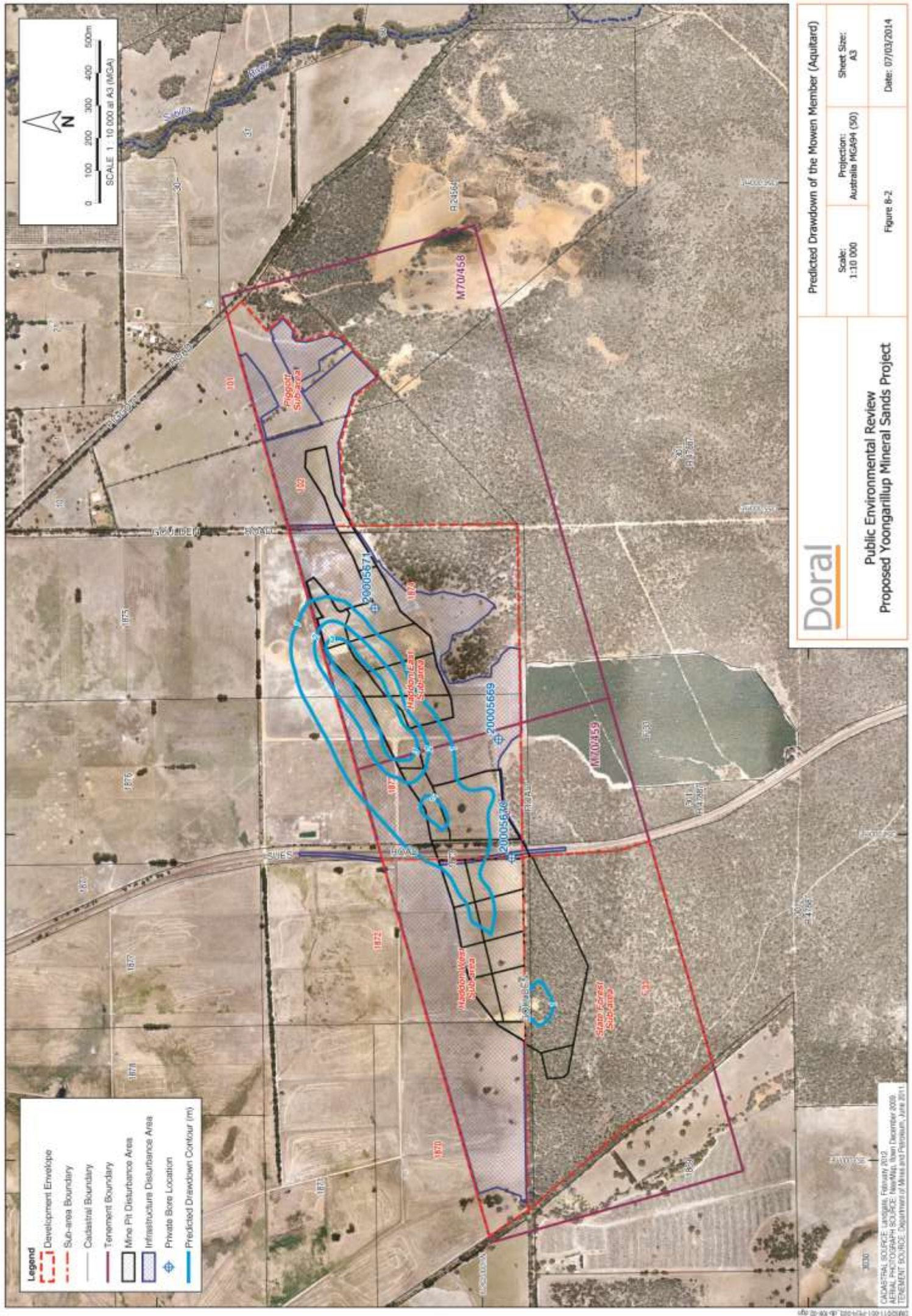
8.6 PREDICTED ENVIRONMENTAL OUTCOMES

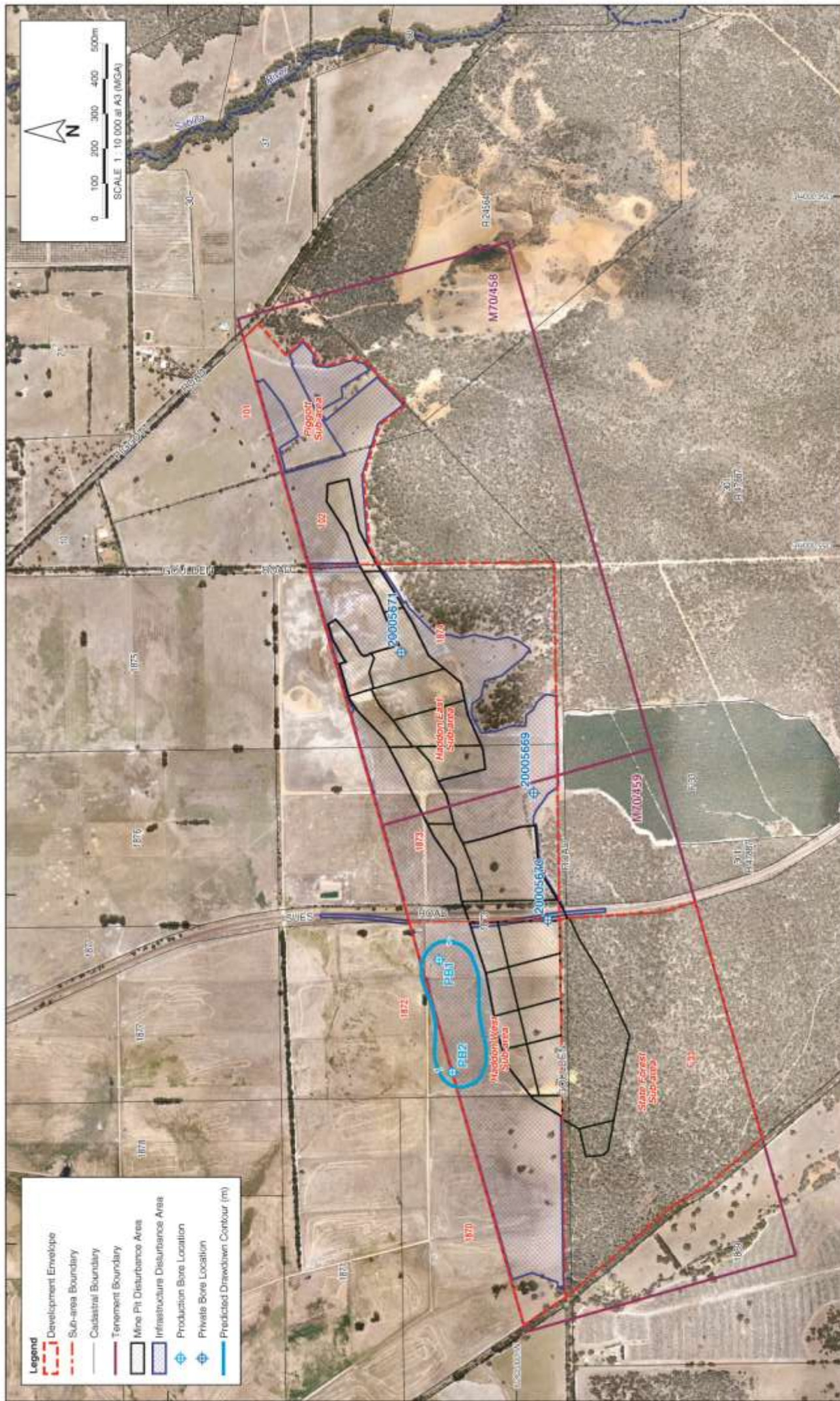
The predicted outcomes once management has been implemented are:

- Three privately-owned bores may be affected by drawdown of up to 4.5m (20005669) and by up to 1m (20005670 and 20005671) during the life of mine. Impacts will be mitigated by the supply of supplementary water to meet the needs of the bore owners;

- No adverse impacts to groundwater dependent vegetation within the State Forest sub-area or Whicher National Park is expected from groundwater drawdown during short-term dewatering of mine pits;
- No impacts are expected to other users of the Yarragadee aquifer or overlying aquifers;
- No adverse impacts to water quality within paddock drains from the emergency discharge of water;
- No adverse impacts to the Vasse River or Sabina River or their catchments;
- No adverse impacts to the Vasse—Wonnerup System Ramsar Wetland.

Doral expects that with the implementation of the above management measures it is likely the EPA's objective to protect hydrological regimes of groundwater and surface water will be met.





Legend

- Development Envelope
- Sub-area Boundary
- Cadastral Boundary
- Tenement Boundary
- Mine Pit Disturbance Area
- Infrastructure Disturbance Area
- Production Bore Location
- Private Bore Location
- Predicted Drawdown Contour (m)

0 100 200 300 400 500m

SCALE 1 : 10 000 at A3 (MGA)

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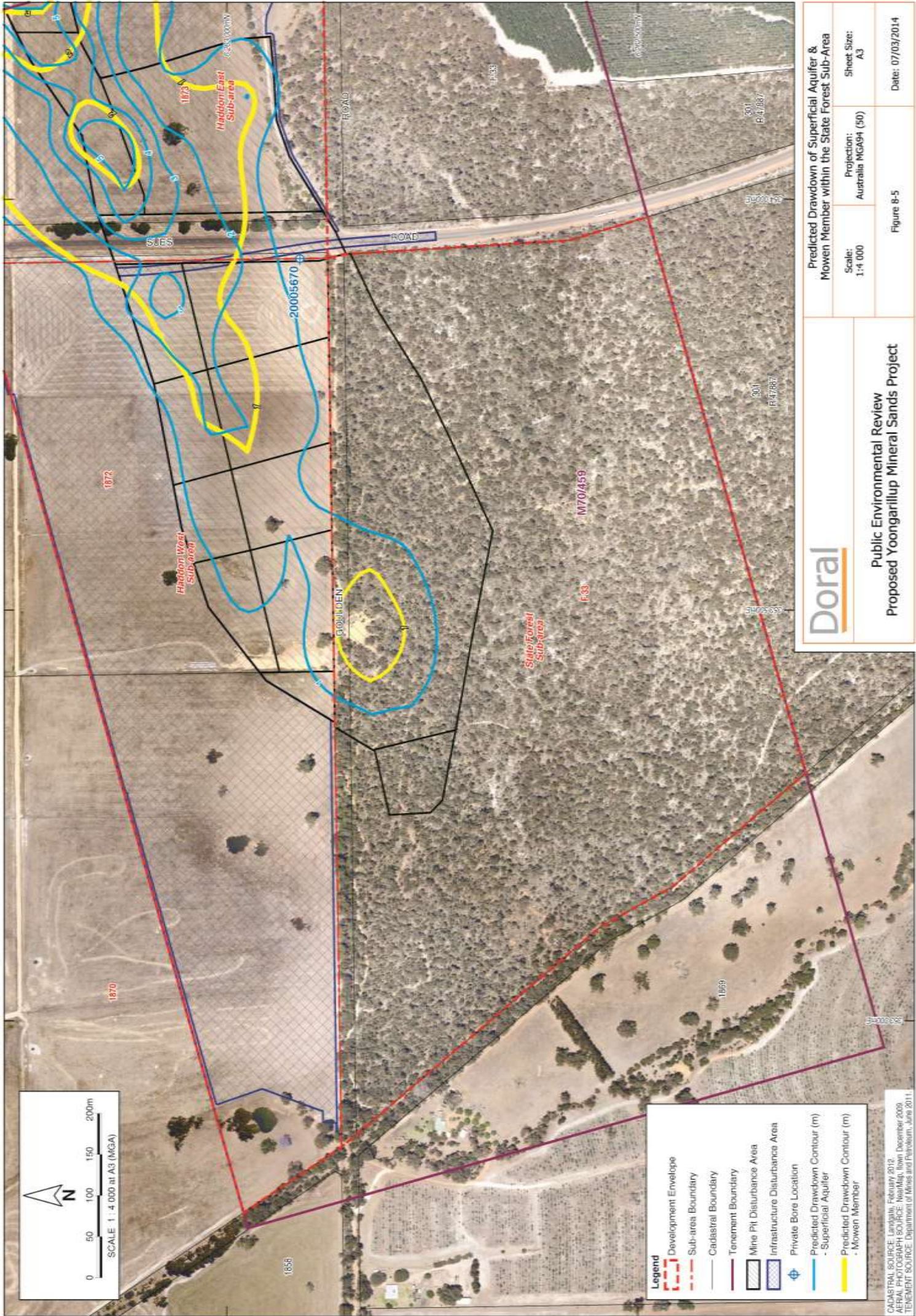
Predicted Drawdown of the Vasse Member
(Leederville Aquifer) From Production Bores

Scale: 1:10 000	Projection: Australia MGA94 (50)	Sheet Size: A3
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Figure 8-3

Date: 07/03/2014

INDUSTRIAL SOURCE: Landgate, February 2012
AERIAL PHOTOGRAPH SOURCE: GeoMap, from December 2008
TENEMENT SOURCE: Department of Mines and Petroleum, June 2011



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Proposed Yoongarillup Mineral Sands Project**

**Predicted Drawdown of Superficial Aquifer &
Mowen Member within the State Forest Sub-Area**

Scale:
1:4 000

Projection:
Australia MGA94 (50)

Sheet Size:
A3

Figure 8-5

Date: 07/03/2014

CADASTRAL SOURCE: Landgate, February 2012.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown December 2009.
TENEMENT SOURCE: Department of Mines and Petroleum, June 2011.

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9 REHABILITATION AND CLOSURE

9.1 RELEVANT ENVIRONMENTAL OBJECTIVES, LEGISLATION, POLICIES, GUIDELINES, STANDARDS AND PROCEDURES

9.1.1 EPA Objectives

To ensure that a planning process is in place so that the mine can be closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed post-mining outcomes and land-uses, and without unacceptable liability to the State.

9.1.2 Policy and Guidelines

Relevant policy and guidelines for rehabilitation and mine closure include the following:

Guidelines for Preparing Mine Closure Plans

The purpose of the *Guidelines for Preparing Mine Closure Plans*. (Environmental Protection Authority and Department of Mines and Petroleum, 2011) is to provide guidance on the preparation of Mine Closure Plans to meet Western Australian regulatory requirements. Consistent with industry practice, the guidelines are based on the principle that planning for mine closure should be an integral part of mine development and operations planning and should start 'up front' as part of mine feasibility studies, before mining begins.

EPA Guidance Statement No. 6

The primary purpose of EPA Guidance Statement No. 6 *Guidance for the Assessment of Environmental Factors Rehabilitation of Terrestrial Ecosystems* (EPA, 2006b) is to ensure the return of biodiversity in rehabilitated areas by increasing the quality, uniformity and efficiency of standards and processes for rehabilitation of native vegetation in Western Australia and to allow more effective monitoring and auditing of outcomes. EPA (2006b) promotes the use of completion criteria and definitions for the rehabilitation of natural ecosystems which:

- Allow success to be measured within realistic timeframes;
- Are sufficiently precise to allow outcomes to be effectively audited, but are also flexible when required;
- Are based on sound scientific principles;
- Acknowledge the consequences of permanent changes to landforms, soils and hydrology.

9.2 EXISTING ENVIRONMENT

The Proposal will result in ground disturbance of both native vegetation (State Forest No. 33) and cleared farmland (current uses include beef cattle, dairy cattle and pasture). Table 9-1 summarises the quantum of ground disturbance associated with the Proposal.

TABLE 9-1: AREAS OF GROUND DISTURBANCE

Total Ground Disturbance	Within Cleared Farmland	Within State Forest No. 33
95.71ha	86.81ha	8.90ha

State Forest No. 33, also known as Millbrook State Forest, is managed by the Department of Parks and Wildlife and lies within the Whicher Scarp Land System (DAFWA, 2007), immediately adjacent to the Whicher National Park. A Floristic Survey of the Whicher Scarp (Keighery *et al.*, 2008) places the project area in the Central Whicher Scarp. This is described as having moderate north facing slopes with areas of laterite capped rises and soils ranging from deep sands to sand, gravel, silt, clay and ironstone combinations.

Ecoedge Environmental (2013) rated the vegetation within the State Forest sub-area as Very Good or Excellent condition, with only a small area (0.08 hectares) on the northern boundary previously being used as a sand pit being rated as Completely Degraded. The Goulden Road track (0.14ha) is also considered to be 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, Ecoedge Environmental (2013) estimates the clearing was probably conducted during the period 1950-1965, perhaps in readiness for pine planting that did not eventuate.

Parts of the previously cleared area are relatively species poor and there is evidence of heavy kangaroo grazing through the State Forest sub-area. A strip around the east and north sides of the State Forest sub-area shows no signs of previous clearing which resulted in the vegetation being classified as excellent condition. *Phytophthora* disease is present along the eastern boundary and part of the western boundary, evidenced by scattered deaths of *Eucalyptus marginata* and *Xanthorrhoea* species (Moore Mapping, 2014). Scattered deaths of *Banksia grandis*, particularly near the southern boundary of the State Forest sub-area are a result of drought. Dumping of domestic and farm refuse has been carried out in various places along the tracks in the northern and western parts (Ecoedge Environmental, 2013). The proportion and cover of introduced species is generally low throughout.

9.3 POTENTIAL IMPACTS

The disturbed areas post mining, will be progressively rehabilitated back to pasture, native vegetation and road reserve/road pavement, as agreed with the landowners and consistent with pre-mining land use.

By not successfully undertaking this rehabilitation, the following critical issues may arise:

- Future land use is impacted as a result of ineffective re-establishment of soil profiles;
- Topsoil resources are depleted;
- Loss or change in species biodiversity and composition (both flora and fauna);
- Loss or change in pasture productivity;
- Introduction of *Phytophthora* dieback into previously uninfested areas;
- Introduction of weeds into previously uninfested areas;
- Contamination of groundwater resources;
- Over compaction of soil layers resulting in poor infiltration;
- Changes to groundwater flow regimes;
- Geotechnical stability of road reserve backfill compromise the structural integrity of the road pavement.

9.4 ASSESSMENT OF POTENTIAL IMPACTS

A desktop study, reviewing the international and national body of relevant literature for mine rehabilitation, has been compiled and included as Appendix 11. This study identifies the issues considered of critical importance for rehabilitation of surface mining in the southwest of Western Australia. These issues include:

- **Characterization of existing and reconstruction of soil profiles**
 - Pre-mining characterisation of natural soil profiles and landforms;
 - Removal and management of vegetation and topsoil;
 - Soil profile reconstruction to support post mining land use objectives
- **Species selection and seed management**
 - Plant species selection; and
 - Seed collection, storage and treatment.
- **Plant establishment**
 - Plant establishment techniques;
 - Controlling threats to rehabilitation success; and
 - Completion criteria and monitoring.

In addition to the Desktop Study on Successful Rehabilitation Procedures (Appendix 11), Doral has undertaken a number of technical studies to assist in documenting the existing parameters of the area to be disturbed as well as the potential impact that the proposal may have on these, and surrounding areas. These studies have enabled the potential impacts of the project to be assessed, modelled and reviewed. A summary of these impacts and their assessment is presented below.

- **Changes to natural soil profiles and landforms**
 - Baseline soil assessment (Appendix 5-A)
 - Baseline flora and vegetation (Appendix 6)
 - Baseline fauna survey (Appendix 7)
- **Removal and reinstatement of topsoil and vegetation**
(Appendix 11 - Section 3.2 and 4.2, Appendix 12 - Section 10.)
 - Topsoil handling
 - Topsoil stockpiling
 - Topsoil substitutes and ameliorants
 - Soil profile reconstruction to support post-mining land use objectives
- **Species selection and seed management** (Appendix 11 - Section 3.3 and 4.3)
 - Plant species selection
 - Seed collection, storage and treatment
- **Plant Establishment** (Appendix 11 - Section 3.4 and 4.4)
 - Plant establishment techniques
 - Controlling threats to rehabilitation success
 - Feral/Grazing animals
 - Weeds
 - Dieback

- **Changes to Hydrological Processes**
 - Groundwater Modelling (Appendix 8-B)
 - Surface Water Assessment (Appendix 8-C)

9.5 MANAGEMENT MEASURES AND PERFORMANCE STANDARDS

Doral Mineral Sands Pty Ltd (Doral) has developed a Mine Closure Plan (MCP) to provide the framework for the planning of activities associated with Mine Closure for the proposed Yoongarillup Mineral Sands Project. This MCP (Appendix 12) describes Doral's strategies for decommissioning mining infrastructure, rehabilitating the land disturbed by mining and releasing the area for future use.

This MCP (Appendix 12) and all comments and information contained within it must be read in entirety, with reference to the gaps and uncertainties identified in the relevant sections. The MCP presented in Appendix 12 is a Preliminary Mine Closure Plan that has been prepared to address the environmental factors outlined in the ESD (Appendix 2-A) pertaining to rehabilitation and mine closure. This MCP is a living document that will evolve as new information is collected to address the information gaps.

9.5.1 Mining Tenement Conditions

The proposed Yoongarillup Mine will operate on Mining Tenements M70/458 and M70/459. The current conditions of each of these tenements have been reviewed and the conditions relevant to closure are included within Table 9-2. It should be noted that at this stage there are no specific mine closure conditions as a mining proposal has not yet been submitted to the DMP.

It also should be noted that there is an error contained in Tenement Condition 21 for both M70/458 and M70/459 in that the condition refers to State Forest 13 and not State Forest 33. Tenement Conditions have been accessed via the DMP's Mineral Titles Online database

TABLE 9-2: MINING TENEMENT CONDITIONS RELATING TO MINE CLOSURE AND REHABILITATION

TENEMENT NO.	CONDITION NO.	CONDITIONS RELEVANT TO MINE CLOSURE
M70/458	21 (v1)	Consent to Mine on State Forest No. 13 granted by the Minister for Mines subject to: The lessee at his expense rehabilitating all areas affected by mining or operations associated with mining conducted during the term of the lease, including the rehabilitation enrichment of dieback or other forest disease affected areas, resulting from the lessees mining or operations associated with mining. Rehabilitation being to the satisfaction of the Regional Mining Engineer and in agreement with the Regional Manager CALM.
M70/459	21 (v1)	Consent to Mine on State Forest No. 13 granted by the Minister for Mines subject to: The lessee at his expense rehabilitating all areas affected by mining or operations associated with mining conducted during the term of the lease, including the rehabilitation enrichment of dieback or other forest disease affected areas, resulting from the lessees mining or operations associated with mining. Rehabilitation being to the satisfaction of the Regional Mining Engineer and in agreement with the Regional Manager CALM.

9.5.2 Past Performance – Rehabilitation of Disturbed Areas

Doral has operated in the southwest of Western Australia since 2002. It operates its facilities, and plans its mining activities to have as minimal impact on the environment as is practicable and values its role in preserving the surrounding environment.

Doral is focused on sustainable development and is committed to operating in an environmentally and socially responsible manner. Doral has always promoted a proactive approach to sustainability and responsible environmental performance, at all times seeking outcomes consistent with industry best practice. A copy of Doral's Environmental Policy has been included in Appendix 15.

Doral has been undertaking rehabilitation and revegetation works at its Dardanup and Burekup West operations since 2009, in accordance with the Rehabilitation Management Plan and Mine Closure Plan approved by the DMP (available for viewing on the Doral Website - www.doral.com.au).

At its existing operations, Doral operates under an Environmental Management System in line with the requirements of the Australian/New Zealand Standard AS/NZS ISO 14001:1996 (ISO 14001). Further details on this Environmental Management System are presented in Section 13. The established Environmental Management Framework will ensure that the proposed Yoongarillup Mineral Sand Mine will have established and proven, processes and procedures in place at the time of commencement. The proposed Yoongarillup Mineral Sands Mine would commence operations with management, technical staff, operators and contractors trained and familiar with the requirements of the system, minimising the risk that the mining operations will have on the environment.

9.6 REHABILITATION AND MINE CLOSURE OBJECTIVES

The proposed Yoongarillup Mine is classified into three post-mining land uses, with specific objectives for each land use. The planned post-mining land use and their relevant objectives are described in Table 9-3 and Table 9-4.

TABLE 9-3: REHABILITATION OBJECTIVES FOR POST MINING LAND USE

Post Mining Land Use	Rehabilitation Objectives
Agriculture	To return the land to a condition capable of supporting dairy and/or beef production with pasture production rates equivalent to or better than pre-mining production rates.
Rehabilitated Native Vegetation	To rehabilitate areas of environmental significance such that their environmental values are restored.
Road and Road Reserve	To re-establish roads to engineering and construction standards acceptable to Main Roads WA (Sues Road) and the City of Busselton (Goulden Road).

TABLE 9-4: CLOSURE OBJECTIVES FOR POST MINING LAND USE

Post Mining Land Use	Rehabilitation Objectives
Agriculture	Top 1 m of soil profiles are consistent with pre-mining soil profiles and where different enable improved agricultural productivity (e.g. covering of rocky laterite surface with soil);
Rehabilitated Native Vegetation	Created soil profiles and landforms are able to support native vegetation;
Road and Road Reserve	Backfilled mine pits do not subside over time and can support road construction.

9.7 REHABILITATION METHODOLOGY

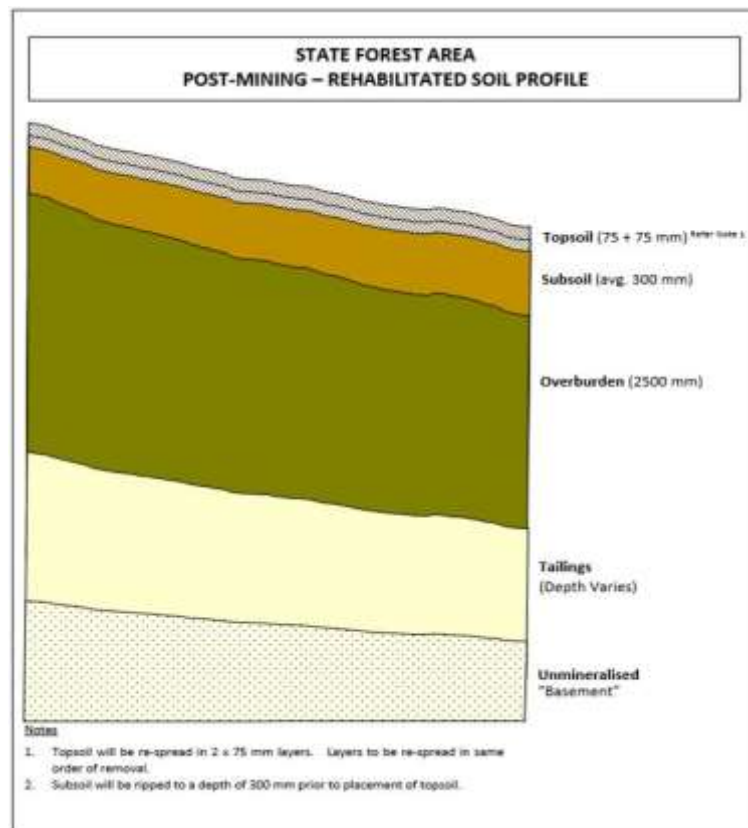
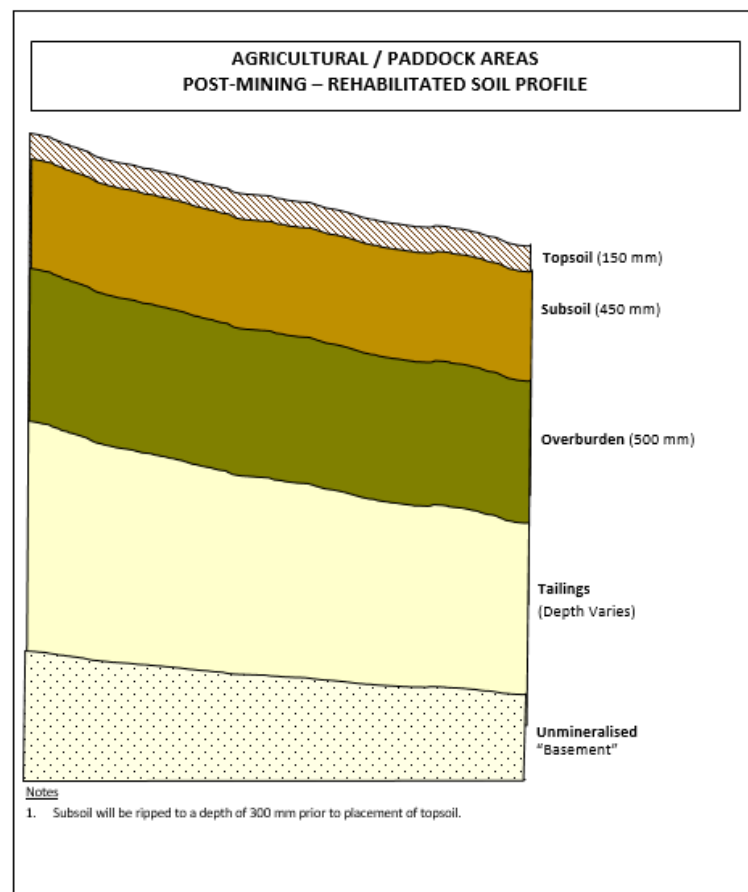
Doral will prepare a Rehabilitation Management Plan, of similar format to the existing plan for their Dardanup Minesite (refer Section 9.5.2), to be included with the Mining Proposal submission to be forwarded to the DMP upon obtaining EPA approval for the proposal.

The Rehabilitation Management Plan will cover the construction, operation and closure phases of the project and will provide information to supplement the Mine Closure Plan for the sections outlined below:

- topsoil management;
- seed bank management;
- weed management;
- dieback management;
- soil profile reconstruction;
- flora and vegetation management;
- fauna management;
- surface water management;
- groundwater management;
- infrastructure decommissioning;

9.7.1 Soil Profile Reconstruction

The re-establishment of functional soil profiles has been identified as one of the critical components to the success of rehabilitation efforts. Plate 9-1 and Plate 9-2 depict the proposed soil profile to be reconstructed during rehabilitation works.

PLATE 9-1: PROPOSED POST MINING SOIL PROFILE – STATE FOREST AREA**PLATE 9-2: PROPOSED POST MINING SOIL PROFILE – AGRICULTURE / Paddock AREAS**

The methodology to be utilised to reinstate the soil profile is described in Table 9-5

TABLE 9-5: SOIL PROFILE RESTABLISHMENT

Backfilling Mine Voids
<p>Progressive pit backfill from new disturbance areas involves the direct placement of materials in mine voids where possible. Backfill material includes:</p> <ul style="list-style-type: none"> • Sand tails from the Wet Concentrator Plant; • Dried clay tails from the excavation of SEPs; • Co-disposed sand and clay tails; • Waste sand and clay material returned from the Picton Dry Separation Plant, blended into sand tails. • Oversize from feed preparation plant and wet concentration plant; • Overburden either from within the pit or from stockpiles; <p>Backfill methods are designed to satisfy the requirement for maintaining a hydrological regime suitable for sustaining the end land use.</p>
Subsoil and Topsoil Placement
<p>The following procedure will be applied to topsoil and subsoil placement:</p> <ul style="list-style-type: none"> • Dieback hygiene procedures will be implemented to ensure no cross-contamination of dieback free material occurs; • Weed hygiene procedures will be implemented to minimise the risk of introducing weeds into the rehabilitated areas; • Water spraying and/or other appropriate measures shall be used for dust control during the placement of topsoil and subsoil. Under high wind conditions, topsoil and subsoil placement will cease; • Subsoil material will be placed to a depth • To alleviate any compaction caused by the movement of heavy machinery, all mined areas will be ripped. Ripping requirements will be tailored to suit specific rehabilitation areas. In native rehabilitation areas, deep ripping may be required. In pastured rehabilitation areas, less aggressive ripping (300 mm) will be required after the replacement of subsoil, but prior to replacement of the topsoil. • Topsoil will be placed on rehabilitation areas just prior to the growing season to avoid dust generation over the summer months; • GPS controlled techniques are used for topsoil and subsoil replacement as they allow more accurate contouring of the final land surface; <p>The final surface design and drainage layout will be as close as possible to the pre-mining surface design with minor undulations and erosional features smoothed out;</p>

9.7.2 Re-establishing Pasture

Procedures for re-establishment of agricultural land will utilise the following practices. The focus of the program is to rapidly stabilise restored landforms with agricultural pastures. A pasture mixture will be sown and fertilised in autumn to ensure a vigorous re-establishment of the pasture.

The methodology is summarised broadly below:

- Stick picking to remove excessive quantities of large sticks and roots in the returned topsoil;
- Seedbed preparation using a combination of secondary tillage implements (e.g. offset discs, scarifier, drag and harrows);
- Application of fertiliser and lime, for which the type, rate and number of applications will be determined via soil testing and agronomic advice;
- Application of seed mix tailored to landowner's specifications.

9.7.3 Re-establishing Native Vegetation

Seed will be sourced locally. An assessment of potential seed sources for the rehabilitation of the State Forest sub area will be undertaken. Seed collected will be given to a suitably experienced nursery where it will be grown specifically for rehabilitation of the proposed Yoongarillup Mine. Any species not able to be supplied by this nursery may be sourced from other suppliers.

For various reasons there is reduced likelihood of successful direct seeding and as such, tubestock will be used to supplement the seeding effort. Seeding rates and species lists will be confirmed after consultation with DPaW and included in the Rehabilitation Management Plan.

9.8 PREDICTED ENVIRONMENTAL OUTCOMES

The EPA's objective of:

"ensuring that a planning process is in place so that the mine can be decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed post-mining outcomes and land-uses, without leaving an unacceptable liability to the State"

will be met by Doral implementing the requirements of the Mine Closure Plan (Appendix 12) and the Rehabilitation Management Plan to be established for the project. An extract of the Completion Criteria section of the MCP is provided in Appendix 13.

The outcomes that Doral aim to achieve for the receiving environment at the completion of the mine closure phase include, but are not limited to:

- Re-establishment of vegetation in the State Forest area that is self-sustaining, perpetual and provides a sustainable habitat for local fauna and successive flora species;
- Creating a stable, free draining post mining landform, which is compatible with the surrounding landscape, capable of a productive land use that achieves a land capability equivalent or better to that of pre-mining conditions;
- Provision of suitable offset areas that ensure the project delivers a net benefit to environmental conservation.

By ensuring close working relationships are developed with all stakeholders and through the implementation of the Doral Environmental Management System and the project Mine Closure Plan, Doral believe they will successfully address the post-mining objectives required by the EPA.



10 OTHER ENVIRONMENTAL MATTERS

10.1 WATER RESOURCES

Water required for the wet concentrator plant process will be sourced entirely from the PWP. Water for the PWP will be obtained primarily from two production bores screened within the Yarragadee aquifer and supplemented with rainfall runoff, mine dewatering effluent and return water from the SEPs. The simple site water balance (PB, 2014c) calculates that a water demand of 4.32ML per day, approximately 131ML per month and approximately 1577ML (1.6GL/yr) will be required for the Proposal. An application to abstract water from the Yarragadee aquifer has been submitted, and preliminary discussions regarding securing this water held with the DoW (refer to Section 4). Further details of water resource related matters are provided in Section 8.

10.2 VASSE WONNERUP SYSTEM RAMSAR WETLAND

No adverse impacts are expected to the Vasse—Wonnerup System Ramsar Wetland. Refer to Section 8.3.2 for the predicted impacts from groundwater drawdown. Refer to Section 8.4.5 for an assessment of impacts from an emergency discharge of water.

An Acid Sulfate Soil (ASS) assessment was conducted by Soilwater Consultants (2012) in consultation with DEC (2012) and is provided Appendix 5-C. Comparison of the field screening results to the DEC (2012) assessment criteria (i.e. more than 10% of sample locations with $\text{pH}_f < 4$, or more than 10% of samples with $\text{pH}_{\text{FOX}} > 3$) show that the results do not exceed the assessment criteria. It is therefore considered that the risk of sulfide oxidation hazard at the site is not significant. Consequently, it is not necessary to complete the additional risk assessment measures detailed in Steps 2-5 of DEC (2012). Although the ASS hazard has a low risk and does not exceed the DEC (2012) assessment criteria, a groundwater monitoring and contingency plan will be prepared and implemented as required by DEC (2012).

10.3 DIEBACK

10.3.1 Existing Environment

Moore Mapping (2014) was commissioned to map vegetation within and adjacent to the Development Envelope (excluding cleared areas) for the presence of dieback (*Phytophthora cinnamomi*). This report is provided as Appendix 5-B. The total area mapped was 75.5ha as shown on Figure 10-1. Disease mapping was undertaken in accordance with *Phytophthora cinnamomi* and the disease caused by it Volume II – Interpreter Guidelines for Detection, Diagnosis and Mapping (CALM, 2001). The results of the mapping indicated 11.5ha is infested with dieback (of which 5.94ha is located within the Development Envelope), based on the identification of *Phytophthora cinnamomi* disease in samples of *Banksia grandis* and *Xanthorrhoea*. The infested areas within the Development Envelope are located adjacent to Sues Road (east and west) (Figure 10-1) correlating with drainage associated with Sues Road and within the western portion of the State Forest sub-area. The infested areas located outside of the Development Envelope are within vegetation in Lot 101 and Lot 102. These areas are also likely attributable to surface water runoff. Approximately 57.3ha is mapped as uninfested and classified as ‘protectable’ (Moore Mapping, 2014) and a further 6.7ha is mapped as ‘uninterpretable’ (Moore Mapping, 2014).

The paddocks within the Development Envelope have not been mapped. They primarily consist of cleared pasture with single trees/shrubs scattered amongst the pasture. In accordance with *Management of Phytophthora Dieback in Extractive Industries* (Dieback Working Group n.d.), the paddocks are considered ‘uninterpretable’ as there is no vegetation present through which the disease can be confirmed. For the

purposes of management the paddocks are treated as if they were 'infested' in line with the precautionary principle.

10.3.2 Potential Impacts

During the Proposal there is potential for the spread of *Phytophthora* dieback to occur from the infested areas to the protectable State Forest and Haddon East sub-area's via vegetation clearing and topsoil stripping. *Phytophthora cinnamomi* is an introduced soil borne water mould which is capable of destroying the root function of susceptible native plant species. The spread of the destructive root disease, known as 'Phytophthora dieback', is through established disease fronts by root to root growth amongst host plants, or the dispersal of zoospores in free-flowing water. *Phytophthora* dieback can be transported by native animals, feral animals, people, machinery and equipment. The impact to an ecosystem includes; death of native plant species, no re-colonisation of infested areas and significant interference with ecosystem processes to the extent that an ecosystem may collapse (CALM, 2003; DEC, 2004).

10.3.3 Assessment of Potential Impacts

During the vegetation clearing and soil stripping process in paddocks and infested areas (Figure 10-1) *Phytophthora* dieback may be transferred into the adjacent disease-free area of the State Forest and Haddon East sub-area's ('protectable area' – see Figure 10-1). Transport of zoospores could occur through incorrect storage (e.g. stockpiling the topsoil from the protectable area directly on infested areas and mixing of infested and uninfested soils in stockpiles) and incorrect handling of the material (i.e. respreading infested topsoil or vegetation roots in the protectable area). The consequence may be severe as previously unaffected areas may become infested, resulting in native plant death and alteration to native ecosystems.

10.3.4 Management Measures and Performance Standards

The management objective is to protect the disease-free areas of State Forest and Haddon East sub-area's during the mining operation. To manage the risk of dieback spreading into uninfected areas, Doral commits to preparing a Dieback Management Plan prior to mining commencing.

The Dieback Management Plan will include the following management:

State Forest Sub-Area

- Blocks 24 and 25 within the State Forest sub-area will be mined following mining and backfilling of blocks 14-21. Mine voids will be backfilled with dry tailings. Topsoil and subsoil from blocks 24 and 25 will be stockpiled to the south on the backfilled mine voids. Dieback free topsoil will be stockpiled separately from infested (or potentially infested) topsoil (refer to Plate 3-2 for staging). Subject to operational constraints, topsoil stripping will be limited to dry soil conditions, where practical;
- Dust suppression of stockpiles will occur as required ensuring that runoff from stockpiles is contained and does not enter vegetated areas. The stockpile of dieback infested topsoil will be hydromulched and banded to capture any runoff;
- No equipment or plant will enter the State Forest sub-area, with the exception of the areas designated to be cleared for mine pits;
- For mining of blocks 24 and 25 a clean-on-entry policy will be implemented. Prior to entry to these mine blocks, vehicles and equipment will be washed / brushed down and verified as 'clean'. No wash/brush down of vehicles and equipment is required on exit, given they will be moving into a potentially infested area (i.e. paddocks);

- Signage will be erected adjacent to the protectable State Forest sub-area south of the mine pits explaining the risk of dieback and preventing access to the protectable State Forest and Haddon East sub-area's from the mine site;
- The protectable State Forest sub-area will be delineated prior to ground disturbance. A recheck of the dieback mapping (Moore Mapping, 2014) will be conducted prior to May 2017;
- The area of the State Forest sub-area infested with dieback will be demarcated using star pickets and 'Day-glow' flagging tape. Knots facing inwards to the infested area will indicate the diseased area. This will assist with topsoil management and replacement of the topsoil;
- The demarcated area will be checked monthly to ensure flagging tape remains in place;
- Hygiene procedures will be established to guide Doral personnel and contractors working in the State Forest sub-area;
- Earthmoving contractors will be educated during site induction and weekly meetings on hygiene procedures to minimise the risk of contaminating the dieback free areas;
- Areas of State Forest within the Development Envelope will be remapped for the presence of *Phytophthora* dieback following cessation of mining and revegetation.

Haddon East and Piggott Sub-Area's

- Block 13 within the Haddon East sub-area will be mined following mining and backfilling of block 24. Dieback infested vegetation, topsoil and subsoil from block 13 will be segregated and stockpiled separately on block 15 (same location as dieback material from block 24). Dieback free topsoil will be stockpiled separately from infested (or potentially infested) topsoil. Subject to operational constraints, topsoil stripping will be limited to dry soil conditions, where practical;
- Doral will fence the northern edge of vegetation within the Haddon East and Piggott sub-areas between the mine pits and the vegetation. This will prevent access of workers into this section of vegetation and prevent motorbike riders entering the mine site from south of the Development Envelope (on the east of Sues Road).

The key performance standard is at the cessation of mining, the 'protectable' areas of the state forest and Haddon East sub-areas, as well as vegetation within Lot 102 (located outside of the Development Envelope) will remain unaffected by *Phytophthora* dieback. This standard will be measured through dieback mapping post-mining, in consultation with DPaW as required.

10.3.5 Predicted Environmental Outcomes

Implementation of the above dieback management measures will reduce the risk of dieback spreading into protectable areas within the State Forest and Haddon East sub-areas, as well as vegetation within Lot 102 (outside of the development Envelope). Whilst there is no EPA objective for dieback, the protection of the mapped disease-free sections from dieback is considered a suitable objective, which is likely to be met once management measures are employed.

10.4 DUST

10.4.1 EPA Objectives

To ensure that dust emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

10.4.2 Potential Impacts

Dry mining has the potential to generate dust from the stripping of topsoil and overburden, by vehicular movement and surface lift-off from exposed surfaces (e.g. stockpiles, mine pits) during dry and windy ambient conditions. Dust may also be generated from rehabilitation activities, and areas recently rehabilitated prior to the establishment of vegetation. Dust generation can result in adverse impacts on surrounding vegetation and create nuisance to landowners in the vicinity of the mine disturbance areas.

10.4.3 Assessment of Potential Impacts

The Proposal will be located within rural farming land set against the foothills of the Whicher Scarp, 17 km southeast of Busselton. Twelve farm houses are scattered around the local area within the vicinity of the mine site. The prevailing winds (for most of the year) in the southwest Region of Western Australia come from the east in the mornings and the south/southwest in the afternoons. In the winter months, strong westerly and north-westerly winds are prevalent. Table 10-1 lists the residences most susceptible to dust each month, based on the historical prevailing wind directions. Figure 10-2 shows the location and distances of the nearest residences.

TABLE 10-1: PREDICTED PREVAILING WIND DIRECTION IN RELATION TO RESIDENCE LOCATIONS

TIME OF DAY	0900 HOURS			1500 HOURS		
MONTH	PREDICTED PREVAILING WIND DIRECTION*	RESIDENCE MOST SUSCEPTIBLE TO PREDICTED PREVAILING WIND DIRECTION	APPROXIMATE DISTANCE TO MINE (m)	PREDICTED PREVAILING WIND DIRECTION*	RESIDENCE MOST SUSCEPTIBLE TO PREDICTED PREVAILING WIND DIRECTION	APPROXIMATE DISTANCE TO MINE (m)
Jan	SE	R6	1612	S	R8	647
Feb	E	R2	391	S	R8	647
Mar	E	R2	391	NW/S	No residences / R8	647
Apr	E	R2	391	NW	No residences	-
May	E	R2	391	N	No residences	-
Jun	E	R2	391	N	No residences	-
Jul	E	R2	391	N	No residences	-

TIME OF DAY	0900 HOURS			1500 HOURS		
MONTH	PREDICTED PREVAILING WIND DIRECTION*	RESIDENCE MOST SUSCEPTIBLE TO PREDICTED PREVAILING WIND DIRECTION	APPROXIMATE DISTANCE TO MINE (m)	PREDICTED PREVAILING WIND DIRECTION*	RESIDENCE MOST SUSCEPTIBLE TO PREDICTED PREVAILING WIND DIRECTION	APPROXIMATE DISTANCE TO MINE (m)
Aug	W	R11	537	N/NW	No residences	-
Sept	W	R11	537	W	R11	537
Oct	E	R2	391	NW/SW	No residences / R8	537
Nov	E	R2	391	NW/S	No residences / R8	537
Dec	E	R2	391	NW	No residences	-

*Prevailing wind direction taken from Bureau of Meteorology data (for Busselton Aero 009603) collated from 1997 – 2010

During dry and windy ambient conditions four residences may potentially be impacted by dust during mining of pits:

- Residence R2, located approximately 390m from the closest mine pit, is most susceptible to dust under easterly winds. However residence R2 will be buffered to some degree from dust by the State Forest which is situated between the mine and residence R2;
- Residence R8, located approximately 645m from the closest mine pit, is most susceptible to dust under southerly winds when mining block 2. Mining of block 2 is currently expected to occur for less than four months. Therefore any dust impacts are temporary and dust management measures will be implemented to minimise dust generation;
- Residence R11, located approximately 535m from the closest mine pit, is most susceptible to dust under westerly winds when mining block 2. Mining of block 2 is currently expected to occur for less than four months. Currently mining of block 2 is scheduled for the summer months, where the prevailing winds are unlikely to move dust in the direction of residence R11. However dust management measures will be implemented regardless of wind direction;
- Residence R6, located approximately 1610m from the closest mine pit, is unlikely to be affected by significant concentrations of dust, given it is located over a km away from the mine pits, however dust management will be in place to minimise dust generation.

The risk of significant off site impacts to any residence is considered low due to the proven performance of the dust management strategies at the Dardanup Mine, which will be implemented for the Proposal.

Surrounding vegetation could potentially be affected by dust deposition arising from mining activities. Dust interferes with physiological processes of plants (e.g. transpiration). In extreme cases dust can smother the leaves of vegetation, resulting in adverse health of the plant and/or death. Generally

significant dust is not generated from within the mining pits, but from stockpiles and unsealed road surfaces. Management measures (outlined below) will be implemented to reduce dust generation. Vegetation health of the adjacent State Forest sub-area will be monitored. The risk of death of vegetation from dust impacts is considered to be low.

10.4.4 Management Measures and Performance Standards

Doral are experienced with dust management due to its previous experience at managing this issue at its Dardanup Mine. Ambient total suspended particulates (TSP) monitoring is undertaken at the Dardanup Mine between September and March, with average concentrations of $49\mu\text{g}/\text{m}^3$ recorded, well below the licence limit of $250\mu\text{g}/\text{m}^3$.

It is expected air quality parameter limits will be included on the Yoongarillup Mine's (i.e. the Proposal) *Environmental Protection Act 1986* Licence. Doral will regularly monitor TSP concentrations in accordance with the Dust Management Plan for the site. Doral will adhere to the limits set for dust within the licence, with a focus on minimising the concentration of TSP leaving the mine site and potentially impacting neighbours.

During the pre-mine establishment phase management will include employing up to three water carts for dust suppression on unsealed roads and in new areas of ground disturbance.

A range of control techniques will continue to be implemented to eliminate, minimise and control dust generation activities for the Proposal. Control techniques already successfully implemented at the Dardanup Mine and proposed to be implemented during operation of the Proposal include:

- Inform all employees and contractors of the importance of reducing the creation of dust generating activities;
- Restrictions on the areas open at any one time to ensure safe and efficient operations;
- The retention and removal of pasture and understorey species together with the topsoil;
- Scheduling topsoil stripping as such to avoid periods of high winds;
- When necessary, stripping operations are to be suspended under particularly high wind conditions;
- Watering all high traffic and haulage areas on a routine basis for dust suppression ensuring that there is no runoff into vegetated areas. Up to three water carts will be available for use at any one time;
- Spreading stockpiles, noise control bunds and pond embankments with fine clay solution such that dust control and soil erosion measures are achieved;
- Minimising the number and size of stockpiles. This involves the direct use of overburden as backfill and the direct replacement of topsoil, wherever possible;
- Encouraging vegetative cover on stockpiles, especially the topsoil stockpiles. Many of these vegetative species generate from stored seed to minimise dust generation;
- The management and monitoring of ore loading and unloading operations such that dust generation is minimised and controlled;
- Spraying HMC stockpiles at the mine with water if they dry to the extent dust generation occurs. HMC stockpiles generally have a moisture content of between 5-9% and are not vulnerable to the adverse effects of strong winds causing dust;

- The co-disposal of sand tails and clay tails into pit backfill areas. This homogenous mixing increases the average particle size and reduces the potential for dust generation;
- When and where necessary, spraying with water or other dust suppression measures (e.g. emulsion spray, erection of wind barriers) is employed;
- Employ routine maintenance and housekeeping practices to ensure that waste materials in and around the mine voids and infrastructure do not accumulate and lead to the generation on unacceptable airborne particulates.

To monitor impacts of dust on vegetation, regular monitoring of vegetation health in adjacent undisturbed vegetation within the State Forest sub-area will occur as per the Flora and Vegetation Management Plan.

10.4.5 Predicted Environmental Outcomes

Implementation of dust control measures will minimise dust generation. Monitoring of dust emissions will be conducted to ensure non-compliance with the Licence are acted upon. Doral is confident that with the above measures in place, the EPA objective to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses can be achieved.

10.5 NOISE

10.5.1 EPA Objectives

To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.

10.5.2 Noise Regulations

Environmental noise is regulated by the EP Act, through the implementation of the *Environmental Protection (Noise) Regulations 1997*.

No noise limits apply for the construction period, as per Regulation 13(2), as long as construction work is carried out between 0700 hours and 1900 hours on any day which is not a Sunday or public holiday if the occupier of the premises, shows that:

- (a) The construction work was carried out in accordance with control of environmental noise practices set out in Section 4 of AS 2436: 2010 Guide to Noise and Vibration Control on Construction, Maintenance and Demolition sites;
- (b) The equipment used on the premises was the quietest reasonably available.

Noise limits for mining on residences (noise sensitive premises) are listed in Table 10-2 as assigned by *Environmental Protection (Noise) Regulations 1997*, Part 2 Division 1 Regulation 8 (3) Table 1.

TABLE 10-2: NOISE LIMITS AT RECEIVING LOCATIONS

TYPE OF PREMISES RECEIVING NOISE	TIME OF DAY	ASSIGNED LEVEL (dB)		
		L _A 10	L _A 1	L _A max
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80

10.5.3 Findings of Noise Investigations

SVT Engineering Consultants (SVT) was commissioned by Doral to carry out a noise impact assessment for the Proposal (SVT, 2014). An acoustic model was developed to predict noise levels at 12 noise sensitive premises for day and night time operations under both worst-case and calm metrological conditions. The assessment was based on the proposed location of fixed plant and mobile equipment according to the proposed mine schedule, sound power levels of the fixed plant and mobile equipment as measured when operational at the Dardanup Mine, and with consideration of likely wind conditions. A copy of the report is contained in Appendix 10. The location of the 12 noise sensitive premises (residences) in relation to the Development Envelope is shown on Figure 10-2.

Six operating scenarios were assessed as shown in Table 10-3, which includes one construction scenario and five mining scenarios. Scenario 1 refers to the pre-mine establishment phase which is restricted to day time activity only. Scenarios 2, 3 and 4 are applicable to mining pits west of Sues Road (Haddon West and State Forest sub-areas). Scenarios 5 and 6 refer to mining pits east of Sues Road (Haddon East and Piggott sub-areas). Mining scenarios are applicable to both day and night time activity.

TABLE 10-3: OPERATING SCENARIOS CONSIDERED IN THE ACOUSTIC MODEL

PHASE	SCENARIO	OPERATING TIME	LIKELY COMMENCEMENT
Pre-mine establishment	1	Day	From March 2015 to June 2015
Mining	2	Day/Night	September 2015
Mining	3	Day/Night	February 2016
Mining	4	Day/Night	June 2016
Mining	5	Day/Night	November 2017
Mining	6	Day/Night	January 2018

A summary of the worst-case noise levels at each residence under the six scenarios is presented in Table 10-4. A 5dB tonality penalty was applied where required depending on the dominating noise sources.

TABLE 10-4: WORST-CASE NOISE LEVELS (DB(A)) AT EACH RESIDENCE PER SCENARIO

CLOSEST RESIDENCES	S1	S2		S3		S4		S5		S6	
	Day	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
R1	31.6	32.8	28.8	40.2*	30.4	33.2	29.1	27.4	25.0	28.1	23.8
R2	51.7*	47.1*	37.5	51.5*	41.4	52.2*	51.3*	33.1	31.6	34.3	30.9
R3	42.1	40.6	36.9	44.1	40.1	48.2*	46.9*	33.6	32.0	33.9	30.8
R4	26.0	27.9	24.4	29.2	25.0	27.6	24.3	22.2	16.9	23.4	17.3
R5	29.0	31.1	27.7	31.7	28.1	30.5	26.9	25.1	20.7	26.8	20.9
R6	31.4	33.8	30.4	33.9	30.7	33.4	30.2	28.1	24.1	30.1	24.3
R7	27.6	30.5	27.8	30.2	27.0	29.6	26.3	31.4	23.4	31.6	23.6
R8	31.4	34.5	32.0	33.8	30.8	33.4	29.7	40.6	37.9*	43.7*	30.1
R9	29.3	32.4	29.9	31.7	28.5	31.3	27.4	47.6*	40.3*	42.4*	30.0
R10	28.7	31.7	29.2	31.0	27.8	30.6	26.7	48.7*	39.6*	43.5*	38.0*
R11	28.4	33.8	31.8	32.9	30.3	31.8	28.9	48.3*	43.3*	47.9*	47.1*
R12	26.3	29.9	26.8	28.9	25.7	29.2	25.0	42.1*	26.3	32.0	35.8*

*Values adjusted for tonality (5dB penalty)

The residences which may experience noise levels above the noise limits (adjusted to account for relevant penalties) are listed in Table 10-5.

TABLE 10-5: COMPLIANCE ASSESSMENT WORST-CASE NOISE LEVEL EXCEEDANCES FOR MINING SCENARIO

Closest Residences	Noise Limit (dB(A))	Scenario 2		Scenario 3		Scenario 4		Scenario 5		Scenario 6	
		Complies (Yes) or Exceedance (dB)	Non-Compliant Wind Directions	Complies (Yes) or Exceedance (dB)	Non-Compliant Wind Directions	Complies (Yes) or Exceedance (dB)	Non-Compliant Wind Directions	Complies (Yes) or Exceedance (dB)	Non-Compliant Wind Directions	Complies (Yes) or Exceedance (dB)	Non-Compliant Wind Directions
Day (Monday to Saturdays)											
R1	45	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	46	0.8-1.1	N-SE	0.6-5.5	N-S	1.9-5.5	N-S	Yes	Yes	Yes	Yes
R3	46	Yes	Yes	Yes	Yes	2.1-2.2	NE-SE	Yes	Yes	Yes	Yes
R4 to R8	45	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R9	45	Yes	Yes	Yes	Yes	Yes	Yes	1.4-2.6	SE-W	Yes	Yes
R10	45	Yes	Yes	Yes	Yes	Yes	Yes	0.1-3.7	SE-W	Yes	Yes
R11	45	Yes	Yes	Yes	Yes	Yes	Yes	2.8-3.3	S-NW	2.2-2.9	S-NW
R12	45	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Days (Sundays and Public Holidays)											
R1	40	Yes	Yes	0.2	N-NE	Yes	Yes	Yes	Yes	Yes	Yes
R2	41	5.8-6.1	N-SE	2.2-10.5	ALL	2.7-11.2	ALL	Yes	Yes	Yes	Yes
R3	41	Yes	Yes	0.8-3.1	N-SE	3.1-7.2	N-S	Yes	Yes	Yes	Yes
R4 to R8	40	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R8	40	Yes	Yes	Yes	Yes	Yes	Yes	0.2-0.6	SE-SW	2.8-3.7	SE-W
R9	40	Yes	Yes	Yes	Yes	Yes	Yes	1.2-7.6	SE-NW	2.1-2.4	S-W
R10	40	Yes	Yes	Yes	Yes	Yes	Yes	4.7-8.7	SE-NW	3.5	S-W
R11	40	Yes	Yes	Yes	Yes	Yes	Yes	0.2-8.3	SE-N	7.2-7.9	S-NW
R12	40	Yes	Yes	Yes	Yes	Yes	Yes	2.0-2.1	SW-NW	Yes	Yes
Night											
R1	35	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	36	1.4-1.5	N-SE	1.0-5.4	NW-S	9.1-15.3	ALL	Yes	Yes	Yes	Yes
R3	36	0.7-0.9	N-SE	1.4-4.1	N-S	3.0-10.9	ALL	Yes	Yes	Yes	Yes
R4 to R7	35	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R8	35	Yes	Yes	Yes	Yes	Yes	Yes	0.6-2.9	SE-NW	Yes	Yes
R9	35	Yes	Yes	Yes	Yes	Yes	Yes	4.1-5.3	SE-NW	Yes	Yes
R10	35	Yes	Yes	Yes	Yes	Yes	Yes	1.5-4.6	SE-NW	1.8-3.0	SE-NW
R11	35	Yes	Yes	Yes	Yes	Yes	Yes	0.2-8.3	SE-NE	8.9-12.1	ALL
R12	35	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0.2-0.8	S-NW

Non-compliances with Noise Regulations are predicted under Scenarios 2, 3, 4, 5 and 6 if no controls are implemented.

10.5.4 Potential Impacts

Noise will be generated during construction and mining activities for the life of mine. Sources of noise include:

- Fixed plant: feed hopper, mining unit, concentrator, tails booster pump, dewatering pumps and lighting tower (diesel powered).
- Mobile plant; bulldozer, grader, water cart, excavator, front end loader, trucks.

The dominant noise sources when operational are the bulldozer and front end loader. Noise levels will vary depending on the type of activities and prevailing wind conditions. During pre-mine establishment construction activities will be limited to day time only. Mining using fixed plant will be conducted constantly, but the water cart and grader (which will not operate simultaneously) will operate during the day time only.

10.5.5 Assessment of Potential Impacts

The Development Envelope is primarily pastoral farmland and State Forest. SVT (2014) identified 12 noise sensitive (residential) receptors in the vicinity of the proposed mine (Figure 10-2). Predictions from the noise modelling indicate that exceedances of the statutory noise limits are likely during worst case wind direction at up to:

- Five residences during day operations on Mondays to Saturdays;
- Eight residences for day operations on Sundays and public holidays;
- Seven residences for night-time noise.

During mining west of Sues Road (Scenarios 2, 3 and 4), residences R1 to R3 may be affected. The worst affected is predicted to be residence R2, during night operations, with up to 15.3dB(A) exceedance of the noise limits predicted to occur under all wind directions. During day operations exceedances of the noise limits at R1 to R3 will be less than 6.2dB(A).

When mining east of Sues Road (Scenarios 5 and 6), residences R8 to R12 may be affected. The modelling predicts that under Scenario 5, winds generally from the southeast to northwest will cause exceedances of between 0.1dB(A) and 8.7dB(A) to these residences during day and night operations (including Sundays and public holidays). Under Scenario 6, residence R11 will be affected at night under all wind conditions, by noise levels up to 12.1dB(A) above the noise limits. Noise levels received at residences R8 to R10 and R12 will be non-compliant under mainly southerly to west/north-westerly winds by between 0.2dB(A) and 8.7dB(A). These predictions are based on worst case meteorological conditions for noise propagation.

10.5.6 Management Measures and Performance Standards

As the noise modelling predicts non-compliances with the Noise Regulations during mining, under worst case meteorological conditions, management measures will be implemented. During the pre-mine establishment phase, all construction work will be carried out in accordance with *AS 2436-2010 Guide to Noise and Vibration Control on Construction, Maintenance and Demolition Sites* with the quietest noise equipment feasible.

A Noise Management Plan will be prepared for the mine and will be included in Doral's EMS. The objective of the Noise Management Plan will be to maintain the amenity of neighbouring residences during mining operations. The Noise Management Plan will include noise management strategies and control measures to reduce noise levels to below noise limits.

The key strategy to reduce noise levels when mining the Haddon East sub-area (Scenario 6) to achieve compliance with night-time noise limits is to construct and maintain noise bunds. Four walls/bunds will be constructed as shown on Figure 1-2:

- A 5.5m high noise bund at the eastern end of block 2;
- A 2 m high noise bund adjacent to the pit dewatering pump;
- Increased height of the wall of SEP06 from 3m to 6m;
- Increase height of the wall of SEP08 from 3m to 5m.

SVT (2014) recommended that a noise bund be constructed on the western edge of block 25 to reduce the noise impacts at R2 and R3 (Scenario 4) when mining the Haddon West and State Forest sub-areas. The construction of the noise bund would provide compliance at R3 (using 3m bund) but only night time compliance (using 6.5m bund) at R2. Doral however recognise the significance of clearing vegetation within the State Forest (particularly for a noise bund) and as such propose to manage the impacts of noise on R2 and R3 through the use of amenity agreements.

In addition to noise bunds the following management strategies which are successfully implemented at the Dardanup Mine, will be implemented for the Proposal:

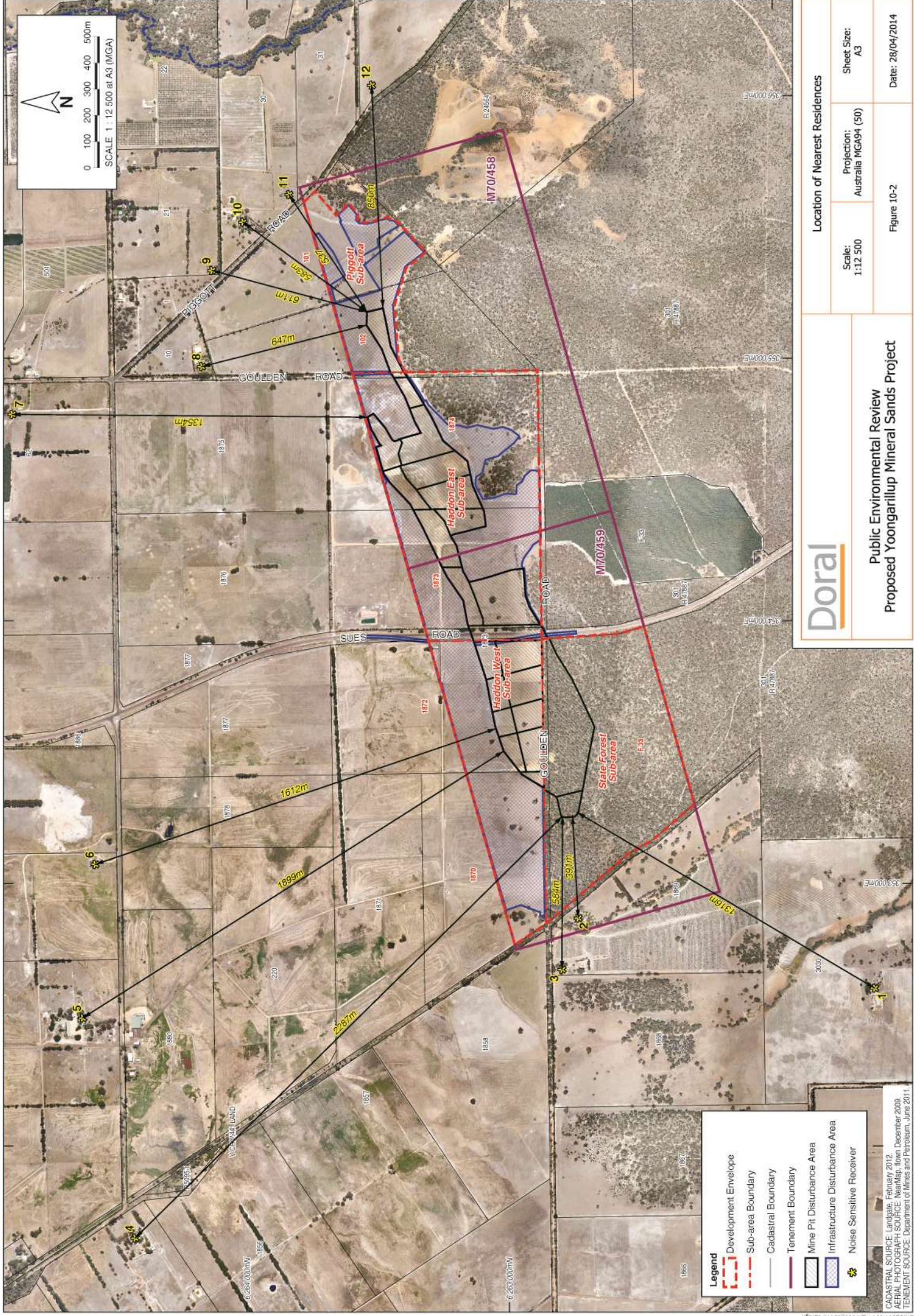
- Select quieter bulldozer or front end loader;
- Install silencers to reduce exhaust noise of the bulldozer and front end loader;
- Ensure that no overburden fleet or ore fleet will operate simultaneously in the same mining block at any one time;
- Restrict the operation of machinery relative to worst case weather conditions on Sundays and Public holidays to minimise potential noise impacts;
- Restrict the operation of ancillary machinery (water cart and grader) to only one in operation at a time and operate during day-time only;
- Establish preventative maintenance schedules for all vehicles, fixed plant and mobile equipment;
- Educate employees and contractors on the importance and requirements for noise management prior to commencing work on the mine, as part of the site induction process;
- Maintain ongoing effective dialogue with nearby residents to ensure noise impacts are communicated to Doral to allow for rapid resolution;
- Continue to implement an effective public comment and complaint communication system to ensure all concerns are received, recorded and acted upon.

If noise limits are exceeded after the above management strategies are implemented, the following contingency actions will be implemented:

- Attenuation of machinery where practicable;
- Temporary shutdown of relevant (noise generating) operations to ensure compliance during persistent wind conditions;
- Investigate and implement methods to reduce noise emissions in accordance with best practice;
- Temporary relocation of the mining fleet to alternate mining pit to ensure compliance with respect to worst case scenario wind conditions.

10.5.7 Predicted Environmental Outcomes

Doral are experienced at managing noise impacts associated with mineral sands mine sites. Noise levels associated with mining will be controlled as described above. Effective implementation of these noise management strategies will ensure noise emissions from the operations comply with the Noise Regulations. Therefore it is expected that the environmental objective for this matter can be met.



Public Environmental Review
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Location of Nearest Residences

Scale: 1:12 500	Projection: Australia MGA94 (50)	Sheet Size: A3
Figure 10-2		Date: 28/04/2014

Legend

- Development Envelope
- Sub-area Boundary
- Cadastral Boundary
- Tenement Boundary
- Mine Pit Disturbance Area
- Infrastructure Disturbance Area
- Noise Sensitive Receiver

CADASTRAL SOURCE: Landgate, February 2012
AERIAL PHOTOGRAPH SOURCE: GeoEye, June 2009
TENEMENT SOURCE: Department of Mines and Petroleum, June 2011

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11 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

The Proposal has the potential to affect the following Matters of NES:

- Listed Threatened species and communities (Sections 18 and 18A of the EPBC Act);
- Migratory species (Section 209 of the EPBC Act);
- Wetlands of international Importance (under the Ramsar Convention) (Section 16 and 17B of the EPBC Act).

11.1 RELEVANT ENVIRONMENTAL OBJECTIVES, LEGISLATION, POLICIES, GUIDELINES, STANDARDS AND PROCEDURES

11.1.1 EPBC Act Objectives

The EPBC Act objectives are to:

- *Provide for the protection of the environment, especially Matters of National Environmental Significance.*
- *Promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources.*
- *Control the international movement of wildlife, wildlife specimens and products made or derived from wildlife.*

11.1.2 Legislation, Policy and Guidelines

Australian Government Protection

The Australian Government EPBC Act protects species listed under Schedule 1 of the EPBC Act. In 1974, Australia became a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As a result, an official list of endangered species was prepared and is regularly updated. This listing is administrated through the EPBC Act. The current list differs from the various State lists however some species are common to both.

The EPBC Act aims to prevent significant impacts occurring to MNES, including threatened species, through assessment of proposed actions against the Matters of National Environmental Significance: Impact Guidelines (DSEWPac, 2013).

International Agreements

Australia is party to the Japan-Australia (JAMBA), China-Australia (CAMBA), Republic of Korea-Australia (ROKAMBA) Migratory Bird Agreements and the Convention on the Conservation of Migratory Species of Wild Animals. Most of the birds listed in these agreements are associated with saline wetlands of coastal shorelines and have little relevance to the Development Envelope; however, some migratory birds not associated with water are also listed on these international treaties.

11.2 EXISTING ENVIRONMENT

11.2.1 Matter of NES: Listed Threatened Species and Migratory Species

Based on the results of flora and vegetation surveys (Ecoedge Environmental, 2013; Matiske 2012a and 2012b) detailed in Section 0 and Fauna Surveys (Harewood, 2014) detailed in Section 7, two Threatened flora (Long-leaved - *Daviesia Daviesia elongata* subsp. *elongata* and Long-stalked Featherflower - *Verticordia densiflora* var. *pedunculata*), three Threatened fauna species (Forest Red-tailed

Black-Cockatoo, Baudin's Black-Cockatoo and Carnaby's Black-Cockatoo) and one Migratory bird species (Rainbow Bee-eater) listed under the EPBC Act are known to occur within the Development Envelope.

The status, distribution and habitat preferences, along with the results of targeted surveys and threats to each of these species is outlined below in Table 11-1.

TABLE 11-1: SUMMARY OF LISTED THREATENED SPECIES AND MIGRATORY SPECIES

Species	<i>Daviesia elongata</i> subsp. <i>elongata</i>	Table 11-1 (A)
Status and Distribution	<p><i>Daviesia elongata</i> subsp. <i>elongata</i>, is listed as Vulnerable under the EPBC Act and Threatened under the WC Act.</p> <p>The <i>Daviesia elongata</i> subsp. <i>elongata</i> has a restricted distribution as a result of specific ecological requirements, which has probably been further reduced by extensive clearing in the region. <i>Daviesia elongata</i> subsp. <i>elongata</i> is known from seven locations on the Swan Coastal Plain, in the Busselton area near Carburnup, approximately 200km south-southwest of Perth, Western Australia. It occurs in the Southwest Natural Resource Management Region (DEC, 2007). Of the seven known populations (DEC, 2007), one population occurs in a nature reserve which is managed for conservation of flora and fauna, although not specifically for this species. The remaining six subpopulations occur within State Forest, with the exception of subpopulations 1 and 2 which occur in Shire reserves (DEC, 2007). Known populations are healthy and not immediately threatened (DEC, 2007).</p> <p>The subspecies distribution is considered to be fragmented with considerable distance between populations (DEC, 2007). The extent of occurrence is estimated at 1442km². A dataset taken from the DPaW's Threatened Flora Database (which contains a single GPS coordinate for each subpopulation) was used to determine the area of occurrence.</p> <p>The area of occupancy for this subspecies is approximately 0.035km² (or approximately 3.56ha) based on averages of populations 1, 2 and 5. There is no data to indicate trends in the area of occupancy for this sub-species (DEC, 2007).</p>	
Habitat Preference	<p><i>Daviesia elongata</i> subsp. <i>elongata</i> occurs on grey sandy loam soils in low forest over heath with Jarrah (<i>Eucalyptus marginata</i>), <i>Dryandra squarrosa</i>, Round-fruited Banksia (<i>Banksia sphaerocarpa</i>), Jug-flower (<i>Adenanthos obovatus</i>), Blueboy (<i>Stirlingia latifolia</i>), <i>Allocasuarina</i> spp. and <i>Xanthorrhoea</i> spp. (Brown <i>et al.</i>, 1998; Williams <i>et al.</i>, 2001).</p>	
Results of Targeted Surveys	<p>Seven individual <i>Daviesia elongata</i> subsp. <i>elongata</i> were recorded within the Development Envelopment during a targeted flora survey conducted by Ecoedge Environmental (2013). All were found within the State Forest Sub-area (Figure 6-5).</p>	
Mapping	Figure 6-5	
Threats	<p>Past threats to the species include infection by dieback (<i>Phytophthora cinnamomi</i>), roadworks and drainage works, logging operations and prescribed burning. Current threats to the species include the plants tendency to senesce and its poor ability to regenerate. Firebreak maintenance, fire, roadworks and recreational activities will be threats to this species in the future.</p> <p>Several species within the genus <i>Daviesia</i> are considered susceptible to dieback caused by <i>Phytophthora cinnamomi</i>. While <i>Phytophthora</i> dieback is recorded as occurring in state forest in the vicinity of all populations, the subspecies does not yet appear to be affected by the pathogen (Brown <i>et al.</i>, 1998). Dieback may be a threat in the future if not managed appropriately.</p> <p>Weed infestation does not appear to be a significant threat to any of the known subpopulations (DEC, 2007). The taxon appears to be most vulnerable to stochastic events associated with small, isolated populations (DEC, 2007).</p>	

Species	<i>Verticordia densiflora</i> var. <i>pedunculata</i>	Table 11-1 (B)
Status and Distribution	<p><i>Verticordia densiflora</i> var. <i>pedunculata</i> is listed as Endangered under the EPBC Act and listed as Threatened under the WC Act.</p> <p>In Australia, <i>Verticordia densiflora</i> var. <i>pedunculata</i> is known from eight locations, south and east of Busselton and east of Manjimup, in the southwest of Western Australia (Williams <i>et al.</i>, 2001; DEC 2007). It occurs in the Southwest Natural Resource Management region.</p> <p><i>Verticordia densiflora</i> var. <i>pedunculata</i> extent of occurrence is 85km² and its area of occupancy is approximately 0.05km² (or approximately 4.7ha) (DEC, 2007).</p>	
Habitat Preference	<p><i>Verticordia densiflora</i> var. <i>pedunculata</i> grows on light yellow or grey sands in low-lying, winter-wet areas. It has been recorded as occurring with <i>Melaleuca viminea</i>, Preiss's Paperbark (<i>Melaleuca preissiana</i>), Redheart (<i>Eucalyptus decipiens</i>), Flooded Gum (<i>Eucalyptus rudis</i>), Jarrah (<i>Eucalyptus marginata</i>), Marri (<i>Corymbia calophylla</i>), Balga Grass (<i>Xanthorrhoea preissii</i>), Western Australian Christmas Tree (<i>Nuytsia floribunda</i>), <i>Hypocalymma angustifolium</i> and Blueboy (<i>Stirlingia latifolia</i>) (DEC 2007). The variety is associated with the Shrublands on Southern Swan Coastal Plain Ironstones, which is listed as an Endangered ecological community under the EPBC Act (Meissner and English, 2005).</p>	
Results of Targeted Surveys	<p>Nine individual <i>Verticordia densiflora</i> var. <i>pedunculata</i> were recorded within the Development Envelope during a targeted flora survey by Ecoedge Environmental (2013). All were found within the State Forest Sub-area (Figure 6-5).</p>	
Mapping	Figure 6-5	
Threats	<p><i>Verticordia densiflora</i> var. <i>pedunculata</i> has a restricted distribution which is probably caused by specific ecological requirements. The extent of occurrence of this species is likely to have been diminished by extensive clearing. The long term survival of this variant is threatened by clearing, degradation of road verges, small areas of remnant vegetation and pressure for development in the region (DEC, 2007).</p> <p>Weeds, inappropriate fire regimes, Rabbit (<i>Oryctolagus cuniculus</i>) grazing, Kangaroo (<i>Macropus</i> spp.) grazing, dieback caused by <i>Phytophthora cinnamomi</i>, roadworks and firebreak maintenance threaten subpopulations in varying intensities. Weeds of greatest concern are grassy weeds and <i>Patersonia</i> spp. frequent fire, too infrequent fire and fire during the flowering phase are all threats to <i>Verticordia densiflora</i> var. <i>pedunculata</i> (DEC, 2007).</p>	

Species	<i>Rainbow Bee-eater</i>	Table 11-1 (F)
Status and Distribution	<p>The Rainbow Bee-eater is listed as migratory under the EPBC Act, as Schedule 3 under the WC Act and under international agreements to which Australia is a signatory. It is a common summer migrant to southern Australia but in the north they are resident (Morcombe, 2004).</p> <p>This species is distributed across much of mainland Australia, and occurs on several near-shore islands but is not found in Tasmania. It is thinly distributed in the most arid regions of central and Western Australia (Barrett et al., 2003; Blakers et al., 1984; Higgins, 1999).</p> <p>The Rainbow Bee-eater also occurs in eastern Indonesia, including Bali, the Lesser Sundas and Sulawesi, and east to Papua New Guinea, the Bismarck Archipelago and, rarely, the Solomon Islands. It is a vagrant visitor to locations further north including Palau, south-western Micronesia, Saipan, the northern Mariana Islands, and Miyako Island and the southern Ryuku Islands in Japan. The majority of the global population breeds in Australia.</p> <p>The extent of occurrence and area of occupancy of the Rainbow Bee-eater in Australia has not been estimated but is known to be widespread.</p>	
Habitat Preference	<p>The Rainbow Bee-eater is listed as migratory under the EPBC Act, as Schedule 3 under the WC Act and under international agreements to which Australia is a signatory. It is a common summer migrant to southern Australia but in the north they are resident (Morcombe, 2004).</p> <p>This species is distributed across much of mainland Australia, and occurs on several near-shore islands but is not found in Tasmania. It is thinly distributed in the most arid regions of central and Western Australia (Barrett et al., 2003; Blakers et al., 1984; Higgins, 1999).</p> <p>The Rainbow Bee-eater also occurs in eastern Indonesia, including Bali, the Lesser Sundas and Sulawesi, and east to Papua New Guinea, the Bismarck Archipelago and, rarely, the Solomon Islands. It is a vagrant visitor to locations further north including Palau, south-western Micronesia, Saipan, the northern Mariana Islands, and Miyako Island and the southern Ryuku Islands in Japan. The majority of the global population breeds in Australia.</p> <p>The extent of occurrence and area of occupancy of the Rainbow Bee-eater in Australia has not been estimated but is known to be widespread.</p>	
Results of Targeted Surveys	<p>This species was heard calling during the field survey work in December 2011. This species may breed in some sections of the Development Envelope where ground conditions permit.</p>	
Mapping	-	
Threats	<p>The only actual, identified threat to the Rainbow Bee-eater is the introduced Cane Toad (<i>Bufo marinus</i>). Cane Toads reduce the breeding success and productivity of the Rainbow Bee-eater by feeding on eggs and especially nestlings, and usurping and occupying nesting burrows (Boland, 2004).</p>	

Species	<i>Forest Red-tailed Black-Cockatoo</i>	Table 11-1 (C)
Status and Distribution	Listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act the Forest Red-tailed Black-Cockatoo is endemic to southwest WA from Gingin in the north and east to Mt Helena, Christmas Tree Well, West Dale, North Bannister, Mt Saddleback, Kojonup, Rocky Gully, upper King River and east to the Green Range (Johnstone and Storr, 1998). Small isolated breeding populations are on the Swan Coastal Plain and can be found during the fruiting season of Cape Lilac (<i>Melia azederach</i>) (CALM, 2006; Stranger, 1997).	
Habitat Preference	<p>The Forest Red-tailed Black-Cockatoo prefers Eucalypt forests where it feeds on Marri, Jarrah, Blackbutt, Karri, Sheoak and Snottygobble and nests in the large hollows of Marri, Jarrah and Karri (Johnstone and Kirkby, 1999). In Marri the nest hollows of the Forest Red-tailed Black-Cockatoo range from 9-14m above ground, the entrance is 12-41cm in diameter and the depth is 1.5m (Johnstone and Storr, 1998).</p> <p>There are few records of breeding of the Forest Red-tailed Black-Cockatoo (Johnstone and Storr, 1998). Recent data however indicates that breeding in all months of the year occurs with peaks in spring and in autumn-winter (Ron Johnstone pers comms). Eggs are typically laid in October and November (Johnstone 1997; Johnstone and Storr, 1998) with an incubation period of 29-31 days. Young fledge at 8 to 9 weeks (Simpson and Day, 2004).</p>	
Results of Targeted Surveys	<p>The Forest Red-tailed Black-Cockatoo was sighted several times within the Development Envelope and nearby. Foraging evidence attributed to this species was also found (chewed Jarrah fruits). Almost all the remnant vegetation within the Development Envelope presents potential foraging habitat for this species, particularly Marri, Mountain Marri and Jarrah Species (Figure 7-1).</p> <p>Larger trees (>50cm DBH) are considered potential breeding habitat by DoE (DSEWPac, 2012a). Larger trees (>50cm DBH), some with one or more hollows, were recorded within State Forest sub-area (Figure 7-2). This species may also roost within the Development Envelope on occasions as several trees with evidence of roosting activity were observed within the State Forest sub-area (Figure 7-3).</p>	
Mapping	Figure 7-1, Figure 7-2, Figure 7-3	
Threats	The main threats to the Forest Red-tailed Black-Cockatoo are habitat loss, nest hollow shortage, competition for available nest hollows from other species, injury or death from the European Honeybee (<i>Apis mellifera</i>), illegal shooting (Chapman, 2005) and fire (CALM, 2006).	
Reference	The above details have been adapted from Harewood (2014).	

Species	<i>Baudin's Black-Cockatoo</i>	Table 11-1 (D)
Status and Distribution	<p>The Baudin's Black-Cockatoo is listed as Vulnerable under the EPBC Act and as Schedule 1 under the WC Act. The range of the species is confined to the southwest of Western Australia, north to Gidgegannup, east to Mount Helena, Wandering, Quindanning, Kojonup, Frankland and King River and west to the eastern strip of the Swan Coastal Plain including West Midland, Byford, Nth Dandalup, Yarloop, Wokalup and Bunbury (Johnstone and Storr, 1998). Breeding has been recorded in the far south of the range (Higgins, 1999; Saunders, 1979b; Storr, 1991).</p> <p>The extent of occurrence is estimated at 40,000km² based on published maps, and this estimate is considered highly reliable (Garnett and Crowley, 2000). No specific information is available on past changes in the extent of occurrence, however it is likely to have declined due to the clearance of habitat (Blyth, 2005 pers. comm.).</p>	
Habitat Preference	<p>The preferred habitat of Baudin's Black-Cockatoo is mainly Eucalypt forests where it feeds primarily on Marri seeds (Morcombe, 2004), <i>Banksia</i>, <i>Hakeas</i> and <i>Erodium</i> sp. They also strip bark from trees in search of Beetle larvae (Johnstone and Storr, 1998).</p> <p>Nests are built in large hollows in tall eucalypts, especially Karri, Marri and Wandoo (Johnstone & Storr 1998; Higgins 1999; Saunders, 1974, 1979b). As with other black cockatoos, Baudin's Black-Cockatoo nests in large vertical hollows of very long lived trees. Trees with hollows suitable for Baudin's Black-Cockatoo are likely to be >50cm DBH. As trees approaching this size are close to developing suitable hollows, trees below 50cm DBH are considered to have the potential to develop hollows and are therefore also important resources for Baudin's Black-Cockatoo.</p> <p>Preferred roosts are in areas with a dense canopy close to permanent sources of water, providing the birds with protection from weather conditions (Johnstone and Kirkby, 2008).</p>	
Results of Targeted Surveys	<p>Evidence of foraging attributed to this species (such as chewed Marri fruits) was found within the Development Envelope during the December survey. Almost all the remnant native vegetation within the study area presents potential foraging habitat for this species (Figure 7-1).</p> <p>Larger trees (>50cm DBH) are considered potential breeding habitat by DoE (DSEWPaC, 2012a). Larger trees (>50cm DBH), some with one or more hollows, were recorded within State Forest sub-area (Figure 7-2). This species may also roost within the Development Envelope on occasions as several trees with evidence of roosting activity were observed within the State Forest sub-area (Figure 7-3).</p>	
Mapping	Figure 7-1, Figure 7-2, Figure 7-3	
Threats	<p>Loss of habitat was formerly the major threat to Baudin's Black-Cockatoo, however the threat has abated for several reasons: the clearing of forest for agricultural purposes has largely ceased; areas of forest that contain nest sites, or that are likely to contain nest sites, are protected from harvest or clearing; and logging practices are monitored (Blyth, 2005 pers. comm.).</p> <p>The major threats to the species at present appear to be illegal shooting and competition with introduced bees for nest hollows (Blyth 2005, pers. comm.). Baudin's Black-Cockatoo can feed on and do damage to cultivated fruit in orchards (Halse, 1986; Long, 1985). To prevent such damage, the species was subject to</p>	

Species	<i>Baudin's Black-Cockatoo (cont.)</i>	Table 11-1 (D)
	<p>shooting under an Open Season Notice from the 1950s until 1989, when the notice was revoked (Mawson and Johnstone, 1997). The species has been protected since 1996 (Mawson and Johnstone, 1997), but illegal shooting may still be occurring (Garnett and Crowley, 2000).</p> <p>Baudin's Black-Cockatoo has a low annual reproductive rate of 0.6 young per pair (Storr, 1991), which limits the potential of the species to recover in the presence or aftermath of a threatening process.</p>	
Reference	The above details have been adapted from Harewood (2014).	

Species	<i>Carnaby's Black-Cockatoo</i>	Table 11-1 (E)
Status and Distribution	<p>Carnaby's Black Cockatoo is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act.</p> <p>It is endemic to and widespread in the southwest of Western Australia. Occurring mostly in the Wheatbelt in areas that receive 300-750mm of rainfall annually, it is also found in wetter regions in the far southwest. Its range extends north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock). Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20km east-southeast of Condingup and Cape Arid. It has also occasionally been seen on Rottnest Island (Johnstone and Storr, 1998).</p> <p>The extent of occurrence is estimated at 32,000km² based on Birdlife International GIS. This estimate is considered to be of medium reliability (Garnett and Crowley, 2000). The range of Carnaby's</p> <p>Black-Cockatoo is said to have contracted by more than 30% since the late 1940s (Mawson, 1997) and the species is also said to have disappeared from more than a third of its former breeding range between 1968 and 1990 (Saunders and Ingram, 1998).</p>	
Habitat Preference	<p>Carnaby's Black-Cockatoo prefers forest, woodlands, heathlands and farm environments where it feeds on Banksia, Hakea and Marri. This species has specific nesting site requirements - nests are mostly in smooth-barked Eucalypts with the nest hollows ranging from 2.5 to 12m above the ground, an entrance from 23-30cm diameter and a depth of 0.1-2.5m (Johnstone and Storr, 1998).</p> <p>Breeding occurs in winter/spring mainly in eastern forest and wheatbelt where they can find mature hollow bearing trees to nest in (Morcombe, 2004). Judging from records in the Storr-Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into Jarrah-Marri forest of the Darling Scarp and into the Tuart forests of the SCP including the region between Mandurah and Bunbury. Carnaby's Black-Cockatoo has been known to breed close to the town of Mandurah, as well as Dawesville, Lake Clifton and Baldivis (Ron Johnstone, WA Museum, pers. comm.) and there are small resident populations on the southern SCP near Mandurah, Lake Clifton and near Bunbury. At each of these sites the birds forage in remnant vegetation and adjacent pine plantations (Johnstone, 2008).</p> <p>Carnaby's Black-Cockatoo lays eggs from July or August to October or November, with most clutches being laid in August and September (Saunders, 1986). Most of the breeding is in September through to December (Ron Johnstone pers comms). Birds in inland regions may begin laying up to three weeks earlier than those in coastal areas (Saunders 1977). The female incubates the eggs over a period of 28-29 days. The young depart the nest 10-12 weeks after hatching (Saunders 1977; Smith and Saunders 1986).</p>	
Results of Targeted Surveys	<p>This species was sighted several times within the survey area and nearby. Foraging evidence (such as chewed Marri and Jarrah fruits) attributed to this species was also found. Almost all the remnant vegetation within the study area presents potential foraging habitat for this species (Figure 7-1).</p> <p>Larger trees (>50cm DBH) are considered potential breeding habitat by DoE (DSEWPaC, 2012a). Larger trees (>50cm DBH), some with one or more hollows, were recorded within State Forest sub-area (Figure 7-2).</p>	

Species	<i>Carnaby's Black-Cockatoo (cont.)</i>	Table 11-1 (E)
	This species may also roost within the Development Envelope on occasions as several trees with evidence of roosting activity were observed within the State Forest sub-area (Figure 7-3).	
Mapping	Figure 7-1, Figure 7-2, Figure 7-3	
Threats	<p>The decline of Carnaby's Black-Cockatoo is due primarily to the loss and fragmentation of habitat. This has been caused by the clearing of native vegetation, mainly for agricultural purposes, since the middle of the 20th century (Cale, 2003; Mawson and Johnstone, 1997; Saunders, 1979b, 1980, 1986, 1990; Saunders and Ingram, 1987, 1995, 1998; Saunders et al., 1985). Carnaby's Black Cockatoo is a highly mobile species. They move sequentially through the landscape, utilising different habitat types at different times of the year, makes them especially vulnerable to the loss, fragmentation or degradation of any one component of the landscape.</p> <p>The long-term survival of Carnaby's Black-Cockatoo depends on the persistence of suitable breeding habitat (i.e. woodland), nest-sites (i.e. tree hollows) and foraging habitat (e.g. heathlands) capable of providing enough food to sustain the population. At present, the loss of foraging habitat is thought to pose the greatest risk to the species (Saunders and Ingram, 1998).</p> <p>The breeding habitat of Carnaby's Black-Cockatoo has also been extensively cleared (Garnett and Crowley, 2000). Hollow-bearing trees that are suitable for nesting are now located in remnant patches of woodland and at sites where selected trees have been retained in areas that have otherwise been cleared of native vegetation (Saunders and Ingram, 1998).</p> <p>The impact of clearing has also had other consequences for the remaining habitat. In some areas, the remnant native vegetation has become threatened by an increase in the salinity of soils (Mawson and Johnstone, 1997; Snyder et al., 2000). Clearing also exposes remnant habitats to invasion by weeds and, potentially, other processes that will degrade the habitat.</p> <p>Other threats include Competition for nest hollows, Illegal trade predation by Wedge-tailed Eagles <i>Aquila audax</i>, collisions with cars, drowning and entrapment in tree hollows (Saunders, 1982).</p> <p>Carnaby's Black-Cockatoo is a long-lived species (Higgins, 1999; Saunders and Ingram, 1998) that does not breed until four years of age (Saunders, 1982, 1986), has an estimated generation time of 15 years (Cale, 2003; Garnett and Crowley, 2000) and has a low rate of productivity (i.e. most successful pairs fledge only one young per year) (Saunders, 1982). These characteristics limit the potential of the species to sustain numbers or to recover in the presence or aftermath of a threatening process.</p>	
Reference	The above details have been adapted from Harewood (2014).	

11.2.2 Matter of NES: Wetlands of International Importance (under Ramsar Convention)

The Vasse-Wonnerup System is listed as a Wetland of International Importance (under the Ramsar Convention) and is located approximately 14km north of the Development Envelope (Figure 1-1). Hydrogeological investigations and hydrology assessments undertaken by Parsons Brinckerhoff (refer to Section 8 and Appendix 8) investigated the potential hydrological and physico-chemical impacts of the Proposal on the Vasse-Wonnerup System Ramsar wetland.

Groundwater Drawdown

Parsons Brinckerhoff prepared a numerical groundwater flow model (PB, 2014a) to assess the dewatering requirements and groundwater drawdown associated with the development of the Proposal. Results of PB (2014a) showed that during the short-term dewatering of mine pits the maximum extent of drawdown to the north of the Development Envelope is predicted to be 350 m. Given the Vasse-Wonnerup System Ramsar wetland is over 14km away from the Proposal (Figure 1-1) the system will not be affected by dewatering of mine pits

Emergency Discharge

The proposed locations for emergency discharge of water are shown on Figure 8-6. Emergency discharge of water will not occur until strict water quality criteria are met (see Section 8.4.5). Once discharged, water will move through paddock drains north of the mine, where water is likely to sit until it evaporates. Paddock drains are separate to major diversion drains in the region therefore there is no pathway for the discharged water to move into the Vasse-Wonnerup System Ramsar wetland.

Section 8.4 provides further details of predicted groundwater drawdown impacts and management of the emergency discharge of water.

11.3 POTENTIAL IMPACTS

Activities or aspects of the Proposal that may potentially affect Matters of NES, not considering mitigation efforts, include:

- Vegetation clearing for development within the mining areas could potentially impact threatened fauna habitat and/or directly impact threatened flora;
- Dewatering activities may negatively affect groundwater-dependent vegetation and therefore the condition of threatened fauna habitat;
- Spread of dieback and weeds may negatively affect vegetation health and therefore the condition of threatened fauna habitat and/or nearby populations of threatened flora (dieback is considered a threat to *Daviesia elongata* subsp. *elongata*; Dieback and weeds are considered a threat to *Verticordia densiflora* var. *pedunculata*);
- Changes to fire regime from introduced ignition sources may affect nearby populations of threatened flora (alteration of fire regime is considered a threat to *Daviesia elongata* subsp. *elongata* and the *Verticordia densiflora* var. *pedunculata*). Wildfire is considered a threat to Black-Cockatoos through habitat destruction (loss of older hollow bearing trees) and loss of foraging habitat;
- Vehicle strikes from vehicle movement during construction and operation may result in the loss of individual threatened fauna (vehicle strikes is considered a threat to Carnaby's Black-Cockatoo).

11.4 ASSESSMENT OF POTENTIAL IMPACTS

11.4.1 Threatened Flora (*Daviesia elongata* subsp. *elongata* and *Verticordia densiflora* var. *pedunculata*)

Potential Impacts to *Daviesia elongata* subsp. *elongata* and *Verticordia densiflora* var. *pedunculata* include clearing, the spread of dieback and weeds and changes in fire regime.

Six individuals of *Daviesia elongata* subsp. *elongata* will be removed through clearing of vegetation. These six individuals represent 0.59% of the known population of 1016 mature plants (DEC, 2007). It is not considered that the removal of these individuals will result in a significant impact on the population (refer to Section 6.4.1). No *Verticordia densiflora* var. *pedunculata* individuals will be cleared.

There is a risk that dieback could spread from potentially infested paddock areas (mapped as dieback uninterpretable) and/or infested vegetation area on the west and east of the State Forest sub-area (west of Sues Road) to un-infested areas within the State Forest sub-area. The paddocks are uninterpretable and are therefore assumed to be infested. To manage the risk of dieback spreading into the disease-free areas of State Forest sub-area, Doral will prepare a Dieback Management Plan (detailed in Section 10.3.4). The key performance standard is at the cessation of mining the 'protectable' area of state forest will remain unaffected by dieback. This standard will be measured through dieback mapping post-mining, in consultation with DPaW as required.

Strict weed hygiene measures will be implemented to reduce the risk of weed introduction into adjacent uncleared areas and areas that are largely weed-free. This will include regular monitoring of weed cover and weed spraying programs. Measures will be implemented to target the control of the Declared Plant *Zantedeschia aethiopica*. Weed management will be included in Doral's Flora Management Plan.

Construction and operation of the Proposal will increase the risk of accidental fire. Fire risk will be managed through the development of a Fire Management Plan which will include procedures for mobile refuelling of equipment/machinery, storage of flammable substances, preparation and maintenance of fire breaks and a fire response procedure.

With consideration to the significant impact criteria for Vulnerable and Endangered species (DSEWPac, 2013) no significant impacts to *Daviesia elongata* subsp. *elongata* or *Verticordia densiflora* var. *pedunculata* will result from the implementation of the Proposal as:

- No *Verticordia densiflora* var. *pedunculata* individuals will be removed through clearing;
- Removal of six individuals of *Daviesia elongata* subsp. *elongata* will not result in a significant impact on the population (0.59%);
- Strict weed hygiene measures and dieback management will ensure that invasive species and diseases do not spread and cause these species to decline;
- Fire management controls will reduce the risk of wildfire.

11.4.2 Threatened Flora (Black Cockatoos)

Given the similar habitat requirements, the following species have been considered together:

- The Forest Red-tailed Black-Cockatoo;
- Baudin's Black-Cockatoo;
- Carnaby's Black-Cockatoo.

Loss of foraging, breeding and roosting opportunities will occur as a result of the Proposal. The Proposal will result in clearing 8.68ha of Black-Cockatoo foraging and breeding habitat within the State Forest sub-area.

The remnant native vegetation within the State Forest sub-area to be cleared represents potential Black-Cockatoo foraging habitat as the area contains plant species documented as foraging habitat for one or more of the three Black-Cockatoo species known to frequent the area. Evidence of all three Black-Cockatoo species foraging within the Development Envelope was found. Evidence observed was primarily in the form of chewed Jarrah/Marri fruits and *banksia* cones and to a lesser extent Mountain Marri fruits. Most of the evidence observed was attributed to the Forest Red-tailed Black-Cockatoo.

The habitat to be cleared is known to contain 110 identified black cockatoo habitat trees (i.e. DBH >50cm). Of the habitat trees 44, (40%) were not observed to contain hollows of any size, 56 trees (51%) contained one or more “small” hollows (~ less than 12cm entrance size) considered by Harewood (2014) not to be suitable for black cockatoos to use for nesting purposes and 10 (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 (Harwood, 2014).

One tree is to be cleared (of four total within the State Forest sub-area) that showed signs of being used as a roost site by Black-Cockatoos (numerous droppings and branch clippings). No direct evidence (i.e. actual Black-Cockatoos) of the trees being used for roosting was seen during either of the seasonal surveys and it seems, based on this observation alone, that the roost trees seen may only be used on a “rotational” basis with other roost trees in the general area.

Given the presence of foraging, breeding and roosting habitat within the area to be cleared the Proposal is regarded as having a “high risk of significant” impact using referral guidelines issued by DoE (DSEWPaC, 2012a). However, Doral considers that the reduction in the availability of foraging, breeding and roosting habitat for three conservation significant Black-Cockatoo species is temporary only, and that there is predicted to be an overall net gain in Black-Cockatoo foraging, breeding and roosting habitat as a consequence of rehabilitation of mined areas in combination with long-term conservation offsets proposed (refer to Section 9 and 12 respectively).

11.4.3 Migratory Species Rainbow Bee-eater

Clearing 8.68ha of native vegetation within the State Forest sub-area has the potential to remove the habitat of this species. Given the widespread occurrence of this species in the region and within Australia, with consideration to the significant impact criteria for Migratory species (DSEWPaC, 2013) no significant impacts on this species are anticipated as:

- Individuals present are unlikely to represent an ecologically significant proportion of the population of the species;
- The habitat to be cleared is not considered an area of critical importance to the life cycle of the species;
- The Proposal will not result in the introduction of an invasive species that is harmful to the Rainbow Bee-eater.

11.4.4 Vasse-Wonnerup System Ramsar Wetland

No adverse impacts to the Vasse-Wonnerup System Ramsar wetland is expected from groundwater drawdown or emergency water discharge as:

- During the short-term dewatering of mine pits the maximum extent of drawdown to the north of the Development Envelope is predicted to be 350m (the Ramsar wetland is over 14km away);
- Paddock drains are separate to major diversion drains in the region therefore there is no pathway for the discharged water to move into the Vasse-Wonnerup System Ramsar wetland (Figure 8-6).

11.5 MANAGEMENT MEASURES AND PERFORMANCE STANDARDS

Doral's overall principles for managing the impacts to matters of NES for the Proposal are to:

- Minimise native vegetation clearing and land disturbance;
- Meet the Commonwealth laws governing flora and fauna conservation as contained in the EPBC Act;
- Conduct pre-clearing surveys;
- Implementation of specific clearing procedures including the demarcation of cleared areas and authorisation requirements;
- Monitor vegetation health in adjacent undisturbed vegetation located with the State Forest sub-area;
- Minimise the timeframe between disturbance and rehabilitation.

The potential impacts to matters of NES will be managed through the development and implementation of several management plans. Those plans specific to the protection and management of Matters of NES include:

- A Fire Management Plan;
- A Dieback Management Plan (refer to Section 10.3.4);
- A Flora and Vegetation Management Plan (refer to Section 6.5.1);
- A Fauna Management Plan (refer to Section 7.5).

Residual Impacts will be managed through appropriate offsets.

11.6 PREDICTED ENVIRONMENTAL OUTCOMES

After mitigation measures have been applied, the Proposal is expected to result in the following outcomes in relation to matters of NES:

- No Impacts to the Vasse-Wonnerup Wetland System are expected;
- Six (6) individuals (representing 0.59% of the known population) of *Daviesia elongata* subsp. *elongata* will be removed as a result of clearing. However this is not considered to constitute a significant impact to this species under the EPBC Act;
- No impacts to *Verticordia densiflora* var. *pedunculata* are expected;
- Given the widespread occurrence of the species and the range of habitats available throughout the region and Australia it is considered that the Rainbow Bee-eater will not be significantly affected by the Proposal;
- It is likely that the Proposal will result in a temporary reduction in the availability of foraging, breeding and roosting habitat for three conservation significant Black-Cockatoo species (i.e.

8.68ha). However, there is predicted to be an overall net gain in Black-Cockatoo foraging, breeding and roosting habitat as a consequence of rehabilitation of mined areas in combination with long-term conservation offsets proposed (refer to Section 9 and 12 respectively);

- No fauna or flora of conservation significance listed under the EPBC Act will cease to exist or have its conservation status affected as a result of the Proposal.

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12 RESIDUAL RISK MANAGEMENT (OFFSETS)

12.1 PURPOSE AND SCOPE OF THIS SECTION

The assessment of environmental factors presented in Sections 6, 7 and 11 describe a number of residual impacts (not considered significant) that are unable to be avoided, minimised, rectified or reduced. This section details the proposed strategy to offset these residual impacts. The proposed offset strategy addresses residual impacts to environmental values relevant to the State as assessed by the EPA, and Matters of NES as assessed by the DoE.

Specifically, the proposed offset strategy outlines Doral's approach to achieving a net environmental benefit from the Proposal following the unavoidable residual impact of clearing 8.68ha of Yelverton vegetation within the Whicher Scarp soil-landscape system. In addition Doral is committed to achieving long-term conservation gains for the Forest Red-tailed Black-Cockatoo, Baudin's Black-Cockatoo and Carnaby's Black-Cockatoo, in response to the predicted impacts to foraging and potential breeding habitat.

The proposed offsets strategy aims to secure a positive environmental outcome by securing established vegetation on a 'like for like' basis (or as near to as practical). Doral has held discussions with DPaW to identify a suitable offset site through land acquisition.

12.2 EPA OBJECTIVE

To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.

12.3 OFFSETS POLICIES, GUIDELINES AND DOCUMENTS

The relevant policy and guidelines which provide a framework for offsets for both State and Commonwealth governments are described in Table 12-1 and Table 12-2.

TABLE 12-1: STATE GOVERNMENT – RELEVANT OFFSET POLICIES AND GUIDELINES

Policy / Guideline	Overview
Position Statement No. 9 Environmental Offsets (EPA, 2006c)	Position Statement No. 9 sets out the EPA's views on environmental offsets. The EPA considers that environmental offsets should be included, where appropriate, as part of approvals for environmentally acceptable projects to maintain and wherever possible enhance the State's environment. To this end, Position Statement No. 9 establishes a purpose, scope and principles for environmental offsets that the EPA will consider in future advice and recommendations.
<i>Western Australian Environmental Offsets Policy, September 2011 (EPA, 2011)</i>	This Policy seeks to ensure that environmental offsets are applied in specified circumstances in a transparent manner to engender certainty and predictability, while acknowledging that there are some environmental values that are not readily replaceable. It serves as an overarching framework to underpin environmental offset assessment and decision-making in Western Australia.

Policy / Guideline	Overview
<p><i>Final Guidance Statement No 19 – Environmental offsets – Biodiversity September 2008 (EPA, 2008)</i></p>	<p>This Guidance Statement specifically addresses environmental offsets for proposals or schemes that impact on biodiversity. It should be read in conjunction with Position Statement No. 9 <i>Environmental Offsets</i> (EPA, 2006c).</p> <p>Environmental offsets are required by the EPA to counterbalance unavoidable adverse environmental impacts. Ideally the offset will achieve a net environmental benefit rather than replacement on a 'one for one' basis. In considering environmental offsets, the EPA will have regard to the following eight principles:</p> <ul style="list-style-type: none"> A. Environmental offsets should only be considered after all reasonable attempts to mitigate adverse impacts have been exhausted; B. An environmental offset package should address both direct offsets and contributing offsets, as appropriate; C. Environmental offsets should ideally be 'like for like or better'; D. Positive environmental offset ratios should apply where risk of failure is apparent; E. Environmental offsets must entail a robust and consistent assessment process; F. Environmental offsets must meet all statutory requirements; G. Environmental offsets must be clearly defined, publicly registered, transparent, auditable and enforceable; H. Environmental offsets must ensure a long lasting benefit.

TABLE 12-2: COMMONWEALTH GOVERNMENT – RELEVANT OFFSET POLICIES AND GUIDELINES

Policy / Guideline	Overview
<i>Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy Oct 2012 (DSEWPaC, 2012b).</i>	<p>This Policy Statement provides a description of the types of offsets that may be applied when impacts cannot be adequately reduced through avoidance and mitigation. Eight principles for environmental offsets are provided.</p> <p>Suitable offsets must:</p> <ol style="list-style-type: none"> 1. deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action 2. be built around direct offsets but may include other compensatory measures 3. be in proportion to the level of statutory protection that applies to the protected matter 4. be of a size and scale proportionate to the residual impacts on the protected matter 5. effectively account for and manage the risks of the offset not succeeding 6. be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action, see section 7.6) 7. be efficient, effective, timely, transparent, scientifically robust and reasonable 8. have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.
<i>Environment Protection and Biodiversity Conservation Act 1999 referral guidelines for three threatened black cockatoo species: Carnaby's Black-Cockatoo (endangered) Calyptorhynchus latirostris, Baudin's Black-Cockatoo (vulnerable) Calyptorhynchus baudinii and Forest red-tailed Black-Cockatoo (vulnerable) Calyptorhynchus banksii naso (DSEWPaC, 2012a).</i>	<p>These Guidelines provide assistance in determining whether your action needs to be referred to the DoE. The Guidelines refer to Black-Cockatoos only (Forest red-tailed, Baudin's, Carnaby's).</p>

Policy / Guideline	Overview
<i>Black Cockatoos on the Swan Coastal Plain. Report for the Department of Planning Western Australia (Johnstone and Kirkby, 2007).</i>	This report provides information regarding the distribution, status, breeding, food, movements and historical changes to Carnaby's Black-Cockatoo, Baudin's Black-Cockatoo and the Forest Red-tailed Black-Cockatoo on the Swan Coastal Plain

12.4 ASSESSMENT OF OFFSET REQUIREMENTS

12.4.1 Proposal Summary

The proposal is outlined in detail in Section 3 of this report. In summary, Doral proposes to extract ore from the strand of heavy mineral deposit, known as the Yoongarillup Mineral Sands Deposit. The life of mine is expected to be three years, including an initial pre-mine establishment phase and three mining phases. Rehabilitation and mine closure will be implemented at the cessation of mining; this phase is likely to take up to five years. The Proposal has a total ground disturbance of 96ha within a Development Envelope of 152ha. A total of 87ha of the disturbance area is located on previously cleared farmland (currently used for farming beef cattle, dairy cattle and pasture), with just under 9ha located within State Forest No. 33. Evidence of past clearing by others within the 9ha area can be found. This previously cleared area has now regenerated, details of which are presented in Section 6. 0.22 ha of the 9ha remains cleared as a result of a sand pit (by others) and an unsealed section of Goulden Road.

12.4.2 Mitigation Measures

Doral has incorporated significant modifications to the Proposal to avoid, minimise, rectify or reduce impacts on environmental factors. Specifically Doral has reduced the extent of native vegetation clearing within the State Forest sub-area from 20ha (as specified in the original referral to the EPA) to just under 9ha, a reduction of approximately 56%. In addition, environmental management commitments detailed in Section 6.5 and Section 7.5 will further limit the extent of impacts during construction and operation of the Proposal, resulting in a limited number of unavoidable residual impacts.

12.4.3 Summary of Residual Impacts

State Government

Following the application of mitigation and management measures, a residual impact of 8.68ha of native vegetation (containing one Threatened and two Priority listed flora) will occur as a result of the Proposal. Doral has demonstrated in Section 0, that these impacts are not considered to be significant for the following reasons:

- Clearing for the Proposal represents 0.04% of the original pre-European vegetation extent and 0.09% of the area remaining of the Whicher Scarp soil-landscape system and does not significantly reduce the regional extent of this soil-landscape system;
- Clearing for the Proposal represents 0.10% of the original pre-European vegetation extent and 0.25% of the area remaining for the Yelverton (Y) vegetation complex and does not significantly reduce the extent of this vegetation complex and is in keeping with the target's set in the EPA's Position Statement No. 2 (EPA, 2000) (i.e. 30% or more);
- No PEC or TEC will be impacted by the Proposal;

- Impacts to the Threatened flora *Daviesia elongata subsp. elongata* are not considered to be significant as only six individuals (0.59%) of the known population of 1016 mature plants (DEC, 2007), will be impacted. This species is known from seven locations of which one is located within a nature reserve which is managed for conservation of flora and fauna. The other subpopulations are located with State forests, with the exception of subpopulations 1 and 2 which occur in Shire reserves (DEC, 2007). Known populations are healthy and not immediately threatened (DEC, 2007);
- Populations of the Priority flora *Conospermum paniculatum* (P3) and *Acacia semitrullata* (P4) will be reduced, however these species are known from several locations outside of the Development Envelope. It is considered that the conservation status of these species is unlikely to change.

For the reasons described above, Doral considers the impacts of the proposal to flora and vegetation are not significant.

Commonwealth Government

Based on fauna habitat mapping by Harewood (2014) and the known habitat requirements of the Forest Red-tailed Black-Cockatoo, Baudin's Black-Cockatoo and Carnaby's Black-Cockatoo, development of the Proposal will result in a residual impact of 8.68ha (110 habitat trees >50cm DBH) of Black-Cockatoo foraging habitat and potential breeding habitat.

The habitat to be cleared is known to contain 110 identified Black-Cockatoo habitat trees (i.e. DBH >50cm). Of the habitat trees 44, (40%) were not observed to contain hollows of any size, 56 trees (51%) contained one or more "small" hollows (~ <12cm entrance size) and 10 trees (9%) trees contained hollows with larger entrances (~ >12cm). Harewood (2014) considered that the "small" hollows are not suitable for Black-Cockatoos to use for nesting purposes but the "large" hollows appeared big enough and orientated favourably to possibly allow the entry of a Black-Cockatoo. Of the trees containing "large" hollows, there was no evidence of current or past use by Black-Cockatoos (Harewood, 2014).

One tree to be cleared (of the four within the State Forest sub-area) showed signs of being used as roost site by Black-Cockatoos (numerous droppings and branch clippings). No direct evidence (i.e. actual Black-Cockatoos) of the trees being used was observed during either of the seasonal surveys and it seems, based on this observation alone, that the roost trees seen may only be used on a "rotational" basis with other roost trees in the general area.

Table 12-3 summarises the residual impacts of the Proposal after mitigation measures have been applied.

TABLE 12-3: SUMMARY OF RESIDUAL IMPACTS FOR THE PROPOSAL

ENVIRONMENTAL FACTOR	EXTENT OF IMPACT	RELEVANT AGENCY
Native Vegetation	Clearing of 8.68ha of Excellent to Very Good quality Yelverton vegetation within the Whicher Scarp soil-landscape system containing one Threatened and two Priority listed flora species.	EPA

ENVIRONMENTAL FACTOR	EXTENT OF IMPACT	RELEVANT AGENCY
Black-Cockatoo Habitat and Potential Breeding Habitat	<p>Loss of foraging, breeding and roosting opportunities will occur as a result of the proposal. The proposal will result in clearing 8.68ha of Black-Cockatoo foraging and breeding habitat. This habitat is known to contain 110 identified black cockatoo habitat trees (i.e. DBH >50cm), of which 56 trees contain small hollows not suitable for a Black-Cockatoo, 10 trees containing large hollows possibly suitable for a Black-Cockatoo and 1 night roosting site.</p> <p>Although the proposal will result in a short-term loss of habitat for the Black Cockatoo, there is predicted to be an overall net gain in Black-Cockatoo foraging, breeding and roosting habitat as a consequence of rehabilitation of mined areas in combination with the provision of long-term conservation offsets.</p>	DoE

Doral has always promoted a proactive approach to sustainability and responsible environmental performance, as such, they are committed to providing a net benefit for environmental conservation for the State. Through the provision of an environmental offset package on a 'like for like' principle (or as near as practicable), they believe that a positive outcome for environmental conservation can occur.

12.5 PROPOSED OFFSET STRATEGY

Doral is committed to delivering an offset strategy that addresses the requirements of both the State and Commonwealth Offset Policies. This will be achieved through the provision of both direct and indirect (contributing or compensatory) offsets.

Doral intend to use land acquisition as its primary method for providing a direct offset for the proposal. Doral have commenced discussions with DPaw (Section 4.1) to identify a suitable site or sites with conservation values that address the residual impacts of the proposal. These discussions are ongoing and further details on proposed offset sites are included in Appendix 16-B (Note: Appendix 16-B contains commercially sensitive information and will only be available for review by those government agencies directly involved in the assessment of environmental offsets. Appendix 16-B will not be provided for public review.). Further consultation with the DoE will also be undertaken to ensure all the Commonwealth offset requirements are addressed.

In identifying suitable offset sites, Doral will achieve the following:

- Secure, for conservation purposes, parcels of land within the Whicher Scarp that have conservation values that, in their present condition, are acceptable to the relevant government agencies; and/or
- Secure, for conservation purposes, parcels of land within the Whicher Scarp that have conservation values that, through the implementation of a rehabilitation program, will be acceptable to the relevant government agencies within an agreed timeframe;

Doral will also undertake post-mining rehabilitation and revegetation of the 8.68ha of State Forest No. 33 to be cleared as a result of this proposal. This will, over time, reduce the long-term impact of the proposal on the environment.

Supplementing the direct offsets, and in consultation with the relevant agencies, Doral will develop a package of contributing/compensatory offset activities that complement the direct offsets provided for the proposal. These contributing offsets will include, but not be limited to:

- Control of weeds
- Control of feral animals
- Maintaining the existing diversity of native flora and fauna (post rehabilitation) through the use of visual monitoring and photopoints.

A summary of the proposed environmental offsets strategy, as required by Principal G of EPA (2008) is detailed in Table 12-4. A review of the proposed Offset Strategy against the Commonwealth Offset Policy principles is detailed in Table 12-5.

TABLE 12-4: OFFSETS REPORTING FORM

SECTION A: ADMINISTRATIVE INFORMATION
<p>1. Proposal or scheme name: Yoongarillup Mineral Sands Project</p> <p>2. Summary of proposal or scheme: The Yoongarillup Mineral Sands Project (i.e. the Proposal) is located on mining tenements M70/458 and M70/459 approximately 17km southeast of Busselton and 250km south of Perth, Western Australia in the City of Busselton. Ore from the deposit will be mined progressively via a series of open-cut pits using dry mining techniques and processed onsite to produce a heavy HMC. The Proposal has a disturbance area of 95.71ha, which includes clearing of 8.68ha of native vegetation.</p>
<p>SECTION B: TYPE OF ENVIRONMENTAL ASSET (S) <i>State whether critical or high value, Describe the environmental values and attributes</i></p> <p>Critical Assets:</p> <ul style="list-style-type: none"> One listed Threatened flora species <i>Daviesia elongata subsp. elongata</i> (six individuals) will be impacted by the Proposal, although Doral consider the impact to not be significant (refer Section C below). <p>High Value Assets:</p> <ul style="list-style-type: none"> The area to be disturbed (8.68ha) is located within the Whicher Scarp soil-landscape system and is considered to be a High Value asset based on “vegetation that is good to excellent condition, is considered valuable by the community and/or government” (EPA, 2006c). Two Priority listed species <i>Conospermum paniculatum</i> (P3) and <i>Acacia semitrullata</i> (P4) will be impacted by the Proposal.
<p>SECTION C: SIGNIFICANT IMPACTS <i>Describe the significant adverse environmental impacts related to the proposal or scheme before mitigation measures are applied</i></p> <p>Doral considers the impacts of clearing 8.68ha of native vegetation, containing One Threatened and two Priority listed flora species as not significant for the following reasons:</p> <ul style="list-style-type: none"> Clearing for the Proposal represents 0.04% of the original pre-European vegetation extent and 0.09% of the area remaining of the Whicher Scarp soil-landscape system and does not significantly reduce the regional extent of this soil-landscape system; Clearing for the Proposal represents 0.10% of the original pre-European vegetation and 0.25% of the area remaining for the Yelverton (Y) vegetation complex and does not significantly reduce the extent of this vegetation complex and is in keeping with the target’s set in the EPA’s Position Statement No. 2 (EPA, 2000) (i.e. 30% or more); No PEC or TEC will be impacted by the Proposal; Impacts to the Threatened flora <i>Daviesia elongata subsp. elongata</i> are not considered to be significant as only 0.59% of the known population of 1016 mature plants (DEC, 2007), will be impacted. This species is known from seven locations of which one is located within a nature reserve which is managed for conservation of flora and fauna. The other subpopulations are located with State forests, with the exception of subpopulations 1 and 2 which occur in Shire reserves (DEC, 2007). Known populations are healthy and not immediately threatened (DEC, 2007); and Populations of the Priority flora <i>Conospermum paniculatum</i> (P3) and <i>Acacia semitrullata</i> (P4) will be reduced, however these species are known from several locations outside of the Development Envelope. It is considered that the conservation status of these species is unlikely to change.

SECTION D: MITIGATION MEASURES*Describe all measures to avoid, minimise, rectify and reduce*

Doral has applied the following mitigation measures to avoid, minimise, rectify and reduce the impacts to the listed High Value assets:

- Doral has reduced the area of clearing from 20ha to 8.68ha (approximately 56% reduction) in order to minimise the impacts to native vegetation and flora; and
- Commitment to implement environment management plans including the following :
 - Flora Management Plan;
 - Rehabilitation Management Plan;
 - Dieback Management Plan;
 - Dust Management Plan; and
 - Fire Management Plan.

SECTION E: SIGNIFICANT RESIDUAL IMPACTS*Describe all the significant adverse residual impacts that remain after all mitigation attempts have been exhausted*

Doral considers a residual impact of 8.68ha of native vegetation (containing one Threatened and two Priority listed flora species) will remain as a result of implementing the Proposal. Due to the small proportion of this impact in relation to the overall population of these species, the impact is not considered to be significant.

SECTION F: PROPOSED OFFSETS FOR EACH SIGNIFICANT RESIDUAL IMPACT*Identify direct and contributing offsets – include a description of the land tenure and zoning, reservation status of the proposed offset site.**Identify any encumbrances or other restrictions on the land that may impact the implementation of the proposed offset and provide evidence demonstrating how these issues have been resolved*

Doral is committed to providing an offsets package for the Yoongarillup Mineral Sands Project that addresses the requirements of both the WA Environmental Offsets Policy and the EPBC Act Environmental Offsets Policy as detailed in Section 12.3 and results in securing a net environmental conservation benefit.

To achieve this, Doral will commit funds to acquire land for conservation purposes with a preference of securing established Whicher Scarp vegetation on a 'like for like', or as near to as is practicable, principle. Doral has commenced discussions with DPaW with the aim of identifying suitable land parcel(s) for use as environmental offsets for this proposal and discussions with them are ongoing.

A number of potential sites have been identified, for which Doral will engage suitably qualified persons to undertake relevant technical studies (flora/fauna) to assess the sites suitability for use as an environmental offset to be determined. Details of potential sites to be used for environmental offsets and studies completed and proposed on these sites are included in 0 of the Yoongarillup Mineral Sands Project – Public Environmental Review document. Due to commercial sensitivities, 0 will only be available to those government agencies involved in assessing the suitability of offset sites and will not be available for public review.

SECTION G: SPATIAL DATA RELATING TO OFFSET SITE/S*See EPA Guidance Statement No 19 – Environmental Offsets – Biodiversity – Appendix 4*

Spatial data sets for the potential offset sites will be provided as they become available. The available data will be provided on the data CD included in 15Appendix 16-A

SECTION H: RELEVANT DATA SOURCES AND EVIDENCE OF CONSULTATION*Consultation with agencies, relevant stakeholders, community and references to sources of data / information. Include details of specific environmental, technical or other relevant advice and information obtained to assist in the formulation of the offset.*

Consultation with DPaW was conducted in December 2013 and May 2014 to discuss land acquisition options. These discussions are ongoing and will continue to enable a suitable offset site to be identified and secured.

TABLE 12-5: REVIEW OF THE COMMONWEALTH OFFSET PRINCIPLES

COMMONWEALTH OFFSET POLICY PRINCIPLES	DORAL OFFSET STRATEGY
1. Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action	<p>Doral is committed to funding the purchase a suitable parcel (or parcels) of land for the purpose of providing an environmental offset that provides foraging, nesting and roosting habitat for Black Cockatoos.</p> <p>In addition to the purchase of land for this purpose, the proposed clearing of 8.68ha of State Forest No. 33 will be rehabilitated and managed to reinstate a habitat suitable for the foraging and potential breeding of Black Cockatoos in the longer term thus improving the viability of the protected matter.</p> <p>Existing and created Black Cockatoo habitat will be protected in perpetuity through the use of a formal mechanism (conservation covenant) or by ceding acquired land to the State of WA for conservation purposes.</p>
2. Be built around direct offsets but may include other compensatory measures	Offsets will be focused on direct offsets in accordance with policy guidelines. A minimum of 90 per cent of the offset requirements for any given impact will be met through direct offsets.
3. Be in proportion to the level of statutory protection that applies to the protected matter	Offsets will be calculated utilising the DoE – Offsets Assessment Guide. The Black Cockatoo species with the highest level of statutory protection (Carnaby’s Cockatoo) will be used to determine the probability of annual extension which will form the basis for further calculation of appropriate offsets for this species.
4. Be of a size and scale proportionate to the residual impacts on the protected matter	The quantum of offsets required will be calculated utilising the DoE – Offsets Assessment Guide.
5. Effectively account for and manage the risks of the offset not succeeding	Potential risks to the successful management and rehabilitation of Offset Areas will be assessed and management actions prescribed to address these risks.
6. Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs	Doral will be addressing the requirements of both the State and Commonwealth Offset Policies for this proposal. Specifically, the Commonwealth Offset Policy applies to addressing residual impacts resulting from the clearing of Black Cockatoo foraging, nesting and roosting habitat.

COMMONWEALTH OFFSET POLICY PRINCIPLES	DORAL OFFSET STRATEGY
7. Be efficient, effective, timely, transparent, scientifically robust and reasonable	An implementation strategy to meet rehabilitation targets and completion criteria will ensure the delivery of offsets in a timely and transparent manner. Completion criteria will be realistic and based on previous industry success in the rehabilitation of disturbed areas after near-surface mining in the southwest region of Western Australia.
8. Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	Offsets will be monitored and reported to DoE annually through the Doral Mineral Sands Annual Environmental Report (AER). An independent environmental audit of the offset will be conducted within two years of approval and every three years following until mine closure

12.6 PREDICTED ENVIRONMENTAL OUTCOME

Doral believe that, through the provision of an agreed environmental offsets package, a net environmental benefit can be gained as a result of the Proposal.

The offset strategy described above will counterbalance the short-medium term residual impacts resulting from the proposal. Upon successful rehabilitation of the 8.68ha of State Forest No. 33 to be cleared, the land parcels secured through the offset strategy will provide a net gain for environmental conservation.

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13 ENVIRONMENTAL MANAGEMENT FRAMEWORK

13.1 OVERVIEW

In addition to implementing the requirements of specific environmental conditions set by the EPA if the Proposal is approved, Doral will minimise environmental impacts through:

- Maintaining an EMS;
- Implementing the Environmental Management Plans (EMPs) for the Proposal;
- Regularly reviewing the performance of the EMS and EMP;
- Updating mine plans and closure plans as required, progressively rehabilitating decommissioned areas and measuring success;
- Training staff and contractors in environmental requirements and considerations of their work;
- Ensuring that stakeholder views are sought, respected and considered;
- Reporting regularly to stakeholders on performance.

13.2 ENVIRONMENTAL POLICY

Doral's environmental policy outlines its intentions and commitment to environmental performance. A copy is provided in *Appendix 15*.

The environmental policy is the foundation of the EMS and provides the framework for setting and reviewing objectives and targets. The Policy is stated as follows.

"Doral Mineral Sands is focused on sustainable development and is committed to operating in an environmentally and socially responsible manner.

Doral acknowledges the importance of operating in compliance with all relevant environmental laws, regulations and standards and commit to the following:

- *Employ risk assessment processes to minimize environmental impact,*
- *Comply with legislative requirements which we recognise as the standard to be upheld,*
- *Conduct effective site rehabilitation,*
- *Endeavour to use resources more efficiently to reduce greenhouse gas emissions in line with the Energy Efficient Opportunities Program,*
- *Maintain an effective Environmental Management System to include all sites and employees,*
- *Measuring, monitoring, and reporting of environmental aspects,*
- *Ensure adequate training of personnel and contractors to uphold environmental standards and communicate targets and objectives,*
- *Encourage the community to participate in Doral's environmental management through employment and communication.*
- *It is Doral's expectation that all its employees and contractors understand, promote and assist in the implementation and compliance with the Policy."*

13.3 ENVIRONMENTAL MANAGEMENT SYSTEM

Doral is committed to its environmental performance and has developed, implemented and continually improved its EMS since it was established in 2001. The EMS was initially developed in response to advice from the EPA and Department of Environmental Protection (DEP) during the planning and approval process for the Dardanup Mineral Sands Mine. Doral's EMS is in line with the requirements of the Australian/New Zealand Standard AS/NZS ISO 14001:1996 (ISO 14001).

Doral's EMS consists of the following elements:

- Environmental aspects and impacts;
- Legal and other requirements;
- Objectives and targets;
- Environmental management program;
- Implementation and operation;
- Checking and corrective action.

These elements are discussed in the following sections.

13.3.1 Environmental Aspects and Impacts

Doral has an established System Procedure "*SP-01 Environmental Planning – Aspects and Impacts*" to identify the environmental aspects of its current activities, products and services. Doral has also detailed methods in SP-01 to determine which of those environmental aspects have a significant impact on the environment.

Should the Proposal be approved, Doral will revise the environmental aspects and impacts procedure, including a risk analysis to incorporate activities from the Proposal.

13.3.2 Legal and Other Requirements

All legal requirements will be updated in regards to the Proposal including requirements under any Ministerial Statements and audit tables.

13.3.3 Objective and Targets

Doral has established System Procedure "*SP-03 Objectives and Targets*" to identify environmental objectives and quantifiable targets which meet the Company's environmental policy. These environmental objectives and targets will be reassessed in light of the Proposal.

13.3.4 Environmental Management Program

An environmental management program has been developed for the purpose of turning the objectives and targets into actions. The Environmental Management Program includes performance indicators that will be used to assess environmental performance. This program will be updated in light of the revised "*SP-03 Objectives and Targets*".

Doral has committed to updating/preparing specific EMPs for the Proposal:

- Flora and Vegetation Management Plan
- Rehabilitation Management Plan;
- Dieback Hygiene Management Plan;
- Fire Management Plan;

- Fauna Management Plan;
- Dust Management;
- Noise Management Plan;
- Groundwater Operating Strategy;
- Surface Water Management Plan.

13.3.5 Implementation and Operation

This component of Doral's EMS is concerned with the implementation of the EMS and the development of necessary capabilities and support mechanisms to achieve Doral's environmental policy, objectives and targets. This component consists of the following elements:

- Structure and responsibility;
- Training awareness and competence;
- Communication;
- Environmental management system documentation;
- Document control;
- Operational control;
- Emergency preparedness and response.

All components of implementation and operation will be updated should the Proposal be approved.

Numerous Operating Procedures have been developed for the Doral EMS which will be updated to include the Proposal. Relevant operating procedures for the Proposal include the following:

- Contractor Management Procedure;
- Vegetation Clearing Procedure;
- Fauna Spotter Procedure;
- Topsoil and Subsoil Management Procedure;
- Solar Evaporation Pond Construction and Operation Procedure;
- Emergency Discharge – Pre-release Discharge Procedure;
- Emergency Discharge – Discharge Monitoring Procedure;
- Groundwater Monitoring Procedure;
- Hydrocarbon Management Procedure;
- Waste Management Procedure;
- Radiation Monitoring and Management Procedure

13.3.6 Checking and Corrective Action

This component of Doral's EMS relates to the monitoring and evaluation of Doral's environmental performance and consists of the following elements:

- Monitoring and measurement;

- Non-conformance and corrective and preventive action;
- Records;
- Environmental management system audit;
- Management review.

13.4 MANAGEMENT REVIEW

“System Procedure SP-12 Management Review” in the Doral Environmental Management System (EMS) was implemented for Senior Management to undertake reviews to assess the ongoing suitability and effectiveness of the EMS. It is anticipated that the frequency of management review will need to increase in light of incorporating the Proposal.

Doral continues to demonstrate a sound level of environmental performance and continual improvement. Doral is in an excellent position to incorporate the Proposal into their existing EMS in a rapid and best practice manner.

14 SUPPORTING INFORMATION

14.1 SPATIAL DATA

The following spatial data files have been provided on the CD included in Appendix 16-A.

- Spatial data files for Key Proposal Characteristics Table (Table ES - 1, Table 3-1 and Figure 1-2) in accordance with EAG 1 (EPA, 2012);
- Spatial data files for flora and vegetation (quadrat locations; vegetation communities; locations of threatened, priority and regionally significant flora; locations of declared plants and dieback mapping;
- Spatial data files for terrestrial fauna (fauna habitats; Black-Cockatoo potential breeding trees and Black-Cockatoo roosting trees);
- Spatial data files for hydrological processes (potential groundwater drawdown contours for the Superficial aquifer, Mowen Member, Vasse Member (Leederville), Yarragadee aquifer; emergency discharge points; paddock drains; monitoring bore locations and production bore locations);
- Spatial data files for locations of nearest residences (noise and dust);

14.2 CHECKLISTS

The following checklists have been included as attachments to this report:

- Checklist for documents submitted for EIA on marine and terrestrial biodiversity (Appendix 14-A)

14.3 ELECTRONIC DATABASE

An electronic database excel format) of all survey data from terrestrial biological surveys (i.e. flora and vegetation and fauna) including site locations has been provided in the CD included in Appendix 16-A.

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15 CONCLUSION

Doral are proposing to mine the Yoongarillup Mineral Sands Deposit using open-cut dry mining techniques to extract and process ore to produce zircon, ilmenite and rutile. The Proposal presented in this PER has demonstrated key environmental factors, as outlined in the ESD, can meet EPA's objectives and can be managed to be environmentally acceptable.

Clearing 8.68ha of native vegetation will not affect the Commonwealth or EPA's target of ensuring 30% or more of pre-European vegetation extent of specific vegetation complexes is maintained. The implementation of the Proposal will clear 0.10% of the pre-European extent of the Yelverton (Y) vegetation complex, and will reduce the current extent from 38% to 37.75%, which remains above the target of 30%.

Clearing conservation significant flora (*Daviesia elongata subsp. elongata*) is not considered to be significant as only six individuals (0.59%) of the known population of 1016 mature plants (DEC, 2007), will be impacted. *Daviesia elongata subsp. elongata* is currently protected within an existing nature reserve, which is managed for the conservation of flora and fauna.

The natural values of the Whicher Scarp are highly unlikely to be 'significantly' impacted, given the implementation of the Proposal will clear 0.09% of the area remaining of the Whicher Scarp soil-landscape system, and reduce the current area remaining of the Whicher Scarp vegetation from 9200 ha to 9191.32ha. Whilst the EPA considers protection of the natural values of the Whicher Scarp to be important to Western Australia, only 3.4% of the Whicher Scarp is protected in formal conservation reserves (EPA, 2006a). The section of Whicher Scarp proposed to be cleared is within previously cleared State Forest, and is not within a formal conservation reserve.

Although Doral considers the impacts to flora and vegetation to not be significant, Doral recognises the value of the Whicher Scarp and is committed to providing a suitable environmental offset package to secure a positive environmental outcome for the State on a 'like for like' principle.

It is likely the Proposal will result in a temporary reduction in the availability of foraging, breeding and roosting habitat for three species of conservation significant Black-Cockatoos. However there is predicted to be an overall net gain in Black-Cockatoo foraging, breeding and roosting habitat as a consequence of rehabilitation of mined areas in combination with the long-term conservation offset. No fauna of conservation significance will cease to exist or have its conservation status affected as a result of the Proposal.

Residual impacts of the Yoongarillup Mineral Sands Project are proposed to be offset through the acquisition of land, with negotiations currently underway with DPaW, to locate land with similar values to the vegetation and habitat proposed to be cleared.

Drawdown of groundwater to allow dry mining to occur is predicted to be centred on the mine pits and no adverse impacts to groundwater-dependant vegetation or private bores is expected following the implementation of management measures. No impacts are expected to other users of the Yarragadee aquifer or overlying aquifers.

Doral will manage the rehabilitation and mine closure of the Proposal through the implementation of a Rehabilitation Management Plan and Mine Closure Plan which will include, but not be limited to, the following key aspects:

- A surface profile reconstruction plan;

- A topsoil management plan;
- A seed bank management plan.

Doral considers that by implementing these plans, successful mine rehabilitation will be achieved that will meet the EPA's objective of ensuring that a planning process is in place so that the mine can be decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed post-mining outcomes. It is envisaged that with successful rehabilitation of the State Forest and purchase and protection of suitable land for environmental offsets, the Proposal will provide a net environmental benefit to Western Australia.

APPENDIX 1 FIGURES FROM ALL SECTIONS (A3 FORMAT)

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APPENDIX 2 CORRESPONDENCE - ENVIRONMENTAL PROTECTION AUTHORITY

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APPENDIX 2-A ENVIRONMENTAL SCOPING DOCUMENT – JANUARY 2013

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APPENDIX 2-B CORRESPONDENCE FROM EPA

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APPENDIX 3 CORRESPONDENCE - DEPARTMENT OF ENVIRONMENT

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APPENDIX 4 IN-PRINCIPAL CONSENT FORMS

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APPENDIX 5 BASELINE SOIL ASSESSMENTS

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APPENDIX 5-A SOIL ASSESSMENT–YOONGARILLUP MINERAL SANDS MINE

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APPENDIX 5-B DIEBACK SURVEY

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APPENDIX 5-C ACID SULPHATE SOIL ASSESSMENT

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APPENDIX 6 FLORA AND VEGETATION SURVEYS

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APPENDIX 6-A LEVEL 2 – FLORA & VEGETATION SURVEY AT YOONGARILLUP (ECOEDGE-2013)

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APPENDIX 6-B FLORA AND VEGETATION SURVEY OF YOONGARILLUP RESOURCE ZONE SURVEY AREA (MATTISKE-2012)

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**APPENDIX 6-C THREATENED AND PRIORITY SPECIES SURVEY OF DRILL LINES WITHIN THE
MILLBROOK STATE FOREST (MATTISKE, 2012B)**

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APPENDIX 7 FAUNA SURVEYS

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APPENDIX 8 HYDROLOGY STUDIES

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APPENDIX 8-A WATER QUALITY TESTING RESULTS

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APPENDIX 8-B HYDROLOGICAL REPORT – GROUNDWATER

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APPENDIX 8-C HYDROLOGICAL REPORT – SURFACE WATER

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APPENDIX 8-D HYDROLOGICAL REPORT – SITE WATER BALANCE

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APPENDIX 9 ARCHAEOLOGY AND ETHNOGRAPHY STUDIES

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APPENDIX 9-A ARCHAEOLOGICAL SURVEY (TEMPUS-2012)

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APPENDIX 9-B ETHNOGRAPHY STUDY (ETHNOSCIENCES-2012)

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APPENDIX 10 NOISE ASSESSMENT

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APPENDIX 11 DESKTOP STUDY – MINE REHABILITATION

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APPENDIX 12 MINE CLOSURE PLAN (PRELIMINARY)

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APPENDIX 13 PROPOSED MINE CLOSURE - COMPLETION CRITERIA

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CLOSURE OBJECTIVES	INDICATIVE COMPLETION CRITERIA	COMPLETION CRITERIA	MEASUREMENT TOOLS
Compliance			
All legal and stakeholder obligations relevant to closure and completion of the site are met	Completed checklist and evidence demonstrating compliance with all legal and stakeholder obligations	100% compliance with all legal and stakeholder obligations	Obligations Checklist Written landowner acceptance of rehabilitation outcome.
Safety and Public Health			
To leave the site in a condition where the risk of adverse effects to people, livestock and other fauna, and the environment in general, has been reduced to a level acceptable to all stakeholders.	Artificial barriers and sign are removed All excavations and voids are back filled to provide a safe and stable landform. All drill holes and bores are securely capped, filled or otherwise made safe Construction materials shall be removed from the site or where approved to do so, material (e.g. concrete footings) shall be buried deep enough to eliminate risk of exposure.	All safety hazards are removed and all areas are safe for public access.	Visual Inspection
Landforms			
Final landforms are returned to topography as close as possible to pre-mining levels or to meet landowner specifications.	The post mining profile is integrated into the surrounding undisturbed landscape No slopes greater than 1:5 will remain unless required by landowner	Final topography is constructed.	Physical survey Landowner acceptance
Final landform can support agricultural post-mining land use	Agriculture land use: Top one metre of soil profiles are consistent with pre-mining soil profiles and where different enable improved agricultural productivity.	The measured agricultural productivity of each lot is equal to or more than either it's pre-mining yield assessment or an equivalent surrounding landform type. No subsidence maintenance required after 4 years.	Pasture productivity measurement Visual inspection

CLOSURE OBJECTIVES	INDICATIVE COMPLETION CRITERIA	COMPLETION CRITERIA	MEASUREMENT TOOLS
Final landform can support rehabilitated native vegetation land use	Created landforms are able to support native vegetation	No subsidence maintenance required after 4 years	Visual inspection and survey of topography.
Final landform can support Road and Road Reserve land use	Backfilled mine pits do not materially subside over time and can support road construction	Main Roads WA and City of Busselton sign off that Geotechnical and Engineering standards have been met.	Road construction technical reports and Main Roads WA and City of Busselton acceptance of compliance with standards.
Soils and landforms exhibit erosion rates consistent with surrounding areas and do not compromise post-mining land uses.	The ongoing management required to maintain the landform is no greater than would be required for similar properties in the area	There will be no active erosion rills greater than 10 m X 0.1 m	Visual inspection and photo monitoring
Native Vegetation (State Forest Sub-area)			
Soil properties are suitable to support the target ecosystem	Soil physical, chemical and biological characteristics will be consistent with those of the target landscape. Soil to the depth of reconstruction have similar pH and salinity as soils from the target ecosystem	Soil physical, chemical and biological specifications are still to be determined when baseline soil assessment for this area is completed.	Soil analysis using accredited laboratory, Field measurements
Vegetation in rehabilitated areas will have equivalent values as surrounding natural systems	Vegetation composition on the rehabilitated area is representative of the target ecosystem in species diversity and vegetation structure	Attainment of agreed species of ecosystem diversity targets The mean stem count of native species of at least 1200 stems per ha. Species richness is greater than 70% of the mean value recorded in all 20 m X 20 m reference plots in analogue sites in the target ecosystem. All species present in baseline environmental studies are present in rehabilitation area	Quantitative vegetation monitoring using recognised standard techniques acceptable to EPA and DMP. Quarterly monitoring of permanent quadrats and photo monitoring points. Audit of rehabilitation records for sources of plant materials used in rehabilitation.

CLOSURE OBJECTIVES	INDICATIVE COMPLETION CRITERIA	COMPLETION CRITERIA	MEASUREMENT TOOLS
Vegetation in rehabilitated areas will have equivalent values as surrounding natural systems (<i>cont</i>)	Understand the recovery trends of the specific plant communities of the rehabilitated area	Defined relative cover is 60% of area rehabilitated.	Visual inspection
	Plants used in rehabilitation to be of local provenance	All plant material used in rehabilitation sourced from within 10 km of the area rehabilitated.	
	No new weeds to be introduced into the area	No evidence of weed species, including both declared agricultural weeds and environmental weeds	
	Rehabilitated areas have the potential to regenerate after fire	The rehabilitated area is capable of recovering after fire	
The rehabilitated ecosystem has equivalent functions and resilience as target ecosystem	The capacity to retain water and nutrient resources is equivalent to target ecosystem	<p>Infiltration Index is within the range of values from analogue sites in target ecosystem</p> <p>Nutrient Cycling Index is within the range of values from analogue sites in the target ecosystem</p>	<p>Ecosystem Function Analysis (EFA)</p> <p>Infiltration Index</p> <p>EFA Nutrient Cycling Index</p>
Dominant Plant Species and Plant Strata		Restore vegetation structural complexity 10 years post-mining.	Flora and vegetation survey
Pests and Diseases			
Dieback		Dieback has not infested previously uninfested areas	Dieback mapping
Radiation			
Surface level radiation levels are within acceptable standards.	Post mining radiation levels vary little from the baseline conditions	Soil surface gamma radiation levels are accepted by the DMP.	Post-mining surface gamma radiation measurement.

CLOSURE OBJECTIVES	INDICATIVE COMPLETION CRITERIA	COMPLETION CRITERIA	MEASUREMENT TOOLS
Water			
Ensure that groundwater recovers from drawdown.	Groundwater will recover to 90% of pre mining levels within 3 years.	Groundwater will recover to 100% of pre mining levels within 5 years.	Ensure that groundwater recovers from drawdown.
Surface and groundwater levels and quality are consistent with surrounding areas.		Groundwater levels in monitored bores are stable within the range of variation of surrounding monitoring bores and show the same seasonal patterns as surrounding monitored bores. Groundwater quality (pH, EC, Total Dissolved Salts, Total Acidity, Total Alkalinity, chloride, sulfate, Al, Fe and Mn) is within the range monitored within the surrounding areas.	Groundwater level monitoring Surface and groundwater quality measurement utilising appropriate field meters and samples analysed at a National Association of Testing Authorities accredited laboratory.
Surface and groundwater flows are consistent with surrounding areas.		Groundwater levels in 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.	Groundwater level monitoring Visual inspection and site audit.
Infrastructure			
All mining and processing equipment and structures are removed from site.		No mining and processing equipment present on site.	Visual inspection and photographic record.
Waste generated during deconstruction is managed in a manner consistent with waste minimisation principles.		Waste disposed of at appropriately licenced waste disposal facilities.	Waste disposal records. Inspection during deconstruction.
Re-established infrastructure is installed to standards accepted by key stakeholders.	Stock water dams as required by landowner	Infrastructure is installed, functioning and accepted by landowner.	Visual inspection Written acceptance by landowner.

APPENDIX 14 CHECKLISTS

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APPENDIX 14-A CHECKLIST FOR DOCUMENTS SUBMITTED FOR EIA ON MARINE AND TERRESTRIAL BIODIVERSITY

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APPENDIX 15 DORAL ENVIRONMENTAL MANAGEMENT POLICY

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APPENDIX 16 SUPPORTING INFORMATION

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APPENDIX 16-A ELECTRONIC DATA – CD

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APPENDIX 16-B CONFIDENTIAL – NOT FOR PUBLIC REVIEW - CONCEPT OFFSET STRATEGY

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