APPENDIX A

Dardanup Mineral Sands Project-Rehabilitation and Decommissioning Plan

Appendix E

Rehabilitation and Decommissioning Plan

Dardanup Mineral Sands Project – Mine Rehabilitation and Decommissioning Plan

Doral Mineral Sands Pty Ltd

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Date: August 2001
File ref.: gba00101
Rev.: C

Author:

Date:

Distribution:

As this is an electronic version of the Report, the signed copy is available in the hardcopy of the Report.

Contents

1. Introduction

Doral Mineral Sands Pty Ltd ("Doral") has acquired a mineral sands deposit at Dardanup, approximately 15 km west of Bunbury, and a dry separation plant at Picton, in the south-west of Western Australia. Doral plans to commence mining operations at the new Dardanup Mineral Sands Project and supply heavy mineral concentrate (HMC) to the Picton plant. Environmental approvals for the project were originally obtained in 1991 by ISK Minerals Pty Ltd but commencement of the project has been delayed pending favourable market conditions.

All mining and associated soil and overburden removal at Dardanup will be conducted by scrapers. Oversize material and sand tailings will be returned directly to mined-out portions of the pits and clay tailings will be stored in solar drying ponds for later return as backfill. The major environmental issues identified during the original impact assessment (ISK Minerals, 1991) included surface and groundwater management, both during the operations and in the rehabilitated landforms after mining is complete. The latter is to ensure the existing hydrogeological regime is maintained for future land uses, particularly as the opportunity exists to improve the existing agricultural capacity of the soils through the judicious management of backfill operations, and topsoil and subsoil preservation and re-use. The original project commitments include a requirement to develop a progressive rehabilitation plan prior to the commencement of mining.

In October 2000, the Minister for the Environment granted an extension to the existing project approval to August 2003. An additional commitment, to prepare a preliminary decommissioning plan prior to the commencement of mining, was included.

The purpose of this report is to fulfil the requirement for a rehabilitation and decommissioning management plan prior to the commencement of mining, and to assist Doral to plan and integrate their rehabilitation activities. It forms part of an overall environmental management program.

2. Site Environment

2.1 Topography and Soils

In the original project documentation, the soils of the project area have been described as "sandy to the east and clayey to the west, producing the problems of having intractable clays in some areas in winter and fast-drying sands in other areas in summer" (ISK Minerals, 1991). Since then, Agriculture WA has conducted a soil and land capability assessment of the area (Barnesby and Proulx-Nixon, 2000a,b). From their information, the project area occurs across two landscape units – the Forrestfield System to the east and the Pinjarra System to the west. The Forrestfield System consists of lateritised, low relief foothills of the Darling Scarp formed by shoreline sediments, alluvium and colluvium whereas the Pinjarra System is the broad low relief plain west of the foothills, with predominantly fluvial sediments and often poorly drained soils. Beyond these major classifications, the project area can be further divided into a number of landscape subunits, as shown in Table 2-1, but is predominantly within the Forrestfield System.

There appears to be a wide range of drainage patterns within the project area as the landscape subunits range from "rapidly draining" (CSs) to "poorly draining" (CSw). This will be related to their topography within the landscape, and their soil and subsoil profiles. This variability is likely to be of importance when reconstruction of soil profiles is considered.

2.2 Land Capability

The agricultural capability for the various landscape subunits described above is given in Table 2-2. Overall, the existing project area is more suited to grazing rather than annual horticulture (market gardening) or perennial horticulture (orchards and vineyards) and is rated at "fair" for this purpose. A classification of fair indicates that there are "moderate physical limitations significantly affecting either productive land use or risk of land degradation, with careful planning and conservation measures required." (Barnesby and Proulx-Nixon, 2000a,b).

2.3 Climate

Basic climate statistics for the region are shown in Table 2-3. Mean temperatures are mild while mean annual rainfall ranges between 870.9-991.7 mm for regional centres. Maximum monthly rainfall in excess of 400 mm has been recorded during the months of June and July.

Table 2-1: Description of landscape and soil units and estimated extent of each across project area, based on plan of project area (Fig. 1, ISK Minerals, 1991) and Barnesby and Proulx-Nixon (2000a,b).

Unit	Subunit	Description	Est. Coverage Within Project Area (%)
Forrestfield System	CSs	Very low relief (1-5%) footslopes with rapidly drained deep bleached grey sands and occasionally deep yellow brown sands. Minor occurrence of gravels.	35
	CSw	Seasonally inundated swamps, depressions and seepage areas near the base of the foothills with poorly drained deep bleached siliceous sands	10
	CSv	Incised stream channels on low relief (1-5%) footslopes with moderately drained bleached and pale yellow brown gravelly soils.	5
	F2b	Very gently to gently inclined lower slopes (2-5%) with moderately deep to deep, gravelly acidic yellow duplex soils and rare laterite.	15
	F5	Poorly defined stream channels on lowest slopes and with deep acidic yellow duplex soils and sandy alluvial gradational brown earths.	5
Pinjarra System	P1b	Flat to very gently undulating plain with acidic mottled yellow duplex soils comprising moderately deep pale sand to sandy loam over clay; imperfectly drained and moderately susceptible to salinity in limited areas.	5
	P6a	Very gently undulating alluvial terraces contiguous with the plain, with deep moderately well to well drained soils associated with major current river systems and larger streams. Acidic red and yellow duplex soils, less commonly gradational red and yellow earths.	5
	P6b	Very gently undulating alluvial terraces and low rises contiguous with the plain, with deep moderately well to well drained soils associated with prior stream deposits. Soils are uniform brownish sands.	20

Table 2-2: Land capability classes for agricultural for landscape subunits occurring in project area (see Table 2-1) (Barnesby and Proulx-Nixon, 2000a,b). Classes shown are II (high capability, some physical limitations, careful planning required), III (fair capability, moderate physical limitations, careful planning and conservation measures required) and IV (low capability, high degree of physical limitations, extensive conservation requirements).

Landscape Subunit	Agricultural Capability		
	Grazing	General Annual Horticulture	General Perennial Horticulture
CSs	III	IV	III
CSw	III	IV	IV
CSv	III	IV	IV
F2b	II	II	II
F5	III	IV	III
P1b	III	IV	IV
P6a	II	II	II
P6b	III	II	II

Table 2-3: Climate statistics for regional centres in vicinity of project.

Regional Centre	Mean Annual Maximum Temperature (°C)	Mean Annual Minimum Temperature (°C)	Mean Annual Rainfall (mm)	Maximum Recorded Monthly Rainfall (mm)
Bunbury	21.8	13.9	870.9	417.0
Collie	22.5	11.7	948.4	473.0
Donnybrook	23.0	9.6	991.7	435.7

2.4 Surface Water

The only permanent surface water in the area is the Collie River to the north of the project area and the Ferguson River to the south. There are numerous ephemeral streams in the foothills immediately east of the project area and during winter water may pond in areas where soils are slow to drain or the water table is high. Drainage may have been improved by the South West Irrigation Supply Channel which occurs near the western boundary of the ore body.

2.5 Ground Water

The superficial formations of the project area (Guildford and Yoganup) have a maximum depth of 20 m. Groundwater flow in unconfined and semi-confined aquifers is generally westwards. Recharge occurs through rainfall with likely contributions from the irrigation channel in the west of the project area. A number of other formations underlay the superficial formations and a more detailed discussion of these is given in ISK Minerals (1991). These include the Leederville and Yarragadee Formations, both of which are important sources of water for domestic and other uses.

Within the superficial formations, water moves preferentially through interleaving sandy lenses surrounded by zones of much higher clay content (ISK Minerals, 1991). Vertical conductivities are thought to be high at the base of the Darling Scarp and this is where the majority of recharge to the Leederville Formation occurs. Away from the Darling Scarp on the plain below horizontal conductivities are much more significant.

2.6 Vegetation and Biological Values

The project area is largely cleared for agricultural purposes. Remnant native vegetation occurs along roadsides and on sections of uncleared private land. A flora and vegetation survey in 1991 found 75 native plant species, none of which was gazetted as rare or endangered at that time. These species are currently being reviewed to determine if any change to their conservation status has occurred. A further 29 species of introduced or naturalised plants were also recorded. The original vegetation was believed to have been marri (*Corymbia calophylla*) and jarrah (*Eucalyptus marginata*) at better-drained sites with flooded gum (*E. rudis*), swamp paperbark (*Melaleuca rhapiophylla*), moonah (*M. preissiana*) and swamp she-oak (*Casuarina obesa*) all occurring in more poorly drained areas.

Jarrah dieback disease is prevalent throughout the region although it is not known if it occurs within the proposed mining area. There was no reference in the original project documentation to the general condition of the remnants of native vegetation, except that they had been affected by grazing and fire.

3. Objectives of Rehabilitation and Decommissioning

3.1 Regulatory Requirements

The original CER (ISK Minerals, 1991) and Responses to Public Submissions (Environmental Protection Authority, 1991) state the following with regard to rehabilitation:

- The primary rehabilitation strategy for the Dardanup mine will be to restore the agricultural productivity of mined land to at least its current level. Trees and other native vegetation will be included in rehabilitation prescriptions.
- When decommissioned the tailings ponds will be removed and topsoil used to re-establish productive soils.
- Consult with the Department of Agriculture, the Water Authority of WA and landowners to include native vegetation in rehabilitation strategies, with a view to contributing to the management of localised and regional hydrogeological problems of high water tables and salinity.
- Ensure that backfilled mine areas have the capacity to transmit water from east to west in a fashion similar to that which currently occurs.
- After rehabilitation it is ISK Mineral's intention that farmland purchased for mining be sold off – ISK Minerals has no wish to own farming properties for longer than is necessary to complete mining and rehabilitation operations. Land which is not purchased by ISK Minerals, but on which compensation is paid to the landowners, will be handed back to the landowners as quickly as practicable.
- With respect to *Casuarina obesa* which is not well represented in the conservation estate, ISK Minerals will consult with the Department of Conservation and Land Management to understand the ecological requirements of the species. To the extent that it is reasonably achievable, establishment of this species will be included in revegetation plans.

The Ministerial Conditions of Project approval require that:

- prior to the commencement of mining, the proponent shall develop a progressive rehabilitation plan, in order to rehabilitate the mine site to an environmentally stable condition, to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection (DEP), Department of Minerals and Energy (DME), Agriculture WA, Waters and Rivers Commission (WRC) and the owners of land on which mining takes place. The final land use after mining will be determined between the landowners and the proponent (Condition 6-1).

- at least 6 months prior to decommissioning, the proponent shall prepare a Decommissioning Management Plan to the requirements of the EPA on advice of the DEP and the DME. This plan shall address:
- removal or, if appropriate, disposal on-site of plant and infrastructure;
- rehabilitation of all disturbed areas to agreed final land uses (s); and
- identification of contaminated areas, including provision of evidence of notification to relevant statutory authorities (Condition 7-1).

Recently, the condition relating to preparation of a decommissioning plan has been amended to require the proponent to prepare a Preliminary Decommissioning Plan prior to the commencement of mining (DEP, 2000). The Plan is to address:

1. Rationale for the siting and design of the plant and infrastructure and conceptual plans for its removal or, if appropriate, retention;
2. Conceptual rehabilitation plans for all disturbed areas and a process to agree on the end land use(s); and
3. Management of noxious materials to avoid the creation of contaminated areas.

3.2 Corporate Objectives

The corporate objectives for Doral in respect of rehabilitation and decommissioning will include the following:

- Meet all regulatory requirements (see 3.1) and achieve compliance in progress reports for the Department of Environmental Protection;
- Achieve rehabilitation and decommissioning to a standard acceptable to the community;
- Meet all completion criteria set in this report and achieve statutory release from further commitments at the earliest possible stage; and
- Optimise future land use and commercial values such that sale of the land and a return to agricultural uses can occur at the earliest possible time.

In addition, there are other undertakings for roadside tree plantings, 'enrichment' of existing native vegetation and use of vegetation for screening. Other issues may emerge during the community consultation process.

4. Mining and Processing

4.1 Products and Ore Reserves

The Dardanup operation will produce individual products of ilmenite, leucoxene and zircon that total approximately 120,000 tonnes/annum. The economically mineable reserves in the nominated mining area (Mineral Lease 07/675) total approximately 21 million tonnes at an average of approximately 6% valuable heavy mineral. Based on the expected throughputs, the operation has a life of nine years.

4.2 Mining

Mining will commence in the north-east section of the ore body. Mining will involve removal of up to 3.5 million tonnes of ore per annum over a period of nine years. The ore is generally 5-7 m thick and is overlain by variable amounts of overburden and topsoil. Overburden is almost absent (1-2 m only) at the northern end of the project area and can be up to 9 m deep towards the southern end. All mining of ore and stripping of overburden and topsoil will be undertaken by scraper. Overburden is estimated to comprise 15-30% friable coffee rock and harder laterite, which will also be collected by scraper, with pre-ripping by dozer where necessary. It will then be transported, along with the ore, to the feed preparation plant and returned to the pit as oversize. In practice, it is expected that 5-10% of the coffee rock will be left in the pit. Initial recoveries of overburden will be used for the formation of the process water dam, tails and clay tailings ponds, with subsequent recoveries stockpiled for return to mining areas. As the mine develops, direct return to the mining areas will be utilised where this is feasible.

The mining activities are expected to occupy 40 ha over any one year. After removal of topsoil and overburden, scrapers will deliver ore to the Feed Preparation Plant at a design rate of 325 t/hour.

The South West Irrigation Supply Channel runs along the western side of the orebody. Initial mine plans incorporate a 10m-exclusion zone alongside the channel with 37-degree batters. It is anticipated that access to the western side of the channel will be required at some time in the future, requiring bridging or relocation of the channel. Any such proposals will involve appropriate notice to the relevant government body and a management plan developed in conjunction with the South West Irrigation Corporation (SWIC).

4.3 Processing

After passing the ore through the Feed Preparation Plant (comprising an apron feeder, scrubber and trommel), the ore will be pumped as slurry to the Wet Concentration Plant. The Wet Concentration Plant will comprise spiral plants and associated cyclones, tails bin, feed hoppers and pumps. Final concentrate will be produced at a rate of approximately 22 tph at 95% Heavy Mineral Concentrate (HMC). It will be de-watered and stacked by a radial cyclone stacker, with recovered water being returned to the process water pond. Various tails and process water streams are generated during the heavy mineral concentration process and are managed as follows:

- Oversize (comprising +5 mm screened material, mainly coffee rock and organic material) from the Feed Preparation Plant will be returned to the mine pits by scraper. Prior to the development of sufficient pit volume, this material will be stockpiled.

- Clay tails will be managed using conventional solar drying ponds, however investigations into co-disposal options will be carried out and this method will be used in preference to storage ponds if found to be feasible. Clay tails from the cyclone overflow will be gravity fed to a 27 m-diameter thickener. Thickener overflow (i.e. process water) will discharge via an overflow tank to the process water dam. Thickener underflow will be pumped at 22% solids w/w to clay tailings ponds for drying.

- Sandy tails material, which has been processed and depleted of heavy minerals and clays in the rougher spiral plant will be returned to the mining area at 30% solids w/w. Again, this material will be stockpiled until sufficient pit volume has been established. Stockpiles will be located on ground proposed for future mining disturbance.

The clay tailings ponds (to occupy an expected 80 ha, although this will be reduced if co-disposal investigations are successful) will be constructed progressively on future mining areas to minimise the overall footprint of the mine. The dried tailings will be reclaimed and returned to pits as backfill as mining progresses.

HMC will be trucked to the Dry Separation Plant at Picton for further processing. At the Dry Separation Plant, HMC is passed through screens, dryers, coolers and a series of cross belt, roll or drum magnets to separate the heavy mineral into either reject material or product. A wet circuit will also be utilized for the final zircon separation. A small amount of sandy tailings from this plant will be returned to the mine site (see Table 4-1). Temporary storage of this material will be required until such time that it can be returned directly to mined out pits. Final product will be stored at either the dry mill, commercial off site storage facilities or the Bunbury Port, prior to shipment to customers.

For economical use of the mining equipment, the Feed Preparation Plant will generally be located within 500m of the working pit face, and will periodically be relocated as the mining face advances through the deposit. The Wet Concentration Plant is expected to remain in the one position during the mining period considered in this report (nine years). The site is located on land owned by Doral that is neither mineralised nor vegetated, is readily accessible to the mining area, elevated above winter inundation levels and screened from the roads to the west by a stand of mature pine trees. The plant site is also in close proximity to the process water dam.

A summary of the materials to be used in backfilling of pits and rehabilitation is given in Table 4-1.

Table 4-1: Materials to be used for backfill in mine pits.

Process	Material	Source	Quantity (t/annum)	Assumptions / Comments
Mining	Topsoil	In situ	120,000	Depth of 200 mm and SG of 1.5
	Overburden	In situ	0-2,500,000	Varies with location being mined.
Wet separation (Dardanup)	Oversize material (+25 mm) and sand tailings (+3 mm)	Drum scrubber and trommel, and cyclones/ belt filters	2,590,000	Based on ore production rate of 3,500,000 tpa less clay and HMC.
	Clay tailings	Solar drying ponds	710,000	Overall clay content of ore 27%.
Dry separation (Picton)	Sand/quartz tailings	Separators/cyclones	18,000	

5. Rehabilitation Planning and Implementation

5.1 Planning

All rehabilitation activities must be integrated with the mine plan and mining activities to ensure preservation of suitable materials to achieve the rehabilitation objectives, and avoid unnecessary and costly rehandling of soils, overburden and other material.

Planning for rehabilitation must consider two key objectives for the project from those outlined in section 3. They are:

- Restoration of the agricultural productivity of the mined land to at least its current level, and
- Maintenance of a hydrological regime to ensure the post-mining land use can be achieved.

These objectives will require replacement of topsoil and subsoil with underlying strata that do not adversely affect the establishment and survival of pasture or native vegetation.

Management of clay tailings will be a critical factor in the successful achievement of these objectives. Management of clay materials, in particular improvement of their capacity for dewatering, and potential for improvement of poor sandy soils, was identified as a key issue for industry to consider in a review of the mineral sands industry for the Minister for Mines (Minerals Environment Liaison Committee, 1996). In the Dardanup project, productivity of pasture could be improved by the incorporation of clays into the subsoils but this may impede water infiltration and lead to more widespread waterlogging than occurred prior to mining. Given the high (27%) clay content of the ore body, the potential detrimental effects of incorporation of clay near the surface are considered to outweigh potential improvements to soil conditions for pasture growth. *Maintenance of a suitable hydrological regime, therefore, should take precedence over improvement of pasture productivity.*

Other objectives include increasing the amount of deep-rooted vegetation in the landscape (ISK Minerals, 1991) to offer increased protection of the area against future rises in the water table. This can be achieved by using native vegetation in selected areas, while the majority of backfilled pits are returned to pasture. Deep-rooted pasture species could also be an option (see section 5.2.6).

While this plan outlines the principles and basic methodology required for rehabilitation of the site, detailed plans should be produced on an annual basis. These plans should include, but not necessarily be restricted to, stockpile locations and volumes, maps showing proposed final contours, individual pit backfill and profile construction plans, and revegetation plans.

5.2 Implementation

5.2.1 Topsoil and Subsoil Harvesting and Storage

Prior to removal of topsoil, any millable timber will be recovered. Cleared vegetation will be chipped and used as mulch for soil stabilisation. Low scrub will be stripped with the topsoil.

Topsoil will be stripped to a depth of 200 mm by scraper and stockpiled in rows to a maximum height of 2 m. Topsoil from pasture areas and topsoil from areas of native vegetation should be harvested and stockpiled separately to optimise the beneficial use of each. Subsoil (200-1000 mm) will be harvested separately and stockpiled in a similar manner. Subsoil stockpiles need not be restricted to 2 m in height although they should not be of a size such that they lead to a dust nuisance or may be otherwise unstable. Wherever possible, all stockpiles will be located on areas planned for future mining disturbance to keep total ground disturbance to a minimum. Clear classification or signage of all stockpiles (topsoil, subsoil, overburden, sand tailings, oversize) is necessary so that these materials are not inadvertently mixed, incorrectly stockpiled or used for other than their designated purpose.

The timing of topsoil and subsoil harvesting activities will be planned for when dry or moist, but not wet, soil moisture conditions occur. This will maximise the retention of soil structure. The potential for dust generation should be minimised by restricting activities in windy conditions. If necessary, topsoil stockpiles from pasture areas can be seeded with cereal rye to limit dust generation (Carter and Findlater, 1994). Cereal rye should not be used on topsoil to be used for establishment of native vegetation, as it will likely reduce the species diversity subsequently obtained (Tiwest, 2001).

It is anticipated that stockpiling of topsoil should only be necessary during the first years of development and that direct return of topsoil will be practiced thereafter.

5.2.2 Overburden Recovery and Storage

As for topsoil, overburden will be recovered by scraper and dumped in rows, if direct return is not possible. The height limitation applied to topsoil stockpiles need not apply although the stockpiles should not be of a size such that they lead to a dust nuisance or may be otherwise unstable. Stabilisation of the surface of the stockpiles using cereal rye, or some other means, may be required.

As for topsoil, opportunities for direct return of overburden should be optimised.

5.2.3 Pit Backfilling and Soil Profile Construction

After year 3, rehabilitation will take place on a continual basis. It will commence with the placement of a mixture of sand tails, oversize and dried clay tailings back into the mined out area. The pit volume will gradually be filled with a heterogeneous mixture of sand tailings, dried clay tailings and oversize. Wherever possible, backfilling of clay tailings should seek to establish thin layers (< 0.5 m) or discrete patches such that no significant areas of low permeability materials occur, and that a profile resembling the pre-existing "sandy lenses" exists. It is assumed, on advice from Doral, that there are no deleterious geochemical features of any of the ore, overburden or soils that would require particular consideration in the way in which backfilling and soil profile construction occurs.

Following backfill of tailings, overburden will be replaced. Should weather conditions dictate that there has been insufficient drying of clay tailings to keep pace with the mining program, it may be necessary to return some undried clay tailings direct to the pits. Should this occur, the tailings would be spread in thin (< 0.5 m) layers over the overburden and allowed to dry. The dried material will then be deep ripped to incorporate the clayey material within the overburden and facilitate downward movement of water through the clay layer.

After replacement of subsoils over the overburden, the surface will be contoured to provide drainage and be ready for replacement of topsoil. Following topsoil replacement, the surface will be chisel ploughed on the natural contour. The actual timing of the replacement of topsoil and subsequent seeding will be determined by the need to use some of the mined out and backfilled areas of mining for relocation of clay tailings ponds as mining encroaches upon their original location.

Backfilling should be such that, once the subsoil and topsoil have been replaced, slight mounding (100-200 mm) of the overall profile should be evident to allow for some settlement, especially in areas where compaction may not be as efficient as elsewhere e.g. around the pit edges. Overall, there should be no overall change in topography (ISK, 1991) although some areas are low-lying anyway and may be more suitable for return to native vegetation than pasture.

Different profiles might be required for areas where native vegetation is to be planted. This may necessitate the minimisation or exclusion of clays near the surface where they can impede the establishment and survival of deep-rooted vegetation (e.g. Enright and Lamont [1992]).

5.2.4 Stockpile and Tailings Pond Areas

Stockpiles and clay tailings ponds will be constructed ahead of the mining program with the aim that they are progressively recovered and utilised as mining progresses. Where relevant, topsoil should be recovered from these areas in advance and stockpiled separately. Subsoil can remain and be recovered at the same time as overburden removal.

5.2.5 Soil Amendments

A dressing of gypsum might be advisable for any clayey areas where water is very slow to infiltrate (Fosberry and Howell, 1985). Application rates up to 5 t/ha are used but soils must be tested first for "gypsum-responsiveness" as some soils will not respond.

Fertiliser application should be made on advice from Agriculture WA. Typically, a dressing of superphosphate (200-250 kg/ha) is applied in autumn. A slow-release variety ("Coastal Super") is available and should be used to minimise P content in runoff. A spring dressing of gypsum may be necessary to provide subterranean clover with a source of sulphur (Yeates, 1985).

5.2.6 Pasture Re-establishment

Pasture re-establishment will be undertaken by seeding areas with a subterranean clover/ryegrass mix. Suggested seeding rates are 20 kg/ha each of clover and ryegrass. This constitutes a reasonably 'heavy' seeding rate and assumes recruitment from topsoil will be limited. Varieties of clover and ryegrass that are more likely to be successful may vary with the area. Lower lying areas can use clover varieties with a higher water use (see Nichols [1993]). Advice on the most suitable varieties should be obtained from Agriculture WA.

Reseeding during the mine life should not be necessary, especially after a heavy initial application, but may be required if a bad drought year occurs and seed production in the existing clover and ryegrass is poor.

Deeper-rooted fodder shrub options, such as tagasaste (*Chamaecytisus proliferus*) or *Acacia saligna,* could also be considered. Intermittent plantings of these species could assist in groundwater control and provide a more valuable agricultural resource when mining is complete. . Again, advice on this should be sought from Agriculture WA.

5.2.7 Establishment of Native Vegetation

While the majority of revegetation work will involve re-establishment of pasture, native vegetation will be established for the following:

- Areas where screening of plant operations is desirable;
- Amenity plantings;
- Roadside plantings and 'enrichment' of existing roadside vegetation;
- Establishment or enhancement of wildlife corridors and shelterbelts, especially where linked to existing vegetation; and
- Areas where pasture is not desirable or unlikely to be sustainable.

The location and extent of each of these will need to be determined in the light of detailed mine plans.

As a general rule, it is anticipated the species used should be drawn from those recorded in the original vegetation and flora surveys (see section 2.6). If this were the case, the main tree species would consist of jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*). Plantings in low-lying areas should include swamp she-oak (*Casuarina obesa*), of which special mention is made in the project commitments (see section 3.1). *C. obesa* has been established by direct seeding, grows well on salt-affected and waterlogged sites, and prefers sandy soils (Marcar *et al*, 1995). Where topsoil from existing areas of native vegetation has been stockpiled separately and re-used for the same purpose, recruitment of native species from seed banks can be expected, but will be dependent on the duration of topsoil storage and the extent of weed incursion.

Advice should be obtained from the Department of Conservation and Land Management regarding practical steps to prevent or restrict jarrah dieback disease from areas to be revegetated with native vegetation.

5.2.8 Weed Control

Herbicide control may be needed for any replaced topsoil that carries declared weeds or is earmarked for native vegetation. Skimming of topsoil (turning over top few cms of soil after germination has occurred) could be used as an alternative.

While it is not possible to eliminate weed species, the maximum level of weeds should not be more than that typical of the region.

5.3 Initial Mine Plan

An outline of the likely mine plan, and the integration of rehabilitation activities within it, is given in Appendix A. The measures by which the implementation of the plan meets the environmental objectives are discussed in section 7.

6. Decommissioning

At the cessation of mining, currently planned for the end of Year 9, the operation will close unless further economic ore bodies have been identified. Should ore of marginal economic value be identified, a period of care and maintenance of plant and equipment may ensue. Whether or not this is the case, however, the following will relate to the final site decommissioning:

- Removal of the Feed Preparation Plant: this plant will be moved during the life of the operation so that it remains in close proximity to the mining activity. When mining ceases permanently, the plant will be disassembled and removed from site.

- Removal of the Wet Concentration Plant: when mining and processing permanently cease, the plant will be disassembled and removed from site. The Wet Concentration Plant is expected to remain in the one position during the mining period considered in this report. This position is on land that is neither mineralised nor vegetated, is readily accessible to the mining area, elevated above winter inundation levels and screened from the roads to the west by a stand of mature pine trees.

- Footings will be ripped up and buried and the site covered with topsoil and rehabilitated to the same standard as the mining areas. Records should be kept of locations where footings and other debris are buried. There may be instances where footings could be valuable for the subsequent land use, in which case their retention would be by agreement.

- Hydrocarbon storage facilities: all facilities will be removed from site and a contaminated site audit conducted of fuel storage and refuelling, and vehicle service areas to determine the requirements, if any, for site remediation. No other hazardous substances are used in significant quantities.

- Other infrastructure: removal of all buildings and offices, power lines, roads, fencing and other infrastructure unless otherwise determined in consultation with stakeholders.

- Return of the land to pasture with native vegetation established in selected areas is the final land use objective.

- A detailed Closure Plan to be developed at least six months before the expected closure.

Decommissioning of the Dry Separation Plant at Picton is not considered in this plan. The Picton facility operates under a separate licence and, if no other reserves are available at the time, it is likely to be retained under care and maintenance for some period to be determined.

Relinquishment of the site will follow when the required criteria and standards for decommissioning and rehabilitation have been met to the satisfaction of the regulatory authorities. These criteria and standards are discussed further in section 7.

7. Completion Criteria

Rehabilitation of a mine site is regarded as successful if the "site can be managed for its designated landuse without any greater management inputs than other land in the area being used for a similar purpose", and is "capable of withstanding normal disturbances such as fire or flood" (Ward, 1995). Success criteria are often comprised of:

- Physical parameters e.g. stability and erosion resistance
- Biological aspects
- Water quality standards, and
- Public safety and aesthetics.

An initial compilation of completion criteria and values by which success can be measured are presented in Appendix B. They largely reflect the broad regulatory requirements that have been determined, and established practices for handling of topsoil and other procedures associated with successful rehabilitation after mining.

During the course of the operation, these completion criteria should be developed further in consultation with stakeholders. They should also be used as a management tool to give assurance that the site is achieving, or is likely to achieve, the long term objectives, including eventual relinquishment.

The completion criteria given are preliminary and should be amended and supplemented as the operation progresses. Particular areas where there is scope for further development are the following:

- *The development of quantitative and semi-quantitative measures by which success of pasture and native vegetation establishment can be assessed.* These should be based on comparative rather than absolute measures. For example, pasture production can be measured against district averages and/or selected analogue sites. This compares production directly with what is occurring on land where the expected final land use is already established, and it also removes annual fluctuations that may occur as a result of climatic conditions or some other environmental variable not specific to the mine site.

- *Reconstruction of landforms.* The management of backfill operations, incorporation of clay materials, and re-establishment of soil profiles are critical issues for the operation. There is potential for further criteria to be developed to assess the success or otherwise of the practices adopted, especially as they relate to the maintenance of the current groundwater regime whereby flows from east to west occur.

The method by which relinquishment is achieved warrants close attention. In practice, it can be a lengthy process but progressive return to agricultural use may be possible if an agreed process can be achieved.

8. Acknowledgements

This report was prepared with advice from Mark Cannon (Department of Minerals and Energy), Bill Smart and Peter Tille (Agriculture WA), and Andre Riedmann (Waters and Rivers Commission). Informal advice on rehabilitation methods was also obtained from industry personnel.

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Appendix A

Mining and Rehabilitation Plan - Materials Handling Schedule

Appendix A

Dardanup Minerals Sands Project
Mining and Rehabilitation Plan - Materials Handling Schedule

Year	Ore	Topsoil/Subsoil	Overburden	Sand Tailings/ Oversize	Clay Tailings
0	Year 1 pit area identified. Mining to commence in the north-eastern sector of the ore body and to proceed in an east to west and north to south direction.	Stockpile area identified. Topsoil (top 200 mm) and subsoil (200-1000 mm) over Year 1 area removed by scraper and stockpiled separately. Maximum height of topsoil stockpiles is 2 m.	Stockpile area identified. Overburden removed by scraper and stockpiled. Limited overburden in north-east sector of ore body.	Storage area identified for first year sand tailings and oversize. Bunds constructed using cut and fill from the local vicinity.	Storage area identified for first year clay tailings. Storage facilities to be constructed using cut and fill from the local vicinity.
1	Year 1 ore mined and treated. Year 2 mining and stockpile areas identified.	Year 2 topsoil and subsoil stripped and stockpiled.	Year 2 material stripped and stockpiled. Massive coffee rock may be left in pit.	Sand tailings and oversize from the wet processing, and tailings from the Picton plant, stored within designated facilities for gradual return to pits as space permits.	Clay tailings stored in designated facility for drying.
2	Year 2 ore mined and treated. Year 3 mining and stockpile areas identified.	Year 3 topsoil and subsoil stripped and stockpiled.	Stored direct in Year 1 pit, if possible, or stockpiled.	Stored direct in bunded ponds within Year 1 pit. Return of Year 1 sand tailings and oversize to pits commences.	Fresh clay tailings stored in ponds constructed in Year 1 pit area. Dried clay tailings from Year 1 used to construct new storage in Year 2 mining area for sand tailings. Remainder of dried tailings deposited in Year 1 pit in discrete rows running east to west.
3	Year 3 ore mined and treated. Year 4 mining	Year 4 area stripped and placed direct over	Year 4 overburden stripped and stored direct	Stored direct in Year 2 pit.	Dried clay tailings removed and placed into

Year	Ore	Topsoil/Subsoil	Overburden	Sand Tailings/ Oversize	Clay Tailings
	areas identified.	replaced overburden in Year 1 mining area.	in Year 2 mining area.		Year 2 pit. Fresh clay tailings replace dried tailings.
4-8	Years 4-8 ore mined and treated. Following years mining area identified.	Next years area stripped and placed direct over previous year replaced overburden.	Next years overburden stripped and placed directly into previous years pit.	Stored direct in previous years pit.	Dried clay tailings removed and placed into previous years pit. Fresh clay tailings replace dried tailings.
9+	Year 9 ore mined and treated.	Topsoil and subsoil returned from stockpiles to cover overburden in year 9 mine area.	Overburden returned from stockpiles to backfill Year 9 mine area.	Stored direct in previous and current years pit.	Dried clay tailings removed and placed into previous years pit. Fresh clay tailings replace dried tailings. First Year tailings used as final fill.

Appendix B

Completion Criteria for Rehabilitation and Decommissioning

Appendix B

Dardanup Minerals Sands Project
Completion Criteria for Rehabilitation and Decommissioning

Criterion	Phase	Standard	Desired Value
Detailed annual rehabilitation plan produced.	Annual	Plans produced (Y/N)	Y
Millable timber recovered.	As required (if timbered areas to be cleared)	Timber recovered (Y/N)	Y
All topsoil stripped to 200 mm.	As required	Amount of available topsoil stripped and stockpiled or re-used (%)	100
Topsoil stockpiles to a maximum of 2 m in height.	As required	No. of topsoil stockpiles exceeding 2.2 m in height (n)	0
All subsoils stripped to 1 m.	As required	Amount of available subsoil stripped and stockpiled or re-used (%)	100
Acceptable dust levels from stockpiles.	As required.	No. of days per month of visible dust blowing off stockpiles (n)	0
Stockpiles clearly marked on plans and separated.	As required.	No. of stockpiles not clearly designated (n).	0
Topsoil returned directly wherever possible.	Annual after Year 3.	Amount of topsoil returned directly to backfilled pits (%).	100
Increased use of deep-rooted vegetation.	Annual after Year 3.	Change in area (ha) of deep-rooted vegetation from pre-mine conditions.	+
Topsoil from areas of native vegetation to be recovered and stockpiled separately.	Annual (if native vegetation present)	Amount of topsoil from areas of native vegetation recovered and stockpiled separately (%)	100
Clay tailings to be incorporated in pits in thin layers or east-west lying strips.	Annual after Year 1.	Amount of clay tailings incorporated into pits to optimise east-west groundwater flows (%).	100

Criterion	Phase	Standard	Desired Value
Available pit areas to be backfilled to required contour and rehabilitated progressively.	Annual after Year 3.	Amount of available pit areas backfilled and rehabilitated (%).	100
Enhance existing native vegetation and conduct tree planting.	Annual	No. of trees planted (n)	To be determined
Casuarina obesa to be included wherever possible.	As required.	No. of trees planted (n) or amount of seed used (kg).	To be determined
Pasture establishment and survival to be equivalent to or better than annual district averages and/or selected analogue sites.	Annual after Year 3.	Ratio of pasture productivity in rehabilitated areas to that of annual district average and/or analogue sites.	≥ 1
Establishment of native vegetation includes key tree species and a shrub understorey.	Annual after Year 3 (if native plant revegetation undertaken).	Presence of key species (species to be determined) (Y/N)	Y
		Species diversity	To be determined
Native vegetation likely to be sustainable in the long term.		Vegetation health (semi-quantitative scale or specific physiological measurements)	To be determined
Rehabilitate surfaces to be stable under normal environmental conditions	Annual after Year 3	Area (ha) required recontouring or repair	0
Maximum level of weeds to be that typical of the region.	Annual after Year 3.	No. of unacceptable infestations remaining untreated (n)	0
Consultation to be maintained with regulatory authorities.	Continuous	No. of annual contacts (n).	To be determined.
Detailed closure plan to be produced.	Six months before the expected closure.	Plan produced (Y/N).	Y

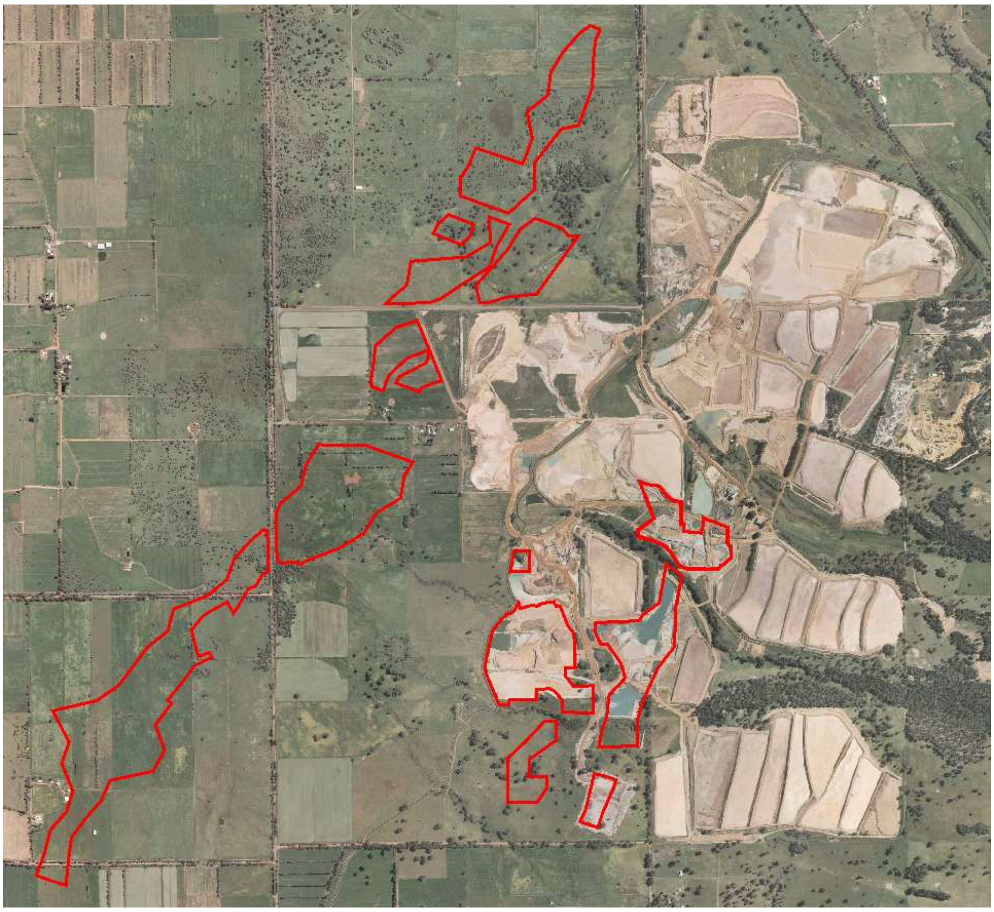
APPENDIX B

Soil Management Plan,
Dardanup Mineral Sands Project

Doral

SOIL MANAGEMENT PLAN

DARDANUP MINERAL SANDS PROJECT



CONTENTS

1 INTRODUCTION

This Topsoil Management Plan is a revision of the GHD (2001) and the Iluka EPS (2007) documents to incorporate the western extension to the Dardanup Mineral Sands Project.

1.1 Purpose

To ensure that topsoil and subsoil are harvested, stored and reused in a manner that facilitates successful rehabilitation at all Doral operations.

1.2 Scope

This Soil Management Plan applies to any ground disturbing operations and details the requirements and responsibilities for:

- Pre-mining radiation survey;
- Stripping of topsoil and subsoil;
- Handling of topsoil and subsoil;
- Storage of topsoil and subsoil;
- Placement of topsoil and subsoil; and
- Pasture Management.

2 PROCEDURES

2.1 Pre-mining Radiation Survey

A background radiation survey must precede any topsoil stripping. Readings must be taken on a maximum 200m x 100m grid in MGA94 coordinates. If initial survey highlights unusually high natural readings, infill points may be required.

The operations are subject to the Mines Safety and Inspection Act and the Mine Safety and Inspection Regulations and have to satisfy Part 16 of the Mines Safety and Inspection Regulations. As a requirement of Part 16 a Radiation Management Plan (RMP) has been prepared for approval by the State Mining Engineer (SME). Within this RMP a commitment was made to undertake a pre-operational radiation monitoring programme (Radiation-Wise 2001)

2.2 Topsoil and Subsoil Stripping

The following procedures shall be applied to topsoil and subsoil stripping;

- Prior to removal of topsoil, any millable timber will be recovered. *Kingia australis* (Grass skirts) will be potted into bags and irrigated until they can be transplanted back into the rehabilitated area;
- The removal of topsoil and subsoil from disturbed areas shall be maximised and, no matter how small the area of disturbance, topsoil and subsoil shall be salvaged;
- Topsoil from native vegetation and pasture areas shall be stripped separately and stockpiled separately;
- Small vegetation should be stripped with the topsoil;
- Topsoil from native vegetation areas shall be stripped in two passes with top 10cm removed and stored separately from the underlying 10cm;
- Topsoil from pasture areas shall be stripped to a depth of 15cm or to the depth of black/grey colouration whichever is greater in a single pass;
- To reduce dust generation topsoil and subsoil stripping will be maximised during the autumn months to minimise the period before natural germination; and
- Topsoil and subsoil stripping required out of season will be sprayed with a binding tackifer or irrigated by water-cart to promote early germination.

2.3 Topsoil and Subsoil Handling

Topsoil shall <u>not</u> be stripped under saturated soil conditions which would be conducive to soil damage. Similarly scheduling of topsoil and subsoil stripping should be such that dry windy conditions, particularly in mid-late summer are avoided.

Topsoil and subsoil shall not be used for any other purpose than stockpiling or direct placement for rehabilitation.

Topsoil from SMU1 and SMU 4 areas shall be removed and stockpiled separately from topsoil and subsoil from SMU2 and SMU3 areas (see appendix 1 :Soil Mapping Units). These should also be returned to their pre-mining location during rehabilitation. SMU1 and SMU 4 soils will break down quickly and appropriate handling will be required to minimise dust generation.

Pale grey sands from SMU2 represent Subsoil 1 material. This can be easily handled during mining and rehabilitation. Yellow Sandy Loam from SMU2 represents typical Subsoil 2 material. Care needs to be taken not to handle this material if it is too wet or too dry as this will lead to subsoil degradation.

The yellow-brown mottled duplex from SMU4 contains clay content to high in salinity/ sodicity to be used in subsoil material. This should be used as Overburden 1 material. Blue grey sandy clay and brown clay from all SMU areas should be placed at the bottom of backfill areas. This material is classed Overburden 2 and should be overlain by Overburden 1 material.

2.4 Topsoil and Subsoil Storage

The following procedure shall be applied to topsoil and subsoil storage:

- Records of topsoil and subsoil removal and storage locations shall be maintained;
- Planning shall endeavour to facilitate the direct placement of topsoil and subsoil from disturbed areas to areas scheduled for rehabilitation;
- The height of stockpiles Shall not exceed a maximum height of 3m;
- Stockpiles should be located where they will not be disturbed by future mining and preferably in a location where they will not be trafficked;
- Topsoil and subsoil stockpiles shall not be located where they will be mixed with other materials (e.g. drain spoil) or standing vegetation;
- Where vegetation does not re-establish on topsoil stockpiles within 3 months, revegetation should be encouraged by seeding; and
- If there is drying of the surface of the topsoil and subsoil stockpiles prior to vegetation establishment dust suppression measures shall be employed as necessary.

2.5 Topsoil and Subsoil Placement

Topsoil and subsoil placement on rehabilitation areas shall be along the contour to minimise water erosion.

Topsoil should be placed on rehabilitation areas just prior to the growing season to avoid dust generation over the windy summer months.

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 may have to cease.

Following topsoil and subsoil replacement, the surface will be chisel ploughed on the natural contour.

The final surface design and drainage layout will be similar to the pre-mining surface design with minor undulations and erosional features smoothed out.

It is required to use GPS controlled techniques for topsoil and subsoil replacement as they allow a more accurate final land surface.

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 (500mm) will be required after the replacement of subsoil, but prior to replacement of the topsoil.

2.6 Pasture Management

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

The methodology is summarised broadly below:

- Application of lime at a rate determined via soil testing and agronomic advice;
- 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, for which the type, rate and number of applications will be determined via soil testing and agronomic advice;
- An application of seed mix consisting of sub clover and ryegrass varieties in years one and three at rates constant with dairy land and Iluka conventions; and
- After seeding, the area is rolled to provide a firm seed bed for pasture establishment.

2.6.1 Grazing

In the first spring after sowing, the primary objective is to develop a stable, productive soil profile by encouraging proliferation of pasture roots and soil biota. Pasture will be grazed lightly to promote tillering of ryegrass, a healthy component of clover, and to discourage pasture weeds (e.g. capeweed) from attaining dominance.

In subsequent years, it is expected that with appropriate management, pasture productivity will be comparable to other pastures in the locality. Grazing intensity will be gradually increased to levels considered appropriate for the district and seasonal conditions.

2.6.2 Weed and Pest Control

Weed control will primarily be achieved by ensuring pasture species are appropriately grazed such that they out-compete pasture weeds. Pastures will be monitored for problem weeds and pests. Where warranted, weeds will be controlled via herbicide application. Similarly, where warranted, pests such as red-legged earth mite will be controlled via insecticide application.

Invasive weeds or Declared Plants such as Silver Wattle, Blackberry, Bridal Creeper and Narrow leaf Cotton Bush will require spot spraying with a suitable herbicide should they occur in rehabilitated pasture.

Weed control procedures will follow normal agricultural practices, with agronomic advice sought where necessary.

2.6.3 Fertiliser

Pastures will be fertilised annually as part of an ongoing maintenance programme. The type, rate and number of fertiliser applications will be determined via soil testing and agronomic advice.

2.6.4 Farm Infrastructure

As a minimum, the pre-mining infrastructure will be reinstated. Farm layouts will be developed in consultation with the landowner and will include surface design, fencing specifications, drain locations, stock water points and farm laneways.

3 RESPONSIBILITIES

The Mine Superintendent shall designate responsibility for planning topsoil and subsoil stripping, placement and determining stockpile locations.

The Mine Superintendent shall be responsible for ensuring that stripping; placement and stockpiling procedures are carried out in accordance with this Topsoil and subsoil Management Plan.

The Environmental Officer shall be responsible for maintaining records of stripping, stockpiling and placement records as provided by the Mine Superintendent.

4 DEFINITIONS

Topsoil – The A1 horizon of the soil, generally the first 100mm of the soil horizon, containing the organic matter, seeds plant propagules and cyclable nutrients.

Direct replace – This term refers to the relocation of topsoil from its location of origin to its final rehabilitation location in one move.

Shall – A mandatory action.

Should – A recommended action but not mandatory.

5 REFERENCES

GHD (2001) Sample Operational Control Procedure Topsoil Management. In: *Dardanup Mineral Sands Project Environmental Management System* Document Number: 4665

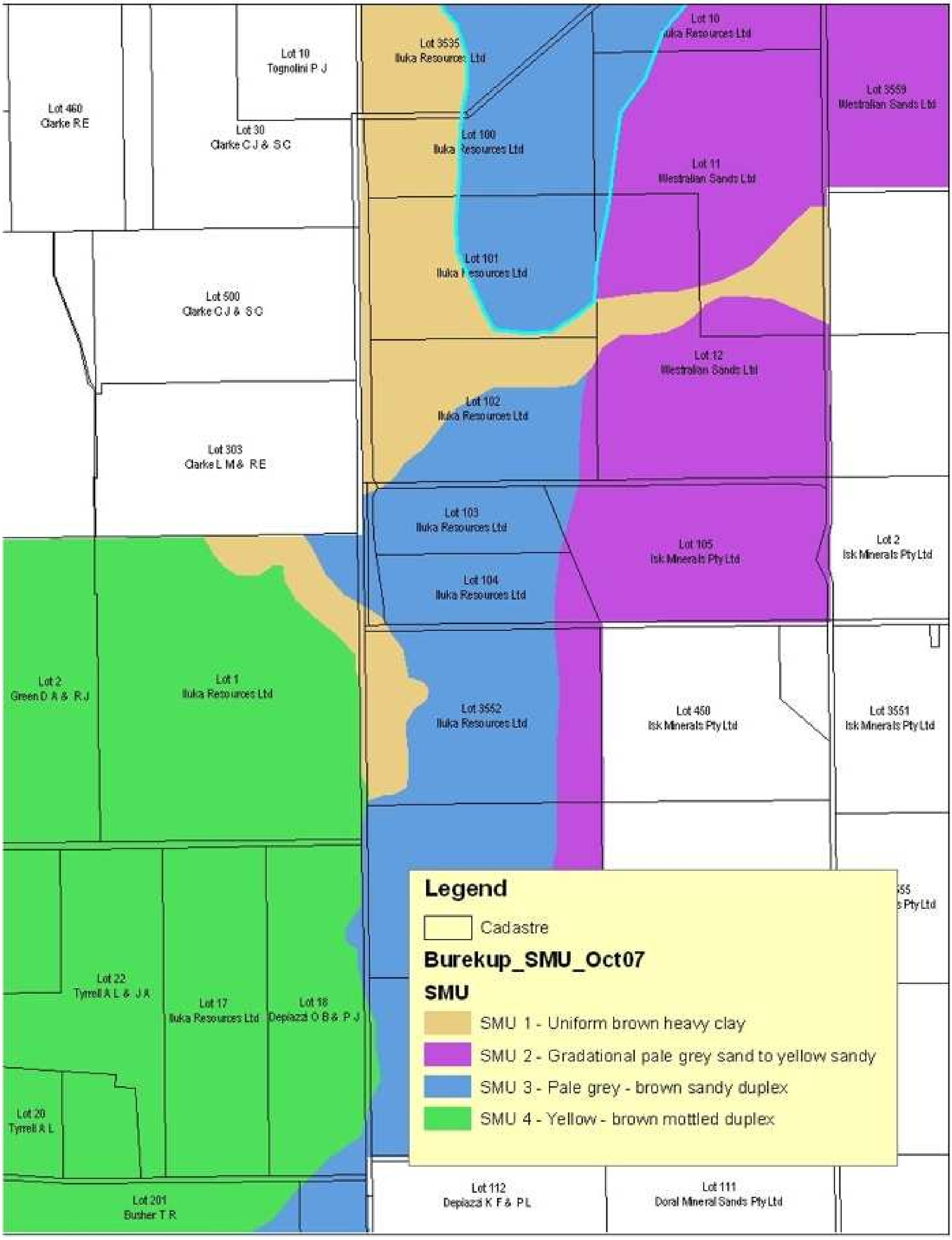
Iluka (2007) Burekup Mineral Sands Project, Environmental Protection Statement- Draft.

Iluka (2009) Burekup Soil Management Plan- Draft.

Radiation Wise (2001) Pre-operational radiation monitoring at mine site for Doral Mineral Sands Pty. Ltd.

6 APPENDIX 1

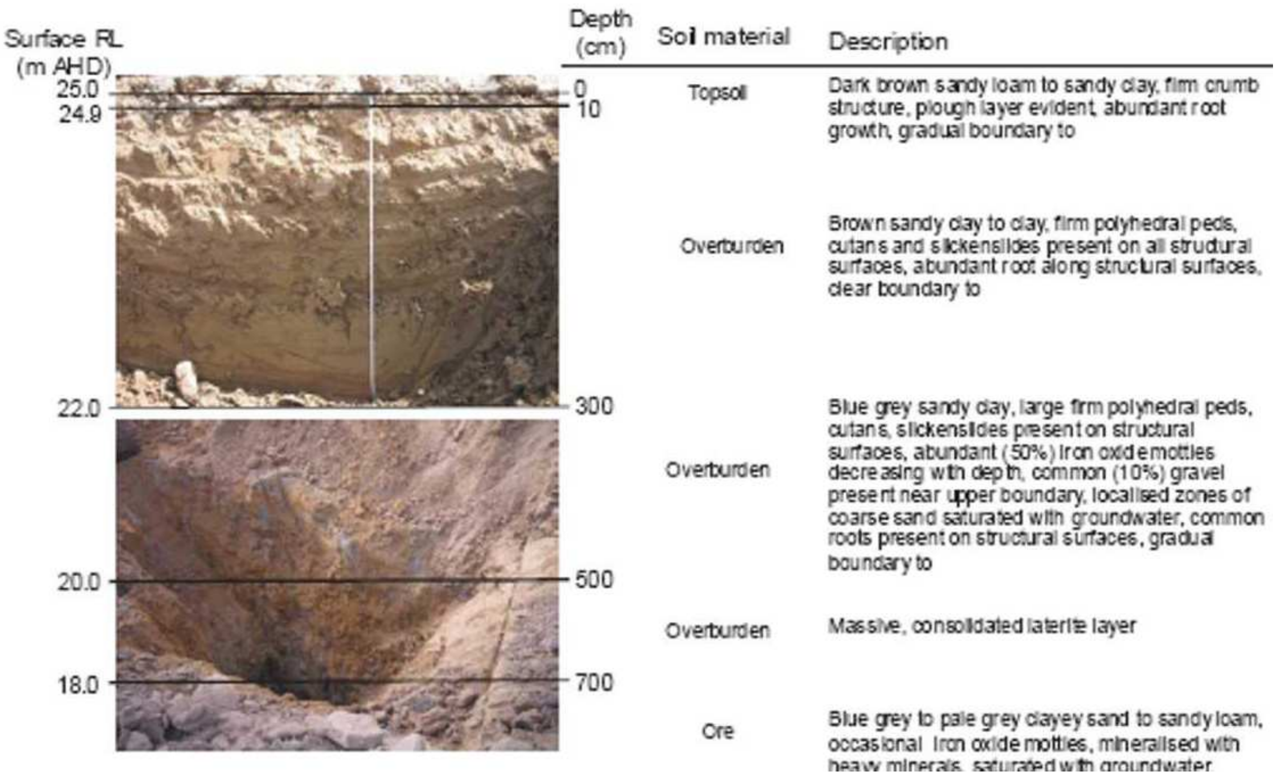
6.1.1 Soil Mapping Units



6.1.1.1 SMU1: Uniform Brown Heavy Clay

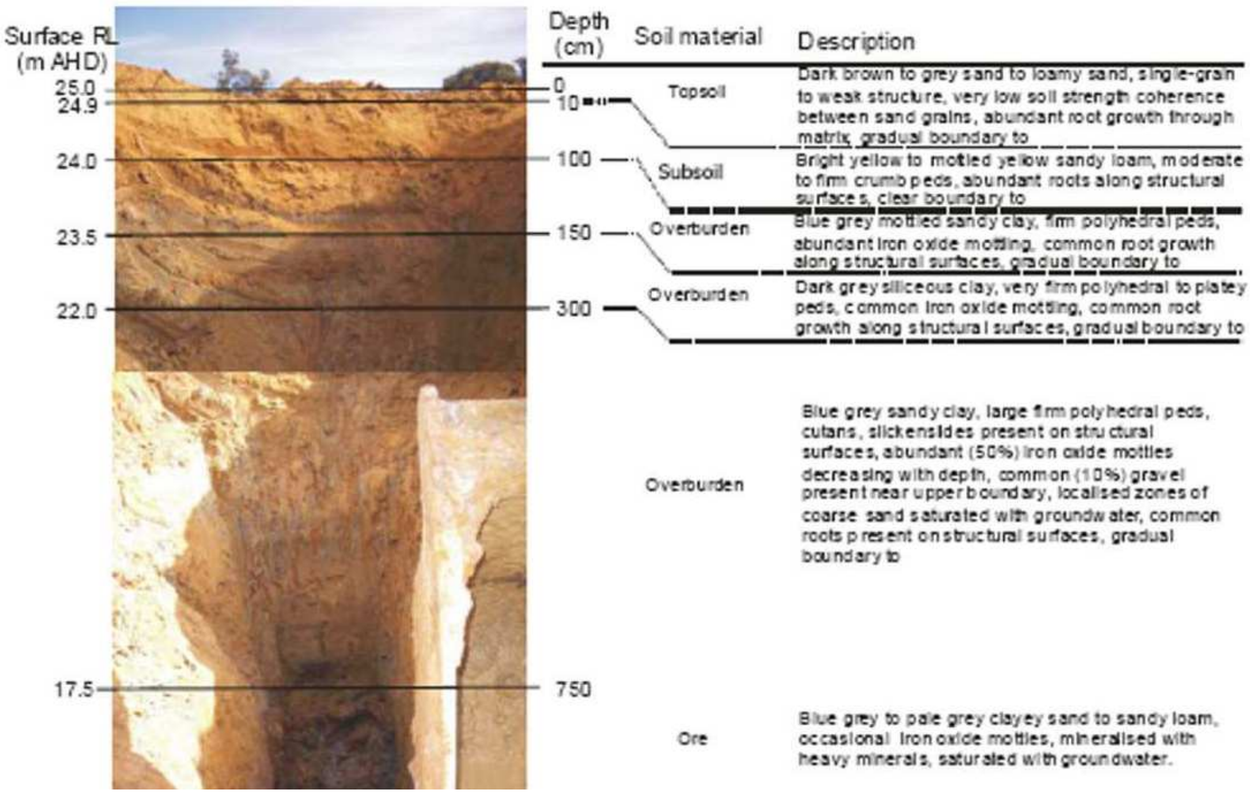
This SMU occurs in two isolated areas within the site and likely represents the basal portion of remnant stream channels through the area. The soil extends from the surface to depths of up to 4 m and is deposited directly onto the blue-grey sandy clay soils of the Guildford Formation.

The topsoil is structurally degraded, resulting in slaking and dispersion, causing the soils to hardset. The underlying brown clay soils are well structured and abundant roots occur throughout. This material is moderately saline with a relatively high sodicity and poor structural stability. The blue-grey sandy clay soils of the Guildford Formation occur beneath the brown clay and shows signs of shrink-swell properties.



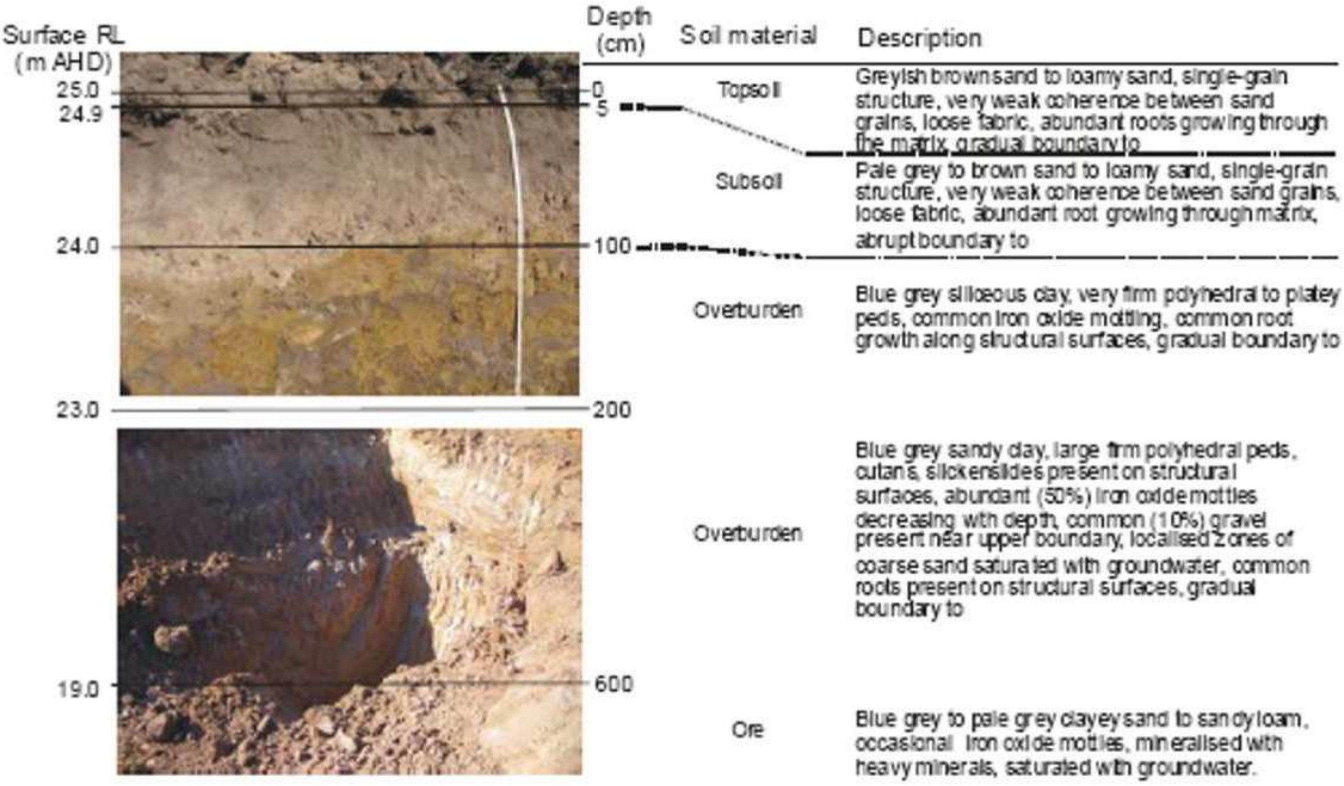
6.1.1.2 SMU2: Gradational Pale Grey Sand – Yellow Sandy Loam

This SMU is restricted to areas of higher elevation in the northeast. The surface soils consist of 10 to 40 cm of pale grey sand grading into a bright yellow to mottled yellow sandy loam at depth. These soils are not structurally degraded like those of SMU1. The surface soils exhibit a sandy texture with little clay and therefore are well drained and friable. There is a clear boundary between the surface sandy soils and the underlying blue-grey sandy clay soils of the Guildford Formation.



6.1.1.3 SMU3: Pale Grey – Brown Sandy Duplex

This SMU is isolated to the north eastern margin of the proposed main pit. It consists of a pale grey – brown sand overlying the blue-grey sandy clay soils of the Guildford Formation with an abrupt textural boundary. The sandy surface soils have a very low water holding capacity and subsequently they become saturated in winter months with water perching on the clayey soil below, and drying rapidly in spring. The defined duplex boundary facilitates perching and subsequent lateral flow of water, which has implications for the formation of surrounding areas of inundation. It is likely that these soils have formed in depressions on the upper surface of the underlying Guildford Formation.



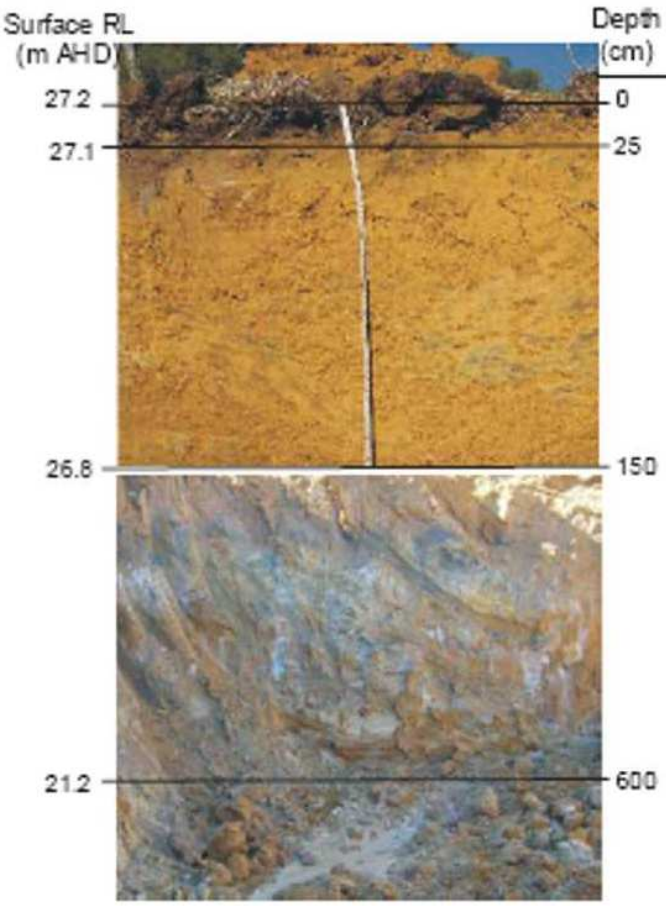
6.1.1.4 SMU4: Yellow – Brown Mottled Duplex

This is the most dominant SMU in the site. The bright yellow to brownish orange surface soils overlying the Guildford Formation are coarser than those in SMU1 and therefore better drained. Again, the boundary between the surface soils and the Guildford Formation is abrupt, indicating a depositional, rather than pedogenic, mode of formation.

The topsoil has a sandy clay texture which is structurally sensitive. These soils slake rapidly when rewet and show moderate dispersion resulting in hard setting. Cultivation of these soils is also likely to enhance hard setting, and considerable shrink-swell properties are observed.

The subsoil consists of bright yellow sandy clay with a very good structure and firm crumb peds. It is less dispersive (due to iron oxides) with relatively high plant available water content.

It is important to note that the clayey Guildford Formation underlies all surface soils across the site. The Guildford clay remains unsaturated throughout the majority of the year, as evidenced by the extensive mottling and laterisation. Water movement through the clayey matrix is extremely slow, however preferential flow does occur through isolated coarse sandy lenses.



Soil material	Description
Topsoil	Dark greyish brown sandy loam to sandy clay, firm crumb structure, plough layer evident, abundant root growth, gradual boundary to
Overburden	Bright yellow to brown sandy clay, moderate to firm crumb peds, mottles increasing with depth, abundant roots along structural surfaces, clear boundary to
Overburden	Blue grey sandy clay, large firm polyhedral peds, cutans, slickenslides present on structural surfaces, abundant (50%) iron oxide mottles decreasing with depth, common (10%) gravel present near upper boundary, localised zones of coarse sand saturated with groundwater, common roots present on structural surfaces, gradual boundary to
Ore	Blue grey to pale grey clayey sand to sandy loam, occasional iron oxide mottles, mineralised with heavy minerals, saturated with groundwater.

APPENDIX C

Burekup West Environmental Offset Summary

Environmental Offsets Summary

Section A: Administrative information

1. Proposal or scheme name: Proposal for a Western Extension to the Dardanup Mineral Sands Project to include the Burekup Mineral Sands Deposit. Doral Mineral Sands Pty Ltd.

2. Summary of proposal or scheme: The Burekup Minerals Sands Deposit (mining tenements M70/652 and M70/720) is located approximately 150km south of Perth and 11km east of Bunbury in the Shire of Dardanup. Doral propose to mine the deposit, commencing by mid 2009. The proposed mining includes the following key features:

- Removal and stockpiling of 5.8 Million Bank Cubic Metres of overburden;
- Removal of 9.5 Million tonnes of ore for the production of 900,000 tonnes of heavy mineral concentrate;
- Construction of a conveyor belt to the existing Doral processing facilities immediately to the east of the orebody; and
- Rehabilitation of the site after mining.

Section B: Type of environmental asset (s) – State whether Critical or High Value, describe the environmental values and attributes

Critical Assets

- The area to be disturbed contains vegetation within the Guildford Vegetation Complex which is poorly reserved. The vegetation is mostly highly disturbed and exists as scattered to dense trees over pasture within paddocks as well as some more intact vegetation along road reserves.
- One CCW occurs close to but outside the mine disturbance area (see Plates 8.2.1 and 8.2.2).
- Some of the road reserve vegetation may provide foraging habitat for the Western Ringtail Possum at different times of the year.
- Marri trees in the area have historically provided foraging habitat for Baudin's Black Cockatoo. Survey work carried out for this EPS saw no evidence that Black Cockatoos were currently foraging in the area.

High Value Assets

- The area contains a known population of the Priority 4 plant species *Aponogeton hexatepalus*. The population (2B on DEC's records) has had between 20-70 plants recorded from within a road reserve. Surveys by Mattiske in 2006 and 2007 did not re-locate this population.

Section C: Significant impacts (describe the significant adverse environmental impacts related to the proposal or scheme before mitigation measures are applied)

The proposal will result in the following adverse environmental impacts:

- Clearing of 0.13ha of Guildford Vegetation Complex in Very Good condition, 2.04ha in Good condition and 25.15ha in Degraded condition. Remnant vegetation in the western extension area is considered regionally significant as it is part of the poorly reserved (4.4% of pre European is remaining) Guildford Vegetation Complex (EPA, 2003). This complex is under the reserve requirement of 10% (currently 0.4% is reserved under existing and proposed regional open space). In summary, Doral will be clearing 0.15% (2.17 ha) of the Guildford Vegetation Complex that is rated Good to Very Good;
- Loss of approximately 450 trees from within paddocks and road reserves, the majority of which are Paperbark (*Melaleuca rhaphiophylla*) as well as some Marri (*Corymbia calophylla*) and Wandoo (*Eucalyptus wandoo*) trees;
- Potential indirect impact on the CCW;
- Loss of potential Western Ringtail Possum foraging habitat in road reserves;
- Loss of Marri trees that have been historically used (i.e. some time ago) as foraging habitat for Baudin's Black Cockatoos; and
- Potential loss of a population of *Aponogeton hexatepalus* (20-70 plants). Note: this population has not been found in recent surveys and it is unsure if it still exists (see Section D).

Section D: Mitigation measures (describe all measures to Avoid, Minimise, Rectify and Reduce)

- Loss of trees within the orebody footprint is unavoidable for a mining operation (see Section F for offset of clearing);
- A buffer of 200m will be set between the mine operations and the CCW. In addition, the following measures will be put in place to avoid any indirect impacts from dewatering:
  - Dewatering of the pit within the potential impact zone of the CCW will occur in winter as far as practicable and for as short a time as possible to avoid any impacts of local groundwater drawdown (the CCW is a perched wetland therefore groundwater drawdown is not likely to affect the hydrology of the wetland);
  - A monitoring program will be put in place to monitor the water levels in the CCW as well as tree health. Trigger values for water levels will be determined in consultation with DEC together with a contingency plan in the event that dewatering is considered to have an adverse impact on water levels in the CCW. Contingency measures could include irrigation of the CCW with the water from dewatering operations, or ceasing mining in the area until conditions allow for recommencement;
- Any road reserve that is required to be upgraded for the operation will be surveyed prior to design for the possible presence of Western Ringtail Possums, Western Ringtail Possum foraging habitat trees as well as Marri trees (foraging for Baudin's Cockatoos). Where possible, works will avoid areas of potential Western Ringtail Possum and Baudin's Cockatoo habitat; and
- The site where the population of *Aponogeton hexatepalus* has previously been recorded from will be quarantined and fenced until further works in winter and spring of 2009 confirm whether or not the population still exists. If the population still exists then DEC will be consulted on potential management options.

Section E: Significant residual impacts (describe all the significant adverse residual impacts that remain after all mitigation attempts have been exhausted)

- Clearing of 0.13ha of Guildford Vegetation Complex in Very Good condition, 2.04ha in Good condition and 25.15ha in Degraded condition.
- Loss of approximately 450 trees from within paddocks and road reserves, the majority of which are Paperbark (*Melaleuca rhaphiophylla*) as well as some Marri (*Corymbia calophylla*) and Wandoo (*Eucalyptus wandoo*) trees.

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.

1. Doral propose to secure and rehabilitate approximately 20ha of Guildford Vegetation Complex located within their Dardanup Mineral Sands Mine immediately to the east of the western extension area (see Figure 8-1). The area contains approximately 10ha of upland and valley/drainage line vegetation from the Guildford Complex, predominantly Marri and Jarrah woodland with some Banksia (*B. grandis* and *B. attenuata*). The condition of the remnant native vegetation is considered Good to Very Good. Approximately 10ha of the area is either completely cleared or parkland cleared. The valley part of the site is approximately 1.4km long and provides a corridor of good quality native trees linking the palusplain area to the west to vegetation on farms to the east (refer to Plate 8.2.3).

   The area is currently unprotected and not managed for its environmental values. Doral propose to place a conservation covenant over this land to give the site protection for its environmental values. In addition, Doral commit to providing $250,000 over 5 years to manage the area which will include rehabilitation of the degraded and parkland cleared areas with trees, and understorey where possible, that are consistent with the soil type and surrounding vegetation. The area will also be fenced and a weeding program put in place.

2. Doral commit to offsetting the approximately 450 trees to be cleared with the planting of 5,000 trees within the offset site described in point 1 above. Tree species for rehabilitation of this area are expected to be predominantly Marri trees with some Jarrah and Banksia trees.

3. Doral have support from the owners of the CCW to place the wetland and a buffer within a conservation covenant. The CCW Covenant Area has been agreed in principal in preliminary discussions with the owner and the DEC (see Figure 8-1). The details of the Conservation Covenant and associated management strategies will be finalised within one year from the commencement of mining. The CCW will be fenced and managed to improve its environmental values. Management will include weeding and rehabilitation with appropriate wetland species for the area. A CCW understorey rehabilitation plan and program will be designed in consultation with the DEC. Where possible, local provenance species will be included in the design of the understorey.

4. Post mining rehabilitation (to be incorporated in the Rehabilitation and Decommissioning Plan for the Project) will include the planting of trees within strategic corridors such as adjacent to road reserves and fence lines to link strengthen or improve corridors for native fauna. The areas for replanting will be determined in consultation with DEC and included in the Plan.

5. Doral will submit an annual report to the DEC outlining the status of the commitments in this section. The annual report will be for the 12 months following Ministerial approval. Annual reports will be submitted within 3 months of the end of each 12 month period.

6. The Annual report will provide summary evidence of expenditure by Doral for the maintenance of the Offset to the agreed amount of $250,000 over 5 years.

7. Doral will commit to finalising the covenant requirements and Rehabilitation and Decommissioning Plan for this area within 12 months of commencing mining.

Section G: Spatial data relating to offset site/s (see *EPA Guidance Statement No.19: environmental offsets- biodiversity*, Appendix 4)

Figure 8-1 of this offset is CAD-drafted figures and is spatially correct. The drafting file can be provided to the EPA on disc if required.

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.

The Willoughby Offset Area proposed for covenanting and rehabilitation within the Dardanup Mineral Sands Mine area was surveyed by ATA Environmental in 2003. The Environmental Offset was discussed with the DEC in November 2008.