DMS
A Subsidiary of Astron Limited

ENVIRONMENT EFFECTS STATEMENT
DONALD MINERAL SANDS PROJECT

DONALD MINERAL SANDS PTY LIMITED

MAIN REPORT
VOLUME 1

972_5_v5
February 2008

coffey natural systems
SPECIALISTS IN PEOPLE AND PLACE

coffey natural systems
SPECIALISTS IN PEOPLE AND PLACE

ENVIRONMENT EFFECTS STATEMENT

Donald Mineral Sands Project

CR 972_5_v5
February 2008

DMS
A Subsidiary of Astron Limited

Coffey Natural Systems Pty Ltd ABN 61 005 041 878
126 Trenerry Crescent Abbotsford VIC 3067 Australia
T (+61) (3) 9418 0600 F (+61) (3) 9418 0650
www.coffey.com/naturalsystems

Project director	Phil Towler
Project manager	Guy Hamilton
Senior consultant	Amelia Jenkinson
Consultant	Susannah Kenny, Jessica Wiltshire, Vicki Alivanoglou, Elissa Bell, Marissa Haywood
Draftsperson/graphic designer/GIS	Felicity Thomson, Hanna Blaszkiewicz, Drew Smith, Grant King, Helli Kotasek
Desktop publishing	Jill O'Neil
Version:	**Distribution:**
CR 972_5_v5 February 2008 (Via email)	TRG – 50 copies DMS – 10 copies Coffey Natural Systems – 5 copies

Tables

Figures

Plates

Supporting Studies

EXECUTIVE SUMMARY

1. Introduction

Astron Limited (Astron), through its wholly owned subsidiary, Donald Mineral Sands Limited (DMS), proposes to develop a titanium and zirconium mineral sand mine in western Victoria, approximately 240 km northwest of Melbourne and 66 km northeast of Horsham (Figure ES1). The project area is mainly freehold agricultural land with remnant patches of native vegetation. Although sparsely populated, there are several residences in the project area.

In December 2005, following consultation with key stakeholders and regulatory authorities, the Minister for Planning determined that the Donald Mineral Sands Project (the project) would require assessment under the *Environment Effects Act 1978* in the form of an Environment Effects Statement (EES).

On 24 November 2005, the project was declared a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Commonwealth has accredited the Victorian EES process for the assessment component; however, it retains its decision-making powers.

This EES describes the project and its environmental, cultural, social and economic consequences. The EES has been prepared in accordance with assessment guidelines issued by the Department of Planning and Community Development under the guidance of a technical reference group (TRG) comprising local, state and federal governments. It is designed to inform future decision-making by government regulators and will not, of itself, provide consent to commence mining.

The project will involve mining mineral sand ore from an open pit, processing it into heavy mineral concentrate (HMC) and transportation of the concentrate to port for export.

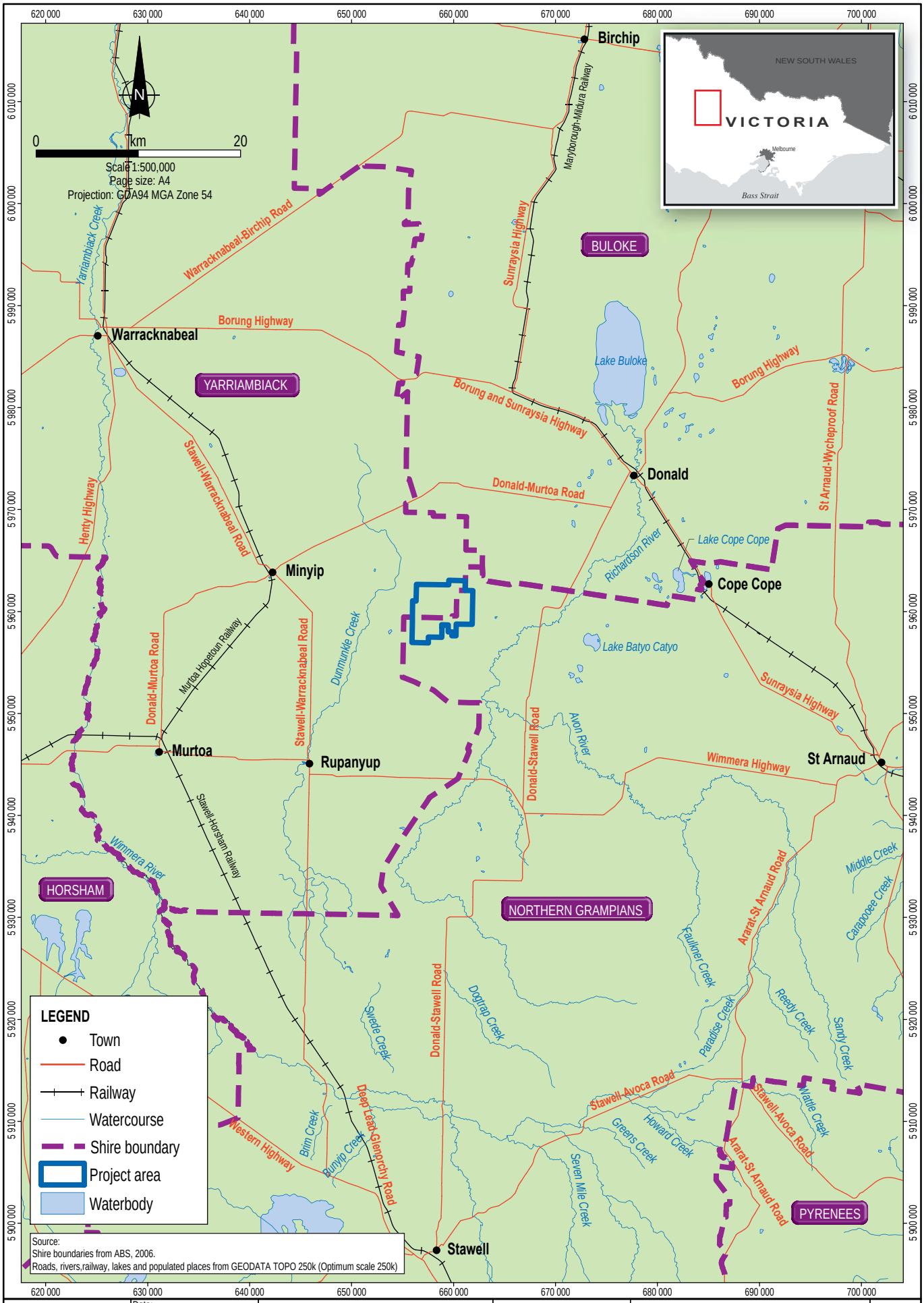
The mine will use conventional earthmoving machinery such as excavators, trucks, bulldozers and scrapers. In the first 6 to 12 months, topsoil, subsoil and overburden will be stripped and stockpiled, while tailing will be placed in one of three dedicated tailing storage facilities (TSFs). After this period, further excavated materials will be returned to the pit progressively backfilling the mine. The TSFs will then be decommissioned and rehabilitated.

Two concentrate products will be produced; magnetics (predominantly ilmenite) and non-magnetics (predominantly rutile, zircon and leucoxene). Concentrates will be separately stockpiled on site then progressively transported to port either by road or a combination of road and rail. If rail is selected, a rail siding near Minyip will be built specifically for the project.

The project will produce 398,000 tonnes of HMC annually, which requires excavation of 21 million tonnes of ore and overburden per year during the planned 25-year mine life.

The final rehabilitation of the mined area will produce a landform similar to that existing before mining, including the restoration of native vegetation and agricultural land. Existing drainage patterns will be maintained both during and after mining.

At the time the EES process began, DMS was considering seeking approval for an area of approximately 5,000 ha (referenced herein as the superseded project area) and for many of the specialist studies undertaken, this larger area was the subject of their reports. Following a review of project economics and consideration of the potential impact on native vegetation of national and state significance, DMS chose to reduce the project area to approximately 2,800 ha at the northern end



coffey natural systems	Date: 25.09.2007 MXD: 972_DonaldMineralSandsGIS File Name: 972_05_ES001_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Project location	Figure No: ES1

of the area originally proposed. This reduced area is the subject of the EES and the future mining licence. The two areas are shown in Figure ES2.

2. Project Description

Project Scope

The project area is part of the Donald deposit, which is broad scale and blanket-shaped, extending over an area approximately 50 km long and up to 8 km wide.

The global resource of the project area has been estimated at 693 Mt of ore containing 5.1% heavy minerals (see Figure ES2). Of this, the indicated resource is 477 Mt and contains 0.3% rutile, 1.1% zircon, 1.8% ilmenite and 1.1% leucoxene.

The open pit will be on average 20.6 m deep, comprising an ore horizon 5.7 to 15.2 m thick (averaging 9.8 m) and overburden of sands and clays 5.4 to 17.6 m thick (averaging 10.8 m).

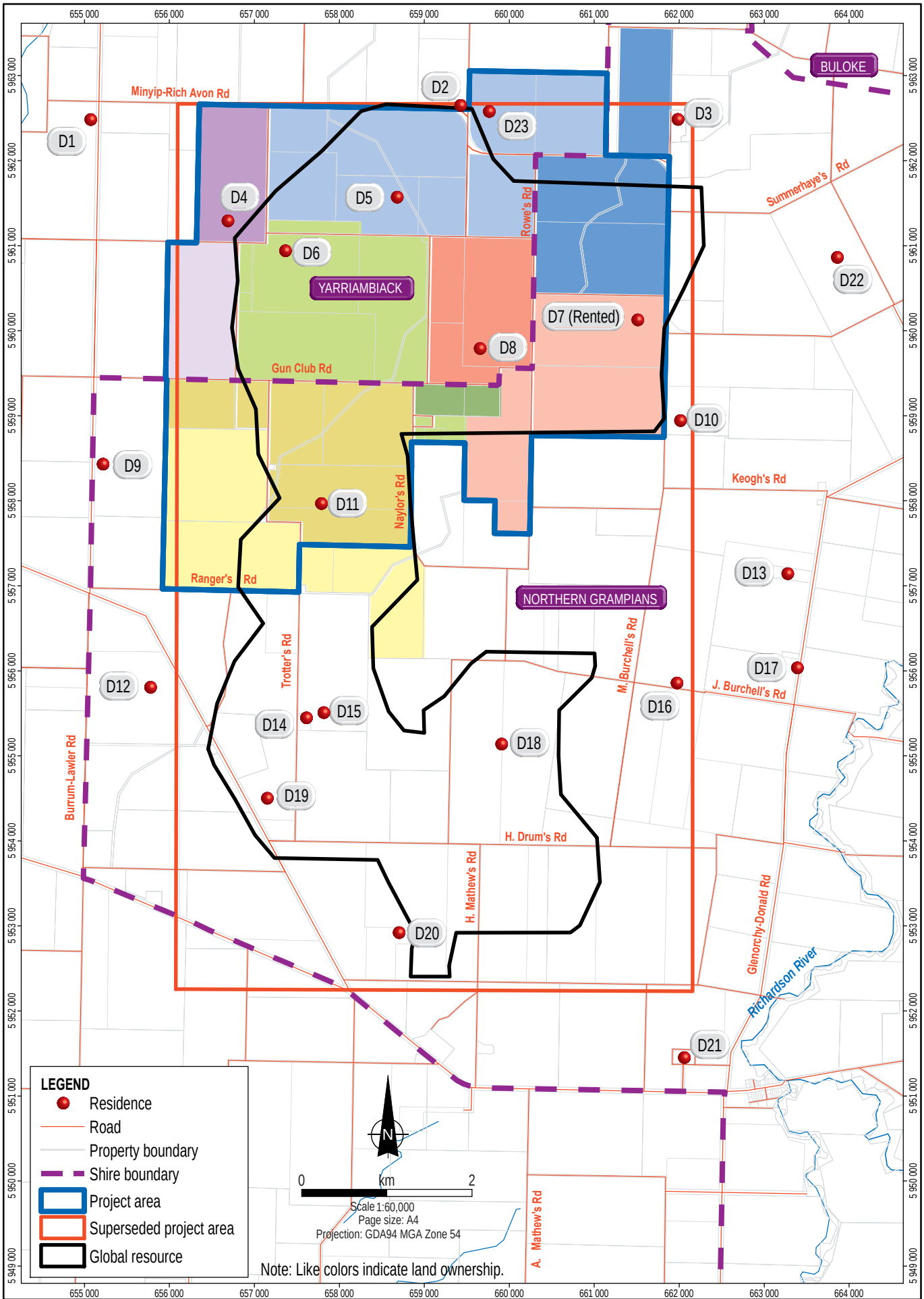
The top of the orebody is, on average, 3.0 m above the top of the water table; however, it does extend into the water table. The proportion of the orebody that is saturated varies across the project area.

Mining Sequence

Mining will be a continuous sequence of the following activities:

- Surveying and pegging the mine area.
- Clearing vegetation.
- Annual campaigns to strip and stockpile topsoil. Topsoil stockpiles will be 2 m high or less.
- Stripping the subsoil and stockpiling it off the mining path. Subsoil stockpiles will be 5 m high or less.
- Removing overburden to a variable, predetermined depth. Temporary overburden stockpiles will be 30 m high or less.
- Mining using a hydraulic excavator.
- Pumping the ore as a slurry from the open pit to the ore processing plant.
- Wet processing to separate heavy minerals from the sand and clays.
- Return pumping of the tailing to the excavation.
- Solar drying the returned tailing.
- Replacement of overburden and reshaping of the ground surface to a landform similar to the surrounding topography.
- Respreading of the subsoil.
- Return of topsoil on an annual campaign basis and revegetation of the disturbed areas.

Once the pit is large enough, and the dried tailing strong enough to support machinery, the pit will operate on a continuous cycle of removal of overburden and ore at one end of the pit and backfilling with tailing and overburden at the other.



coffey natural systems	Date: 25.09.2007 MXD: 972_DonaldMineralSandsGIS File Name: 972_05_ES002_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Project area and surrounds	Figure No: ES2

Mining

Most earthmoving will be conducted by hydraulic excavators loading into large, off-highway dump trucks. There will be three operating levels within the pit:

- A single excavator and two trucks will be used for ore duty and,
- Two excavators working with a fleet of seven trucks on overburden duty.

Scrapers may be used on occasion, while bulldozers will assist in preliminary breakage (ripping) and shaping of stockpiles. Graders will be used to maintain haul roads.

Ore haulage will be entirely within the pit, from the excavator to the mining unit plant (MUP). Ore dumped at the MUP will be screened in a trommel to remove oversize material (that could damage pumps) and then slurried with water.

Overburden haulage distances may be as far as 1 km on the surface either to the stockpile or to the rear of the pit for backfilling. Wherever possible, overburden haulage will be within the pit to reduce noise emissions.

Earthmoving will operate 24 hours per day, 7 days a week.

Ore Processing

Ore slurry will be pumped from the MUP to the wet concentrator plant (WCP). There, it passes through circuits of spirals that separate the heavier minerals from the lighter silica and clays to produce a mixed concentrate of heavy minerals. This concentrate will be pumped to the concentrate upgrade plant (CUP) where wet, high-intensity magnetic separators (WHIMS) produce two concentrates, one magnetic (predominantly ilmenite) and the other non-magnetic (predominantly rutile, zircon and leucoxene). The only chemical used in the process is a biodegradable flocculant. No other chemical or other additives are involved at any stage of the process.

On average, 110,000 tpa of non-magnetic concentrate and 288,000 tpa of magnetic concentrates will be produced each year and stockpiled on separate, purpose-built pads.

The MUP will operate 24 hours a day, 7 days a week.

Tailing Management

The processing operation produces two types of tailing, a dense sand slurry, and process water containing suspended silt and clay, known as fine tailing or slimes.

At the very start of the operation, sand tailing will be pumped to an external TSF constructed to one side of the mine start-up area. Once the normal sequence of mining and backfilling has been established, the tailing will be pumped directly into the rear of the pit for drying and later burial below overburden. Water draining from the tailing will be captured and recycled.

Rehabilitation and Final Landform

The goal of rehabilitation is to progressively backfill the open pit and return the area to a landscape that is very similar to the existing one. This will include return of native vegetation and resumption of broad-acre cropping.

The large start-up overburden stockpiles will be reclaimed and used to backfill the open pit. The most significant permanent change in the landscape will be from the three TSFs, covering 130 ha. They will stand approximately 5 m above the surrounding plain and will be covered in native vegetation.

DMS is committed to achieving a net gain in quality and quantity of native vegetation.

3. Infrastructure

Water Supply

Water will be needed as a transport medium to move the run-of-mine (ROM) ore from the pit to the WCP and within the WCP. It will also be used to move tailing from the WCP to the TSF or pit.

It is estimated that approximately 143 L/s of water is needed to meet mine water requirements. The estimated water balance shows that 19 L/s of water will be recovered from sumps within the pit and 37 L/s will be recovered decanted and seepage water. However, based on a worst-case scenario, an additional 87 L/s of water is needed for processing.

The GWMWater water distribution system and an underground, saline aquifer near Cope Cope, the Avon Deep Lead, are two water supply options being considered by DMS to make up for water lost to entrapment in the tailing, evaporation or seepage.

The majority of water consumed does not need to be of stock and domestic supply standard. Nevertheless, some high quality water (up to 12 L/s) is desired for the final stages of ore processing to wash out salt and for dust suppression on non-saline materials and haul roads.

GWMWater has not yet defined how it will supply water to the site (whether pipeline, channel or a combination of the two). Similarly, any pipeline route from the Avon Deep Lead is subject to pump testing to prove the aquifer abstraction point. For either option, DMS will need a planning permit from the relevant councils. For the borefield, it will also need a groundwater extraction licence. DMS has made a range of commitments relating to the route selection and construction of a pipeline. These include surveys for flora and fauna and cultural heritage along the final route and avoidance of mature trees and vegetation with a high conservation significance.

Should it be necessary, DMS will install a water desalination plant to meet its potable water needs. Reverse osmosis plant rejects will be reused in the process water circuit.

Electricity Supply

Powercor Australia will supply DMS with its power requirements. The project area will be supplied with electricity from the transmission grid via a new 66-kV transmission line from the Horsham Terminal Station to a new substation on the project area, then distributed along 11-kV or 22-kV overhead lines from the substation to the mine site (where the voltage will be lowered to 415 kV). A diesel generator may be used within the pit to power the MUP.

4. Project Context

Government

In order for the project to proceed, the project requires approval under several pieces of state and federal legislation. The Victorian Government has also developed a range of policies to provide a vision

for both government departments and industry of how it sees the development of the State of Victoria socially, culturally, environmentally and economically.

Policy

The over-arching policy of the current Victorian Government is expressed in the policy document 'Growing Victoria Together'. 'Growing Victoria Together' is closely aligned to the principles of ecologically sustainable development and aims to encourage development of a Victorian community that is happier, better educated, has greater faith in the democratic processes and has greater job opportunities.

Victorian Government policies relating to development of mineral resources, regional development, water resources and their allocation, and native vegetation have been considered by DMS in the design of its mine plan and in the preparation of this EES.

Legislation

The Victoria Minister for Planning required DMS to prepare an EES under the *Environment Effect Act 1978* due to the potential significant effects on the environment. The EES approvals process for the DMS project is shown in Figure ES3.

Due to the potential to adversely affect two threatened bird species (the swift parrot and plains wanderer) and a plant community (the Buloke Woodlands or the Riverina and Murray-Darling Depression Bioregions), the project requires separate approval from the Australian Government under the provisions of the *Environment Protection and Biodiversity Conservation Act 1999*.

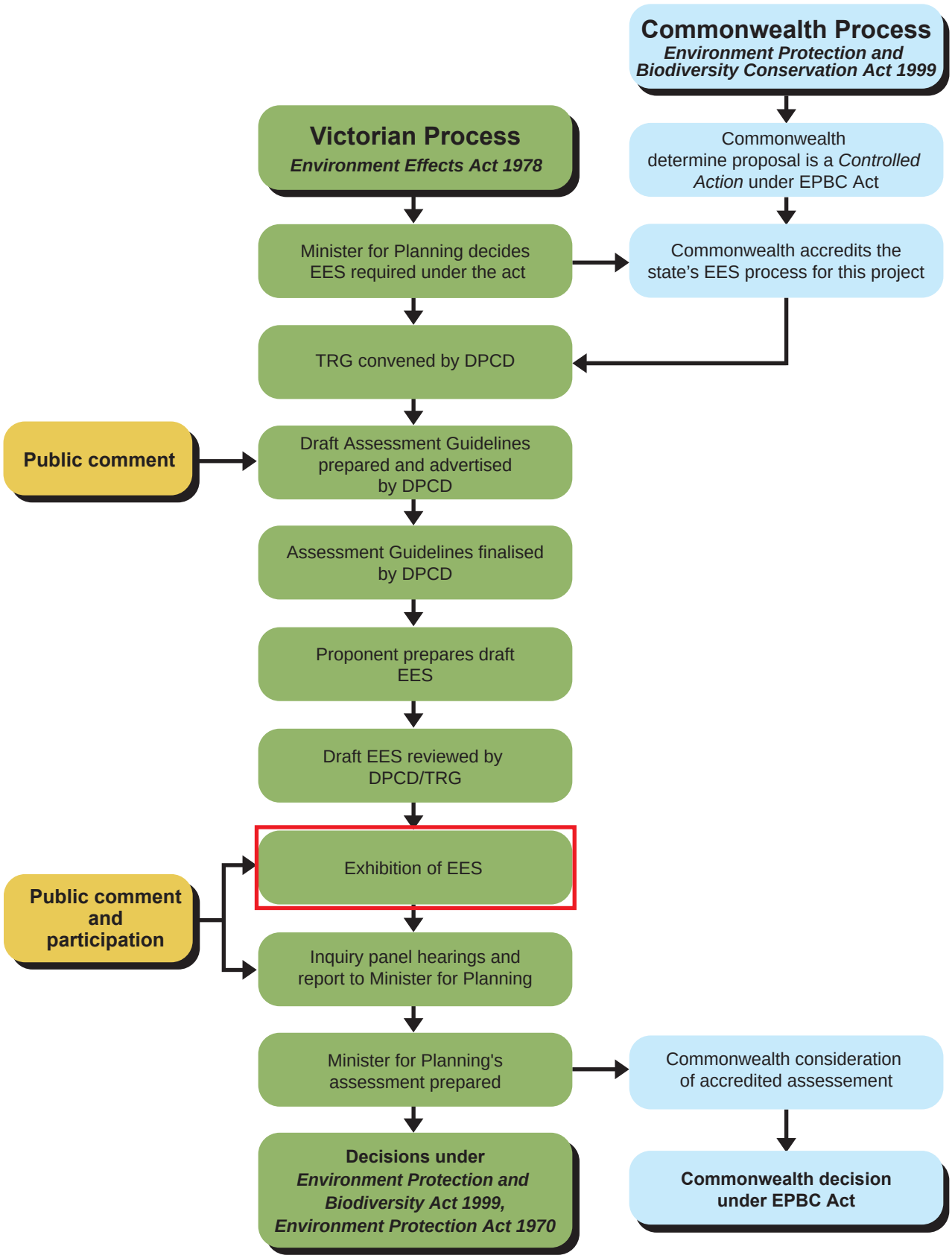
In practice, government's assessment of this EES will be the principle determinant of whether the project will proceed or not. The EES is the holistic, 'big picture' public review of the project.

Should the Minister for Minerals and Energy Resources accept the recommendation that the project proceed, other approvals under Victorian legislation will be required in relation to the *Mineral Resources (Sustainable Development) Act 1990,* the *Aboriginal Heritage Act 2006*, the *Heritage Act 1995*, the *Water Act 1989*, the *Planning and Environment Act 1987* and the Code of Practice for Mining and Mineral Processing (ARPANSA 2005).

The work plan required under section 40 of the *Mineral Resources (Sustainable Development) Act 1990* will provide further definition of the mine and proposed plans to manage the safety, environmental management and rehabilitation of the mine. This will be provided to the Department of Primary Industries (DPI) at a later date.

Socio-economic

The local community is tightly knit due to long-term residency, high participation rates in sporting and social clubs and, an established ethic of mutual assistance during times of need. Like much of rural Australia, it is also under stress at the moment due to the prolonged, severe drought.



coffey natural systems	Job No: 972	DMS Pty Limited	DMS A Subsidiary of Astron Limited	EES approval process	Figure No: ES3
	File Name: 972_05_ES003_HU	Donald Mineral Sands Project			

The majority in the community was born in Australia. If they live outside of towns, the residents are typically broad-acre farmers of cereals and pulses while, if they live in towns, they're more likely to work in management, administration or health services.

Overall, the age distribution of the population is increasing and, with the exception of the larger towns such as Horsham and Warracknabeal, show a medium-term trend of declining populations. Some local residents attribute this to a drift away from farms to the larger towns in search of work and better education. There is also a feeling amongst many that the current severe drought is adding to this trend.

Unemployment rates in 2006 in most of the towns closest to the project area–Minyip, St Arnaud and Warracknabeal–are higher (5.7 to 5.9%) than the state (5.4%) and national averages (5.2%), however the rate in Donald was 3.3%.

Environment

The project area is predominantly flat (average elevation is just over 130 m AHD), and there are no defined watercourses or permanent waterbodies within the project area although there is a weak northward-draining path in the central north of the project area. The closest river is the Richardson River, approximately 4 km to the east. This also drains into the closest major water body, Lake Buloke, approximately 25 km northeast. Due to the flat terrain and the absence of defined watercourses, sheet floodwater flows can occur following major rainfall events.

There are numerous low sandy rises up to 5 or 6 m high, giving a slightly undulating landscape. Most of the native vegetation has been cleared for farmland and is now limited to scattered patches within paddocks or along road-side verges. Of the remnants, several patches are of state or national significance.

The project area is within the semi-arid climatic zone of southern Australia and therefore generally experiences dry, hot summers and wet, cool to mild winters.

Geologically, the Parilla Sand is part of a sedimentary sequence in the Murray Basin, once an ancient embayment of the Australian coastline. The Parilla Sand can be enriched in titanium and zirconium minerals and has been mined elsewhere in Victoria, such as at Wemen and Douglas.

Cultural Heritage

The project area lies within the tribal boundary of the Jardwadjali, who occupied the Wimmera plains and western Gariwerd region. The Jardwadjali were bordered to the east by the Djadja Wurrung, whose western boundary was formed by the Richardson River and Wallabo Creek.

The Jardwadjali are thought to have used the area for foraging and as a thoroughfare between the relatively food-rich areas along the Wimmera River to the west and the Richardson River.

Due to the clearance of the original forest and the development of freehold title over the area, there is little evidence of the earlier occupation by these indigenous groups. Remaining artifacts, such as lithic scatters and scar trees, are therefore highly significant to local Aboriginal people.

5. Existing Environment and Management of Project Impacts

The existing environment is multi-faceted and DMS will need to understand and integrate a wide range of studies to minimise adverse impacts to develop a successful project. The main environmental impact will be excavation of the open pit.

The practice of progressive backfilling and rehabilitation means that the size of the pit does not continually increase; rather, its location merely changes. In effect, the mine will be a moving pit that slowly moves across the landscape, feeding the fixed WCP.

The net result of the moving pit location is that, for most members of the community affected by the mine, impacts will ebb and flow. Nevertheless, for some residents situated over the orebody, accessing the ore will necessitate relocating or dismantling their house and, in that respect, impacts on lifestyle are certain and likely to be long-term.

The moving pit concept is also relevant to a concern expressed to DMS early in the consultation process, that is, the maintenance of community cohesion. One of the options considered to resolve the potential impacts on residents is that of compensation, in particular, property purchase. DMS believes that simply seeking to purchase all of the affected farms offers operational advantages but is also clearly a poor option with respect to maintaining the existing community.

This will be subject of continuing discussion with the local community.

Surface Water

Surface drainage of the area is mainly to the north and northwest along a weakly developed surface depression. As a result of this subdued topography, major rainfall events can cause shallow, sheet flood flows over large areas.

The two stock and domestic water supply channels that cross the area, both with extensive branch channels, are:

- Taylors Lake Extension Channel (220 ML/d capacity).
- East Laen Channel (80 ML/d capacity).

GWMWater plans to decommission these channels before 2010 as part of the development of the Wimmera Mallee pipeline system.

The topography in the mined area will rise by around 1 m due to the loss of compaction of the soil. To prevent this from altering existing drainage patterns, DMS has initiated a program of detailed surveys to ensure that flood diversion bunds are correctly located and sized and that future surface topography mimics that which currently exists.

Groundwater

The Parilla Sand hosts the main groundwater aquifer in the project area. In general, groundwater flows in a northwesterly direction from the recharge area near St Arnaud. The high salt content (16,930 mg/L TDS) and low yield (<0.5 L/s) means that the project area is not in a declared Groundwater Management Area. The low demand for groundwater is further evidenced by the absence of registered bores, the closest of which is 20 km away.

The maximum yield from mine dewatering of the open pit means that the inflow may be as high as 57 L/s and result in a drawdown cone approximately 2.5 km in diameter. This drawdown and the drying of tailing prior to reburial means that elevation in the groundwater level is not expected. Further, the 7.6 m average depth to the top of tailing in the backfilled pit means that the post-closure water table will be at least 3 m from the ground surface.

Biodiversity and Habitat

Due to the extensive clearance of native vegetation in the area, most of the remaining native vegetation exists as scattered patches or along roadsides. The area, part of the Wimmera Bioregion, contains five Ecological Vegetation Classes (EVC), all of which are endangered and, as a result, all remnants have heightened ecological significance:

- Plains Woodland, typically in poor condition.
- Plains Savannah, dominated by buloke (*Allocasuarina leuhmannii*) in poor to good condition.
- Low Rises Woodland, dominated by slender cypress pine (*Callitris gracilis*) in medium to good condition.
- Black Box Lignum Woodland, with an overstorey comprised of mature black box and a midstorey of lignum (*Meuhlenbaeckia florulenta*) in medium to good condition.
- Ridged Plains Mallee, dominated by bull mallee (*Eucalyptus behriana*) in medium to good condition.

Of the 154 plant species recorded in the project area, 52 are introduced and 102 are native, including one species of national conservation significance (EPBC Act-listed), the turnip copperburr (*Sclerolaena napiformis*).

There are five flora species of state conservation significance (Flora and Fauna Guarantee Act-listed);

- Bluish raspwort (Haloragis glauca).
- Buloke mistletoe (Amyema linophyllum ssp. orientale).
- Pale flax-lily (Dianella sp. aff. Longifolia).
- Plains joyweed (Alternanthera sp. 1).
- Umbrella mulga (Acacia oswaldii).

There are 23 flora species of regional conservation significance.

Based on the proposed development and vegetation clearance strategy (i.e., preferred mining scenario) an estimated 14.28 habitat hectares are proposed to be cleared in the project area, including:

- 9.38 habitat hectares of Plains Woodland.
- 4.34 habitat hectares of Plains Savannah.
- 1.10 habitat hectares of Black Box Lignum Woodland.
- 516 large old trees in remnant vegetation patches.
- 141 scattered large old trees.
- 38 scattered medium old trees.

Based on the requirements of the Victorian Government's Native Vegetation Management Framework, the following offsets will be required to achieve a net gain in the quality and quantity of native vegetation whose clearance cannot be avoided in project design:

- 6.06 habitat hectares of Plains Savannah.
- 12.31 habitat hectares of Plains Woodland.
- 1.95 habitat hectares of Black Box Lignum Woodland.

Additional requirements include:

- Protection of 3,268 large old trees.
- Recruitment or planting of 17,320 new trees, mostly from Plains Woodland and Plains Savannah.

Initial assessments indicate that most of the necessary offset can be achieved in the project area. A formal plan detailing these offsets will be prepared in consultation with the DSE and the Wimmera CMA prior to the start of any site works.

A total of 98 fauna species were observed during field surveys. Database searches identified an additional 90 species that had been recorded in the area and the EPBC Act search identified another eight species as occurring, or potentially occurring, within 10 km of the superseded project area. Two nationally significant fauna (growling grass frog and hooded robin), were recorded in the superseded project area during the survey.

Fifteen fauna species of state significance have been identified as likely to occur in the project area. Of these, only the brown treecreeper, bush stone-curlew and diamond firetail were sighted in the project area by this or other surveys.

Air Quality

Potential impacts to air quality were the subject of mathematical modelling using AUSPLUME, a Gaussian plume dispersion model. The modelling examined the likelihood of change in air quality with respect to particulate matter (particularly PM_{10} and $PM_{2.5}$), nitrogen dioxide, carbon monoxide, polycyclic aromatic hydrocarbons and respirable crystalline silica.

In conjunction with financial and noise modelling, DMS has used the results of this modelling to abandon plans for truck haulage of ROM ore to the WCP. Instead, DMS plans to pump ROM ore to the WCP as a slurry. As a result of the adoption of ore slurry pumping, it is now predicted that the mine will satisfy all government air quality criteria for the project.

With respect to emissions from the loading HMC onto trains at either of the two sites considered near Minyip (North and South), either as containers or in bulk, all air quality criteria are satisfied.

Greenhouse Gas Emissions

An assessment of the future emissions of greenhouse gases arising from the project activities was made. Greenhouse gases included in the emissions inventory developed for the project are carbon dioxide, methane and nitrous oxide and are reported on a carbon dioxide equivalent (CO_2-e) basis.

Of these, carbon dioxide and nitrogen dioxide are the most significant greenhouse gases for the project. These gases are the main products of combustion of diesel used in earthmoving equipment and from the generation of electricity. Electricity generation will account for slightly more than half of the greenhouse gases produced as a result of project activities.

Electricity will be sourced from the grid and used to power the processing plant and ancillary site facilities; however, electricity consumed by the MUP will be provided by an on-site diesel generator.

The estimated annual consumption of electricity for the project is 24.4 GWh, which equates to emissions of approximately 35,311 t of CO_2-equivalent per year. Over the life of the project, the worst-case estimate of greenhouse gas emissions is estimated to be 882,500 t CO_2-e from electricity and 1,285,000 t CO_2-e from diesel, totalling 2,167,500 t CO_2-e.

Noise

Computer modelling of the predicted noise emissions from the mine has been undertaken. The background monitoring has made clear what the local community already knows: the area is very quiet and the noise of large machines is noticeable over a long distance.

The background noise monitoring for the project was carried out after harvest, a period of inactivity on surrounding farms. During sowing and harvest, farm machinery will be operating around the clock over several weeks, sometimes in close proximity to residences.

There are no specific noise criteria applicable to country and rural Victoria in relation to operational noise. An indicative guide is the EPA's Interim Guidelines for Control of Noise from Industry in Country Victoria N3/89 (N3/89) and this has been used as the basis of assessing appropriate noise criteria for the proposed mine. Other criteria have been considered for the construction period and sleep disturbance.

Modelling of noise from the open pit under the most likely operating scenario shows that noise levels generated by the project will exceed N3/89 guidelines during all periods (day, evening and night) at nine residents under neutral conditions and ten residences under worst-case conditions (i.e., a temperature inversion or enhanced wind conditions) when the mine is operating in their vicinity (this number may be less at any given time if accessing the ore necessitates relocating or dismantling the residence). N3/89 evening/night guidelines will be exceeded at an additional two residences under neutral conditions, and seven residences under worst case conditions, when the mine is operating in their vicinity. For the seven residences in the core of the project area (D4, 5, 6, 7, 8, 11 and 23) and two residences on the edge of the project area (D2 and 10), this will be the situation for most, if not all, of the project life. N3/89 night guidelines will be exceeded at an additional seven residences when the mine is operating in their vicinity under a temperature inversion.

Six residences (D1, D2, D4, D5, D6 and D23) are expected to be able to hear night-time construction noise. As such, this contravenes the TG 302/92 guidelines for construction noise. Several of these residences–D2, D4, D5, D6 and D8–are located either on the orebody or adjacent to the ore processing plant and it is DMS's desire to purchase the properties. In this circumstance, compliance with noise criteria will no longer be relevant.

Residents closest to the train loading locations should not experience any noise levels above the guidelines once mitigation measures have been implemented.

DMS has examined a range of options to reduce, minimise or mitigate the impact of noise. This includes construction of bunds, different ROM ore transport methods, noise mitigation works at residences, different earthmoving machinery, additional noise kits for trucks and confining overburden removal to dayshift only. All options come at a cost, some of which the project cannot bear financially.

The community then is faced with a project that will be noticeable and may disturb some residents. In order to minimise affects on local residents, DMS will negotiate with potentially affected people to reach a mutually agreeable outcome. This may involve compensation, purchase of the property, temporary relocation, changes to operating practices or modifications to the house to minimise noise intrusion (such as double glazing or façade upgrades). Nevertheless, elevated noise levels will be noticeable to the community, should the project proceed. Further, perceptions of whether predicted impacts are acceptable or not depend on individual values and sensitivities.

Radiation

All heavy mineral sands orebodies contain traces of the natural radioactive elements uranium and thorium, together with their decay products. However, the only component of mineral sands that is significantly radioactive is the mineral monazite. Monazite will be part of the heavy mineral assemblage extracted during the ore treatment process and the majority of it will leave the site in the non-magnetic concentrate.

A survey of the project area revealed that the range for the average radioactive concentrations of uranium and thorium in surface soil is low in comparison to the range for the average global background levels. Similarly, levels of radium in the groundwater are variable throughout the project area but, overall, they were relatively low.

The most potentially exposed site workers, those handling HMC during processing, were conservatively estimated to receive a total external dose of 1.6 mSv/year, well below the 20 mSv/year recommended upper dose limits adopted for use in Australia by the National Health and Medical Research Council. The estimated annual dose from inhalation ranged from 0.01 to 1.6 mSv again, well below the occupational exposure limit.

The transport of mineral sand materials, either off site or within the project area, will be conducted in compliance with the 2001 ARPANSA Code of Practice for Transport of Radioactive Materials.

A Radiation Management Plan will be prepared for the project.

Visual and Landscape Character

Initially, the project will result in a significant modification to the existing landscape. Locally, there will be high visual impacts likely to last for three to five years for eight residences at various times in the project life:

- Two residences in the first 1 to 5 years (D2 and D23).
- No residences in years 6 to 10.
- Six residences in years 11 to 25. (D2, D23, D3, D9, D10, D11) and users of Burrum–Lawler Road.

Impacts on remaining residences are medium to high or medium.

Early progress on the establishment of perimeter and foreground screening at affected sensitive viewing locations will significantly reduce the visual impact of the project.

Progressive landscape remediation works will reduce the duration of the visual impacts. After completion of progressive rehabilitation works in each area–primarily consisting of surface shaping and cover crop reestablishment over a two-year period–the visual impact will be very low at all viewing locations.

Roads, Traffic and Transport

It is predicted that the mine will generate between 215 and 272 vehicle movements per day. Estimated average truck traffic comprises:

- 30 round trips between the mine and port facilities and/or the railway siding per day.
- 6 trucks of materials or equipment to the site per day.
- 1 tanker load of diesel per week.

Other contractors, including sewage disposal contractors will regularly visit the project area.

The road network adjacent to and within the project area includes one Class B Declared Main Road under the control of VicRoads, local roads under the control of Yarriambiack and Northern Grampians shire councils, and private roads. The condition of roads within the project area varies from poor to average. There are no roads within the project area in good condition.

The main access road to the mine will be unsealed; however, R. Funcke Road and the HMC haul road to Minyip will be upgraded (widened and sealed) to cope with increased traffic.

In conjunction with the Northern Grampians, Yarriambiack and Buloke shire councils, DMS will monitor road conditions and usage patterns over the first 18 months after construction has been completed to establish which additional roads, if any, need to be upgraded. Road upgrades will ultimately improve the condition of roads, which is likely to balance out to some extent inconvenience as a result of changed traffic conditions.

Localised road closures in the project area, which generally carry low daily traffic volumes, may be required; however, alternative travel routes will be provided. It is expected that these road closures will be a temporary measure.

Potential Haul Route Roads

DMS is seeking maximum flexibility in the transport options for HMC leaving the site to ensure the most competitive freight costs. The potential impact and management of each option has been assessed in the EES and approval is sought for all options.

30 loads of HMC will be delivered each day i.e., 60 truck movements (one-way trips to or from the mine to the rail siding). Each truck will transport approximately 40 t of HMC each trip.

The stockpiles at the rail siding will hold a maximum of 80,000 t of HMC, covering an area of 1.5 ha. These stockpiles will be covered within a steel and polycarbonate-clad shed.

The following options are proposed for the transport of HMC for the project to the ports of Portland, Melbourne, or Geelong:

- Truck from the project area to a port via Horsham.
- Truck from the project area to a port via Horsham, in containers.
- Truck from the project area to the train loading facility south of Minyip, then rail to port.

Before construction starts, a Traffic Management Plan will be developed for the project in consultation with relevant councils and emergency services.

Cultural Heritage

A field survey of the project area achieved survey coverage of approximately 27% which, when accounting for survey conditions, is equivalent to approximately 17.3%. Subsurface testing has not been undertaken at this stage. During the survey, 21 artefact scatters and 11 scar trees were recorded in the project area. The scatters were flaked quartz artefacts and were predominately associated with sandy rises overlooking black box depressions or swamps. Seven of these sites had a scientific significance of moderate or higher while all sites are considered to have a high cultural significance to the local Aboriginal people.

A total of six post-European contact historic sites were located and recorded during the survey in the superseded project area. These sites comprise three artefact scatters, one rural structure (shed) and one rural house with an associated artefact scatter. The house and associated artefact scatter is outside the project area; the remaining five sites are within the project area.

As the entire site has not been sampled at this stage, there is a potential for as yet, unidentified sites of cultural heritage to be disturbed during earthmoving activities. All Aboriginal sites of cultural heritage will be managed in accordance with any measures, including contingencies, outlined in the Cultural Heritage Management Plan (CHMP) prepared in consultation with the Registered Aboriginal Party (or AAV) after the EES has been approved and before any site works commence. Such measures could include alteration to the current mine plan. Heritage Victoria will be notified of any new non-Aboriginal cultural heritage sites.

Land Use and Infrastructure Planning

The project area sits across the shires of Yarriambiack and Northern Grampians. The majority of the land is Farming Zone (FZ), although there is an environmental significance overlay (ESO3) along the water channels. The main aim of the zone and overlay is to protect the subject land for these specific purposes.

Powercor Australia will supply DMS with electricity from the transmission grid via a new 66-kV transmission line from Horsham Terminal Station to a new substation, then distributed along 11-kV or 22-kV overhead lines from the substation to the mine site (where the voltage will be lowered to 415 kV).

Social Impacts

Six families operate farms or own or live on land within the project area. Each farm within the project area is approximately 800 ha in size. Two additional residences, including one that is leased also occur within the project area. There are a further 13 landholders located with 2 km of the project area.

The project will bring change to the area. A permanent workforce of 75 will work on the project and increase demand for all social services such as housing, food, services, health and education. The mine will also affect the amenity (visual and noise) for several residents and cause temporary road closures as mining progresses across the landscape.

During public consultation at the start of the EES process, some members of the community expressed concerns on issues such as reduced community cohesion, loss of amenity and affects on farm incomes, particularly on rehabilitated land. Since that time, DMS has endeavoured to seek ways to resolve these issues with those affected and provide information about developments with the project through regular newsletters, community information evenings and an open-door policy at its Minyip office.

For its part, DMS will seek to minimise disruption to the local community by negotiating with individual owners and occupiers to determine the best outcomes. The intention of this strategy is to relocate residents locally only for the period that their property is occupied, or affected by the mining purposes and so, retain the community structure. Legally, DMS is also obligated to ensure that consent or compensation arrangements are agreed in writing before work can commence on any given property affected by mining works.

Whether or not this project will outweigh the perceived costs to the community is up to the community and government to judge.

Economic Impacts

During the first 25 years of mining, the following is predicted:

- Total capital investment of $93 million (associated with the mine site).
- Total, unescalated revenues of $1,635 million (25 years).
- Annual operating expenditure of $30 to $40 million ($750 million to $1,000 million over 25 years).
- Annual government royalties of $1.8 million (over $50 million over 25 years).
- Annual salaries for operational employees and contractors of approximately $6.5 million.
- Generation of income tax.
- Construction workforce of approximately 100 to 120 people (8 to 12 months).
- Operations workforce of approximately 75 people.

The project will increase local employment in a region of relatively high unemployment. Should the mine proceed, it will create 100 to 120 short-term jobs during the 8 to 12 months of construction and 75 jobs that should last for the life of the mine. In addition to this, the socio-economic study estimated that 180 to 255 jobs will be created indirectly.

The project will also generate wealth from the sales revenue far in excess of that currently available through continued farming. At current commodity prices, it would take 187 years of the estimated farming revenue to achieve the same revenues as the mine, which are estimated to be between $750 million and $1,000 million over the life of the project.

There is also a financial opportunity cost, that is, an alternative financial benefit foregone should the project proceed. Over the life of the mine, an average of 342 ha of agricultural land will be unavailable for cropping representing an opportunity cost of $4 million. This loss will be internalised by DMS due to compensation provisions of the *Mineral Resources (Sustainable Development) Act 1990*.

Soils and Mine Materials

The Avon–Richardson catchment is regarded as seriously degraded and the Avon–Richardon Land and Water Management Plan, developed for the North Central Catchment Management Authority, identified the following major threats:

- Increases in salinity, soil erosion and pest plants and animals.
- Decreases in trees, water quality, river and wetland health and soil structure and fertility.

The Murra Warra soil system is the most dominant soil system, making up 80% of the project area. The topsoil is thin (100 to 150 mm), self-mulching, and has an approximately neutral pH. It overlies hard, sodic subsoil, which, like the underlying overburden, has a high level of soluble salts and boron.

The Kalkee soil system covers approximately 5% of the project area and is regarded as the best soil for agriculture. The vertosols formed from the Shepparton Formation alluvial sediments are self-mulching, cracking clay soils of the Wimmera. The soil profile is deep and can exceed 1.5 m.

The remaining 15% of the project area consists of the Donald soil system, which has been described as ‘Donald lakes and lunettes’.

The careful management of the topsoils and other layers in the soil profile is critical to the success of rehabilitation of agricultural and native vegetation. As a general principle, topsoil will be stored on

topsoil, subsoil on subsoil and overburden on overburden. All stockpiles will be surrounded by cut-off drains linked to sedimentation ponds to reduce the risk of turbid runoff after storm events.

Rehabilitation

A primary objective of the rehabilitation program is that soils be restored to at least their current condition in terms of the viability of agriculture as well as native vegetation and faunal populations.

The major outcomes of the rehabilitation strategy will be to:

- Re-establish some of the larger dunes, although not necessarily in the original locations.
- Burying small sand dunes below subsoil in Murra Warra or Kalkee clay soil areas, leaving a clay plain (preferred by local farmers).
- Establish several wetland areas for the Black Box Lignum Woodland EVC. This will also assist in flood mitigation.
- The TSFs will become a permanent feature approximately 5 m above the natural ground level. The steep outer banks will be planted with native grass species.
- Crop or pasture will be sown as soon as possible to reactivate the biological processes in the soil and agriculture.

All propagules (i.e., seeds, cuttings or diversions) will be sourced from within the project area or the immediate surroundings (i.e., within 10 km). The proposed rehabilitation method will ensure an approximation of the landscape will be restored, by consolidating dunes and lunettes into fewer, larger areas.

Detailed surveying of the project area will occur prior to mining to assist in planning drainage, so that drainage is not impeded by mining activities.

6. Environmental Management Framework

DMS will develop an Environmental Management System (EMS) based on the set of internationally coordinated standards for EMS developed by the International Organisation for Standardisation (ISO), under the ISO 14000 framework.

The EMS will outline systems and procedures for the regular internal and external review of environmental performance, for which measurable indicators are identified, to enable:

- Evaluation against clearly defined objectives and targets aimed at continually improving environmental performance.
- Compliance with legislation.

The project EMS will be set out:

- DMS’s environmental policy.
- DMS’s environmental planning requirements, objectives and targets.
- EMS implementation and operation, including structure, responsibility, training, communication, documentation, operational control and emergency preparedness and response.
- Checking and corrective action, including monitoring, measurement and auditing.

- An annual EMS review to assess the suitability, adequacy and effectiveness of the system, and determine whether any changes in procedure, method or philosophy are required to improve the system.

The *Mineral Resources (Sustainable Development) Act 1990* requires that a licencee proposing to work under a mining licence must submit a detailed work plan, including environmental management plans, for the project. The locations of the monitoring sites will be determined following consultation with the DPI and the EPA.

Enforcement of DMS's obligations established through the EES process will be the responsibility of DMS's management, DPI Mines Inspectors, EPA and WorkCover and it is expected that the majority of the obligations will become legally enforceable conditions on the future work plan and mining licence. It is also expected that one of the outcomes of the EES process will be the establishment of an Environment Review Committee that will provide the community and government agencies opportunity to participate in the ongoing review of site operations.

1 INTRODUCTION

1.1 Project Overview

Astron Limited (Astron), through its wholly owned subsidiary, Donald Mineral Sands Pty Limited (DMS), proposes to develop a titanium and zirconium mineral sand mine in western Victoria, approximately 240 km northwest of Melbourne and 66 km northeast of Horsham (Figure 1.1).

The Donald Mineral Sands Project (hereafter referred to as 'the project') will involve mining the ore by open pit, processing it into a heavy mineral concentrate (HMC) and transporting it to port for export. The project area is mainly freehold agricultural land with remnant patches of native vegetation. Although sparsely populated, there are several residences spread throughout the area.

The project area is part of the large, fine-grained mineral sand deposit, known as the Donald deposit. This deposit is broad scale and blanket shaped, extending over an area of approximately 50 km in length and up to 8 km in width. The global resource within the 2,785-ha project area has been estimated at 693 Mt of ore containing 5.1% heavy minerals. Of this, the indicated resource is 477 Mt and contains 0.3% rutile, 1.1% zircon, 1.8% ilmenite and 1.1% leucoxene.

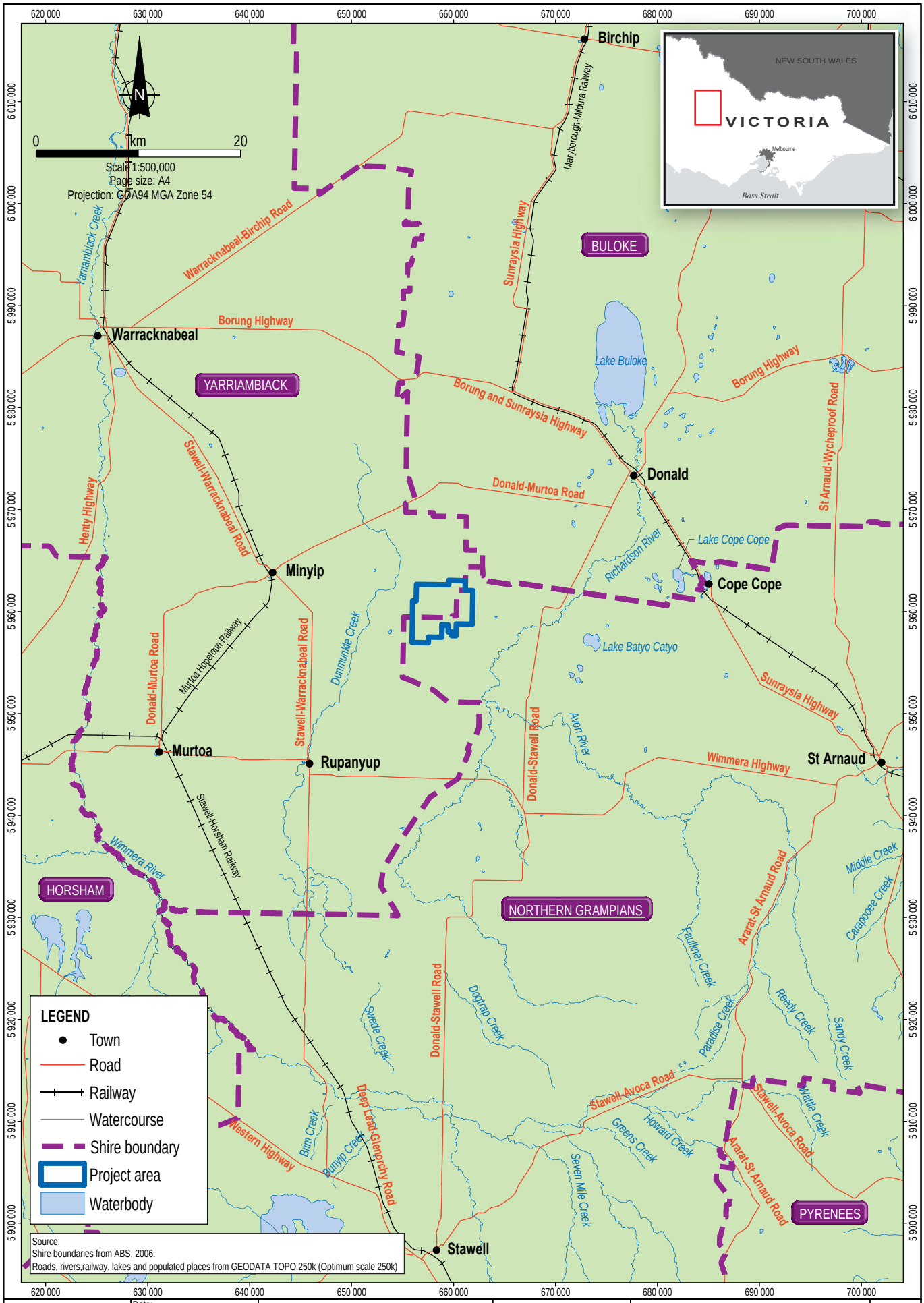
The project will produce 398,000 t of HMC annually, which equates to a mining rate of 7.5 Mt of ore per year. Originally, DMS planned to mine everything within the Donald Project Area (known as the superseded project area) but, subsequently reduced the project area to just the northern half (Figure 1.2). This reduced area is the subject of a mining licence application. The planned mine life for the project area is 25 years.

The deposit will be mined using conventional earthmoving machinery such as excavators, trucks, bulldozers and scrapers. In the first 6 to 12 months, topsoil, subsoil and overburden will be stripped and stockpiled, while tailing will be placed in a dedicated tailing storage facility (TSF). After this period, further production of all these materials will be returned to the pit and the mine progressively backfilled. In order to protect topsoil fertility, all topsoil movements will be done in an annual campaign. The TSF will then be decommissioned and rehabilitated.

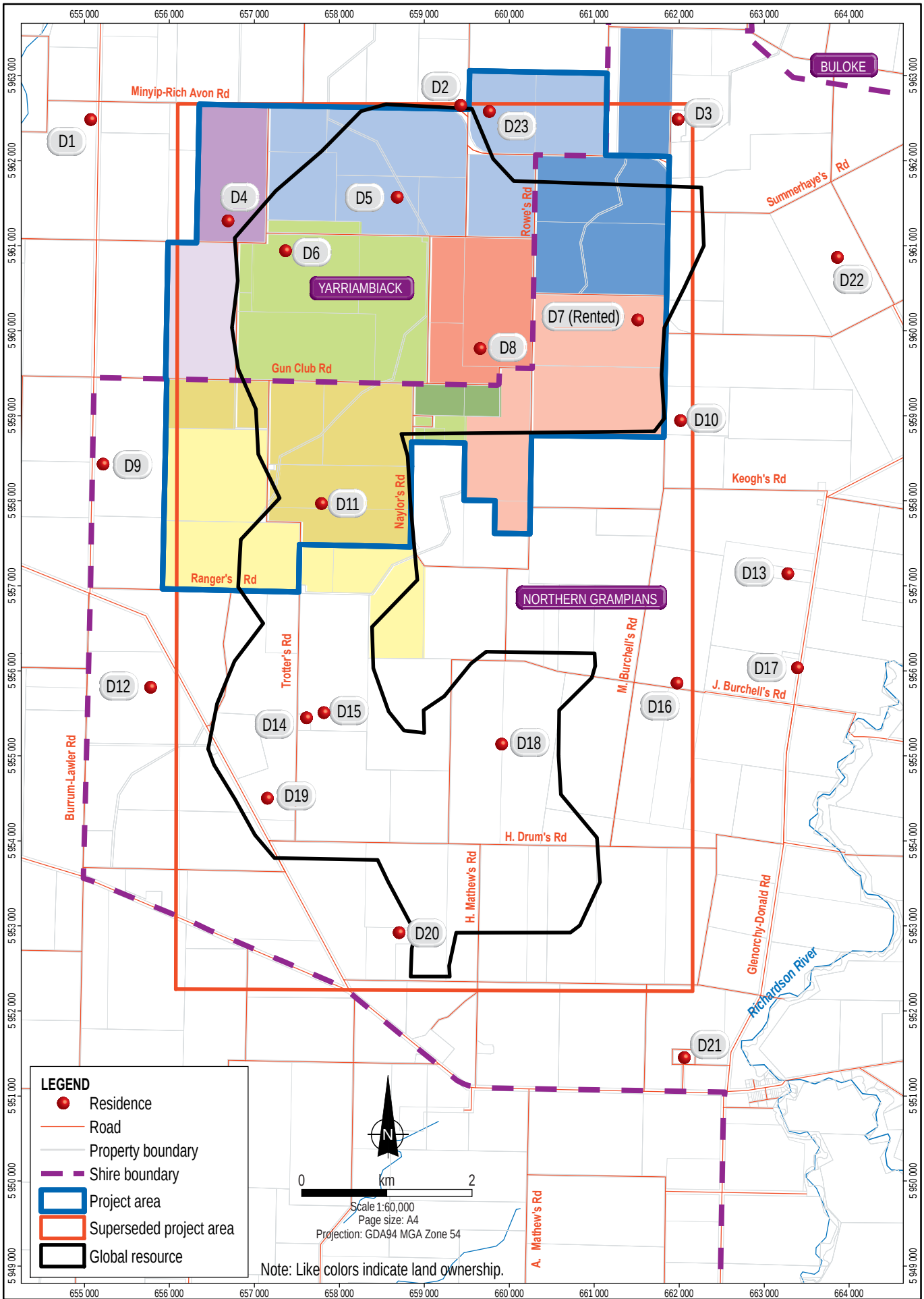
The HMC, rich in ilmenite (iron-titanium oxide), rutile (titanium dioxide), leucoxene (another iron-titanium oxide) and zircon (zirconium silicate), will be separated from non-valuable clays and sand by wet gravity separation, followed by wet magnetic separation. Two concentrate products will be produced; magnetics (mainly ilmenite) and non-magnetics (mainly rutile, zircon and leucoxene).

The final rehabilitation of the mined area will produce a landform similar to that existing before the mining operation, including the restoration of native vegetation and agricultural land.

Concentrates will be separately stockpiled on site then progressively transported to port either by road or a combination of road and rail. If rail is selected, a rail siding near Minyip will be used.



coffey natural systems	Date: 25.09.2007 MXD: 972_DonaldMineralSandsGIS File Name: 972_05_F01.01_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Project location	Figure No: 1.1



coffey natural systems

Date: 25.09.2007
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F01.02_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Project area and surrounds

Figure No: 1.2

1.2 Project History

The Donald deposit was once part of the Wimmera Industrial Minerals (WIM) deposits extensively explored by CRA Exploration (now Rio Tinto) in the 1980s. Significantly, the WIM deposits are finer grained than the strandline deposits currently being mined, for example, by Iluka Resources at its Douglas mine, southwest of Horsham. The Donald deposit forms part of one of the largest undeveloped mineral sands deposits in the world. However, in 1998, Rio Tinto judged the fine-grained deposit to be uneconomic and relinquished the licences.

GDM Pty Ltd acquired the exploration tenements in December 1999. In the period since 2000, there have been two major drilling programs and a bulk sample program within the project area and surrounds, as well as extensive metallurgical testing. In November 2003, Astron acquired the exploration rights for the Donald (WIM 250) deposit and created Donald Mineral Sands Pty Ltd to become the corporate vehicle for the project.

Feasibility studies by DMS have concluded that the combination of improved zircon prices and advances in mineral processing methods has made these deposits economic to develop.

1.3 Project Objectives

DMS's commercial and technical objectives for the project are to provide a competitive financial return to its equity investors by supplying world markets with competitively priced, first quality, rutile, leucoxene and zircon products and to provide meaningful employment for its staff.

The social, economic, environmental and cultural objectives for the project are to develop the project to the advantage of the people of the project area and the wider community by means of:

- Recognition of local amenity, values and culture.
- Ecological sustainability.
- Contribution to the economy and human well-being.

The company's environmental objectives are to plan and operate the project according to the requirements of government, and community expectations.

1.4 Project Proponent

Astron is an Australian, publicly listed company that has interests in mineral sand mining, mineral sand processing and downstream production of titanium products. These include mineral sand mines in Gambia and Senegal, and downstream processing in China.

In 2006/07, Astron had approximately 630 employees and annual sales of $182 million.

DMS will be the mine owner and operator, and will be responsible for the development of the project. Contact details for the head office and project management personnel are provided in Table 1.1.

Table 1.1 Proponent contact details

Corporate Details	Project Management Personnel
Astron Limited Level 19, 2 Market Street Sydney NSW 2000 Website: http://www.astronchem.com Donald Mineral Sands Pty Ltd 67-71 Main Street, Minyip VIC 3392 Website: http://www.donaldmineralsands.com.au	Mining Manager – Emma Vogel: Tel: 03 5385 7098 Mobile: 0437 809 057 E-mail: emma.vogel@bigpond.com Logistics and Water Development Manager –Simon Peters: Tel: 5385 7099 Mobile: 0408 502 248 e-mail: SimonAPeters@bigpond.com Metallurgical Manager – Arno Kruger Tel: 5573 5110 Mobile: 0400 200 307 e-mail: arnokruger@bigpond.com

1.5 Purpose of this Document

1.5.1 Statutory Requirements

In Victoria, the majority of new mining projects require assessment by government by way of a planning permit application under the *Planning and Environment Act 1987* or, an environment effects statement (EES) under the *Environment Effects Act 1978*.

Planning permit applications are administered by the local council and are normally used for relatively small, short-term projects, such as the development of a new factory or housing estate.

In contrast, assessment under the Environment Effects Act is used for larger (more costly or complex) projects that are more likely to have impacts on cultural heritage, social, environmental or economic values.

On 2 December 2005, Victoria's Acting Minister for Planning advised Astron that the Donald Mineral Sands Project required assessment under the Environment Effects Act and that an EES was required to inform government approvals.

The Minister then requested the Department of Sustainability and Environment (DSE)[1] to convene a technical reference group (TRG) to advise DPCD and the proponent on the scope of the environmental investigations needed, as well as the adequacy of the draft EES. As part of this process, DPCD, in consultation with the TRG, prepared assessment guidelines for the EES. Draft assessment guidelines were advertised for public comment (30 days) then finalised by DPCD following review of the submissions received. The final guidelines are reproduced in Attachment 1 with cross-references to the relevant sections of this EES.

[1] In mid 2007, DSE's Office of Planning & Urban Design (government's administrators of EESs) became part of a new department, the Department of Planning and Community Development (DPCD). For simplicity, all further references in this regard will refer to DPCD.

The assessment guidelines require the EES to assess the potential environmental, social and economic impacts of the project and to describe how the proponent intends to avoid, mitigate and manage residual impacts. A series of specialist studies were initiated to investigate and assess the potential impacts of the project. These studies are the foundation of the main volume of the EES and are appended to it.

This EES will not provide consent for the project in its own right; instead, it will be used to inform consents issued by various government agencies under other acts at local, state and federal levels. An example of this is the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Under this act, a consent separate from the Victorian process is required. The Commonwealth has accredited the Victorian EES process for the assessment component; however, it retains its decision-making powers.

Statutory requirements for the project are discussed in more detail in Chapter 2.

1.5.2 Objective of this EES

The purpose of this EES is to inform members of the public, government regulators and other interested parties about all aspects of the proposed project and to provide a solid foundation for any future decisions to which it relates.

1.5.3 Structure of the EES

The EES is in three parts (Table 1.2):

Table 1.2 Donald Mineral Sands Project EES documentation

App. No	EES Volume	Author	Title/Subject
EES Summary Brochure			
		DMS and Coffey Natural Systems	Donald Mineral Sands Project EES Summary Brochure
EES Main Report			
	1	DMS and Coffey Natural Systems	Donald Mineral Sands Project EES Main Report
EES Supporting Studies Volume 2			
1	2	Heggies Pty Ltd	Air quality and greenhouse gases assessment study
2	2	Sinclair Knight Merz	Cultural heritage assessment study
3	2	Ecology Partners	Flora and fauna assessment study
4	2	Ecology Partners	Net Gain assessment study
5	2	Dryland Agricultural Services and Goldfields Revegetation Pty Ltd	Rehabilitation assessment study
6	2	Heggies Pty Ltd	Noise assessment study
7	2	Australian Radiation Services Pty Ltd	Radiation assessment study
8	2	Grogan Richards Pty Ltd	Roads and traffic assessment study
9	2	Enesar Consulting	Socio-economic assessment study
10	2	GHD	Groundwater and surface water assessment study

Table 1.2 Donald Mineral Sands Project EES documentation (cont'd)

App. No	EES Volume	Author	Title/Subject
11	2	Goldfields Revegetation Pty Ltd	Water supply options appraisal study
12	2	Goldfields Revegetation Pty Ltd	Water supply flora and fauna impact assessment study
13	2	EDAW	Visual and landscape assessment study

The Summary Brochure that provides an overview of the project and the EES.

- The Main Report (this report), which is meant to be understood without reference to the specialist studies reports on which it is based.
- Two volumes containing the reports of the specialist studies.

The main report comprises a title page, table of contents, an Executive Summary and 11 chapters plus figures, tables and plates throughout. The format of the main report is:

- Chapter 1 (this chapter) – project overview, project history, project objectives, details of the project proponent, purpose of this report, report structure and report conventions.
- Chapter 2 – legislative context (including international conventions, government policies, and codes of practice) within which the project will be evaluated and under which it will be built and operated.
- Chapter 3 – social and environmental context, including the physical and socio-economic aspects.
- Chapter 4 – detailed description of the project.
- Chapter 5 – description of stakeholder consultation to date, and that proposed for the future.
- Chapter 6 – description of the existing environment, identification of the potential issues (risks) relating to the various environmental aspects, description of the proposed avoidance, mitigation and management measures, and detailed assessments of the residual impacts in terms of likelihood and consequence.
- Chapter 7 – description of the environmental management system that will be adopted for the project.
- Chapter 8 – bibliographic details of each reference used in the EES.
- Chapter 9 – details of the study team.
- Chapter 10 – glossary.

1.5.4 EES Distribution

Copies of the EES main report and supporting studies have been lodged at the exhibition locations listed in the summary brochure and are available there for viewing. Personal hard copies will be available but are subject to a nominal fee to cover printing costs. The cost and ordering details for the EES documentation are described in the summary brochure.

The EES documentation will be available for free on compact disc or via DMS's website (www.donaldmineralsands.com.au) for download.

Free copies of the summary brochure are also available.

1.5.5 Report Conventions

The project is a development proposal and its implementation is conditional on a number of factors such as project approvals and successfully raising the required finance. For reason of style however, the project and related proposed activities have been described in the active mood 'will' rather than 'would'.

The developing and operating entity for the project is DMS (see Section 1.4), a wholly owned subsidiary of Astron. For reasons of transparency and clarity, reference throughout the remainder of this report is made to DMS rather than Astron.

Information contained herein that describes existing conditions, avoidance, management and mitigation measures, and residual impacts is taken from both literature sources and the specialist studies reports listed in Table 1.2. To avoid excessive repetition, the number of references in the text to these sources, particularly when summarising information from the specialist studies reports in Chapter 6, has been minimised.

2 POLICY AND LEGISLATIVE CONTEXT

2.1 Required Project Approvals

The project will require approvals under a range of Victorian and Commonwealth legislation. The key legislation that apply are the *Environment Effects Act 1978* and the *Mineral Resources (Sustainable Development) Act 1990*. Table 2.1 below summarises the legislation that applies to the project at both the Commonwealth and state levels.

Table 2.1 Summary of approvals

Legislation	Regulatory Outcome	Regulatory Authority	Reason
Commonwealth			
Environment Protection and Biodiversity Conservation Act 1999	Environmental approval under Commonwealth guidelines or an accredited Victorian process.	Department of Environment, Water, Heritage and the Arts (DEWHA).	The project has been determined to be a 'controlled action' by DEWHA.
Victoria			
Mineral Resources (Sustainable Development) Act 1990	Mining licence. Approved work plan. Work authority to commence mining.	Department of Primary Industries (DPI).	Required for mining. Gives effect to the Native Vegetation Management: A Framework for Action.
Environment Effects Act 1978	Environmental assessment of project by Minister.	DPCD.	Directed to prepare an EES by the Minister for Planning.
Aboriginal Heritage Act 2006	Approval of Cultural Heritage Management Plan (CHMP).	Registered Aboriginal Party (RAP) (or Aboriginal Affairs Victoria (AAV) in their absence).	Required for mining impact on Aboriginal cultural heritage values.
Heritage Act 1995	Approval to disturb known historic sites.	Heritage Victoria.	Historic sites are to be disturbed.
Water Act 1989	Groundwater extraction licence.	Grampians Wimmera Mallee (GWM) Water.	To extract groundwater.
Planning and Environment Act 1987	Planning permit.	Yarriambiack Shire Council. (Buloke Shire Council, Northern Grampians Shire Council).	High voltage power line and potentially, a water supply pipeline.
Code of Practice for Mining and Mineral Processing (ARPANSA, 2005)	Approved radiation management plan and radioactive waste management plan.	Department of Human Services (DHS).	The code specifically applies to mineral sand mines.

2.2 Commonwealth Law

2.2.1 *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects the environment, particularly matters of National Environmental Significance (Protected Matters). It streamlines national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and cultural places.

Matters defined as nationally significant include:

- World heritage properties.
- National heritage places.
- Ramsar wetlands of international importance.
- Nationally threatened animal and plant species and ecological communities.
- Internationally protected migratory species.
- Commonwealth land and marine areas.
- Nuclear actions.

A referral and assessment process determines the application of the EPBC Act, which involves the following steps:

- The proponent submits an EPBC Act referral with preliminary project information and an assessment of the project's implications for the above-listed criteria.
- The referral is posted on the Department of Environment, Water, Heritage and the Arts (DEWHA) website (http://www.environment.gov.au) and public comment is invited over a ten-day period.
- The Commonwealth Minister for Environment and Heritage makes a determination on whether the project is to be a controlled action (i.e., significant potential impacts to matters of national significance).

The EPBC Act empowers the Minister to list threatened species for protection and issue permits for activities that would normally incur an offence under the act, such as the taking or destruction of a threatened species.

DMS submitted an EPBC Act referral to the DEW on 27 October 2005. DMS noted the presence of listed threatened species and communities, including the swift parrot, plains wanderer and the Buloke Woodlands (or the Riverina and Murray-Darling Depression Bioregions). The referral noted that, while listed threatened species and ecological communities and listed migratory species may sometimes be present in the project area, important habitat for these species is absent and thus, no significant impacts on these species were expected as a result of the project. After considering the referral, the Minister's delegate decided on 24 November 2005 that the project was a controlled action on the basis that the project had the potential to impact listed threatened species and communities. Accordingly, assessment and consent of the project by the Commonwealth under the EPBC Act is necessary. The Commonwealth has accredited the Victorian EES process for the assessment component; however, it retains its decision-making powers.

2.2.2 *Native Title Act 1993*

The *Native Title Act 1993* (Cwlth) recognises and protects native title. The objectives of the act are to:

- Provide for the recognition and protection of native title.
- Establish ways in which future dealings affecting native title may proceed and set standards for those dealings.
- Establish a mechanism for determining claims to native title.
- Provide for, or permit, the validation of past acts and intermediate period acts, invalidated because of the existence of native title.

The National Native Title Tribunal is an independent body set up under the act to provide administrative processes to deal with native title applications and to provide information to indigenous people, and the broader community, about the native title process. This tribunal is part of the Commonwealth Attorney-General's Department.

The relevance of native title to the DMS project relates to the need to resolve native title before grant of any future mining licence by the Department of Primary Industries.

2.3 Commonwealth Policy

Mine approval documents may need to consider the following Commonwealth initiatives:

- National Framework for the Management and Monitoring of Australia's Native Vegetation (DEH, 2001).
- National Greenhouse Strategy: Strategic Framework for Advancing Australia's Greenhouse Response (DEW, 1998).

2.3.1 National Framework for the Management and Monitoring of Australia's Native Vegetation

The national framework is a joint initiative of the Commonwealth, state and territory governments and builds on existing intergovernmental agreements. Commonwealth, state and territory governments committed themselves, through the Natural Heritage Trust, to reverse the long-term decline in the quality and extent of Australia's native vegetation cover by June 2001. The framework complements the objectives of the National Strategy for Ecologically Sustainable Development (DEH, 1992) in providing a statement of native vegetation outcomes being sought and the management and monitoring mechanisms used to achieve them.

2.3.2 National Greenhouse Strategy

The National Greenhouse Strategy was developed by the Commonwealth and all state and territory governments. In endorsing this strategy, the Commonwealth, states and territories demonstrate their commitment to an effective national greenhouse response. The growing worldwide attention on climate change is reflected in the assessment guidelines for this project EES which require assessment and a response to greenhouse gas emissions.

2.4 State Law

2.4.1 *Mineral Resources (Sustainable Development) Act 1990*

The *Mineral Resources (Sustainable Development) Act 1990* (MRSD Act) provides for the issue and administration of exploration and mining licences. An exploration or mining licence may be granted over private and Crown land, including reserved Crown land. The MRSD Act includes provisions for the compensation of landowners affected by activities exercised under these licences.

Work under a mining licence cannot start until the proponent receives a work authority from the Department head of the DPI after the following requirements are met:

- Minister's assessment of an EES or an approved planning permit.
- Written consent (or compensation agreements) from private landowners.
- Rehabilitation bond.
- Approved work plan.
- Public liability insurance.

As an EES is required, the project is exempt from the requirement to obtain a planning permit under the *Mineral Resources (Sustainable Development) Act 1990*.

2.4.2 *Environment Effects Act 1978*

The *Environment Effects Act 1978* provides for the preparation of an environment effects statement (EES) for works deemed to be capable of having a significant effect on the environment. The Act includes provisions for the preparation of assessment guidelines and a supplementary statement (if required), the appointment of a panel of inquiry, the receipt of submissions and a requirement for the Minister of Planning to prepare an assessment of the project and its environmental impacts.

On 2 December 2005, the Minister for Planning decided that the project would require an EES on the basis of:

- The potential for significant adverse impacts on hydrology, ecology, local communities and cultural heritage values as a result of the project.
- The need for detailed and integrated assessment of environmental and related effects to inform decisions under Yarriambiack and Northern Grampians planning schemes, the MRSD Act, the *Environment Protection Act 1970* and other relevant legislation.

The EES is also relevant as it is the assessment mechanism to inform decisions made by the Commonwealth under the EPBC Act.

2.4.3 *Environment Protection Act 1970*

The *Environment Protection Act 1970* establishes the Victorian Environment Protection Authority (EPA) as the statutory body empowered to control discharges of waste to the environment.

The Environment Protection (Scheduled Premises and Exemptions) Regulations 2007 prescribe that mining operating in accordance with the MRSD Act is exempt from works approval and/or licensing by EPA. These regulations came into force in July 2007.

Under s. 26H of the Environment Protection Act (as amended by the *Environment Protection (Amendment) Act 2006*) an Environment and Resource Efficiency Plan (EREP) must be prepared where use of environmental resources (such as water or energy) or disposal of waste offsite is in excess of prescribed thresholds. Thresholds are prescribed under the Environment Protection (Environment and Resource Efficiency Plans) Regulations, which are currently in draft form. Under the draft regulations, an EREP must be prepared if energy consumption exceeds 100 TJ/year or if water use exceeds 120 ML/year. Final regulations will come into operation on the 1 January 2008.

Considering the current draft threshold criteria, it is anticipated that an EREP will need to be prepared for the project.

2.4.4 *Heritage Act 1995*

All non-Aboriginal archaeological sites in Victoria older than 50 years are protected by the *Heritage Act 1995*. Such sites include historic buildings and gardens, historic places and objects, historical archaeological sites and historic shipwrecks. The act provides for the establishment and registration of archaeological sites in the Victorian Heritage Register.

It is an offence under this act to disturb or destroy a historical site or place without a permit or consent. Permits and consents may be obtained through Heritage Victoria, which is the statutory authority with responsibility for protecting historical sites and places.

2.4.5 *Water Act 1989*

The purpose of the *Water Act 1989* is to allocate, conserve and manage terrestrial surface and groundwater. The act protects the rights of the Crown relating to the use, flow and control of surface water and groundwater. It also protects the rights of private individuals to take water for domestic and stock use.

The Minister for Environment and Water may allocate water resources through bulk water entitlements and issue licences to take and use water from waterways and groundwater. Under the act, a Groundwater Extraction Licence is required to de-water mine workings.

2.4.6 *Planning and Environment Act 1987*

The *Planning and Environment Act 1987* provides a framework for planning the use, development and protection of land in Victoria that serves both the present and long-term interests of all Victorians. This act regulates the use and development of land through planning schemes and the granting of planning permits. Permits under this act will be required for the high voltage electricity supply line and potentially the water supply infrastructure (bore field, pump stations and pipeline).

2.4.7 *Aboriginal Heritage Act 2006*

In 2006, the Victorian Government introduced the *Aboriginal Heritage Act 2006* which came into force on 28 May 2007. This act replaces Part IIA of the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cwlth) and the *Archaeological and Aboriginal Relics Preservation Act 1972* (Vic). The new act aims to provide more effective protection of Aboriginal cultural heritage and broaden Aboriginal community involvement in decision-making.

The act links the protection of Aboriginal cultural heritage with planning and land development processes. The act also includes processes for dispute resolution including review of certain decisions through the Victorian Civil and Administrative Tribunal (VCAT).

All registered and unregistered Aboriginal archaeological sites and places are afforded blanket protection by the Commonwealth act.

The Aboriginal Heritage Act requires approval of a Cultural Heritage Management Plan (CHMP) for all projects for which an EES is prepared. This plan will be prepared by DMS prior to receiving a work authority and prior to commencing any works which have the potential to harm Aboriginal cultural heritage.

Under the Aboriginal Heritage Act, an Aboriginal Heritage Council was established. The council registers Aboriginal parties to negotiate cultural heritage matters. A registered Aboriginal party (RAP) has not yet been appointed in the project area. Until a RAP is registered, the Secretary of the Department for Planning and Community Development will, in consultation with relevant Aboriginal communities, evaluate the CHMP. Prior to the introduction of the new act, DMS dealt with three Aboriginal communities in the project area:

- Goolum Goolum Aboriginal Co-operative.
- Jupagalk Peoples (Native Title Services Victoria).
- Barengi Gadjin Land Council Aboriginal Corporation.

Until a RAP is assigned to the project area, DMS will continue to liaise with all three groups.

2.4.8 *Flora and Fauna Guarantee Act 1988*

The purpose of this act is to establish a legal and administrative structure to enable and promote the conservation of Victoria's native flora and fauna and to provide for a choice of procedures that can be used for the conservation, management or control of flora and fauna and the management of potentially threatening processes.

Where it is proposed that species listed under the act are to be ‘taken,’ a permit is required unless, in the case of mining, an EES has been prepared and assessed, in which case a permit is not required.

2.5 State Policy

2.5.1 Victorian Government Policy – Growing Victoria Together

The Growing Victoria Together policy sets out the Brumby government’s priorities for Victoria for the next decade. Objectives in the policy relevant to this project include:

- Victoria’s productivity and competitiveness will increase.
- Victoria will increase exports to $30 billion by 2010.
- Regional population growth will increase to 1.25% annually by 2006.
- The proportion of freight transported to and from ports by rail will increase from 10 to 30% by 2010.
- The extent and quality of native vegetation will increase.
- The condition of our land will improve as the impact of salinity and soil degradation is reduced.

- The quantity of solid waste generated will be reduced and the amount recovered for reuse, recycling and energy generation will increase.

2.5.2 Earth Resources Policy – Promoting Victoria's Prospects

Promoting Victoria's Prospects recognises the vital role played by the mining, extractive and petroleum industries to the Victorian economy. An important aspect of the policy is the demonstration, on the global stage, of Victoria's extractive, minerals and petroleum industries commitment to providing benefits to the community and improving environmental performance whilst expanding economically. Mineral sands are recognised by the policy as providing a valuable export product, encouraged by government facilitation. The rapid development of the mineral sands industry is also recognised as a result of the Victorian Initiative for Minerals and Petroleum. This initiative is a Government-funded program aimed at increasing investment in Victoria's earth resources industries.

2.5.3 Water Policy

In 2004 the Victorian Government delivered The White Paper – Securing Our Water Future Together (DSE, 2004b). The White Paper sets out an action plan to secure Victoria's water future over the next 50 years. The three key challenges presented in Chapter 2 of the White Paper, *water resources and their allocation,* are to:

- Develop a water allocation system that recognises all water services and balances the needs of the environment with the needs of water users.
- Restore and protect the health of Victorian rivers.
- Facilitate future economic growth.

2.5.4 Regional Development Policy

Regional Development Victoria (RDV), established by the *Regional Development Victoria Act 2002,* began operation on 3 March 2003 and facilitates the economic, infrastructure and community development of regional and rural Victoria. In the resource industry sector, RDV aids in the development of new initiatives in cooperation with businesses aimed at adding value to the state's natural resources including minerals. The Regional Development Victoria Act facilitates new investment and promotes rural and regional Victoria as a place in which to invest, work and live.

2.5.5 Native Vegetation Management Framework – A Framework for Action

Victoria's native vegetation policy establishes a framework to address the management of native vegetation from a whole of catchment perspective. The primary goal identified for native vegetation management is the attainment of net gain; an outcome for native vegetation where individual losses of native vegetation are avoided where possible and where the overall gains are greater than overall losses. Additional outcomes are identified for biodiversity, land and water quality and climate change amelioration.

This policy is Victoria's response to the Australian Government's policy document: National Framework for the Management and Monitoring of Australia's Native Vegetation.

2.5.6 Other State Policies

Other Victorian initiatives that may need to be considered when preparing the mine approval documents include:

- Victorian Greenhouse Strategy (2002).
- Victorian Biodiversity Strategy (1997).
- Environmental Guidelines for Major Construction Sites (1995) (S480).
- Construction Techniques for Sediment Pollution Control (1991) (S275).
- Industrial Waste Management Policy – Waste Minimisation (1990).
- Industrial Waste Management Policy – Prescribed Industrial Waste (2000).
- Protocol for Environmental Management: Greenhouse Gas Emissions and Energy Efficiency in Industry (2002) (S824).
- Heritage Victoria Draft Guidelines for the Assessment of Heritage Planning Applications (2000).
- Victoria's Environmental Sustainability Framework (2005).
- Our Environment Our Future – Sustainability Action Statement (2006).

2.6 Local Law

The project area in under the jurisdiction of two local shire councils with the majority covered by Yarriambiack and the remainder by Northern Grampians (see Figure 1.2). Both shires are part of the Central Highlands Region of Victoria and each shire acknowledges their responsibilities as part of a broader region (Central Highlands). Ensuring that activities within the municipality do not have negative impacts on neighbouring communities and land are part of their responsibility.

2.6.1 Yarriambiack Shire Council Planning Scheme

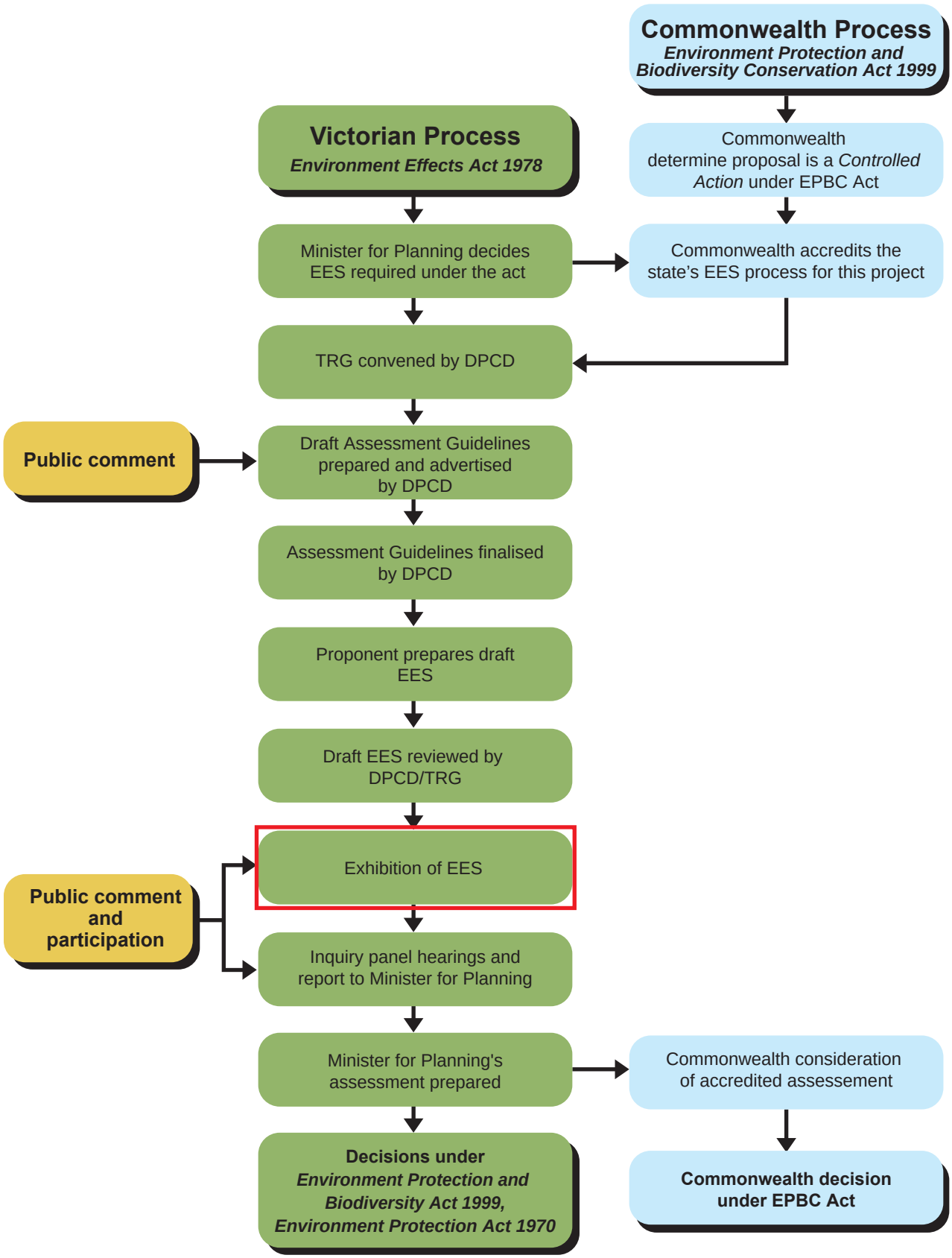
As required by the *Local Government Act 1989*, the Yarriambiack Shire Council prepared a three-year Corporate Plan. The 'Changes and Opportunities for Our Future' plan provides for, among other goals, the facilitation and support of economic development within the shire and the broader community for employment and business opportunities.

2.6.2 Northern Grampians Planning Scheme

The Northern Grampians planning scheme notes that mining and extractive industries are important economic and employment generators for the shire and that sustaining industrial development endeavours and promoting and encouraging new industrial development is a priority. One such objective for the industry sector in the shire is to promote and facilitate mining and extractive industry in the shire in a responsible manner. The planning scheme strategy aims to ensure that the industry sector is endorsed with minimal long-term impacts on the surrounding environment and community.

2.7 Environmental Approvals Process

The approvals required for the DMS project are shown in Figure 2.1. The EES will be used the reference point for decisions on other approvals by a range government agencies.



coffey natural systems	Job No: 972	DMS Pty Limited	DMS A Subsidiary of Astron Limited	EES approval process	Figure No: 2.1
	File Name: 972_05_F02.01_HU	Donald Mineral Sands Project			

2.8 Requirement for an EES

The project was referred to the Victorian Minister for Planning in October 2005, seeking a determination on the application of the Victorian *Environment Effects Act 1978* to the Donald Mineral Sands Project. Under this act, the Minister may require that the proponent prepare an EES. In making a determination, the Minister must take into account:

- The character of the receiving environment.
- Any potential impacts of the proposal.
- The resilience of the environment to cope with change.
- The level of confidence of impact prediction.
- The presence of planning or policy framework.
- Statutory decision-making processes.
- The degree of public interest.

In December 2005, following consultation with key stakeholders and regulatory authorities, the Minister for Planning determined that the Donald Mineral Sands Project would require assessment under the *Environment Effects Act 1978*.

2.9 EES Process

The Department of Planning and Community Development (DPCD) managed the EES process and guided DMS, and its consultants, who were responsible for engaging stakeholders, undertaking studies and preparing the EES.

2.9.1 Technical Reference Group

The Victorian Minister for Planning authorised DPCD to establish a Technical Reference Group (TRG) to provide policy, statutory and technical advice to DPCD and DMS on the adequacy of EES studies and documents.

The TRG was chaired and managed by a representative of DPCD and comprised representatives of government agencies and the proponent:

- DPCD (Chair)
- DPCD (Regional Planning)
- DSE (Biodiversity)
- Department of the Environment, Water, Heritage and the Arts (formerly DEW)
- EPA (North-West Regional office)
- DPI (Minerals and Petroleum Division)
- Aboriginal Affairs Victoria (AAV)
- Department of Human Services (Radiation Safety Services)
- Wimmera Catchment Management Authority
- North Central Catchment Management Authority
- Yarriambiack Shire
- Buloke Shire
- Northern Grampians Shire
- Grampians Wimmera Mallee Water
- VicRoads
- DMS

2.9.2 Scoping and Preparation of the EES

The Assessment Guidelines (see Section 1.5.1) set out the potential impacts, environmental issues and requirements that need to be investigated and assessed in the EES.

The Assessment Guidelines provided the framework for the preparation of briefs for studies, which were undertaken by specialist consultants engaged by DMS. The draft reports were reviewed by the TRG, which also received presentations from the specialist consultants. The TRG's comments were incorporated into the specialist studies and the draft EES.

2.9.3 Document Submission and Public Exhibition

The EES document (comprising Summary Brochure, Main Report and Appendices) is being placed on public exhibition for a period of six weeks during which time the public and stakeholders may make submissions on DMS's proposal. Submissions received during this period will be reviewed by an independent panel, appointed by the Victorian Minister for Planning, to conduct an inquiry into the project.

2.9.4 Independent Panel Inquiry

An independent panel inquiry may be convened to provide an opportunity for the public and stakeholders, including the proponent and government agencies, to make presentations on their submissions. After considering all submissions, hearing all those who wish to be heard, making site inspections and considering all the information presented to it, the independent panel will make recommendations on the proposal to the Victorian Minister for Planning under the *Environment Effects Act 1978* in a public report called the Panel Report.

2.9.5 Minister for Planning's Assessment Report

The Minister for Planning will consider the Panel Report and prepare formal assessment advice, known as the Minister for Planning's assessment. This assessment advice will be forwarded to all relevant statutory decision-makers, including the Victorian Minister for Energy and Resources, AAV and the Commonwealth Minister for the Environment, Water, Heritage and the Arts. The Victorian Minister for Planning's assessment is made public and recommends whether the project should be approved and, if so, under what conditions.

3 ENVIRONMENTAL AND SOCIAL CONTEXT

3.1 Physical Environment

3.1.1 Landscape

The project area is predominantly flat (average elevation is just over 130 m AHD), with a very slight fall to the east towards the Richardson River and a slightly steeper fall to the north. There are numerous low sandy rises up to 5 or 6 m high, which can give the impression of an undulating landscape (Supporting Study 5). Most of the project area has been cleared for farmland, with cereal cropping the dominant activity. Native vegetation is limited to scattered patches within paddocks or along road-side verges.

3.1.2 Climate

The project area is within the semi-arid climatic zone of southern Australia, and therefore generally experiences dry, hot summers and wet, cool to mild winters (Supporting Study 5). The median annual rainfall in Donald is about 374 mm, with rain falling on an average of 98 days per year. The wettest months are generally May to October (BOM, 2007).

Average daily minimum temperatures range from 3.9^{o} C in July to 14.4^{o} C in February. Average daily maximums range from 13.3^{o} C in July to 29.8^{o} C in February (BOM, 2007).

The annual average 9.00 a.m. relative humidity is 71%. Relative humidity is highest in June, with a 9.00 a.m. average of 91%, and lowest in January, with a 3 p.m. average of 29% (BOM, 2007).

3.1.3 Geology

The typical stratigraphy (from surface to depth) within the project area is (Supporting Study 5):

- Woorinen Formation (equivalent) (aeolian, 0 to 6 m thick).
- Shepparton Formation (fluvial, 5 to 20 m thick).
- Parilla Sand (marginal marine, 10 to 15 m thick).
- Geera Clay (marine, 10 to 30 m thick).
- Renmark Group (Olney Formation) (fluvial, 10 to 30 m thick).

The project orebody is located within the Parilla Sand.

3.1.4 Hydrogeology

Hydrogeology in the project area is understood on a regional scale, but local information is very limited. The principal aquifer is the Parilla Sand, an aquifer of limited beneficial use due to the high salinity of the contained water and low bore yields (less than 0.5 L/sec). As a result, licensed groundwater bores are few in number and the area is not a declared Groundwater Management Area.

The regional groundwater salinity varies between 14,000 and 35,000 mg/L TDS and the average local salinity is 16,930 mg/L TDS.

In the vicinity of the project area, the groundwater elevation is generally between 110 and 120 m AHD and the regional groundwater flow is northwesterly towards the deeper section of the Murray Basin. The aquifer thickness is around 25 m.

3.1.5 Surface Hydrology

Although the project area is within the Avon–Richardson catchment, it does not contain any defined watercourses or permanent water bodies. Two domestic and stock supply channels, the Taylors Lake Extension Channel and the East Laen Channel, traverse the area from southwest to northeast.

The closest rivers are the Richardson River, located approximately 4 km to the east, and Dunmunkle Creek, approximately 4 km to the west. The closest major water body is Lake Buloke, located approximately 25 km northeast and into which the Richardson River drains.

Sheet floodwater flows can occur following major rainfall events.

3.1.6 Biodiversity and Habitat

The study area is located in the Wimmera Bioregion (Supporting Study 3), which provides a benchmark for biodiversity within the project area. The majority of the project area has been severely modified by clearing for agriculture (primarily cropping); however, there are numerous remnants of native vegetation of varying size and quality both on public land (along road-side verges) and on private land.

The remnant vegetation present in the study area is made up of five Ecological Vegetation Classes (EVC):

- Plains Woodland, dominated by medium to large black box (*Eucalyptus largiflorens*) trees, typically in poor condition.
- Plains Savannah, dominated by buloke (*Allocasuarina leuhmannii*) in poor to good condition.
- Low Rises Woodland, dominated by slender cypress pine (*Callitris gracilis*) in medium to good condition.
- Black Box Lignum Woodland, overstorey comprised of mature black box and a midstorey of lignum (*Meuhlenbaeckia florulenta*) in medium to good condition.
- Ridged Plains Mallee, dominated by bull mallee (*Eucalyptus behriana*) in medium to good condition.

These EVCs are listed as endangered in the bioregion.

At least five habitat types, consisting of modified woodland/remnant trees, planted vegetation, irrigation channels, artificial waterbodies and exotic grass/crops, occur in the study area (Supporting Study 3).

The following were recorded during the flora and fauna surveys undertaken in November to December 2005 (Supporting Study 3):

- One flora and two fauna species of national conservation significance (EPBC Act-listed):
  - Turnip copperburr (*Sclerolaena napiformis*).
  - Growling grass frog (*Litoria raniformis*).
  - Hooded robin (*Melanodryas cucullata*).

- Five flora and three fauna species of state conservation significance (FFG Act-listed):
  - Pale flax-lily (*Dianella sp. aff. Longifolia*).
  - Umbrella mulga (*Acacia oswaldii*).
  - Plains joyweed (*Alternanthera sp. 1*).
  - Bluish raspwort (*Haloragis glauca*)[1].
  - Buloke mistletoe (*Amyema linophyllum ssp. orientale*).
  - Bush stone-curlew (*Burhinus grallarius*).
  - Brown treecreeper (*Climacteris picumnus victoriae*).
  - Diamond firetail (*Stagonopleura guttata*).
- Twenty-three flora species and eleven fauna species of regional conservation significance.
- Buloke Woodlands of the Riverina and Murray–Darling Depression Bioregions (EPBC-listed threatened community). This community is represented by a number of EVCs, namely Ridged Plains Mallee, Plains Woodland, Plains Savannah and Low Rises Woodland.

3.1.7 Cultural Heritage

The project area lies within the tribal boundary of the Jardwadjali, who occupied the Wimmera Plains and western Gariwerd region. The Jardwadjali were bordered to the east by the Djadja Wurrung, whose western boundary was formed by the Richardson River and Wallabo Creek.

The following groups have ancestral or cultural ties to the project area (Supporting Study 2) but, to date, no Registered Aboriginal Party (RAP) has been appointed for the area:

- Goolum Goolum Aboriginal Co-operative.
- Jupagalk Peoples (represented by Native Title Services Victoria).
- Barengi Gadjin Land Council Aboriginal Corporation.

Known Aboriginal cultural heritage values in the project area comprise 52 Aboriginal archaeological sites (37 stone artefact scatters and 15 scarred trees). The majority of these sites are of low to moderate scientific significance and of moderate to high Aboriginal significance (a measure of how significant sites are to relevant Aboriginal groups) (Supporting Study 2).

Six European cultural heritage sites occur in the project area. Four of the sites are of low historical significance, one is of low to moderate historical significance and one is of moderate historical significance (Supporting Study 2).

[1] This species occurs in roadside reserves proposed as potential pipeline routes for the project (Supporting Study 3).

3.2 Socio-economic Environment

3.2.1 Land Tenure

The project area is located within the Australian Bureau of Statistics-defined Yarriambiack and Northern Grampians Local Government Areas on land zoned as rural use farming (FZ). Some roadside and remnant vegetation is subject to an Environmental Significance Overlay (ESO).

With the exception of the water distribution channel reserve and road reserves, the project area is entirely freehold.

In 2005, the Federal Court determined that native title rights in Crown land within the project area have been extinguished; however, an Indigenous Land Use Agreement (ILUA[2]) covers the project area.

The Donald deposit lies within Exploration Licence (EL) 4433 and was once part of the Wimmera Industrial Minerals deposits extensively explored by CRA Ltd (now Rio Tinto) in the 1980s (Enesar, 2006).

3.2.2 Roads

The condition of roads in the project area ranges from poor to average. Some roads are sealed but the majority of roads within the project area are unsealed (Supporting Study 8).

The Donald–Murtoa Road and Stawell–Warracknabeal roads are the most heavily used roads, carrying approximately 800 vehicles per day. All other roads carry significantly fewer vehicles (generally less than 100 vehicles per day).

A number of school bus routes operate in the vicinity of the project area. School buses operate between 7.30 a.m. and 9.00 a.m. and 3.00 p.m. and 5.00 p.m. Monday to Friday during the school year.

3.2.3 The Region

Horsham is the largest town within 50 km of the centre of the project area and is the main service centre for the district, providing a range of general and community services and facilities (Supporting Study 9).

Dryland agriculture and light industry associated with the production and processing of crops (wheat, barley, field pea, faba bean, kabuli chickpea, lentils) and other farm products (oats, hay, lucerne and sheep for meat and wool) are the dominant industries (Supporting Study 5).

3.2.4 Population and Employment

The population of the Northern Grampians and Yarriambiack shires and all local towns within the study area (excluding Horsham) is decreasing. Between 1991 and 2006 the population of the Northern

[2] The ILUA describes how and when the native title holders will engage with the Government about future dealings in the determined area and ensures that relevant Aboriginal groups continue to have a say regarding certain types of development in that area (including mining).

Grampians and Yarriambiack shires fell from 13,130 to 11,912 and from 8,941 to 7,521 respectively (ABS, 2007b, R023).

Agriculture is the industry employing the most number of people in the majority of local towns. In 2001[3], the unemployment rate in local towns such as Minyip, Murtoa and St Arnaud was higher (8.5%, 7.5% and 7.6% respectively) than the state as a whole (6.8%) and the rest of Australia (7.4%) (ABS, 2006).

3.2.5 Local Residents

Six families operate farms or own or live on land within the 25-km^2 project area representing a population density of less than one person per square kilometre (see Figure 1.2). Each farm is approximately 810 ha in size. Of the six residences within the project area, one is leased. There are at least 13 additional residences within 2 km of the project area boundary.

[3] Not all 2006 census data has been released. Employment data is due to be released on October 25 2007 and in December 2007 (Supporting Study 9).

4 PROJECT DESCRIPTION

4.1 Mining Overview

Mining operations will commence in the northwest corner of the project area and advance in a southerly direction for the first 16 years of mining before progressing to the eastern half of the project area, again working from north to south.

For the first 6 to 12 months, all topsoil, tailing and overburden will be stockpiled outside of the pit in dedicated facilities. Once the pit is large enough to host the full range of earthmoving and tailing management activities, tailing and overburden will be emplaced in the pit. Overburden extracted during the initial stages of mining may be stockpiled for a period of up to 25 years, under a worst case scenario, before being used to fill the final mine void.

Normal mining operations will proceed in a constant cycle of site clearance, removal of topsoil and overburden, ore extraction, replacement of overburden and topsoil, and revegetation, i.e., a ‘moving pit’ concept. Blasting will not be required and any preliminary breakage of the ore will be handled by ripping. Topsoil movements will be conducted on a seasonal, campaign basis.

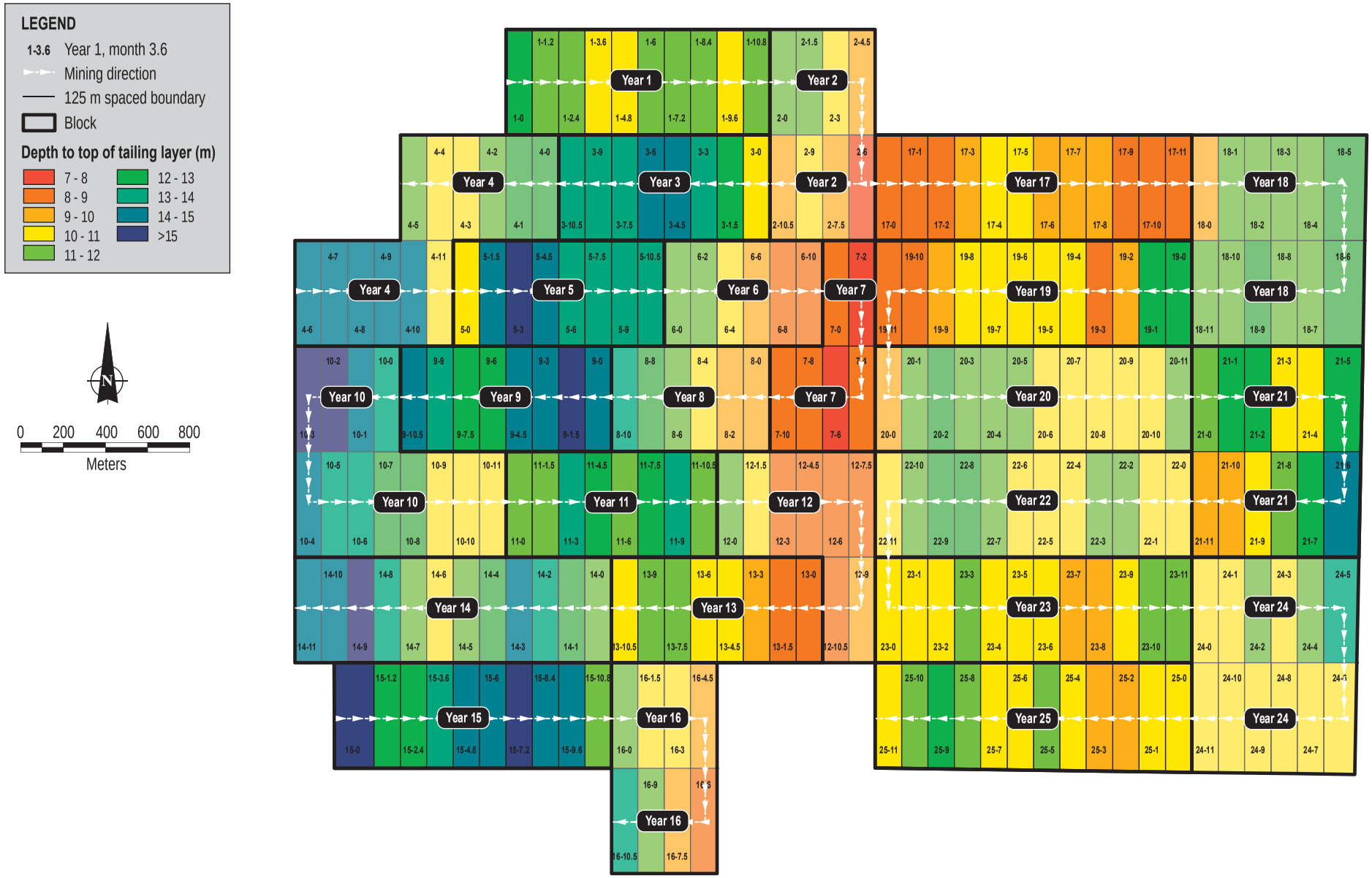
Each year for around 25 years, approximately 7.5 Mt of ore and 13.5 Mt of overburden and soil will be moved during mining operations.

The selected mining layout, described as a cell configuration, is a series of rectangular cells with the average surface area of each cell being 125 m by 500 m. Mining will advance at a rate of approximately 9.8 cells per annum. On average, each cell is actively mined for 1.2 months (Figure 4.1) after which an earthen bund is built to separate the cell from the next. The mined-out cell will then be used to store and dry tailing.

After a short haul by truck within the pit to the mining unit plant (MUP), the ore is screened to remove oversize then slurried. From the MUP, the ore slurry is pumped to the wet concentrator plant (WCP). There, the ore undergoes a two-stage process to produce heavy mineral concentrates (HMC). The first stage takes place in the WCP where valuable heavy minerals are separated from gangue material such as sand and clay. The gangue material is returned to the pit in the tailing stream. The heavy mineral stream then proceeds to the concentrate upgrade plant (CUP), which separates it into a magnetic concentrate (crude ilmenite) and a non-magnetic concentrate. The non-magnetic concentrate includes rutile, zircon and leucoxene. The two concentrates are then stockpiled separately in readiness for transport from site.

Figure 4.2 provides a process flowchart for the mining and processing of mineral sands for the project.

The concept of progressive backfilling and rehabilitation means that the pit does not continue to increase in size; only its location changes. In effect, the mine will be a moving pit that slowly moves laterally across the landscape feeding a fixed WCP.



Note:
The vegetation buffer zone is not shown in this diagram but is accurately represented on Figure 4.3.

coffey natural systems

Job No: 972
File Name: 972_05_F04.01_HB

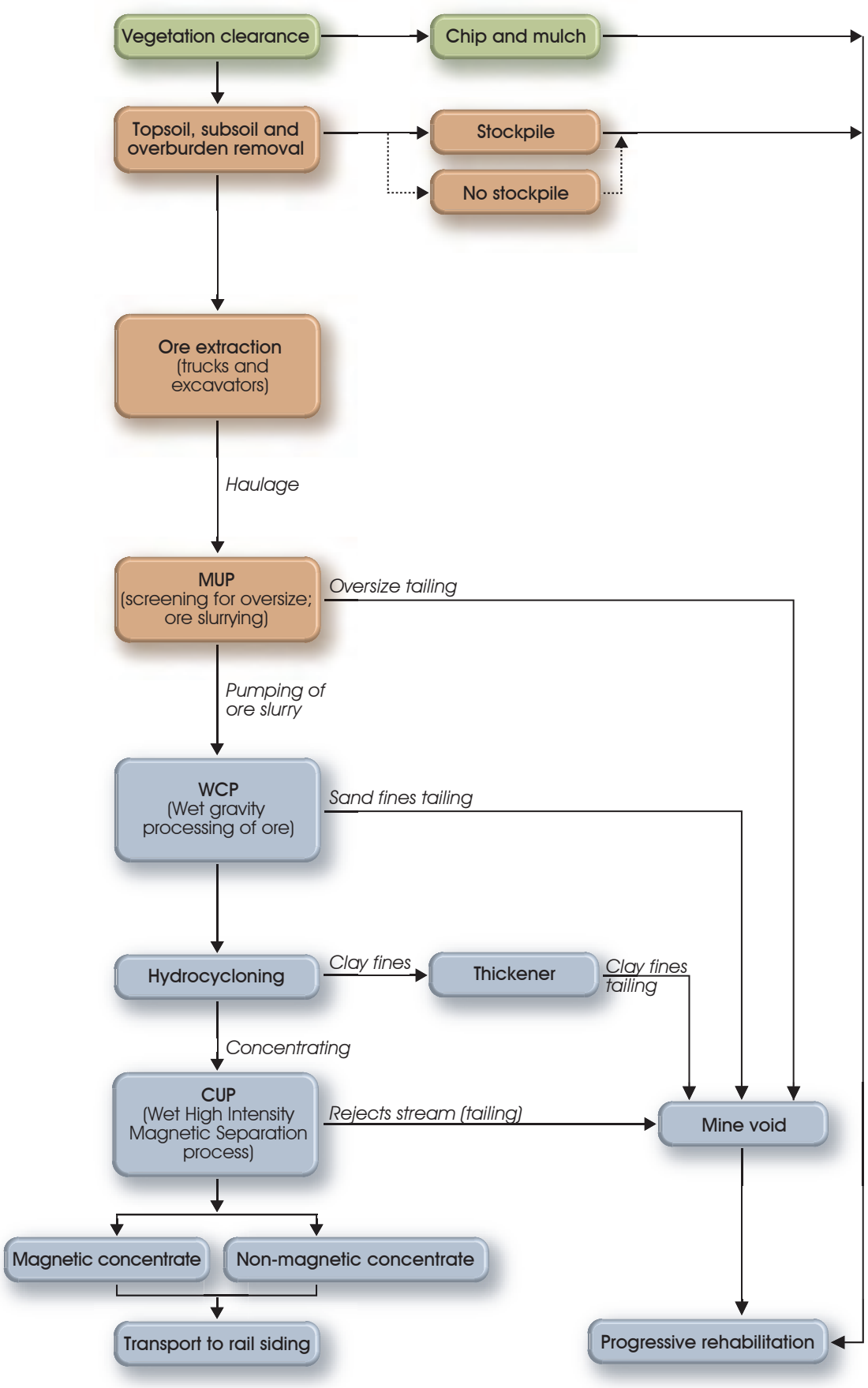
DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Mining schedule (cell configuration) showing depth to the top of the tailing layer

Figure No: 4.1



coffey natural systems	Job No: 972 File Name: 972_05_F0402_HB	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Mining and processing flowchart	Figure No: 4.2

4.2 Project Schedule

Approximately two months after the approval to commence mining has been granted (i.e., the project is approved under the MRSD Act), site works will start.

The processing and production of HMC will begin one to two months after the construction period. Transportation of HMC product to the port is scheduled to commence six months after the plant is commissioned. The project timetable is presented in Table 4.1.

Table 4.1 Indicative project timetable

Phase	Activity	Indicative Timing
Pre-production	Complete environmental approvals.	2008.
	Mine mobilisation (construction).	2 months after approvals.
Mining	Topsoil and subsoil removal commences.	3 months after approvals.
	Overburden removal commences.	5 months after approvals.
	Ore mining commences.	6 months after approvals.
Dewatering	Sump pump commissioning.	During production.
Processing	MUP operation commences.	8 months after approvals.
	WCP operation commences.	8 months after approvals.
	HMC production commences.	9 months after approvals.
	HMC export commences.	12 months after approvals.
Post-mining	Progressive tailing placement.	12 months after approvals.
	Progressive subsoil and topsoil replacement.	12 months after approvals.
	Progressive rehabilitation works commence.	12 months after approvals.
	Final rehabilitation and mine demobilisation.	25 years after approvals.

4.3 Mineral Resource

The indicated and inferred mineral resource over the superseded project area, at a cut-off grade of 1% heavy mineral, is estimated to be:

- 693 Mt at 5.1% heavy mineral.
- 15.3% slimes.

Contained within this resource and within a boundary of composite drill-hole data is an indicated and inferred resource of 477 Mt at 1.1% zircon, 1.8% ilmenite, 0.3% rutile and 1.1% leucoxene (for 5.2 Mt of zircon, 8.5 Mt of ilmenite, 1.2 Mt of rutile and 5.4 Mt of leucoxene).

4.4 Construction

4.4.1 Construction Schedule

Pre-production activities, including construction of processing plants and other infrastructure, will last approximately 12 months, commencing 2 months after the project is approved.

4.4.2 Construction Methods

Before mining operations and processing can commence, a number of facilities and earthworks are required. The following activities will be undertaken in the months preceding and during the construction phase of the project:

- Prior to the granting of the work authority and prior to commencing any works that have the potential to harm Aboriginal cultural heritage, a CHMP must be approved.
- Pre-mining site preparation including, but not limited to, threatened species clearance surveys and habitat tree removal as required.
- Removal of approved sections of vegetation.
- Site fencing.
- Stripping and stockpiling of soil and overburden.
- Establishment of mine access roads and infrastructure:
  - Construction of the office, workshop, stockpile areas, car parking and processing facilities (WCP and the CUP).
  - Provision of the high voltage electricity supply to the site.
  - Provision of water to site. (This will include installation of pumps, a pipework and the excavation of the water storage dams.)
  - Upgrading the haul road, signage and the rail siding at Minyip.

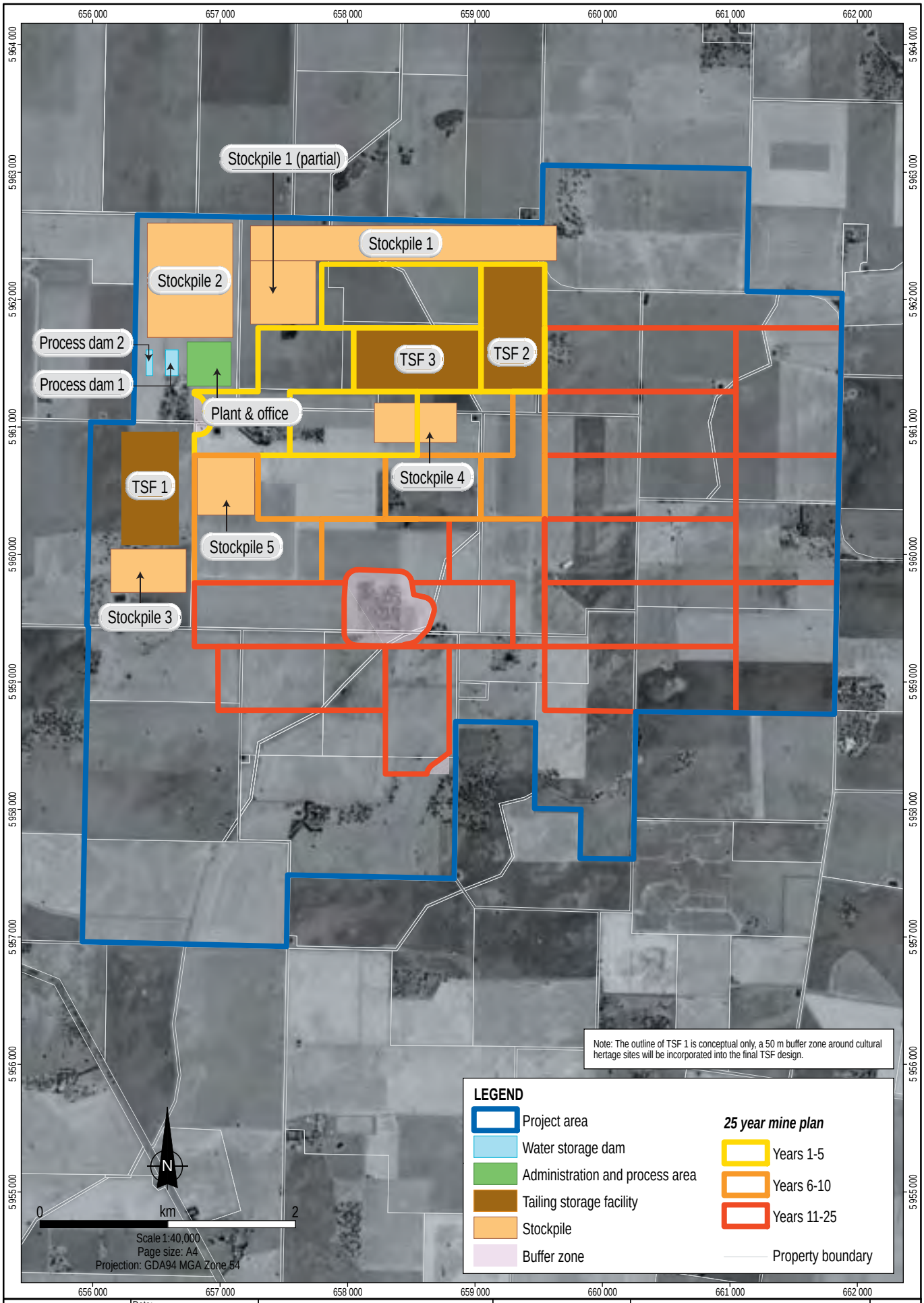
For the tailing storage facility (TSF), topsoil and vegetation will be stripped for later reuse in rehabilitation. The earthen bund that forms the wall of the TSF will be built in a ‘turkey’s nest’ configuration and will incorporate a compacted clay lining to retain both the tailing and entrained water. The TSF will be built and managed in accordance with DPI’s Management of Tailings Storage Facilities (DPI, 2004a).

4.5 Mining

4.5.1 Mine Plan

The proposed project area boundary (shown in Figure 1.2) provides a conservative estimate of the area of disturbance due to the project activities. In reality, the area of disturbance is expected to fall well within this boundary and will be defined in the work plan prepared under the MRSD Act.

The conceptual site layout plan for the duration of the project is shown in Figure 4.3. It shows overburden and topsoil stockpiles (shown as total areas only; in practice, topsoil, subsoil and overburden stockpiles will be separated), initial TSFs and water storage dams.



coffey natural systems	Date: 18.10.07 MXD: 972_DonaldMineralSandsGIS File Name: 972_05_F04.03_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Conceptual site layout	Figure No: 4.3

Mining will involve the following steps:

- Removal of topsoil and subsoil with a tractor and scraper bowl configuration.
- Removal of overburden with conventional earthmoving equipment (including excavators, bulldozers and trucks).
- Dewatering (as necessary) to manage in-pit drainage.
- Ore removal and haulage to the MUP with conventional, fit-for-purpose earthmoving equipment.
- Ore screening and slurrying at the MUP.
- Pumping of ore slurry from the MUP to the WCP.
- Initial wet gravity processing of mined ore at the WCP to produce HMC.
- Processing of HMC into magnetic and non-magnetic concentrates at the CUP:
  - Wet high-intensity magnetic separators (WHIMS) and wet gravity concentration equipment are used to separate the HMC into a magnetic concentrate, a non-magnetic concentrate and a rejects stream.
  - The non-magnetic stream is upgraded using wet gravity separation equipment to further reject silica and light gangue minerals.
- Return of tailing (sand and clays) to the mine void behind the advancing mine face.
- Transportation of HMC by road and/or rail to port for export.
- Progressive rehabilitation of the mined area and other disturbed areas.

The mine pit will be relatively shallow, averaging 21 m deep. Project mining engineers have determined that a provisional wall angle will be 70° but this is subject to advice from geotechnical engineers. Batter angles of 50° were used in the test pit that was constructed in the southern section of the superseded project area in 2005. Visual inspection has shown that these walls have held up adequately over a period of two years.

Progressive rehabilitation behind the mine face means that the maximum area of open pit at any one time will be approximately 75 ha, with up to 25 ha being actively mined and 50 ha being rehabilitated. The depth of the pit at any point is determined by the depth of the ore contained within it, while the area open will vary according to the ore grade and market demand for titanium and zirconium minerals. Within the 25-year schedule, the maximum depth of the pit is 25 m.

4.5.2 Mining Schedule

The mining schedule allows for 9.8 mine cells to be mined and progressively backfilled annually, the equivalent of approximately 50 ha. DMS aims to start commercial production in 2009, developing the project to produce 398,000 t of non-magnetic and magnetic concentrates by 2010 at which time, the potential for expansion could be evaluated.

4.5.3 Mining Methods

Conventional mining equipment will be used for the project; earthmoving machinery such as hydraulic excavators, trucks, bulldozers and scrapers will be used. Blasting will not be necessary; however, ripping may be required for indurated material.

For the first 6 to 12 months, overburden will be stockpiled until the pit is large enough and the tailing dry enough for direct backfilling. Ore will be loaded into a relocatable hopper that will be moved periodically to keep pace with the active mine face. After the oversize material has been removed, the ore will be slurried then pumped to the WCP. DMS plans to extract the ore in a single bench to enable grade blending down the stratigraphic column.

Mined-out cells will be progressively backfilled with sand (sand tailing) and clay/silt (fines tailing) from which ore has been removed. Decant water and seepage from the slowly compressing tailing mass will be collected and recycled. Once they are dried enough to be trafficable, the tailing cells will be buried by replacement of overburden, then subsoil and topsoil (Figure 4.4).

The proposed placement strategy for tailing (see Supporting Study 10) aims to place the tailing in a sequence which allows for an underdrainage layer at the base of the fines tailing and six months of solar drying of the deposited fines tailing prior to overburden placement and rehabilitation (see Figure 4.1). Tests will be conducted to determine whether this strategy allows for adequate drying and strength development of the tailing and, if not, the following feasible alternatives will be considered:

- Co-disposal of the fines tailing with the sand tailing to aid drainage and strength development.
- Placing sand over fines.
- Placing fines over sand.
- Longer drying periods.

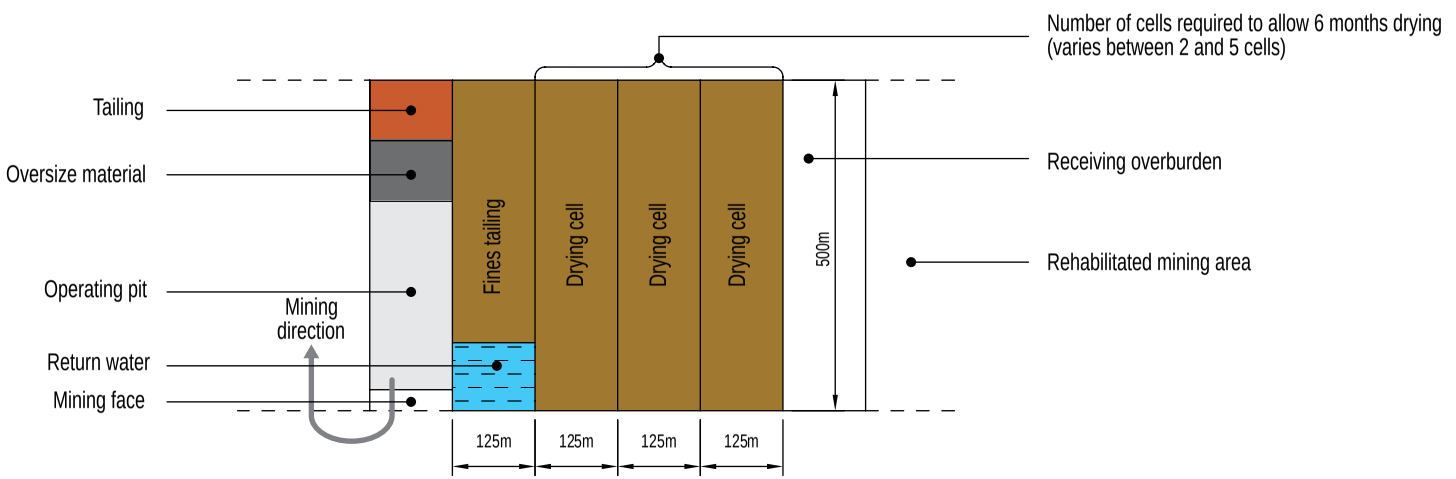
4.5.4 Mining Equipment

Typical mining equipment, outlined in Table 4.2 will be used for the DMS project. The use of trucks for ore haulage to the WCP was considered but rejected due to issues such as compliance with noise and dust emission limits. Nevertheless, there will be in-pit truck haulage of a few hundred metres from the extraction face to the MUP.

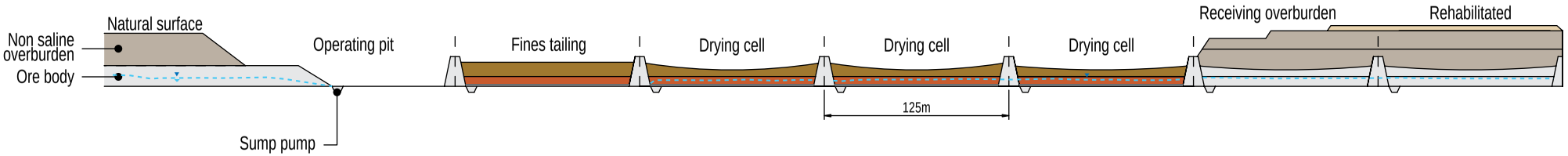
The proposed method for ore extraction is an excavator (Hitachi EX1200, or equivalent) and it is likely these will be in shovel configuration (i.e., loading the bucket above the machine). A shovel/excavator and truck configuration is planned for overburden removal.

Approximately seven trucks (150 t capacity) and two excavators will be required to operate 24 hours/day on overburden removal. An auxiliary fleet consisting of a track dozer, front-end wheel loader, grader, water truck for dust suppression and integrated tool carrier will also be required.

Mining sequence



Typical section through operating mine



	coffey natural systems	Job No: 972	DMS Pty Limited	DMS A Subsidiary of Aitron Limited	Proposed tailing placement strategy	Figure No: 4.4
		File Name: 972_05_F04.04_FT	Donald Mineral Sands Project			

Table 4.2 Indicative mining equipment

Equipment	Number
Topsoil and subsoil removal and return	
Tractor/scoops	2
Overburden mining	
Hydraulic excavator (up to 180 t gross mass)	2
Haul trucks (up to 150 t payload capacity)	7
Ore mining	
Hydraulic excavator (Hitachi EX1200, or equivalent)	1
Haul trucks (up to 100 t payload capacity)	2
Additional mining operations	
Drill for development of de-watering bores (periodic requirement)	1
Ripping bulldozers (to enable excavation of ore with the hydraulic excavator and access ramp development)	1
MUP	1
Grader	1
Water truck - dust suppression and road building (up to 50 t capacity)	2
Integrated tool carrier for moving pipes and services	1
Front-end loader for loading from run of mine stockpiles to MUP	1

4.5.5 Stockpiles

As noted earlier in Section 4.1, there will be a need for short-term stockpiling of some mined materials. This mainly relates to the first 6 to 12 months of operations when the pit is too small and the tailing too weak to allow emplacement of overburden.

In order to protect post-mining soil fertility, stockpiles will be built and managed to prevent cross-contamination. Hence, topsoil will be stored on topsoil, subsoil on subsoil and overburden on an overburden substrate. This has a disadvantage in that the area and cost of stockpiling increases; however, it is regarded as good rehabilitation practice.

Topsoil and Subsoil

The maximum height of topsoil stockpiles will be 2 m to help protect topsoil fertility and to facilitate rehabilitation of the land. Topsoil and subsoil removal will be conducted on a seasonal campaign basis where topsoil and subsoil from several mine cells will be removed in the middle of winter to avoid stripping when the soils are dry. This schedule will ensure the area is ready for the mining process and dust generation is minimised. Different types of topsoil (as classified in the rehabilitation report recommendations, see Supporting Study 5) will also be stockpiled separately. Topsoil removal will be conducted using an agricultural tractor and scoop arrangement, in accordance with current industry standard for rehabilitation of agricultural land.

Specifications for topsoil and subsoil stockpiling are:

- Average haul to be 1 km for the first 5 years.
- Topsoil and subsoil can be stockpiled on the pit edge, away from the advancing mine face.
- Topsoil stockpile height: 2 m.
- Subsoil stockpile height: 5 m.

Replacement of topsoil assumes the topsoil depth to be 200 mm and the subsoil depth to be 800 mm.

Overburden

During the first 12 months of mining, overburden from the open pit will be stockpiled to a maximum height of 30 m. This height was determined to be the most appropriate when considering the trade-off between visual amenity and the area of disturbance (see Section 4.13.5). As noted earlier, the stockpile area will be stripped of topsoil and subsoil so that the overburden sits directly on overburden.

After this initial period, overburden will be directly backfilled into the pit on top of dry tailing in accordance with the outline presented in the rehabilitation section of this document (see Section 6.14). The time involved in establishing this sequence of overburden emplacement behind the active mine face will depend on the drying time of the fines.

The minimum depth to the top of the tailing, following long-term consolidation, is estimated to be 7.6 m below the final ground surface, such that saline groundwater in the tailing is unlikely to cause soil salinisation or encroach on the cropping root zone (see Section 6.2, Groundwater impact assessment for further detail). To minimise the potential for contamination of the root zone, detailed soil mapping will be undertaken before mining commences (see Section 6.14). Overburden will be monitored during removal to determine whether it is saline (from close to or below the water table) or non-saline. The thickness of non-saline overburden will be recorded at each location. Saline overburden will be returned to the mine void and at each location will be covered with non-saline overburden of at least the original thickness.

Overburden removed and stockpiled during the first few months of mining will be re-deposited at the end of the mine, in the final mining void. Before returning the initial overburden stockpile to the mine void, any organic matter established on the stockpile will be removed along with the topsoil layer.

4.5.6 Water Storage

Two process water dams will be constructed to provide a buffer for the water retrieved from the processing plant and the water retrieved from the ‘off-site water supply’.

The process water dam enables water to be recycled and reused in processing, while the make-up water dam provides a buffer storage between the raw water supply and the processing plant.

These dams will cover approximately 2.75 ha and 1.25 ha, respectively with a maximum depth of 5 m providing a total capacity of 21 ML.

The floor of both the process water and make-up water dams will be sealed with a polyethylene liner to prevent losses through seepage to groundwater. Trials of evaporative suppressants will be conducted to minimise evaporation losses.

4.5.7 Operating Hours

All construction and mine operations will be 24 hours/day, in two 12-hour shifts, 7 days a week. This includes construction, mining, ore processing and transport of the HMC to the port.

The proposed roster is that the workforce will work a four-on, four-off rotating shift, (four day shifts, four off, four night shifts, four off) although this may change over time depending on industry standards.

4.6 Ore Processing

Processing plant components will operate continuously once sufficient ore has been excavated. The MUP will be located in the pit and moved regularly to keep pace with its advance. Conversely, the WCP will have a fixed location in the northwest corner of the project area.

4.6.1 Mining Unit Plant

Ore from stockpiles will be processed in the MUP at a nominal rate of approximately 1,050 t/hour. The MUP in the pit consists of a relocatable hopper/conveyor unit that feeds material into a relocatable trommel screen/pulping bin unit, fitted with screens.

Oversize material from the trommel will be dumped ahead of the unit via a belt conveyor and removed by mobile equipment to the overburden emplacement in the mine void. The ore is then slurried and pumped to the WCP. The ore slurry pipeline will be relocated periodically to keep pace with the extraction face.

4.6.2 Wet Concentrator Plant

The WCP, also known as a primary mineral separation plant, is located in the northwest corner of the project area. There the ore will be separated into sand (sand tailing), clay/silt (fines tailing) and heavy mineral concentrate (HMC).

The WCP consists of a number of integrated modules that together process ore to HMC. The plant has been designed to treat a nominal 1,050 t/hour of ore (or 7.5 Mt annually), based on an 81.5% run time at a feed grade of 5 to 6.0% heavy metal, and produce a maximum of 450,000 tpa HMC comprising:

- Magnetic HMC (ilmenite concentrate): 110,000 tpa.
- Non-magnetic HMC: 288,000 tpa.

WCP equipment modules consist of:

- Ore receival and primary screening.
- Cyclone de-sliming.
- Secondary ore screening.
- Multi-stage spirals.
- Paste thickeners.
- Process water tanks and dam.

4.6.3 Concentrate Upgrade Plant

The CUP is a separate component of the ore treatment process located alongside the WCP. Heavy mineral concentrate produced in the WCP is pumped to the CUP, where it will be further processed.

The CUP uses wet high-intensity magnetic separators (WHIMS) and wet gravity concentration equipment to separate the HMC into a magnetic concentrate, a non-magnetic concentrate and a tailing stream (silica and other light gangue minerals).

Tailing from the CUP will join the WCP tailing stream and be pumped back to the TSF or pit for disposal.

4.6.4 Concentrate Storage and Transport

Concentrate Storage

Concentrate will be stockpiled on purpose-built pads to avoid contamination and to allow drying and ease of loading for transport. The stockpiles will cover an area of approximately 0.5 ha with the maximum volume for each of the magnetic and non-magnetic concentrate stockpiles expected to be 10,000 t.

Transport

DMS have considered a number of options for transferring and transporting the concentrate overseas including:

- The mode of transport from the project area (either via truck to port or by truck to a rail siding for freight to a port).
- The concentrate transfer options; either bulk handling or in containers.
- The transport route to the rail siding (should DMS choose to transport the concentrate via rail).
- The rail siding location.
- Rail operational alternatives (existing or dedicated freight train).
- The port from which the concentrate will be sent overseas; Melbourne, Geelong or Portland.

The alternatives for each of these transport options are described in Section 4.13.6.

Based on the two transport route options, it is estimated that 30 load collections are required during operations i.e., 60 truck movements (round trips from the mine to the rail siding) per day. Each truck will transport approximately 40 t of HMC each trip. The HMC will be covered to prevent any loss of material during transportation.

The stockpiles at the rail siding would hold a maximum of 80,000 t, covering an area of 1.5 ha. These stockpiles will be covered within a steel/poly-clad shed.

4.6.5 Reagents and Consumables

Reagents such as flocculants and some other chemicals will be used during the processing of ore and water treatment.

The tailing produced during the ore treatment process is put through a thickener before being pumped back to the mine pits. The thickener aids water recovery and the reclaimed water will be pumped to the process water dam for reuse. DMS will require 350,000 to 400,000 L/year of flocculant to aid the settling of the suspended clay fines. DMS will use a bio-degradable flocculant.

Measures for the storage and handling of reagents and consumables are described in Section 4.9.3.

4.7 Infrastructure and Transport

4.7.1 Energy Supply

The DMS project will consume approximately 24.4 GWh/year of electricity. Electricity is to be supplied by Powercor, one of Victoria's electricity distributors, from the local transmission grid. The provision of power will involve the construction of a new 66-kV transmission line from Horsham Terminal Station to a new substation in the project area, then an 11- or 22-kV overhead line from the substation to the mine site (where the voltage will be stepped down to 415 V).

Powercor has advised that the following augmentation work is required:

- Construction of a new 66-kV exit line from Horsham Terminal Station.
- 66-kV line works from Horsham to the project area.
- Proposed new 66-kV pole line sections for Horsham Terminal Station to the project area.
- Erection of 73 km of new 3-phase All-Aluminium-Conductors (AAC) 66-kV overhead line.

The power line will be constructed in accordance with the relevant regulations, which are governed by the Minister for Energy and Resources. Protection on the private power line will be set and graded to the level of Powercor protection in the area. This will allow for sequential tripping of the mine site without affecting other local users.

A detailed description of the estimated electricity consumption and the associated greenhouse gas production is provided in Section 6.5.

4.7.2 Sewage

Sewage will be collected in a tank for removal and disposal off site by an approved contractor. The contractor will be required to comply with local government statutory requirements.

4.7.3 Road Access and Transport

Mine access roads and haul roads will be constructed adjacent to the pit to minimise interaction and the risk of accidents occurring between mining equipment and general site traffic. A risk assessment will provide the basis of a Traffic Management Plan, which will form part of the mine's Work Plan. Instruction and training will ensure that personnel are aware of the Work Plan and its requirements.

Internal Roads

Haul roads will be constructed in sections parallel to, and alongside, the pit being mined. They will connect the mine workshop, mine pit and overburden stockpiles and will enable the movement of vehicles to and from the MUP, WCP and CUP. Haul roads will be constructed using overburden and local materials and will be of sufficient width to allow passage for haul trucks and light vehicles. The widths of haul roads will be determined after equipment fleets are finalised, but are estimated to be 20 m wide.

Access Roads

The main access road will be R. Funcke Road and will be used by mine construction and operations staff, contractors and delivery personnel, and drivers of trucks carrying HMC. The access road will be sealed as part of the HMC haul route.

Public Roads

Movement of HMC between the mine and port will be by a contracted transport company. If rail is used for shipment of the HMC, it will be transported by road to a new rail siding, located just south of the Minyip, where it will be railed to port.

Employees, service and supply vehicles and visitors to the project area will travel a number of other roads in addition to the HMC haul routes. DMS will, in conjunction with the Yarriambiack Council, monitor road conditions and usage patterns over the first 18 months after construction has been completed to establish which, if any, roads need to be upgraded. The two roads most likely to require upgrading are the Burrum–Lawler Road, a local, unsealed road in generally poor condition, and the Banyena–Pimpinio Road, a sealed road in average condition.

Overburden will be moved on internal haul roads, purpose-built for haulage within the project area. The large, off-highway haul trucks used for earthmoving in the mine will be restricted to the project area and will not use public roads.

Car Parking

Employee and visitor car parking will be established adjacent to the administration building. It will be covered in a gravel sheet and landscaped to provide shade for vehicles.

4.7.4 Ancillary Infrastructure

The site maintenance workshop will be a steel-framed shed with a sealed floor. The building will contain a lock-up store, mechanical bay, electrical bay, earthmoving bay and a machinery wash-down bay fitted with grease traps, oily water separator and water recycling facility. Transportable buildings will also be provided for on-site administration, ablutions and meal rooms.

Safe storage will be provided at the site for diesel fuel, sufficient for at least one week of earthmoving operations. The storage area will be arranged to comply with statutory requirements for the containment of leaks and spills.

4.7.5 Communications

Communication within the mine site will be provided via a self-contained, UHF, two-way radio system. Telephone, fax and internet services will also be connected.

4.8 Wastes

4.8.1 Tailing

During the first 6 to 12 months of operations, tailing will be stored in a tailing storage facility (TSF) adjacent to the mining pit. Once the pit is large enough to accommodate tailing disposal, tailing will be pumped directly into the cells in the open pit. Tailing cells have been scheduled to have a six-month drying period before backfilling occurs (see Figure 4.1).

Two types of tailing will be produced in the processing operation: dense sand tailing and fines tailing consisting of silt and clay (slimes). Overflows (containing silt and clays) from the de-sliming cyclones located within the WCP are collected in a transfer sump and pumped into two paste thickeners, where the clays and silt are dewatered by adding a bio-degradable flocculant. Recovered water is returned to the process for reuse and the thickened silt and clay is pumped to the tailing disposal.

Once in-pit tailing disposal is well established, the TSF will be decommissioned and rehabilitated as a permanent mound.

4.8.2 Solid Waste

Staff and contractors will be made aware of mine-site, solid-waste management practices. The site will be kept free of litter by providing bins where food is consumed. All non-toxic waste (including putrescible and inert) will be securely stored in appropriate receptacles. All waste (including chemical toilet effluent) will be removed from site for disposal by licensed contractors. Recyclable materials (such as aluminum cans, glass and recyclable plastics) will be sent to a licensed recycler.

4.8.3 Hydrocarbons

Waste hydrocarbons will be placed in suitable containers and removed from the mine site for disposal at either an EPA-approved hydrocarbon waste site or a recycling depot. Runoff water from mobile equipment service areas will be directed to an interceptor trap to extract hydrocarbons prior to being discharged to the drain and sump network. A licensed contractor will empty the trap of hydrocarbons routinely.

4.9 Hazardous Materials

It is expected that the following hazardous materials will be used on site:

- Natural gas.
- Diesel.
- Acetylene.
- Compressed oxygen.
- Oils.
- Greases.

4.9.1 Bunding

Bunding around hazardous materials storage will be designed and constructed to ensure hazardous materials are suitably contained in the event of a spill. The capacity (bund height), storage, stormwater control and maintenance and operation of bunded areas will comply with EPA Publication 347, Bunding Guidelines (EPA, 1992).

4.9.2 Transport

The classification, packaging, labelling and safe transport of dangerous materials will be the responsibility of the manufacturers, suppliers and transport contractors. However, once these materials are on site, DMS will comply with the relevant statutory requirements such as the materials safety data sheets (MSDS) and will seek further advice of the appropriate authority as necessary.

Hazardous materials will be transported in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail (FORS, 1998). While transport of these materials will (in most cases) be the responsibility of contractors, a transport procedure will be developed and included in the mine Work Plan.

4.9.3 Storage and Handling

DMS will comply with all relevant statutory requirements including the National Code of Practice for the Storage and Handling of Dangerous Goods (NOHSC:2017, 2001), Australian Standard 1940–The Storage and Handling of Flammable and Combustible Liquids (AS, 1940-2004) and the relevant MSDS. When necessary, DMS will seek advice from appropriate authorities.

4.10 Water Requirements and Supply

The top of the orebody is expected to be typically 3 m above the groundwater level, while the base of the ore is about 7 m below the groundwater level, although this varies across the project area. The result is that only part of ore horizon is saturated (Figure 4.5). Dewatering will be required for the deeper parts of the orebody; however, inflows are expected to be relatively small due to the low permeability of the aquifer (see Supporting Study 10).

The estimated water balance (see Supporting Study 10) shows that 19 L/s of water will be recovered from sumps within the pit and 37 L/s will be recovered seepage and decanted water. Based on a worst case scenario, an additional 87 L/s of water is needed for processing.

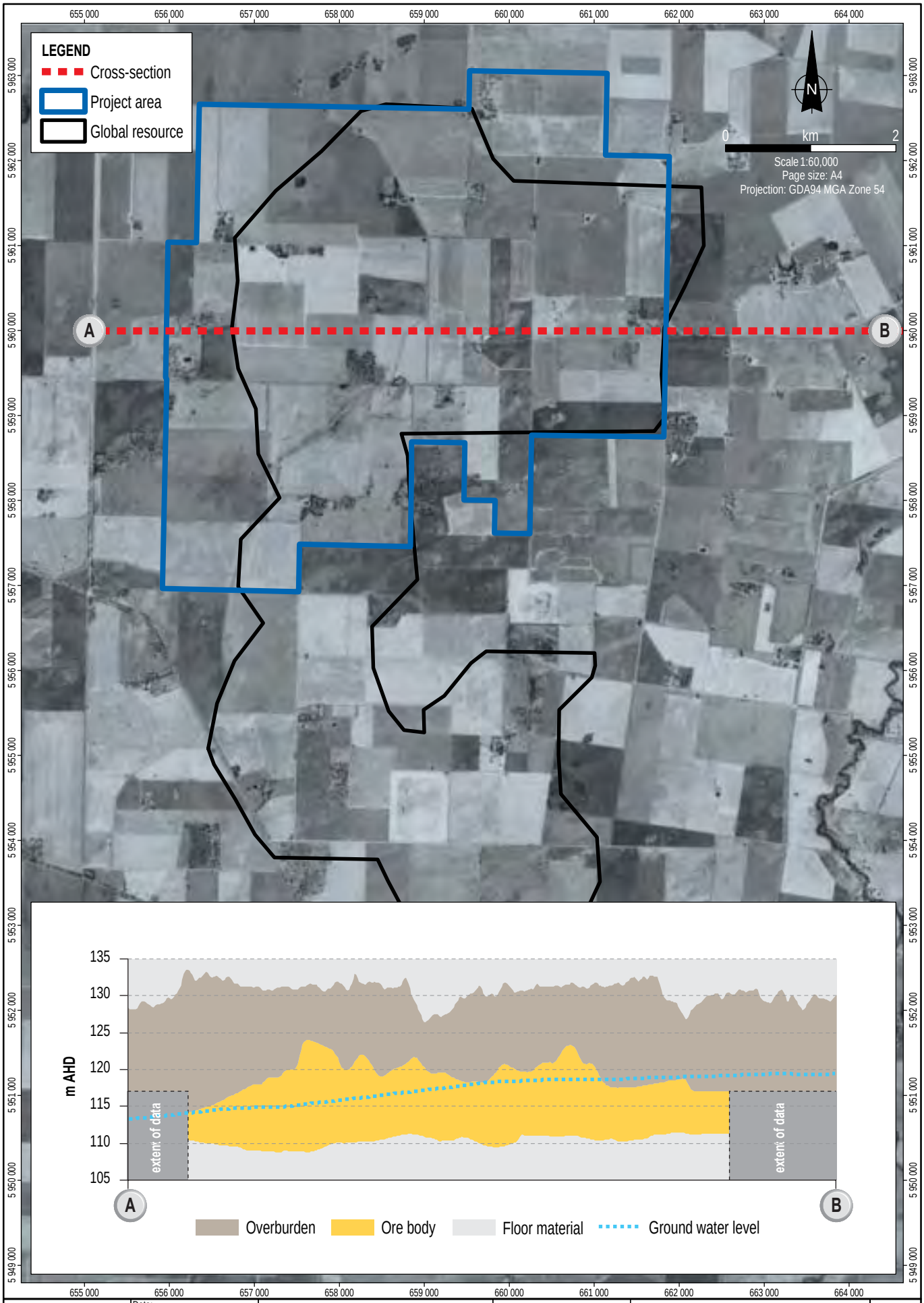
4.10.1 Process Water

Water is the transport medium for ore through the various stages of the ore processing system from the MUP to the WCP. DMS hopes to use saline groundwater for the majority of process water; however, this is subject to further investigation outside of the scope of the EES.

In the final stages of ore processing, fresh water will be used at the WCP to wash the HMC and remove the salt from the minerals before it is transported to the CUP for the final stage of ore treatment prior to export. Washing the salt off the minerals with fresh water optimises the performance of electrostatic separators used to separate rutile from zircon although the latter will not be a part of the on-site ore treatment process.

Water is also used to transport the tailing back to the TSF or pits for disposal. A portion of this water will be lost through evaporation, seepage or become permanently bound in the tailing. The balance of the water (37 L/s) will separate from the tailing when it is decanted into the tailing pond or when it is expressed from the tailing mass as it compresses and consolidates.

Saline water used in processing the tailing should be marginally lower than the groundwater salinity around the project area (with the average local salinity around the project area measured to be 16,930 mg/L total dissolved solids). Furthermore, the additional salt load is likely to be permanently bound in the tailing, which is normally above the watertable, but well below the ground surface (see Supporting Study 10).



coffey natural systems	Date: 25.09.2007 MXD: 972_DonaldMineralSandsGIS File Name: 972_05_F04.05_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Orebody cross section showing position relative to groundwater level	Figure No: 4.5

Saline groundwater will be managed to prevent spillage onto topsoil and subsoil. Management measures will include, but not be limited to:

- Placing pipes carrying saline groundwater in a common pipe corridor, previously stripped of subsoil and topsoil.
- Inspecting bores, pumps and pipes at least daily during operations.
- Establishing containment bunds around booster pumps and other transfer points.
- Ceasing pumping if groundwater spillage cannot be contained during operations.

4.10.2 Mine Dewatering

Dewatering sump pumps will be installed in the open pit to collect the relatively small inflow, estimated at 19 L/s, at the base of the orebody. Water accumulating in the mine pit from the emplacement of tailing (the fines tailing only have a 35% solids content) will also be recovered and reused in the MUP or fed back to the process water dam.

4.10.3 Off-site Water Supply

The additional make-up water to meet the project needs is 87 L/s, which equates to 2.75 GL/yr. There are two water supply options being considered by DMS. They are:

- Water sourced from existing Grampians Wimmera Mallee Water (GWMWater) head works: delivery by existing GWMWater infrastructure (mainly earthen channels, soon to be replaced by pipes).
- Water sourced from a saline aquifer some 25 km east of the DMS project area (the Avon Deep Lead): delivery via a pipeline.

Both supply options will require a thorough assessment by GWMWater in accordance with the requirements of the *Water Act 1989*. For either source, GWMWater will be required to consider the matters referred to in Section 40 (1) (b) to (m) of the Act as part of this assessment.

Both supply options will also require planning permits in compliance with the *Planning and Environment Act 1987* for the installation and operation of infrastructure, such as pipes and pump stations, for the extraction and delivery of the water.

Due to the ongoing drought within the region and the project timetable, it has not been possible at this time to confirm the source or the delivery method of water to the project. For the purposes of this EES, it has been agreed that a worst-case water quality will be used to assess potential impacts of its use on site.

4.10.4 Freshwater

On average, 12 L/s of freshwater will be used at site, predominantly for dust suppression on haul roads and non-saline materials such as the topsoil and subsoil stockpiles, and during the final stage of processing in the CUP. Freshwater will also be used within the ablutions and administration buildings.

These relatively modest freshwater requirements can be met by existing GWMWater allocations and/or installation of a small desalination plant. Brine from the desalination plant would be reused in the process water circuit and eventually disposed of with the tailings in the mined out pit.

4.10.5 Surface Water and Erosion

Detailed avoidance, mitigation and management measures to minimise the potential surface water and erosion impacts are discussed in Section 6.1.3. Standard mining management measures will be employed to address surface water affected by the mining activities. For example, batter angles will be as low as practicable to minimise runoff velocities from stockpiles and the following steps will be taken to minimise erosion:

- Planting cover crops (such as sterile rye and/or corn) and laying mulch materials.
- Strategic contour ripping (this will also help to stabilise stockpiles).
- Incorporating scour-resistant materials in the construction of site drains.
- Checking drains for scouring after high rainfall events and repairing (if necessary) or lining the drains with more scour-resistant materials such as gravel or rocks.

Diversion drains will prevent clean stormwater runoff from entering the pit. This will require infilling of disused water supply channels directly adjacent to the mine sites.

4.11 Workforce

4.11.1 Personnel and Accommodation

The construction workforce is estimated at 100 personnel and the operations workforce is estimated to be 75. Table 4.3 shows the positions that DMS employees are likely to hold during construction and operation.

Table 4.3 Mine site personnel

Position Title	No. of Positions*
Construction workforce	
As per construction contractor.	100
Operations workforce	
Management	3
Administration	4
Earthmoving	32
Mining (engineers, geologists, technicians, OHS, etc.)	8
WCP, CUP (operators, trades, etc.)	24
Support and infrastructure	4

*Indicative numbers only.

It is likely these people would live in the surrounding towns of their choice, including Minyip, Warracknabeal, Rupanyup, Donald, Murtoa and Horsham. There is no intention to build accommodation at the mine site during permanent operation. DMS is an equal-opportunity employer and will provide the necessary training for employees.

4.11.2 Safety Management

DMS will prepare an Occupational Health and Safety Management plan, which outlines the company's occupation, health and safety policies and procedures. The management plan will govern all mining and concentration operations and forms part of the Work Plan.

DMS will ensure that a safe, 'zero harm' culture is promoted on site and that all work is conducted in a safe manner.

DMS's Environmental Management Plan (see Section 7.4) will incorporate a fire management plan, which aims to minimise the potential for accidental fires and protect biodiversity, people, infrastructure and property from fire risks.

4.11.3 Site Security

The premises will be sign posted and a 24-hour security watch will operate. All visitors to the mine site will undergo a safety induction and have to be accompanied by a company employee at all times.

Employees will undergo a more intensive induction tailored to their role on site. This will include cultural heritage, quality assurance, safety and environment, hydrocarbon spillage management, incident reporting systems and waste management. Other topics will be added as the need arises.

4.12 Progressive Rehabilitation and Final Mine Closure

The mine will be progressively rehabilitated, resulting in a relatively short rehabilitation period once mining has ceased. DMS's intention is to return the land to its original land use of broad acre cropping. That said, rehabilitation will produce a facsimile of the existing topography, not an exact copy. Areas of native vegetation including black box swamp and sandy rises soils are to be consolidated and a subtle elevation of land surface due to swell is also expected.

Overburden removed and stockpiled during the initial start up of the mine will be redeposited in the final mining void at the cessation of mining, and tailing held in the TSF used during the initial mining phase will be covered with overburden and soil, once it has consolidated sufficiently for access.

The project rehabilitation plan is summarised in Section 6.14, Rehabilitation and detailed in Supporting Study 5. The aim is to restore the land to a condition that is equal to, or better than, its existing condition. Post-mining land uses will be agreed with landholders and other relevant stakeholders. It is anticipated that land that is currently used for agriculture will be returned to this use (with the aim of achieving or improving current productivity).

Native vegetation disturbed by the project will be re-established by agreement with stakeholders, which include the DSE and Wimmera CMA. Proposed rehabilitation measures have included the re-establishment of well-drained sites with larger dunes, to provide suitable conditions for revegetation with indigenous species and the establishment of wetland areas for flood control.

After discussion with all relevant stakeholders, unwanted project infrastructure (such as buildings, fencing, hardstands, pipelines and powerlines, haul roads and other pavements) will be removed. The area will then be cleared of any debris and rehabilitated. Some infrastructure such as the electricity and water supply system may be retained at the request of landholders or the local shire.

4.13 Project Alternatives

Resource development projects are restricted in the planning phase in the following ways:

- Physically; by location of the orebody and the climatic, topographic and geotechnical constraints imposed by the surrounding landscape.
- Environmentally; by the environmental sensitivities of the project setting.
- Socially; by the expectations and concerns of affected communities.
- Economically; by the need to extract and process the ore profitably.

Mineral resource development can only occur where a commercial deposit is found. Once discovered, despite the restrictions aforementioned, there are opportunities when the developer can assess a number of alternatives and choose the option with the least environmental and socio-economic impact while maintaining the viability of the project.

4.13.1 Project Not Proceeding

The implications of the project not proceeding are that, in the project area, the local environmental and socio-economic impacts will not occur. Both the costs and benefits involved will, in any case, be relatively short-term.

The significant cost of no project would be borne by the mineral sands industry, the region and the national balance of trade. With no project, the opportunity for other, similar, projects to emerge as a result of the lead taken by DMS, would be lost along with the potential for the industry to provide additional employment and economic relief during a time when local industries are suffering from the ongoing drought.

4.13.2 Mining Area

Initially, DMS was seeking approval to mine the superseded project area and an early issue was whether to start mining in the north or the south. DMS compared the environmental and economical advantages and disadvantages of each option. By mining in the north, DMS is able to avoid significant flora species including one nationally listed species and other listed species as described in Section 6.3 (refer to Table 6.3). There were also economic advantages to focus the 25-year mine plan in the north that related to the thickness and grade of the ore horizon.

As demonstrated in Figure 1.2, the superseded project area was reduced and DMS will focus their attention to the north of the superseded project area, in what is described as the project area.

4.13.3 Mining Method

Noise Abatement

Measurements of existing noise conditions in the project area show that it is extremely quiet and management or avoidance of noise has proven to be one of the more significant challenges faced by DMS during the course of the EES. Due to the quietness of the area, DMS has had to consider a range of management and mitigation measures that could assist in complying with the EPA noise criteria. Each of these options was then considered in noise modelling to assess, as a first priority, whether it could actually result in compliance (Table 4.5). Economic feasibility was then considered as a

secondary 'filter' of the practicability of each option (Table 4.4). The options considered are summarised below and the favoured options discussed in more detail in Section 6.6:

- Trucks versus slurry pumping for ROM ore haulage.
- Exhaust noise silencers and acoustic louvres for haul trucks.
- Large earthen bunds at source and/or or receptor.
- Acoustic treatment of houses (e.g., double glazing).
- Overburden movements on dayshift only.
- Train loading; containers or bulk.
- Southern versus northern HMC haulage route to the Minyip rail siding.
- Overburden haulage within pit.
- Long, thin pit shape.
- Broadband (quiet) reversing beepers.
- Paddock dumping.

A combination of engineering noise control options could result in compliance with the EPA noise limits at most receivers outside of the project area. For example, implementing the full mobile machinery noise control kits[1] and large earth mounds near receivers would provide a combined noise reduction in the order of 18 dBA, which would be sufficient to control noise to a receiver approximately 400 m from the nearest pit. Achieving further noise reduction would only be possible via building façade treatments, which do not strictly provide compliance with external noise limits, but may provide an appropriate level of relief to residents during the critical night period.

Table 4.5 provides a summary of required noise reductions and potential combinations of noise control treatments, which are technically feasible.

[1] Manufacturers' claimed noise reductions from the noise kits do not match DMS's experience at operating mines.

Table 4.4 Noise mitigation options assessed

Option	Total Noise Reduction at Receivers dB(A)	Technical Feasibility	Economic Feasibility	Adopted by DMS	Comment
Slurry pumping	~3 to 4.	Y	Y	Y	Pumps and trommel electrically driven and in the open pit.
Silencers to exhausts*	3 to 4.	Y	N	N	~$180,000 per truck plus additional running costs.
Additional silencers (acoustic louvres)*	Additional 5 (up to 9 total).	Y	N	N	An additional ~$100,000 per truck plus additional running costs.
Acoustic panels/stiffening to panels*	Additional 4 (up to 13 total).	Y	N	N	An additional ~$120,000 per truck (total acoustic upgrade package amounting over $400,000 per truck plus additional running costs).
5-m earthen bunds within 80 m of works (scenario 3)	~ 3 to 5.	Y	Y	N	Impractical for a moving pit.
5-m earthen bunds to perimeter of site	No change under enhanced meteorological conditions and very minimal improvement under neutral conditions.	Y	Y	N	Minimal noise benefit. Negative affects on visual amenity and increases vegetation clearance. Will not be effective during temperature inversions.
10-m earthen bunds to perimeter of site	Minimal effect during enhanced meteorological conditions.	Y	Y	N	Negative affects on visual amenity and increases vegetation clearance.
Acoustic treatment to houses	5 to 8 but only achieved internally.	Y	Y	Y	Subject to individual resident's views. Treatments could include basic glazing upgrades (double or thicker glass), and possibly facade upgrades for lightweight buildings. Internal noise level reduced only.
Earthen mounds near houses	2 to 3 with 5-m mound, up to 5- with 8-m mound.	Y	Y	Y	Subject to individual resident's views. Mounds need to be within 20 m of houses.

*Reductions shown here are incremental; total reduction at receivers is shown in brackets.

Table 4.4 Noise mitigation options assessed (cont'd)

Option	Total Noise Reduction at Receivers dB(A)	Technical Feasibility	Economic Feasibility	Adopted by DMS	Comment
Overburden on dayshift only	Increased noise levels during the day: ~3. Reduction at night: up to ~6.	Y	N	N	Reduces project viability.
Train loading method -container or bulk transfer	Container transfer quieter but both options manageable with appropriate measures.	Y	Y	Y	Approval sought for both options.
HMC haulage routes options	Less impacted residents along south option.	Y	Y	Y	Approval sought for both options.
Overburden haulage within pit	Possibly 1 to 4 depending on geometry and arrangement in relation to receptor.	N	N	N	Not technically feasible to have no trucks operating at surface. In detailed designs, haul roads will be designed in pit, where possible.
Long, thin pit shape	Up to 3.	Y	N	N	For this type of project it is more economic to mine in bulk.
Broadband (quiet) reversing beepers	Up to 5, but less intrusive character.	Y	Y	Y	
Paddock dumping^	Minimal (less than 2.5-m-high mounds).	Y	Y	N	Not expected to make any difference as trucks engine is at 3 m and exhaust at 4 m.
Temporary relocation of residents	No noise impact.	Y	Y	Y	Subject to resident's approval.

^ Paddock dumping is where the dumped material remains on the same level as the truck resulting in a series of piles of dumped material 2 to 3 m high, thus providing some noise shielding of vehicle engines.

Table 4.5 Potential noise controls as a function of distance

Distance from Mine Pit	Required Noise Reduction to Achieve EPA Night Noise Limit (32 dBA) under Enhanced Meteorological Conditions	Required Treatments/Comment
50 to 200 m	23 to 35 dBA.	Cannot be achieved with engineering noise controls (mounds, truck treatments, etc). Relocation is the most likely only option although building treatments may be possible in some cases.
200 to 800 m	13 to 23 dBA.	Possible to achieve up to 18 dBA with mounds and full truck treatments. Additional noise reductions only achievable with building treatments that do not achieve external criteria.
800 to 1600 m	7 to 13 dBA.	Possible to achieve with full truck treatments, or with a combination of mound and partial treatment to trucks.
1600 m to 2700 m	1 to 6 dBA	Possible to achieve with mound alone or via some treatments to trucks.

The assessment of alternatives was a useful exercise. It was able to separate those options that were technically feasible and produced a definable benefit from those that were technically feasible but had unacceptable impacts on the project's viability.

The result of the assessment of alternatives has been to:

- Favour slurry pumping rather than trucking for ore transport.
- Reject paddock dumping due to the absence of any noise reduction benefit.
- Reject dayshift-only overburden removal and additional silencers due to the adverse economic impact on the project viability. Confirm both train loading methods are viable subject to additional acoustic shielding at the rail siding.
- Confirm the reduced noise impacts of the northern HMC haulage route to the rail siding.

4.13.4 Off-site Water Supply Options

As mentioned in Section 4.10, an additional 87 L/s of water (or 2.75 GL/yr) is needed from an offsite source to meet the ore processing water requirements. Due to the ongoing drought within the region and the project timetable, it has not been possible at this time to confirm the water source nor water supply method (pipework and/or channel) for delivery of water to the project. Instead, DMS are considering two water supply options (which are discussed, in further detail in Section 6.1):

- Water sourced from existing Grampians Wimmera Mallee Water (GWMWater) head works; delivery by existing GWMWater infrastructure (mainly earthen channels, soon to be replaced by pipes).
- Water sourced from a saline aquifer some 25 km east of the DMS project area (the Avon Deep Lead); delivery via a pipeline.

For the purposes of this EES, it has been agreed that a worst-case water quality will be used to assess potential impacts of its use on site.

Both supply options will require a thorough assessment by GWMWater in accordance with the requirements of the *Water Act 1989*. For the deep lead, GWMWater will be required to consider the matters referred to in Section 40 (1) (b) to (m) of the Act as part of this assessment.

A new pipeline to deliver the water to the mine site may be required for both options and both will also require planning permits in compliance with the *Planning and Environment Act 1987* for the installation and operation of infrastructure such as pipes and pump stations for the extraction and delivery of the water.

4.13.5 Overburden Stockpiles

Various heights of overburden stockpiles were considered in relation to the level of disturbance to native vegetation and impact on visual amenity. The relationship between stockpile height and area of disturbance is not linear, and therefore a reduction in stockpile height would increase the area of impact disproportionately with increased potential for native vegetation clearance or loss of farming land. As such, 30 m was determined to be the appropriate maximum height for overburden stockpiles and no other alternatives are proposed.

4.13.6 Concentrate Transport

A number of concentrate transport options relating to the mode, route and packaging, have been considered and approval is being sought for those options remaining (with further detail provided in Section 6.9). In keeping these options open, it maximises the range of potential transport providers and, by retaining competition between providers, provides the best opportunity for the lowest freight rates.

Road Transport Options

Three road transport options are proposed for the transport of HMC to the ports of Portland, Melbourne, or Geelong (the final port location is still to be determined):

- Truck from the project area to a port via Horsham.
- Truck from the project area to a port via Horsham in containers.
- Truck from the project area to the train loading facility south of Minyip.

Concentrate Transfer Options

If the concentrate is transported by truck to port, the HMC would be trucked in bulk to the relevant port using the state road network. This is the favoured option at present, as double handling of HMC is avoided.

If the option to containerise the concentrate was chosen, the concentrate would first be bulk-carried to Horsham, containerised at a dedicated facility, then transported to port using the state road network. The third option involves a rail siding south of Minyip to provide rail links to the relevant port. Each of these road transport options remains under consideration.

Transport Route to the Rail Siding

The two haul route options between the project area and Stawell – Warracknabeal Road and the railway siding south of Minyip are shown in Figure 6.24 and are described below (with more detail

provided in sections 6.6 and 6.9). Minimising the impact associated with the noise generated to residences will be a governing factor in determining which haul route is preferable.

Option 1: This route follows R. Funcke Road to its intersection with Minyip–Rich Avon Road, then proceeds west along Minyip–Rich Avon Road to Stawell–Warracknabeal Road.

Option 2: This route follows Gun Club Road to its intersection with Minyip–Banyena Road. Minyip–Banyena Road is followed for a short distance to Stawell–Warracknabeal Road.

Based on stakeholder feedback and the findings of the specialist studies, haul route option 1 is preferred; however, further consultation is required with respect to potential impacts on the population of the turnip copperburr along the roadside, and the council's preferences. Therefore, DMS seeks approval for both options.

Rail Siding Location Options

Two options remain for the rail siding location for both of the haul route options (option 1 and 2 in Figure 6.24) therefore, it could be said that there are four possible rail siding options (e.g., haul route option 1 to rail siding option 1, haul route option 1 to rail siding option 2, etc). These options are considered in more detail in Section 6.6.

Rail Operational Alternatives

If the rail option is selected, a rail siding south of Minyip will provide a rail links to the port of Portland, Melbourne, or Geelong. Minyip is located 319 km by rail from Melbourne and forms part of the greater freight rail link. A weekly freight service currently operates on the line. Preliminary discussions regarding the methods available to provide rail transportation to and from the Minyip rail siding have indicated that there are two rail operational options:

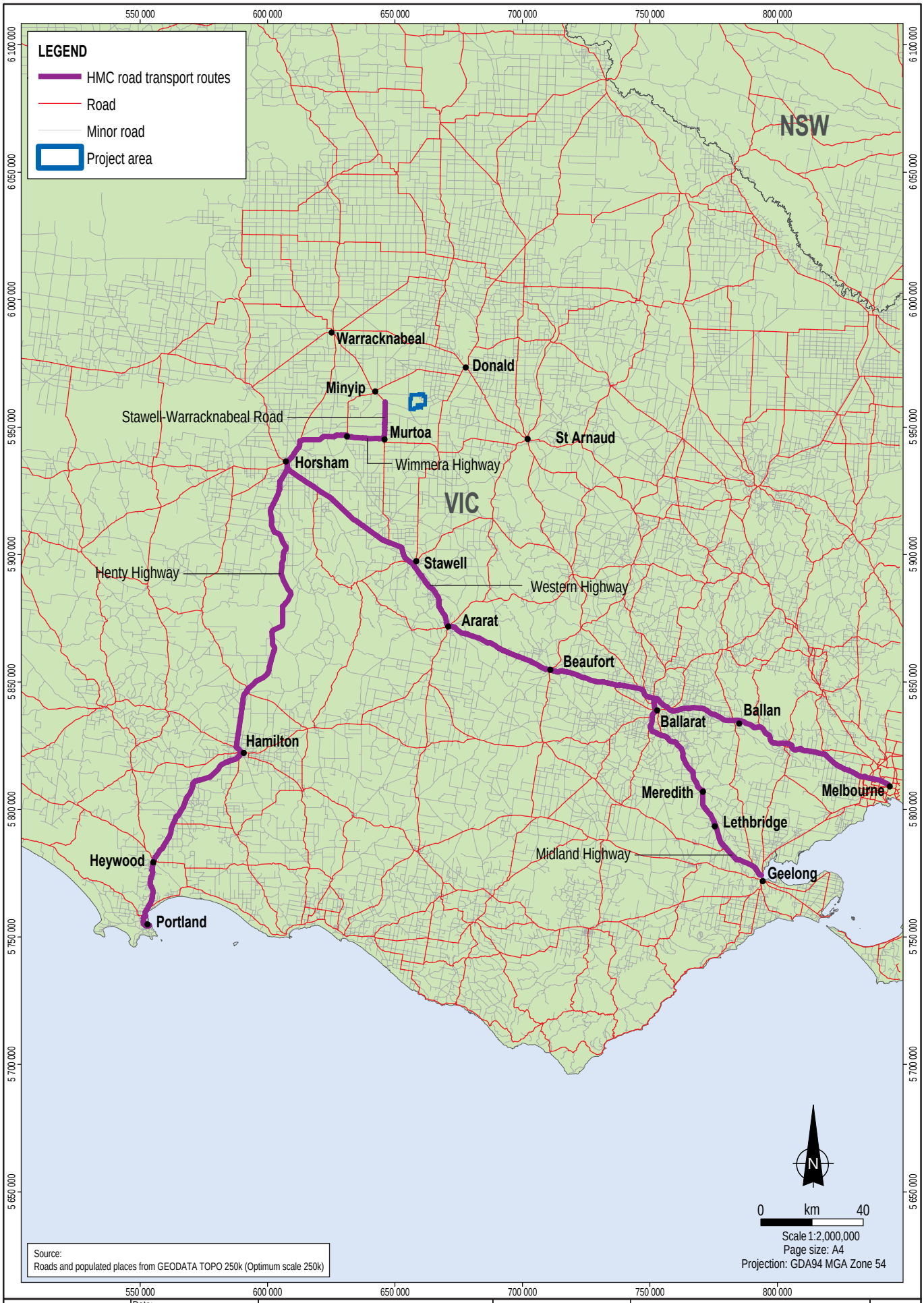
- Dedicated freight train option: this option runs a dedicated train that terminates at the siding, which exclusively carries DMS HMC.
- Existing freight train option: this option attaches extra wagons to existing freight services, carrying containers of HMC.

Port

The decision remains as to whether the concentrate will be freighted to the Port of Portland, Port of Geelong or the Port of Melbourne (Figure 4.6).

4.13.7 Potential Impacts on Residents

As shown in Figure 1.2, there are a number of residences and farms that are located either on the orebody or, in close proximity. One option to reduce the impact on the local community would be to avoid mining the orebody at these locations. This option, while it may address some issues is unlikely to be completely satisfactory to either residents or DMS as specialist studies (outlined in sections 6.4 and 6.6) have shown the difficulty in meeting the prevailing criteria for noise and air quality. In addition, farm incomes and crop rotations would still be affected and for the company, the mineable reserve would be drastically reduced.



coffey natural systems

Date: 29.10.2007
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F04.06_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Potential HMC road transport routes from mine site to port

Figure No: 4.6

DMS is aware that potential adverse impacts to community cohesion was an early concern for some in the community. A significant factor in considering this issue is the 'moving' pit that means that impacts on a given locality (for example, a residence) will vary over time. Nevertheless, for some residences situated on the orebody, accessing the ore may necessitate relocating or dismantling the house.

Purchase of the affected property or providing compensation for those affected may be the best outcome for all concerned. For this, existing law–Part 8 of the MRSD Act–guarantees that owners and occupiers are compensated before work can commence on the affected property.

Compensation will be negotiated on an individual basis and there are many options available to the landholders that allow them to remain in the local community. This may include leasing or purchasing other properties locally and giving the original owner first right of refusal to repurchase the property on conclusion of mining activities. The intention of this strategy is to relocate residents locally for the (nominal) five years their property is occupied for mining purposes and so, retain the community structure. Nevertheless, the choice to return, or leave permanently, rests with the landowner**.**

5 STAKEHOLDER CONSULTATION

Stakeholder consultation with government agencies and landholders for the project commenced in 2005 and will continue throughout the life of the project (i.e., throughout the remaining project planning phases, the construction and operations phases, mine closure and final rehabilitation).

This section describes:

- DMS's program of communication and consultation.
- The objectives of the consultation program.
- The stakeholders identified.
- The communication and consultation methods.
- Results of public and stakeholder consultation.
- The on-going consultation program.

This section addresses requirements of the EES Assessment Guidelines (DSE, 2006), namely:

- The proponent's program for communicating and consulting with the public and stakeholder groups during the EES studies, including the methods for effectively engaging local stakeholders and communities in the assessment of impacts.
- The outcomes of consultation undertaken as part of specific impact studies, the issues and suggestions of stakeholders or members of the public (by theme and source, rather than individually) and the response made by the proponent in the context of either the EES studies or the refined proposal.
- An outline program for community consultation and communications during operation of the mine, including means for the local community to engage with mine management to address and respond to potential community concerns, participation in ongoing monitoring of environmental impacts, and means for the community to participate in the continuous improvement of the Environmental Management Framework.

5.1 Objectives

The goal of the consultation program is to achieve mutual understanding between DMS and its stakeholders. This understanding will maximise opportunities for DMS to identify and address issues and, ultimately, deliver a project most closely aligned to the needs of all stakeholders.

The objectives of the consultation program are to:

- Provide the public with timely project information to assist them in understanding the project and its likely impact on the community and the environment.
- Provide the public and stakeholders with opportunities to provide input into the social, economic and environmental issues affecting them, from the earliest stages in project planning through to construction, operations, closure and rehabilitation.
- Ensure issues or concerns are addressed as early as possible and, where appropriate, in this EES.

- Ensure the appropriate regulatory requirements are met.
- Ensure constructive stakeholder relationships are established and maintained throughout the life of the project.

To meet these objectives, DMS has established a stakeholder consultation database, and has developed and implemented a consultation and community relations program (Table 5.1). The consultation and community relations program outlines the communication and consultation strategy and methods, and is supported by relevant specialist studies during project development. A feature of the program is, and will continue to be, DMS's willingness to ensure that the focus is on *consultation*, i.e., a two-way communication process that involves both talking and listening, rather than simply *information dissemination*. This has been demonstrated through coordination of community information evenings with the objective of delivering the results of specialist studies to stakeholders and gaining an understanding of issues of concern to community members (Section 5.3.2) and DMS's maintenance of its stakeholder consultation database.

5.2 Stakeholders

Stakeholders are groups or individuals that have an interest in the project, may be affected in some way by the project and who can potentially influence (or be influenced by) its development. DMS recognises the following groups of stakeholders (see Table 5.1):

- Government representatives.
- Representative bodies.
- Directly affected stakeholders.
- Indirectly affected stakeholders.

5.2.1 Government Representatives

This group includes ministers, members of parliament and representatives of various government agencies that need to be fully informed due to their central role as both decision makers and regulators.

Ministers and Members of Parliament.

Relevant Victorian Ministers include:

- Minister for Planning, Justin Madden.
- Minister for Environment, Climate Change and Innovation, Gavin Jennings.
- Minister for Energy and Resources, Peter Batchelor.
- Minister for Regional and Rural Development, Jacinta Allan.

Relevant Commonwealth Ministers are:

- Minister for the Environment, Heritage and the Arts, Peter Garrett.
- Minister for Climate Change and Water, Penny Wong.

Table 5.1 Consultation and community relations program

Government Representatives	Method	Representative Bodies	Method	Directly Affected Stakeholders	Method	Indirectly Affected Stakeholders	Method
Ministers	Six monthly meetings	Northern Grampians Shire Council	Quarterly update meetings, quarterly newsletters, community information evenings, media releases.	Landholders within the project area.	Quarterly newsletter, community information evenings, media releases, one-on-one sessions as required.	Surrounding land-holders.	Quarterly newsletter, community information evenings, media releases.
Technical Reference Group	TRG meetings (seven in all)	Yarriambiack Shire Council	Quarterly update meetings, quarterly newsletters, community information evenings, media releases.	Vic Roads.	Project meetings.	Minyip Police.	Community information evenings, media releases.
		Buloke Shire Council	Quarterly update meetings, quarterly newsletters, community information evenings, media releases.	SCT/Toll.	Project meetings.	Rupanyup Police.	Community information evenings, media releases.
		Victorian Farmers Federation	Six monthly update meetings, quarterly newsletter.	PowerCor.	Project meetings.	Donald Police.	Community information evenings, media releases.
		Wimmera Development Association	Quarterly update meetings, quarterly newsletters, community information evenings, media releases.	Landholdings within the area being assessed as a source of groundwater.	Quarterly newsletter, community information evenings, media releases, one-on-one sessions as required.	Country Fire Authority.	Community information evenings, media releases.

Table 5.1 Consultation and community relations program (cont'd)

Government Representatives	Method	Representative Bodies	Method	Directly Affected Stakeholders	Method	Indirectly Affected Stakeholders	Method
		Minerals Council of Australia	Six monthly update meetings, quarterly newsletter.	Port authorities.	Project meetings.	Rural Ambulance Victoria.	Community information evenings, media releases.
		Goolum Goolum Aboriginal Co-operative	Six monthly update meetings.			Local communities.	Quarterly newsletter, community information evenings, media releases.
		Barengi Gadjin land Council Aboriginal Corporation	Six monthly update meetings.			Local businesses.	Quarterly newsletter, community information evenings, media releases.
		Jupagalk Peoples	Six monthly update meetings.			Local schools.	By invitation.
						Local sport clubs.	By invitation.
						Local social clubs (e.g., Lions).	By invitation.
						Landcare.	By invitation.
						Greening Australia.	By invitation.

Technical Reference Group (TRG)

The Technical Reference Group (TRG) was authorised by the Minister for Planning to guide preparation of the EES document and is chaired by a representative of the DPCD's Planning, Heritage & Urban Design group. The TRG includes regulatory authorities and government agencies with a decision-making or specific interest in the project (Table 5.2):

Table 5.2 Members of the Technical Reference Group

Role	Organisation Represented	Individual Representative
Senior Environmental Assessment Officer (*TRG Chair*)	Office of Planning, Heritage & Urban Design, DPCD	Geoff Ralphs
Regional Planner	South West Region, DSE	Geoff Forbes
EPA Officer (North West Region)	EPA Victoria	Owen Davies
Team Leader Infrastructure Development	VicRoads	John Miller
Heritage Project Officer	Aboriginal Affairs Victoria	Anne Ford
Engineering Manager	Northern Grampians Shire Council	Martin Duke
Director, Infrastructure & Planning	Yarriambiack Shire Council	James Magee
Manager, Radiation Safety Services	Department of Human Services	Brad Cassels
Regional Environmental Health Officer	Department of Human Services	Stephen Waddington
General Manager, Catchment & Environment	Grampians Wimmera Mallee Water Authority (GWMWater)	John Martin
Project Officer	Wimmera Catchment Management Authority	Jacqui Norris
Development Manager, Minerals and Petroleum	Department of Primary Industries	Kathy Friday
Biodiversity Officer	South West Region, DSE	Jim McGuire
Assistant Director Mining & Nuclear	Department of the Environment, Water, Heritage and the Arts	Jon Millard
Manager of Business & Community Development	Buloke Shire Council	Graeme Harris
Manager Statutory Functions	North Central Catchment Management Authority	Graham Hall

The TRG meets when project information is available and met on seven occasions during the course of the specialist studies and preparation of the EES document to discuss and advises DMS on the following:

- The scope of the EES.
- Statutory provisions and policy relevant to the assessment of the proposed project.
- The adequacy of environmental studies to investigate the potential environmental impacts.
- The stakeholder consultation program.

Other Government Officials

This group includes:

- State Opposition leader.
- Yarriambiack and Northern Grampians shire councillors, CEOs and mayors.

DMS meets with other government officials on an as-needs basis.

5.2.2 Representative Bodies

This group includes democratically elected or legally and politically appointed representative bodies that have a supporting role to their constituents and include:

- Northern Grampians Shire Council.
- Yarriambiack Shire Council.
- Buloke Shire Council.
- Victorian Farmers Federation (VFF) (mining subcommittee).
- Wimmera Development Association (WDA).
- Barengi Gadjin Land Council Aboriginal Corporation.
- Goolum Goolum Aboriginal Co-operative.
- Jupagalk Peoples.
- Minerals Council of Australia–Victorian Division (and other mineral explorers or producers in the area).

DMS holds quarterly to six monthly meetings for the community (community information evenings) and provides quarterly newsletters. All stakeholders are invited to the community information evenings and representatives of at least one of these stakeholder groups have attended on each occasion. Shire councils and the WDA also receive media releases related to project developments.

5.2.3 Stakeholders Directly Affected by the Project

The project will, to varying degrees, affect the personal lives and businesses of directly affected stakeholders, including:

- The six families who operate farms or own or live on land within the project area.
- Neighbouring and nearby landholders (the 13 residences located with 2 km of the mine).
- Landholders along roads that will be frequently used during operations.
- Residents of Minyip (the nearest town to the project).
- Contractors/suppliers to DMS (including infrastructure providers).
- Residents of Rupanyup and other nearby towns.
- Shareholders of Astron Limited.
- Land/infrastructure agencies/companies (e.g., VicRoads, Powercor, Grampians Wimmera Mallee Water Authority, Wimmera Catchment Management Authority, North Central Catchment Management Authority, Telstra, Port of Portland, Port of Geelong and Port of Melbourne).

DMS recognises its responsibility to keep landholders directly informed as its first priority. DMS holds regular one-on-one meetings to update directly affected stakeholders on the project and environmental studies and to advise of upcoming activities.

Directly affected landholders have been invited to inspect the DMS test pit. These stakeholders are sent the quarterly newsletters, receive letters relating to project updates and are invited to attend community information evenings.

DMS will continue to work constructively with these individuals during the EES assessment phase to maximise benefits to individuals and minimise adverse impacts. Consultation will continue through operations, closure and rehabilitation.

As an Australian company listed on the Australian Stock Exchange, DMS's parent company Astron Limited, has an obligation to shareholders to release to the Australian Stock Exchange all information directly or indirectly affecting their shareholding with respect the DMS project.

As the project has the potential to have an affect on current and future infrastructure requirements in the Wimmera region, DMS will keep infrastructure providers directly informed with respect to its requirements.

5.2.4 Stakeholders Indirectly Affected by the Project

This group includes the wider community and general public who to date have not sought an active involvement in the project but would like to be kept informed:

- Surrounding landholders (located more than 2 km from the project area).
- Residential communities of Donald, Rupanyup, Minyip, Banyena, Murtoa, etc.
- Businesses in the communities of Donald, Rupanyup, Minyip, Murtoa, etc.
- Local clubs (e.g., Lions, CWA, etc.) and sport clubs.
- Landcare groups (e.g., Yarriambiack and Northern Grampians).
- Greening Australia (Minyip Branch).
- Schools and other service providers (e.g., Rural Ambulance Victoria, Country Fire Authority, State Emergency Service, police, and the Dunmunkle Health Service).

Consultation with these groups is through community information evenings, which are held regularly. Some organisations within this group receive quarterly updates (see Table 5.1).

These stakeholders are also notified of DMS's activities (including up-coming community information evenings) via advertisements, of which there has been approximately 10, and community notice boards within the township of Minyip, press releases to local newspapers and interviews on local radio. Project information is also freely available to the community on the DMS website and additional information can be obtained from the DMS office.

Representatives of these groups are invited to attend site inspections. Upon invitation from club presidents, DMS has attended and spoken at local club functions on four occasions (e.g., Lions Club (twice), Country Women's Association and Country Fire Authority).

5.3 Consultation Activities

DMS maintains a policy of open communication. This ensures that stakeholders are well informed and can contact DMS whenever they feel it is necessary. As well as the regular briefings noted earlier, the following consultation methods are used:

- Maintenance of DMS's stakeholder consultation database.
- Community information evenings.
- Site inspections.
- Community newsletters.
- Minyip office.
- Project website.
- Landholder access protocols.
- Community comment and complaint procedure.
- Letters.
- Annual report and corporate brochures.
- Media releases/advertisements.
- Documents.

5.3.1 Stakeholder Consultation Database

DMS has maintained a stakeholder consultation database since October 2006. The date, location, purpose and who attended each meetings is recorded in the stakeholder consultation database.

5.3.2 Community Information Evenings

Community information evenings provide stakeholders with a forum to gain information from senior DMS personnel and to raise issues for consideration during the EES. These sessions will continue throughout the pre-construction/government approvals phase of the project. Community information evenings have been held on the following occasions:

- 28 November 2005.
- 13 December 2006.
- 6 April 2006.
- 18 July 2007.
- 10 September 2007.
- 10 October 2007.
- 21 November 2007.

The results of all specialist studies are presented (in easy-to-read poster format) and the community is free to ask questions. The Project Manager/Operations Manager, Logistics Manager, Metallurgist and, on some occasions, the specialist consultants and government representatives are available throughout the evening to answer questions. In addition, the following documents have been made available for review:

- Landowners' Questions Answered, *Mineral Resources (Sustainable Development) Act 1990.* Minerals and Petroleum Regulation, December 2006 (a DPI publication). An earlier version (August 2004) was also provided.
- Guide to private landholders regarding exploration and mining on private land. Revised January 2000 (a Victorian Chamber of Mines Inc. publication).
- A briefing on compensation under the *Mineral Resources Development Act 1990.*

Feedback forms are provided and the results used to improve ongoing stakeholder consultation.

5.3.3 Site Inspections

A site inspection of the DMS test pit provided TRG members with an opportunity to view the orebody and its proximity to the surface and, at a small scale, to see the proposed stockpiling methods for topsoil and subsoil. Future site inspections are planned and will be undertaken at the request of interested members of the community and other stakeholders.

5.3.4 Community Newsletters

Community newsletters are currently produced quarterly by DMS and are sent to all landholders several days before the public release. The Yarriambiack Shire Council and DPI representatives also receive copies. The newsletter provides updates on the project, specialist studies, EES and community involvement in the project. Community newsletters will continue to be produced throughout the life of the project.

5.3.5 Minyip Office

In November 2006, DMS established an office in Minyip to provide a local base of operations and a local point of contact to discuss any matters related to the project. The Minyip office is open 9.00 a.m. to 5.00 p.m. Monday to Friday.

5.3.6 Project Website

A project website (www.donaldmineralsands.com.au) was established in mid 2006 to provide direct access to information about the project. The website is updated regularly with all literature relating to the EES and the project, including fact sheets and community updates. The DMS website also provides a link to the DPCD website. A copy of the Assessment Guidelines was available through this link when the guidelines were first published.

The website also provides a local telephone number (03 5385 7088) and project email address (donaldmineralsands@bigpond.com) to provide members of the public with direct access to the project team. This number and email address will be maintained throughout the EES process to provide an opportunity to answer questions and receive information and opinions from the community.

5.3.7 Landholder Access Protocols

Although the company's exploration licence over the project area provides some authority, DMS recognises the importance of respecting the rights of landholders. As a result, DMS has developed a Landholder Access Protocol to which DMS and/or its contractors must adhere when requiring access to a landholder's property. This protocol formalises a process that is already in place and ensures a professional and consistent approach. Consultation with the relevant landholder must occur prior to the commencement of any fieldwork. In July 2006, DMS provided relevant landholders with a Landholder Access Request for the environmental baseline studies. This explained the proposed environmental work and provided the contact details of those personnel relevant to the particular work program (including contractors). The Landholder Access Protocol will incorporate the Landholder Access Request and will be used when access to a landholder's property is required.

5.3.8 Community Comment and Complaint Procedure

In addition to feedback forms provided at community information evenings, DMS will develop a Community Comment and Complaint Procedure that outlines how DMS responds to a formal comment or complaint received during any phase of the project. This protocol will formalise a process that is already in place, and will ensure that there is a consistent approach in responding to issues raised and that feedback is provided in a thorough and timely manner.

5.3.9 Letters

Key information and project updates are sent on an as-needs basis to directly affected landholders. These landholders will also continue to be regularly briefed in person.

5.3.10 Annual Report and Corporate Brochures

Astron Limited produces an annual report and corporate brochures that provide information on DMS as a company and the methods it uses to mine mineral sand. The annual report and corporate brochures are available from DMS's Minyip office.

5.3.11 Media Releases/Advertisements

Advertisements have been published in the Wimmera Mail Times (Horsham), Buloke Times (Donald) and the Warracknabeal Herald to provide general project updates.

During construction, advertisements will appear in local newspapers in accordance with legislative requirements (i.e., for approvals purposes), and media releases will be issued as required. During operations, employment opportunities will be advertised as required.

5.3.12 Documents

The following documents are, or will be, publicly available during the course of the government approvals process for the project:

- Environment Protection and Biodiversity Conservation (EPBC) referral document was provided on the Department of the Environment and Heritage web site at www.deh.gov.au. Links- DEH Home/ EPBC/Public Notices/All Referrals/Search 2005/272 in February 2006.
- The EES Assessment Guidelines were published on the DSE web site for public comment at www.dse.vic.gov.au in March, 2006.
- The EES documents and summary brochure will be provided on the DPCD web site at www.dpcd.vic.gov.au and at the following locations scheduled for the first quarter, 2008:
  - DMS office in Minyip.
  - Yarriambiack Shire office.
  - Northern Grampians Shire office.
  - Buloke Shire office.
  - DPCD head office in Melbourne.
  - DPI regional office in Horsham.
  - Other sites as directed by DPCD.

5.4 Consultation Outcomes

Consultation activities have produced the following results:

- Increased government and community awareness and understanding of the project.
- Involvement of regulatory authorities in determining the environmental assessment and approvals route.
- Identification of issues of concern to local landholders and other stakeholders.
- Progression of land access agreements.
- Improvement of relationships and avenues for communication with directly affected and other stakeholders.
- Increased understanding of stakeholders' opinions and concerns.
- Increased opportunities for DMS to address concerns and issues raised by members of the local community.
- Gaining a broad understanding of issues of importance to surrounding communities, namely:
  - The EES process.
  - Rehabilitation of the test pit.
  - Source of process water.
  - Use of groundwater.
  - Ability to rehabilitate mined land.
  - Project timing.
  - Community cohesion.
  - Transport options.
  - Order of mining.

DMS has attempted to address issues raised during the consultation process when considering options relating to infrastructure design, internal engineering and project design. Specific outcomes include:

- Avoiding important vegetation (e.g., site 16a) and maintaining a buffer zone of approximately 100 m around other areas.
- Tailoring the design of the tailing dams to avoid sites of cultural significance (e.g., scar trees at sites DMS44, 45 and 46).
- Disclosing the results of the specialist studies before finalisation of the EES document by presenting summaries of the study findings and recommendations at community information evenings.
- Developing a number of community-oriented commitments, such as sponsorship of local events and not-for-profit organisations.
- Early refinement of the project area, leading to exclusion of a significant portion of the initial project area for the first 25 years.

5.5 Ongoing Consultation

Should the project be approved, it is expected that an Environmental Review Committee (ERC) will be established to oversee construction and ongoing operation of the mine. The ERC will consist of representatives from government regulators, other agencies and the local community. The committee is likely to meet quarterly, and is commonly chaired by a representative of the local council.

Following the approvals process, DMS will develop and implement a community relations policy and procedure. A 24-hour contact number will be established to ensure local landholders can contact DMS 24 hours/day. This will enable immediate action to rectify any situations that might arise.

DMS already keeps a record of stakeholder consultation and will maintain and continue to develop this database throughout the life of the project. Regular reviews will also take place to assess the effectiveness of DMS's community relations policy and procedure, and to determine the most effective means of consultation. DMS will continue to build on the relationships and communication pathways established in the initial stages of project development.

6 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

This chapter identifies and describes potential, credible environmental and social impacts (or issues) that may be associated with the project. Identification of the potential impacts is based on knowledge of the existing environment, experience with similar operations elsewhere and issues of concern to key stakeholders.

For the purposes of three specialist studies (noise, air quality and visual assessments), where a residence overlies the orebody or plant site, it has been assumed that they have been removed.

Initially, the issues described do not take into consideration measures that will be employed by DMS during all stages of the project to minimise project impacts.

Avoidance, mitigation and/or management measures are subsequently described. These reflect DMS's commitment to sound mining and environmental management practices and are technically and economically feasible within the context of the project's setting.

The final aspect of the assessment outlines the residual impacts following implementation of the proposed control measures.

6.1 Surface Water and Water Supply

Section 6.1 presents a summary of surface water and water supply information provided in Supporting Studies 10, 11 and 12:

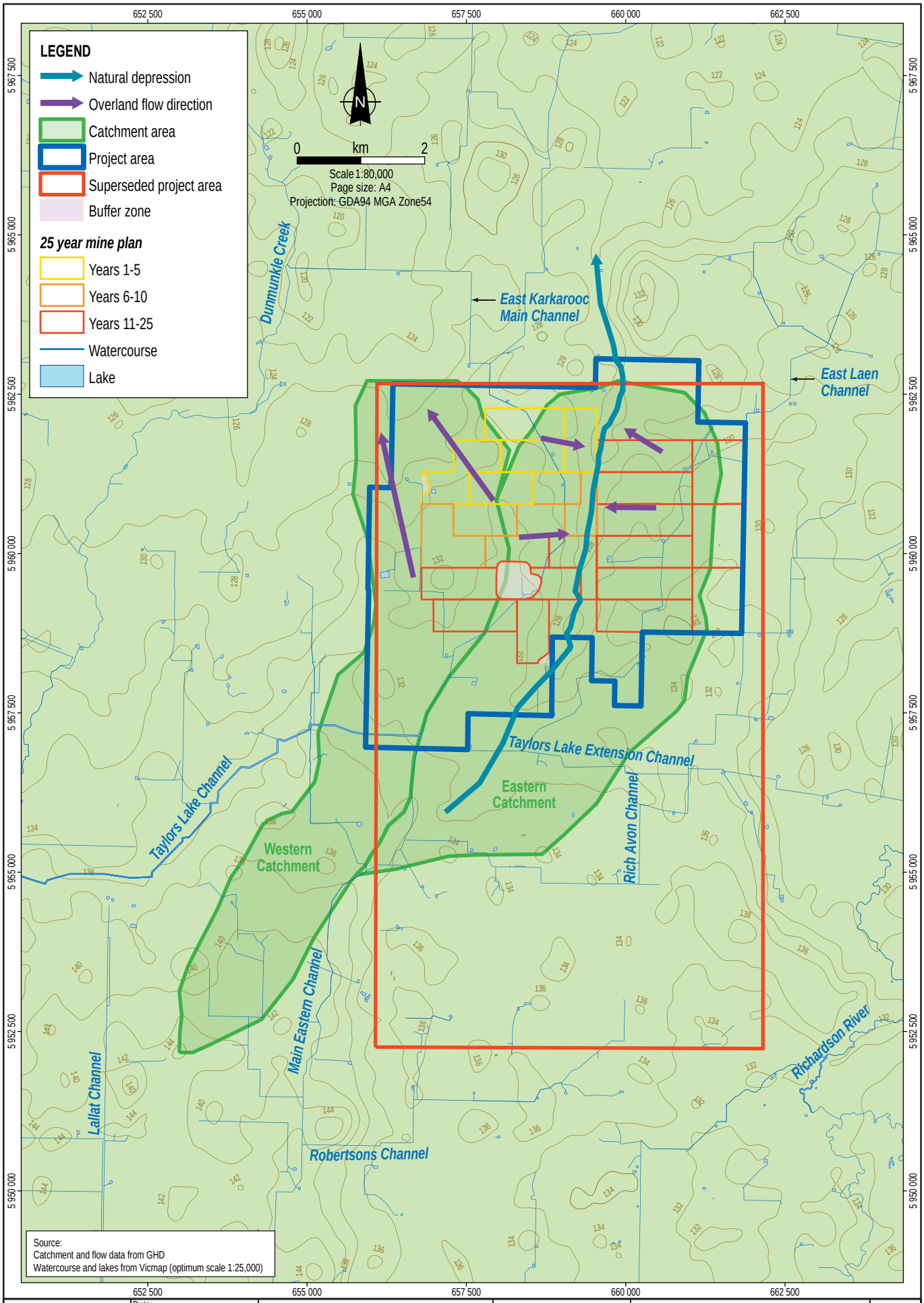
- Supporting Study 10: Groundwater and Surface Water Management by GHD Pty Ltd.
- Supporting Study 11: Water Supply Options by Goldfields Revegetation Pty Ltd.
- Supporting Study 12: Preliminary Assessment of Impacts of Water Supply Options on Flora and Fauna by Goldfields Revegetation Pty Ltd.

6.1.1 Existing Conditions

Hydrology

The greater, superseded project area (containing the refined project area) is relatively flat, with surface elevation varying between 126 and 132 m AHD (as described in Section 3.1.1). The refined project area is characterised by a slight topographical slope, dipping to the north, with a north-south natural depression running through the middle (slightly east of the centre) (Figure 6.1). There are no permanent surface water flows or waterbodies in the project area; however, the Richardson River lies approximately 10 km to the east, joining the Avon River 7 km southeast, and Dunmunkle Creek lies approximately 2.5 km west of the project area. Due to the flat gradients and generally ill-defined drainage, surface runoff is likely to develop into inundation of large areas for relatively long periods and the drainage mechanism is likely to be a combination of flow in small artificial drains, storage in natural depressions and seepage.

There are no wetlands located within the project area; the closest major waterbody is Lake Buloke covering 8,090 ha, into which the Richardson River drains. Lake Buloke is approximately 25 km northeast of the project area. The Lake Buloke wetlands, which include Lake Buloke and Little Lake



coffey natural systems	Date: 08.11.2007 MXD: 972_DonaldMineralSandsGIS File Name: 972_05_F06.01_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Catchments within the project area	Figure No: 6.1

Buloke, (180 ha) are registered on the National Wetland Directory. The Richardson River contributes the primary stream flow to the lake system. Flooding from the Wimmera River, from cross-divide overflows to the south of the project area, also enters the Richardson River catchment and, hence, the lakes. Supply channels also contribute to the inflow. Other significant waterbodies in the region include Lake Batyo Catyo, Lake Cope Cope and the Avon River (see Figure 1.1) and Barnett's Lakes (also known as Waltons Lakes), located east of the project area and west of Lake Cope Cope, which comprises a significant stand of paperbark, *Melaleuca halmaturorum*.

The two main domestic and stock water supply channels that cross the area are the Taylors Lake Extension Channel and the East Laen Channel (see Figure 6.1) with the capacity of 220 ML/day and 80 ML/day, respectively. Drainage inlets are provided in these supply channels, which act as a catchment boundary (up to a certain rainfall event). Both channels are part of the Wimmera Mallee Pipeline Project, portions of which are scheduled for replacement by 2010.

The approximate catchment area of the natural depression to the northern boundary of the project area is 2,400 ha (within the eastern catchment), and approximately 1,300 ha falls within the project area. When surface water does flow within the project area, approximately 67% drains east and west towards the natural depression (see drainage arrows in Figure 6.1) and is temporarily stored before draining away, either by seepage or overland flow to the north. The significance of this natural storage is not well understood due to the lack of detailed survey in the project area. Drainage from the sub-catchment (of the natural depression) continues north, crossing roads and domestic and stock channels, which significantly affect the flow in terms of temporary storage and diversion, eventually draining towards Lake Buloke. The flow has a contributing catchment of approximately 1,700 ha (western catchment), with approximately 800 ha being within the project area.

The remaining 33% of the project area drains northwest into Dunmunkle Creek further downstream.

The peak discharge (in the northern section of the project area) for the 2,400-ha catchment was calculated to be 11 m^3/s (950 ML/d) (Supporting Study 10) while the discharge in the south was calculated to be 6 m^3/s (520 ML/d).

Regional Surface Water

The water quality of the rivers and wetlands in the region is classified as generally slightly-to-moderately modified (Supporting Study 10). Average monthly flows, recorded at the gauging station located about 30 km south of the project area, indicate that runoff in summer is low and, in the case of local drainage lines, non-existent in times of no rain. Lowest flows occur in the period November to April (averaging 16 to 71 ML/month) and highest flows in July to October (averaging 979 to 1,400 ML/month).

Project Water Supply

As described in Section 4.10, 19 L/s of water will be recovered from sumps within the pit and 37 L/s will be recovered decanted and seepage water, leaving an additional 87 L/s to be sourced off site for processing.

Due to uncertainty caused by the continuing drought and the consequent shortage of water in the region, DMS has been unable to define a secure off-site water source, or the delivery system for the project's water supply. Two water supplies that are potentially capable of supplying the water required are:

- Purchase of bulk water entitlements from GWMWater, the local water authority.
- Extraction of brackish water from the Avon Deep Lead located approximately 25 km east of the project area near Cope Cope (see Figure 1.1).

The latter option will require a new pipeline to deliver the water to the mine site; the former may not.

GWMWater Water Supply Option

Rainfall in the Wimmera Mallee region is generally low and fluctuates widely from year to year (see Section 3.1.2). Groundwater supplies in the vicinity of the project area are poor in both quality and quantity, with good quality and quantity groundwater generally only being available west of Dimboola, i.e., well outside the project area. Local surface runoff is unreliable and groundwater is too brackish for domestic or stock water supply. To overcome this, water storages were built by GWMWater in the Grampians to provide domestic and stock water for farms, and distributed by the extensive Wimmera–Mallee open channel system. Water from the GWMWater system is relatively fresh (i.e., low salinity levels with an electrical conductivity (EC) of generally less than 1,500 µS/cm). The channel system is inherently prone to losses through seepage in porous soils and, to a lesser extent, evaporation. To counter this, GWMWater has commenced the Wimmera Mallee Pipeline Project, which involves replacing the open channel system with a network of pipes. The pipeline should prevent the loss of more than 100 GL/year. GWMWater has estimated that approximately 20 GL/year of water arising from these savings will be available for sale when the project is completed (which is expected to be by 2010) (Baker, S., pers. comm., 2007).

Avon Deep Lead

The existence of the Avon Deep Lead was recognised during salinity investigations in the 1980s. The lead is an old river valley, eroded into much older metamorphic basement rocks. As the Murray Basin subsided, the valley was filled with sand and gravel that now forms an aquifer. This begins about 20 km south-southwest of St Arnaud and is believed to terminate at Lake Buloke. The southernmost 15 km of the lead is level with the headwaters of the Avon River and its major tributary, Sandy Creek, before the Avon swings to the northwest. This is likely to be an important recharge area for the deep lead. As the water in the Avon Deep Lead is too saline for stock water, it has not been exploited in this area.

Deep leads are the main source of groundwater in the Northern Plains and the Campaspe and Loddon valleys. Hydraulic conductivities in the region vary widely, but typically exceed 10 m/day and this, combined with the substantial thickness (tens of metres), gives a high transmissivity (i.e., horizontal conductivity of water). However, this is offset, to a degree, by the limited width of the lead, which is typically less than 1 km wide. The typical porosity and permeability characteristics of rock in the region are summarised below (in descending order from the ground surface):

- Aeolian sands (Woorinen Formation lunette deposits are locally present).
- Shepparton Formation (heterogenous, consisting of clays, silts and sand).
- Parilla Sand (the principal regional aquifer comprising fine sand with low permeability).
- Geera Clay (heavy carbonaceous clay that is locally calcareous; it provides the aquitard between the Parilla Sand and Renmark Group).

- Renmark Group/deep lead (comprising sand, lignite, carbonaceous clay and gravel).
- Basement (typically weathered Palaeozoic metasediments).

Within the project area, the basement is elevated (known as a basement high) and the Renmark Group/deep lead is absent, with the Geera Clay directly overlying the basement (Smart, 2006). The Renmark Group's uppermost formation, the Olney Formation, flanks the basement high. However, the Olney Formation is a poorly yielding aquifer and preliminary modelling suggests that the maximum yield is only in the order of 500 ML/year.

The Avon Deep Lead and the overlying sediments are largely confined to a valley bordered by basement hills, thus forming a discrete groundwater system, which is largely separated from the regional system, except in the north. The natural flow through this system is estimated to be 2.1 GL/year, with a certainty of +/- 92%[1] (Ryan, S., pers. comm., 1992). The areal extent of the lead is quite small in itself, but it appears to be in hydraulic continuity with other aquifers, particularly the Renmark Group aquifers. The degree of this continuity and the lithology of the Renmark Group aquifer will influence the long-term yield.

6.1.2 Issues

Potential, credible project-related surface water impacts and the effects due to either of the project water supply options are described below. It should be noted that these do not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by DMS during all stages of the project development (see Section 6.1.3), which will result in residual impacts discussed in Section 6.1.4.

Sediment Discharge from Site Erosion

Flooding has the potential to cause a reduction in the capacity of downstream drainage lines by increasing sediment discharge arising from erosion of the project area. This may lead to poorer drainage and increased inundation of adjacent areas. Increased sediment discharge into downstream watercourses, resulting from erosion of the project area, may also contribute to a lowering of water quality during high rainfall events that already occurs naturally due to turbid overland flow.

Backfilling of mine pits is expected to result in a ground surface swell of less than 10% (see Supporting Study 5). Erosion of the project area during a flood event could also result if overland flow was diverted around these mounded areas causing increased flow velocity. Increased sediment loads in waterbodies downstream of the project area could occur during the period when vegetation planted during rehabilitation is re-establishing.

In the long term, surface elevations are expected to be marginally higher than the surrounding area after settlement.

If the natural depression in the project area was traversed by the mining pits or other works and overland flow was diverted elsewhere, seepage to subsurface storage could be reduced, resulting in an increased flow along other downstream drainage lines, leading to erosion.

[1] This wide range is due to the limited data in the only groundwater study conducted to date on the deep lead and assumptions made as to the hydraulic conductivities.

Altered Flow Regime

Mining activities could potentially alter the existing surface drainage and subsequently alter flooding patterns. Changes to flooding patterns could cause damage to adjacent farmlands, roads and constructed drainage channels during flood events. Flooding patterns would be affected if drainage lines were intersected by mining bunds and/or diversion drains (required to divert runoff around stockpiles and mine pits), which would potentially affect flows and runoff times in downstream watercourses.

Mining voids will capture rainfall and consequently cause a reduction in the volume of surface water runoff in the project area. In turn, the reduced runoff could alter flow regimes and water volumes reaching downstream.

During the first five years of mining, the mine pits and TSF will intersect the Taylors Lake Extension Channel. Installation of diversion bunds could potentially alter the travel time of flow, causing reduced runoff time and increased velocity. There are also smaller channels branching off the main channels that will be affected by the proposed mine. Lake Batyo Catyo and Lake Cope Cope will not be affected by the project.

Mounding of backfilled mine pits (particularly prior to settlement) could lead to a more rapid rise in peak flows in downstream watercourses by increasing the velocity with which flood water travels, potentially causing bed and bank erosion.

Flooding of Mine Pits

Floodwaters from a large catchment area due to a storm event could impact on DMS mining operations, causing loss of production. If floodwaters caused mine pits to overflow, there would also be potential for downstream watercourses to be affected by the release of turbid water from mine pits.

Miscellaneous Chemicals

Fuels, lubricants and process reagents will be stored and used on site. Little, if any, potential exists for spillages to report to downstream watercourses during a flood event and adversely affect aquatic biota.

Vertical Groundwater Movement

Saline groundwater has the potential to undergo vertical movement towards the ground surface; saline water from the fines tailing could vertically migrate towards the ground surface or the fines tailing layer could form an aquitard, holding infiltrating surface water close to the ground surface.

Interruption to Supply of Other Water Users

The mine will intersect the existing domestic and stock water supply channel system (see Figure 6.1) and despite the main pipeline routes, the Taylors Lake Extension Channel and the Eastern Laen Channel, being located outside the project area, there is still potential for mining activities to impact on local distribution pipelines. Supplies from the main pipelines to the local farms will involve an extensive distribution and reticulation pipeline network across the project area that will be affected by the project.

Domestic and stock channels and roads are the main infrastructure within the project area that may currently influence local surface flow. The existing water supply channels may affect site drainage, depending on the adequacy of cross drainage in the project area.

Competition for Water Supply

DMS could be in competition with existing water users if the off-site make-up water comes from the GWMWater system.

Potential Abstraction from the Avon Deep Lead

Based on advice from GHD, the potential impacts associated with the abstraction of the 4 GL/yr (maximum) of saline water from the Avon Deep Lead are as follows:

- Abstraction at an unsustainable rate.
- Impacts on neighbouring bores.
- A reduction of saline water discharging into Lake Buloke.
- Changes in water quality if there is interconnection with other aquifers.

It is believed that the Avon Deep Lead terminates in Lake Buloke with the deep lead discharging saline water into the (saline) lake. Several saline lakes in the Cope Cope area appear to be caused by the rise of saline groundwater, driven by the substantial head in the deep lead. The extraction of the large volumes proposed would reduce the water level in the deep lead. The lower water level head would be apparent many kilometres south (i.e., up-gradient of extraction) of Cope Cope and the volume of water flowing northwards to Lake Buloke also has the potential to be significantly reduced. It is expected that a reduction in head will be observed regionally in the Renmark Group and, eventually, the effect may become apparent in the Parilla Sand aquifer. The scale of this impact will be better understood once pump testing has been completed, which will give an indication of the aquifer properties and drawdown response to extraction. Groundwater extraction licence applications (required for pump testing and operations) will consider the potential affect that the drawdown may have on ecosystems reliant on the affected discharge features e.g., Lake Buloke and the paperbark population at Barnett's Lakes. These investigations will include drilling and the installation of monitoring bores to determine the interconnectivity between the Avon Deep Lead and surrounding aquifers.

The Renmark Group and the Avon Deep Lead are confined aquifers, meaning the water table is above the aquifer's upper boundary (the upper boundary being the Geera Clay aquitard); at Cope Cope, the top of the aquifer is about 40 m below the surface, but the standing water level is about 5 m below ground level. Groundwater flows laterally from Cope Cope (groundwater depth approximately 155 m AHD) north to the Murray River (groundwater depth approximately 120 m AHD). Apart from losses to local discharge features such as Lake Buloke, the saline water is discharged into the Murray River (Supporting Study 10). Any reduction of pressure in the confined aquifer system caused by extracting groundwater, will reduce the discharge of water into the river and into discharge features. It will also lower the water table in the area surrounding the extraction bores. While the extraction of water from the Avon Deep Lead will only have a minor positive impact on the salinity problems of the Murray Basin, it will have the potential to benefit the local area by reducing dryland salinity and reducing the volume of saline groundwater reaching Lake Buloke (Supporting Study 11). Due to the high salinity of the aquifer, there are currently no other water users.

In short, extracting water from the aquifer will reduce the pressure within the aquifer, therefore minimising the likelihood of aquifer discharge and reducing the potential for the extracted saline water to cause damage to vegetation. An estimated 'worst-case' scenario would result in reduced discharge of water to features such as Lake Buloke; however, a better-defined estimate can be made once further studies are conducted as part of the groundwater licence application process.

Potential Installation of New Water Supply Infrastructure

Construction of any pipeline for the delivery of water to the project area could potentially affect native flora and fauna along road-side verges (i.e., remnant vegetation), in reserves or even on farms. The productivity of the soil could also be compromised during the installation of the pipeline, due to the compaction of surface layers, an area critical for the penetration of plant roots. This could also result in loss of amenity through disturbance to the ground surface and clearance of the existing grass or crop. Tree clearance will be minimised as far as is practicable.

There is potential for adverse impacts from salinity on terrestrial ecosystems in the event of a rupture in the pipeline. It is possible that a break in the pipeline could occur and, if it did, it would release saline water. The extent and impacts of the release would depend on where the rupture occurred, the vegetation in the area, the local topography, whether the pipeline was under pressure at the time and whether the pipeline was buried or not.

6.1.3 Avoidance, Mitigation and Management Measures

Surface Water

Due to the absence of permanent surface water flows or waterbodies in the project area, the surface water management plan will focus on sediment control measures for site runoff, flood protection of working areas and maintaining or emulating (and finally reinstating) the original surface drainage. Rainfall and runoff will be treated in two different ways. All water in the pit or on constructed surfaces (roads, stockpiles, TSF and plant area) will be considered as ‘dirty’ and either added to the process water system or treated and used for dust suppression if suitable. Settlement ponds will be constructed to capture runoff from stockpiles and rainfall that is pumped out of the mine pit, if not used for processing. ‘Clean’ water will be diverted around the mine area by either existing drainage lines or purpose-built, temporary diversions.

Diversion bunds will be designed to divert overland flow, from at least a 1-in-100-year flow event, away from the active mine cells, and to ensure runoff in the project area is contained during high rainfall events. Small bunds will be constructed around the edge of the disturbed areas to deflect local overland flows away from the mine. To minimise the length of the bund, the disturbed area (which governs the length of the bund), will be kept to a minimum. Flooding of mine pits will be avoided by installing flood levees around working areas to divert a flow of at least a 1% annual exceedence probability (AEP).

A number of sediment control measures will be implemented to prevent site erosion contributing to sediment discharge into drainage lines and downstream watercourses during flood events. The surface water management plan will ensure that there is no significant change to the behaviour of overland flow for frequent rainfall events. To achieve this, a detailed survey of the project area will be conducted to establish an accurate contour map from which diversion channels and the surface contours of backfilled mine pits will be designed, to ensure maintenance of existing overland flow directions. As part of DMS’s integrated environmental management of the site, part of the main drainage line will be rehabilitated to the Black Box Swamp EVC. This will have the dual benefit of reinstating this endangered EVC and acting as a flood retention area. The existing channels can also capture overland flows exacerbating flooding further down the channel. Realignment of these channels or replacement of sections by pipeline will need to consider the existing conditions in terms of minimising any additional flood impacts around the site and also possible downstream effects.

Diversion channels will be designed to approximate the natural flow regime. The impact of the diversion on the flow regime–both upstream and downstream–of the project area will be minimised by mimicking existing conditions. Drainage diversion channels on the upstream side of the mine pit will have gradients of less than 0.5%, where possible. Where the slope is greater than 0.5%, gravel lining will be used to reduce erosion potential. Where the diverted water rejoins a natural flow path or drainage line, settlement ponds will be provided to reduce sediment loading. Construction of a diversion channel in the eastern catchment will be used to compensate for the mine path intersecting the natural depression. A diversion channel is also required in the western catchment.

The anticipated water supply volumes for the project will require DMS to complete an environment and resource efficiency plan (EREP) during construction and operations (see Section 2.4.3).

Water Supply Infrastructure

While development of the mine will remove some land from use for agricultural purposes, there will be adjacent areas that will need continued access to the stock and domestic supply system. Hence, some piping may need to be temporarily relocated from the current proposed routes due to mine works. If necessary, temporary diversions of open channels or pipelines will be installed when the mining activities affect the supply channels.

With respect to the potential discharge of saline water from a break in the pipeline, a common control mechanism is the use of a differential pressure gauge interlocked to the pump. When a pressure drop is detected, the pump automatically shuts down. Gate valves at intervals along the pipeline could also be considered to isolate sections of the pipe. In the event of a spill, steps will be taken to recover any accumulated water and/or direct it to a place of least harm (such as away from a rare plant community into a farm dam for later removal).

Abstraction from the Avon Deep Lead

Managing potential adverse impacts as a result of extraction of groundwater from the Avon Deep Lead will be by a thorough assessment of sustainable yields through pump testing and numerical modelling. DMS has engaged in extensive consultation with both GWMWater and DSE to confirm the requirements and process for pump testing the Avon Deep Lead. Pump testing, which will involve drilling a series of bores for abstraction and monitoring, is crucial to establishing the sustainable extraction rate (yield) and the lateral extent of affects of that pumping. The pump testing will determine the capacity of the deep lead to supply project needs and will be part of the Groundwater Extraction Licence process, which will involve public consultation. It is noteworthy that this is a consent-based process; if government is not satisfied that the potential impacts are acceptable, consent can be refused and DMS will be required to secure water from other sources (and potentially delaying project commencement).

A groundwater-monitoring network has been established around the perimeter and within the project area. Groundwater levels are currently monitored on a monthly basis and this program will continue during operations and following mine closure. Six observation bores have been installed by DMS along the Richardson River. Groundwater levels will be monitored regularly; however, mining is not expected to cause any material variance.

Groundwater salinity will be monitored quarterly in the two monitoring bores closest to the groundwater extraction area, and yearly salinity monitoring will be conducted in the remaining monitoring bores to ensure that any changes in water quality will be detected and managed appropriately. Monitoring bores

will also be located near surrounding wetlands, e.g., Waltons Lakes, that have been identified as having potential to be affected by groundwater extraction.

The current management strategy for Lake Buloke involves pumping out the recharge from groundwater sources in an attempt to reduce the in-flow of saline water (Morgan, pers. comm., 2007). This form of management is consistent with the outcomes of extracting water from the deep lead.

New Water Supply Infrastructure

Any pipeline from the Avon Deep Lead will have to cross the Richardson River. At the two road crossings (Cope Cope–Laen Road and Rich Avon Road) there are clear areas adjacent to the crossing where a pipe could be laid. The riverbed is sand overlying clay, so trench excavation would be straightforward.

Strategic route selection for the project water supply pipeline will ensure that sensitive areas are avoided where possible. The selected pipeline route will be assessed and the significant areas of avoidance are explained in Section 6.3.1, Water Supply Pipeline Route Options.

Surface Water Management

Surface water management will be further detailed in the Work Plan and will include the above-mentioned avoidance, mitigation and management measures.

Rehabilitation

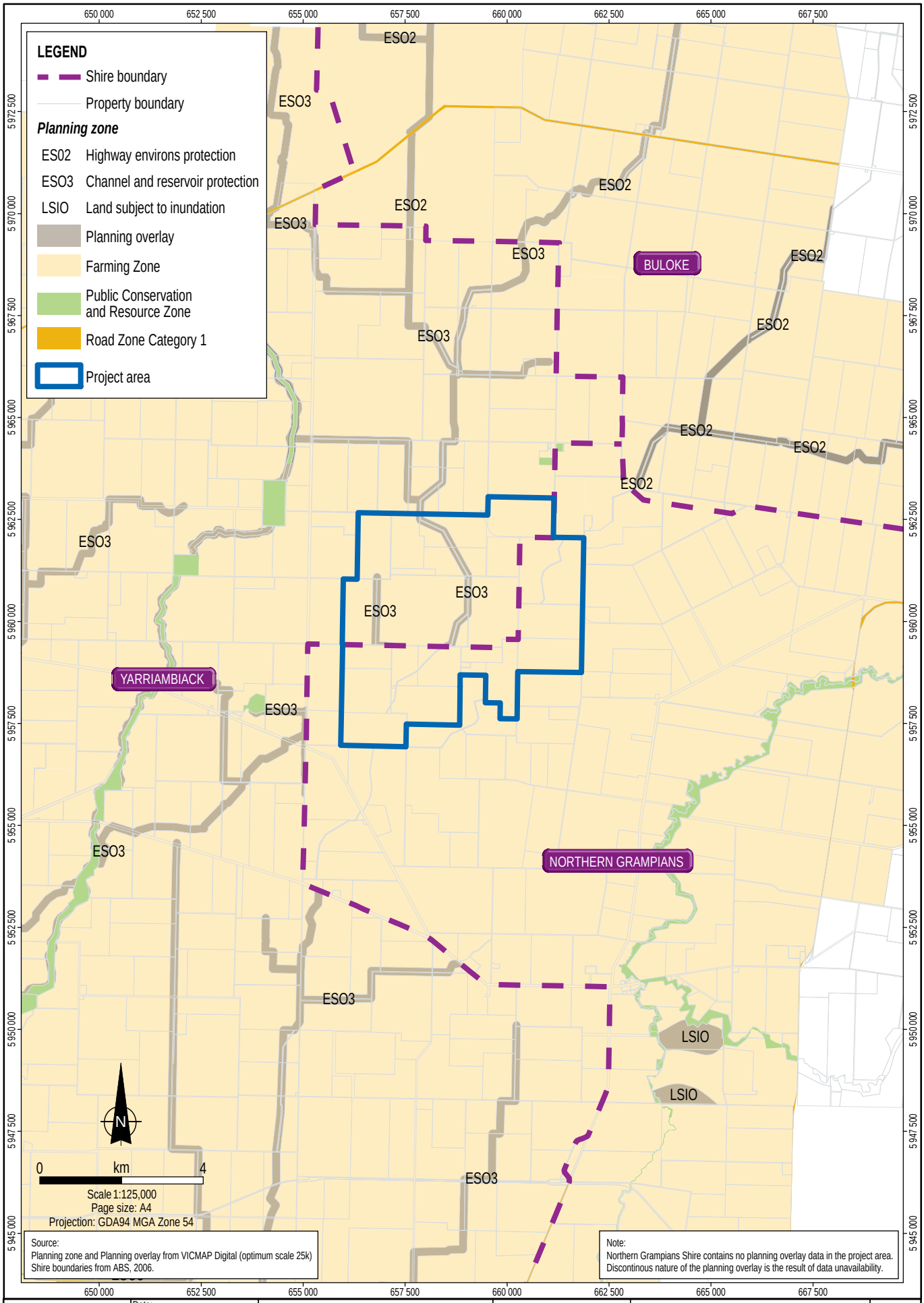
Rehabilitation will be undertaken to ensure the potential for erosion due to the elevated surface level is minimised. Rehabilitation of the project area will reinstate, as closely as possible, the natural surface morphology to emulate natural runoff conditions thus minimising the potential for increased peak flows. Drainage channels will be constructed that either continue around or cut though the elevated surfaces of rehabilitated areas to minimise sediment discharge from erosion of rehabilitated sites. Runoff from rehabilitated (but not revegetated) areas will be directed to settlement ponds before being discharged into a drainage line (primarily those constructed to divert drainage around and/or through the site).

6.1.4 Residual Impact Assessment

Surface Water

The project water supply dams, which will cover approximately 3 ha, will be located within the general area of the WCP and where the Shepparton Formation clay is 5 to 6 m thick. Assuming excavation of about 3 m, there will be at least 2 m of heavy clay below the dam. In its natural state, the clay has a very low hydraulic conductivity (less than 10^{-8}m/s), so seepage will be minimal. Nevertheless, DMS plans to line the ponds with HDPE sheeting to further minimise losses. The water will be less saline than the natural groundwater so the environmental impact will be negligible.

Richardson River and Dunmunkle Creek are not located in the areas described as ‘land subject to inundation’ in the municipality planning scheme (Figure 6.2). Furthermore, based on a 1-in-100-year flood event for both the Richardson River and Dunmunkle Creek, it is unlikely that flooding from either waterbody will impact on the project area.



coffey natural systems

Date: 18.10.07
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F06.02_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Land use

Figure No: 6.2

During the mine operations, the area of the active open pits will be approximately 38 to 63 ha. Any rain that falls on the open pit area will be captured and has the potential to reduce the volume of overland flow. The relatively small area designated to active open pits represents a minor portion of the total contributing catchments (approximately 1,700 to 2,400 ha). Therefore, the loss of contributing catchments due to the proposed mine pit will be negligible. Removal or modification of the channel infrastructure within the project area is also unlikely to have a significant environmental impact on receiving drainage areas. Diversion bunds constructed in the project area and the installation of multiple monitoring bores will alter the travel time of surface water runoff. Where runoff would have been sheet flow, it will now be concentrated along a bund or around the monitoring bore, which will reduce runoff time and increase velocity. However, when diverted into a settlement pond, the discharge runoff flowing into receiving flow paths or drainage lines will be delayed and the sediment load reduced. Given the use of settlement ponds and the fact that the working area of the mine is small compared to the total contributing catchment, the impact of the mine on runoff travel time will be negligible.

Saline groundwater is not expected to undergo vertical movement towards the ground surface considering that the fines tailing, which will act as an aquitard, will be placed at a minimum depth of 7.6 m and the average annual recharge is extremely low (6 mm/year). Additionally, the recorded peak flow fluctuations are generally less than 1 m under the wettest years.

When mining operations are complete, the mine void will be refilled and the existing topography on the mine path restored to a condition that preserves pre-mining surface flow paths. No additional adverse impacts on surface waterbodies are anticipated following closure of the mine.

GWMWater System

DMS is considering purchasing a bulk water entitlement from GWMWater that is expected to arise from the possible 20 GL available for sale from GWMWater as a result of water savings arising from their new water supply system (refer to Section 6.1, GWMWater Water Supply System). The current pipelining project will reduce the effects of the overall GWMWater system, by increasing environmental flows in the Wimmera and other rivers, and by reducing seepage from channels and storages: Purchase of an entitlement will impose no environmental impacts beyond those of the existing GWMWater system.

Should DMS opt to purchase water from GWMWater, it would be one of the beneficiaries of the water savings that are inherent in the new pipeline system (estimated to be up to a total saving of 100 GL/year). Hence, DMS will not be in direct competition with existing water users.

Avon Deep Lead

Due to the relatively high salinity of the deep lead water, there is no agricultural use of the water in the area south of Donald. However, in response to the drought, an emergency bore was sunk further south and this bore is currently used to extract less saline groundwater for stock water purposes. The volume extracted from this bore is small (i.e., trucks are used to transport the water) and use of the bore will decline when the new pipeline system supplies these water users. Reliance on this bore water could potentially be reduced earlier if the drought ceases and farmers are able to revert to supply from the channel system.

At present, the brackish groundwater from the Avon Deep Lead has no apparent use but, in the future, this may not be the case. Desalination technology may become cheaper or ongoing drought may necessitate the use of desalinated water for town or stock supplies. Abalone breeding and seaweed

growing is already being discussed as potential enterprises that make use of, and provide monetary gains from, the brackish water, with trials underway within the Buloke Shire region.

Abstraction from the Avon Deep Lead

The extraction of the proposed large volumes of water from the deep lead would reduce the water level in the aquifer. Due to hydrologic linkages, it is expected that the drawdown cone would be apparent many kilometres south of Cope Cope, and the volume of water flowing northwards to Lake Buloke would also be significantly reduced. It is also expected that a reduction in water level head will be observed regionally in the Renmark Group and, eventually, the effect may become apparent in the Parilla Sand aquifer. Pump testing and the installation of a number of monitoring bores will allow a better definition of how the receiving water environments will be affected by the water extraction.

There are uncertainties about the nature and extent of the residual risk that can only be resolved by pump testing. Groundwater levels and quality are currently being monitored and will continue to be monitored throughout operations and following closure. This will allow any variations in water level or quality due to mining operations to be detected and subsequently managed.

Any reduction of pressure caused by extracting groundwater in the confined aquifer system will reduce the discharge of water into the Murray River and into discharge features such as Lake Buloke.

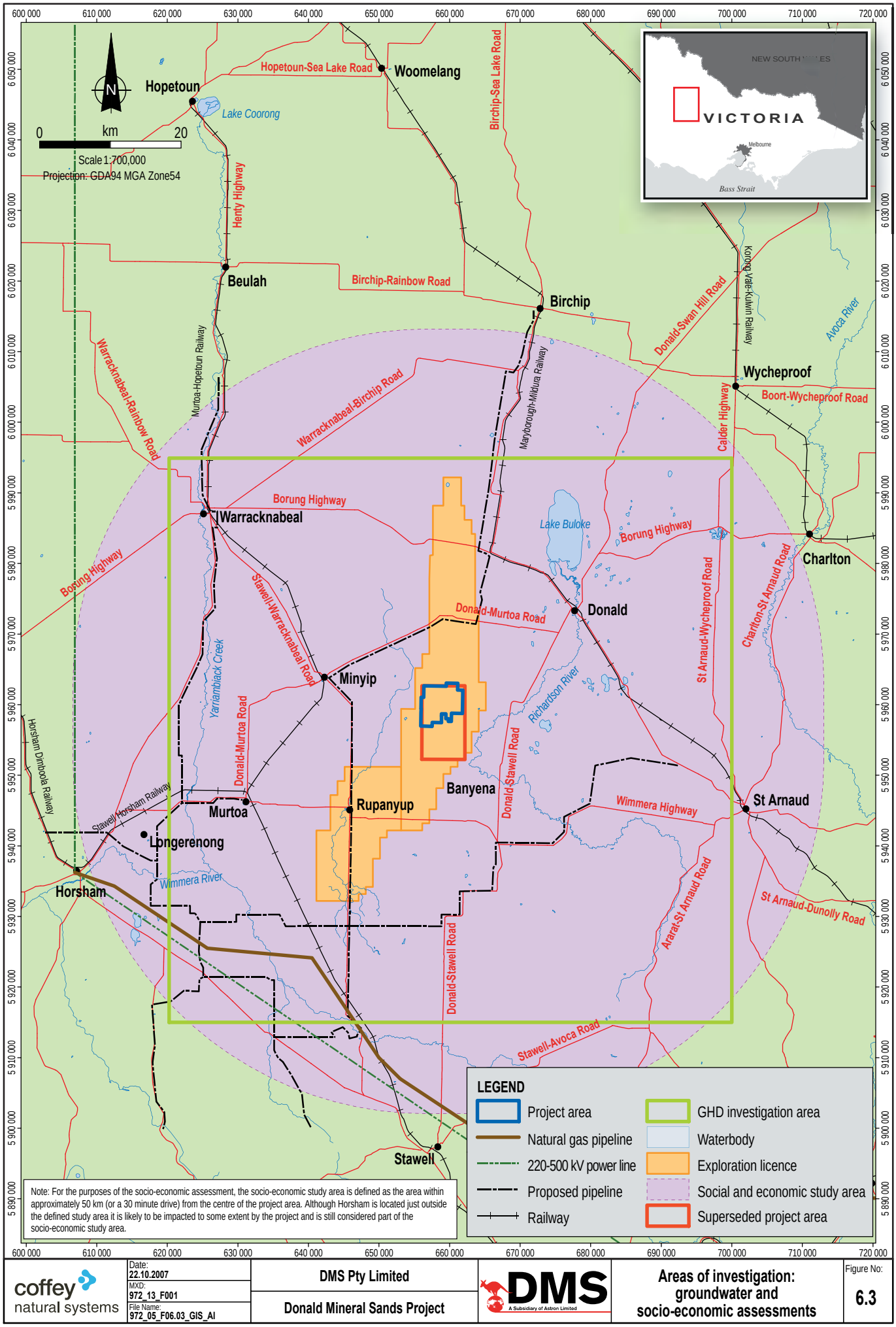
The assessment process for a Groundwater Extraction Licence under the *Water Act 1989* is a public, statutory process that determines whether the potential impacts are acceptable or not.

Water Supply Infrastructure

Construction of the water supply pipeline will be of short duration. No mature trees will be cleared and the area disturbed will be small and carefully rehabilitated. Removal of native vegetation is likely to be minimal and therefore the long-term impact on habitat is negligible. The effect on the local fauna should be very limited, both in duration and intensity. Strategic route selection will minimise the impacts on native vegetation, while the application of good practices in pipe laying and rehabilitation will ensure minimal long-term impact on agriculture, native flora and fauna. As part of this management, once the final route is selected, a more detailed fauna survey will be carried out.

6.2 Groundwater

GHD Pty Ltd (GHD) conducted an assessment of the potential groundwater issues arising from mine pit dewatering and the water used for processing the ore. Figure 6.3 shows the GHD investigation area, which covers an area of approximately 80 km by 80 km encompassing the project area, Warracknabeal, Murtoa and Donald. The full assessment, including proposed avoidance, mitigation and management measures is provided in Supporting Study 10 and is summarised in this section.



coffey natural systems

Date: 22.10.2007
MXD: 972_13_F001
File Name: 972_05_F06.03_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Areas of investigation: groundwater and socio-economic assessments

Figure No: 6.3

6.2.1 Existing Conditions

Existing Groundwater Users

Within the GHD investigation area (see Figure 6.3), 691 bores were identified. The majority of bores are used for investigation and observation purposes with only 24 for stock and/or domestic purposes. Of these, two were constructed for irrigation, reflecting the poor quality of groundwater in the area. Of the 24 stock and/or domestic bores, those closest to the project area are located approximately 20 km to the east, southeast and southwest. The irrigation bores are located approximately 40 km from the project area.

The groundwater resources within the region of the proposed mine are managed by GWMWater.

Groundwater Quality

Groundwater salinity around the global resource (see Figure 1.2) is on average 16,930 mg/L total dissolved solids (TDS) (with a maximum of 19,980 mg/L TDS and a minimum of 14,400 mg/L TDS[2]). According to the Groundwater SEPP (EPA, 1997), the local groundwater is classified as Segment D for the following protected beneficial uses:

- Maintenance of ecosystems.
- Industrial water use.
- Buildings and structures.

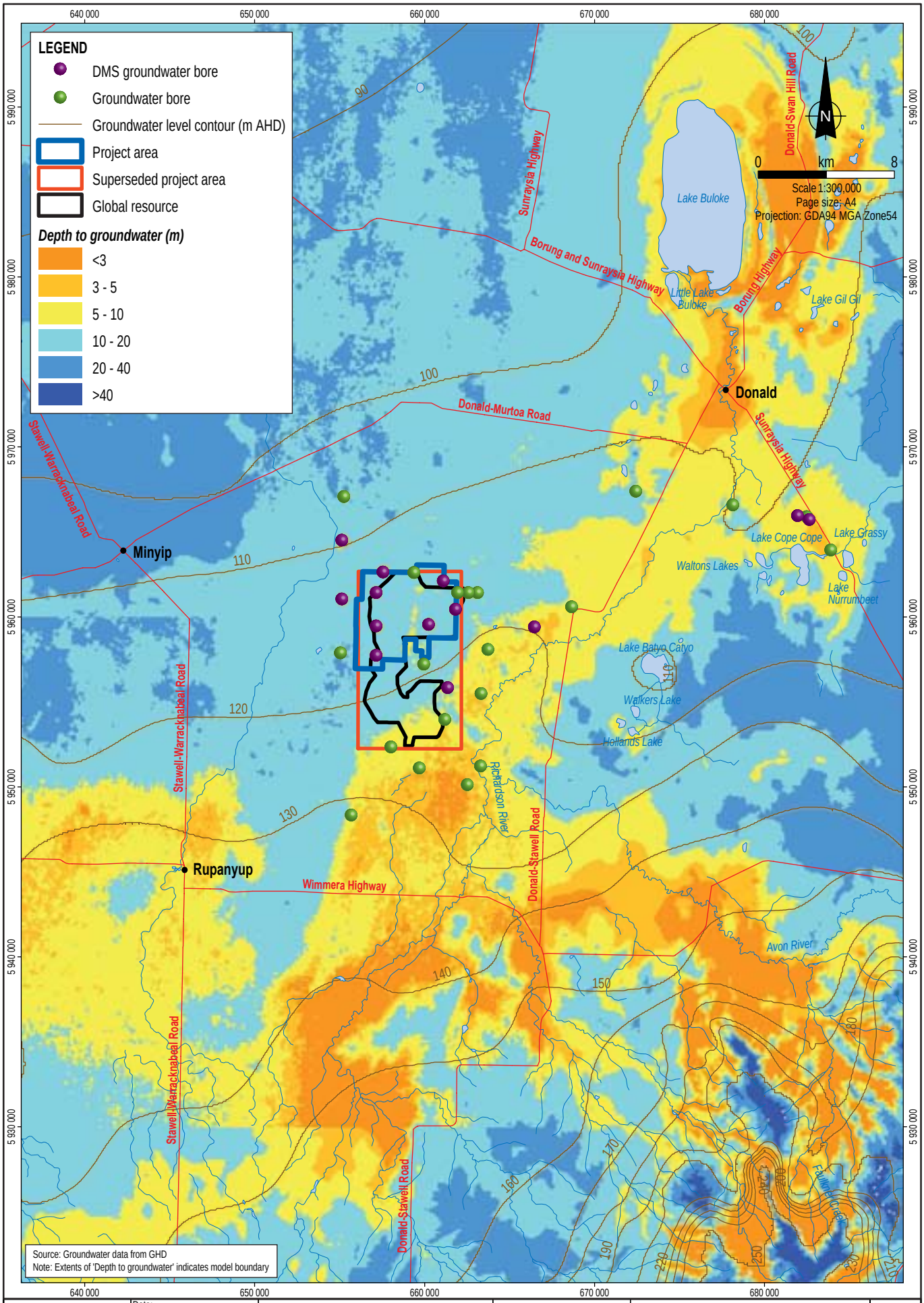
Shallow bores along the Richardson River indicate that the groundwater salinity is slightly lower than around the mine, but still greater than 13,000 mg/L TDS (i.e., it remains classified as Segment D). There are two exceptions: a bore located approximately 10 km east of the project area, which recorded 11,820 mg/L TDS, and another bore located 5 km east of the project area, which recorded 2,580 mg/L TDS. The lower salinity recorded in groundwater bores around the Richardson River is thought to be related to intermittent fresh water recharge that occurs during high flow periods in the Richardson River. Often the extent of this recharge is local and is referred to as ‘bank storage’; when the surface water level falls, the groundwater gradients are reversed and the river returns to ‘gaining’ (or baseflow) conditions.

Regional Hydrogeology

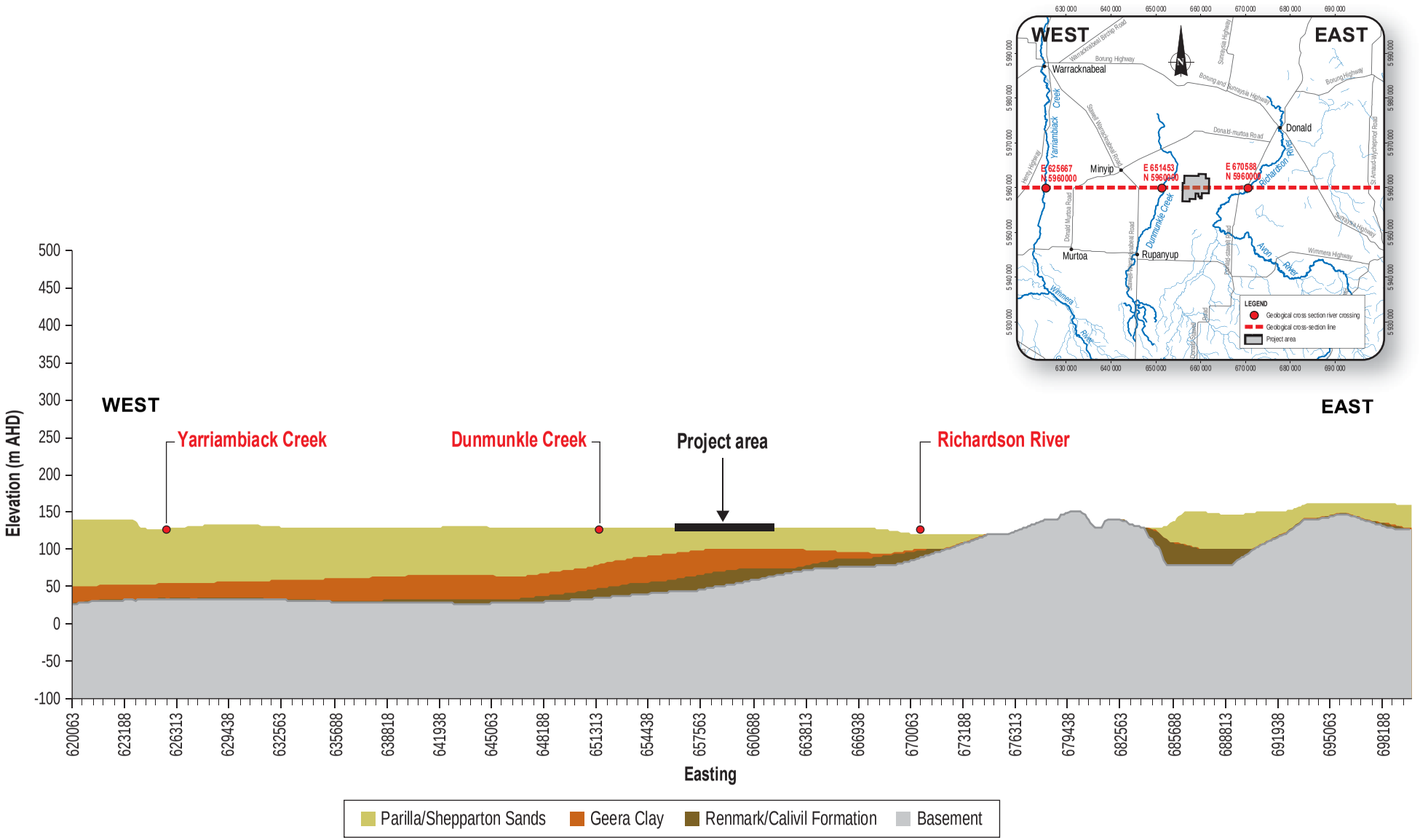
The regional groundwater flow direction is towards the northwest (Figure 6.4). Based on the regional geology, the principal aquifers and aquitards in the vicinity of project area are (from surface down; Figure 6.5):

- Shepparton Formation aquifer system.
- Parilla Sand aquifer system (Pliocene sand aquifer).
- Mid Tertiary low-permeability barrier (aquitard formed by Geera Clays).
- Renmark Group aquifer.

[2] Seawater has a salinity of approximately 35,000 mg/L TDS.



coffey natural systems	Date: 22.10.2007 MXD: 972_DonaldMineralSandsGIS File Name: 972_05_F06.04_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Groundwater contours and depth to groundwater	Figure No: 6.4



	coffey natural systems	Job No: 972	DMS Pty Limited	DMS A Subsidiary of Astron Limited	West-east geological cross-section through the project area	Figure No: 6.5
		File Name: 972_05_F06.05_HB	Donald Mineral Sands Project			

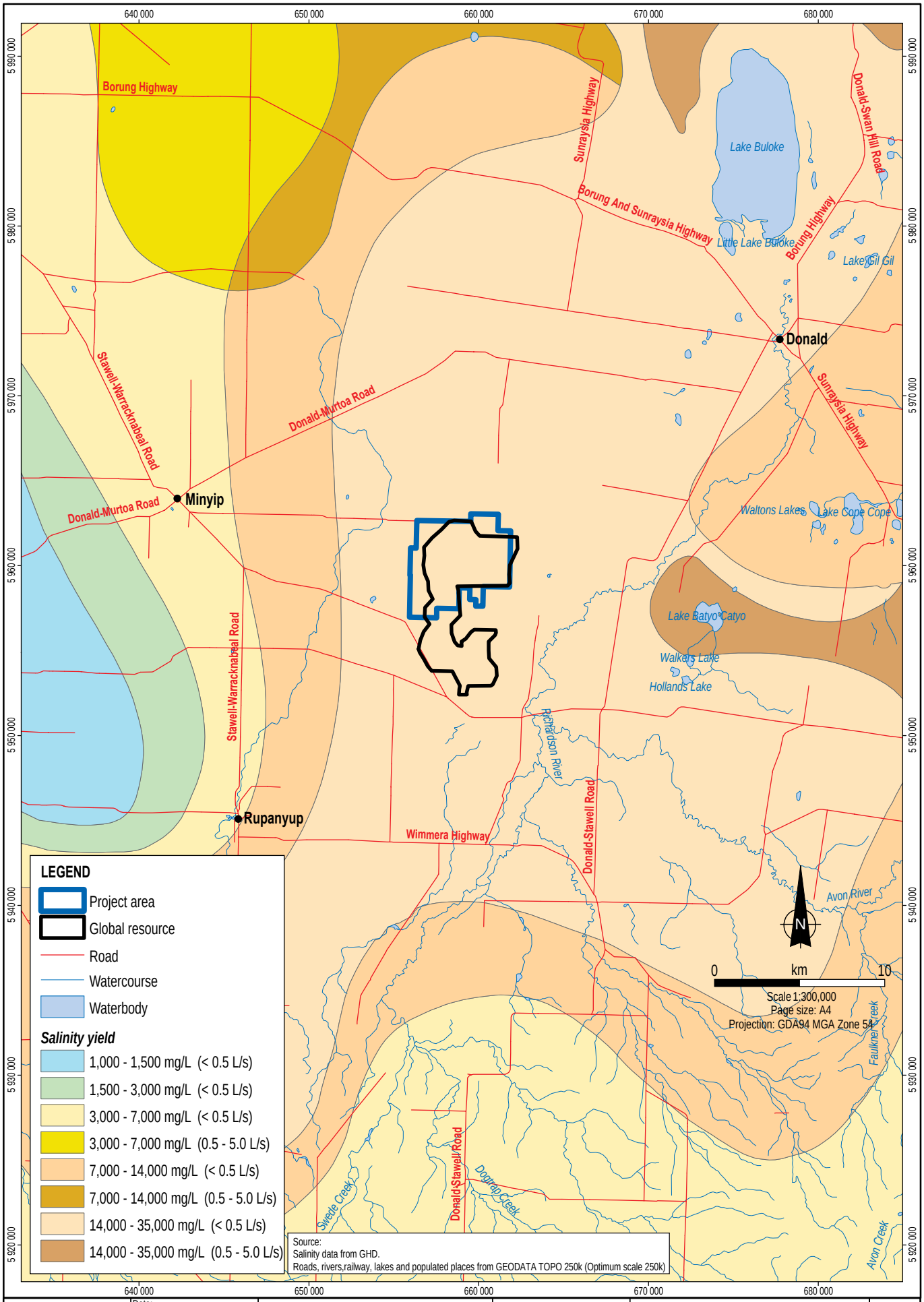
The Shepparton Formation aquifer system forms a thin aquifer system (the saturated thickness is less than a few metres), which overlies the Parilla Sand aquifer on the eastern side of the project area. It is generally expected that these two aquifers are in direct connection; however, in some areas, clay layers may form a confining layer. Groundwater moves laterally into the Parilla Sand aquifer in a northwest direction. The regional yield and groundwater quality within the water table aquifer systems (Shepparton and Parilla sands) are shown in Figure 6.6. The groundwater salinity in the region of the GHD investigation area is generally between 14,000 and 35,000 mg/L TDS. Bore yields are expected to be less than 0.5 L/sec.

The Parilla Sand aquifer is on the western side of the GHD investigation area, and is the main aquifer of concern with respect to ore extraction. The groundwater elevation of the water table is generally between 110 and 120 m AHD and the underlying aquifer in the GHD investigation area is approximately 25 m thick. The Parilla Sand aquifer is recharged predominately by rainfall infiltration, either directly onto the outcropping the Parilla Sand or via seepage through the Shepparton Formation. Recharge rates are low due to the low rainfall and high evaporation rates in the region. However, sporadic recharge to the aquifer system is thought to occur via surface water features, such as the lower Richardson River and Lake Buloke during flooding. Generally, the Parilla Sand aquifer discharges into the low lying areas, such as Lake Buloke and the lower reaches of the Richardson River, and also via evapotranspiration from vegetation where groundwater is at shallow depth.

In the GHD investigation area, the Parilla Sand aquifer system has a relatively low hydraulic conductivity, hence seepage is minimal. The bore yields from this aquifer system are also expected to be less than 0.5 L/sec. Hydraulic conductivity in the vicinity of Lake Buloke is approximately between 1 to 5 m/day.

A low-permeability barrier is formed by the Mid Tertiary Geera Clay and is present across the GHD investigation area at depths of around 70 m. This aquitard separates the overlying Parilla Sand aquifer from the underlying Renmark Group aquifer. Beneath the GHD investigation area, the aquitard thickness is between approximately 5 and 35 m.

On a regional scale, the Renmark Group is generally absent to the east of the Richardson River and south of the GHD investigation area. The Renmark Group aquifer system is thickest along the Avon Deep Lead and beneath Lake Buloke. In the GHD investigation area, the aquifer is expected to be between 0 to 30 m thick. As mentioned, the Renmark Group aquifer is generally isolated from the more shallow aquifer systems by the Geera Clay aquitard, the exception being around the Richardson River, where the Renmark Group is expected to directly underlie the Parilla Sand. In the vicinity of the GHD investigation area, there is a downward gradient from the water table aquifers towards the Remark Group aquifer. There is also a downward gradient in the vicinity of the deep lead and Lake Buloke, where the Geera Clay aquitard is absent, and recharge from the Parilla Sand aquifer to the lead is via downward migration of groundwater. Groundwater salinity is expected to be similar to the overlying Parilla Sand and Shepparton Formation aquifer systems (between 14,000 to 35,000 mg/L TDS). The bore yields from the aquifer are likely to be between 0.5 and 5 L/sec, which are greater than the higher aquifer systems.



coffey natural systems

Date: 25.09.2007
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F06.06_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Groundwater shallow salinity yield

Figure No: 6.6

Within the Avon Deep Lead, where coarse sands are intersected, higher bore yields are expected to be possible (i.e., greater than 10 L/s). DMS is targeting the Avon Deep Lead as a potential process water supply source (see Section 6.1.1). Poor groundwater quality in the deep lead is thought to be the result of direct vertical groundwater migration (recharge) from the overlying Parilla Sand and Shepparton Formation, which are also of poor groundwater quality.

Mine Stratigraphy

DMS conducted bulk sampling of the ore horizon from a trial pit (130 m long, 20 m wide and 18 m deep) at the southern end of the global resource in 2005. A summary of the stratigraphy intersected in the DMS trial pit (which was conducted in the south of the superseded project area) is shown in Table 6.1. The depth from ground level and the nature of the Parilla Sand and Shepparton Formation at this location can be seen in Plate 6.1.

Table 6.1 Summary of stratigraphy in the trial pit

Depth (m)	Description	Stratigraphy
0 to 1.2	Black silty sand and black clay.	Shepparton Formation.
1.2 to 8.0	Silty clay: light grey, brown to orange, high plasticity, moist to very moist.	Shepparton Formation.
8.0 to 9.6	Clayey sand: light grey, brown to orange, fine to medium grained, moist to wet.	Shepparton Formation.
9.6 to 10.7	Silty sand: grey, very fine grained, low plasticity fines, very moist to wet.	Parilla Sand.
10.7 to 11.3	Silty sand: light grey to grey, very fine to coarse-grained sands, slightly cemented, scattered fine gravel, wet and seepage from this unit, ore horizon.	Parilla Sand.
11.3 to 11.8	Silty sand: light grey, very fine to medium grained, some coarse sand and traces of fine to medium gravel, wet and seepage from this unit, ore horizon.	Parilla Sand.
11.8 to 18	Silty sand: light grey and dark yellowish brown, fine-grained, low plasticity fines; moist; no seepage observed from this unit; ore horizon.	Parilla Sand.

Groundwater was intersected at 6.5 m depth; groundwater inflow into the pit occurred from 10.7 to 11.3 m depth through a 0.5-m-thick silty sand layer. This inflow was initially estimated at 2.7 L/sec over a 13-hour period. Geotechnical investigations undertaken by IGT (2005; as cited in Supporting Study 10,) estimated that the silty sand layer had a hydraulic conductivity of 3.25 m/day, based on an exposed surface area of 72 m^2.

Groundwater Levels and Flow Directions

Groundwater elevation mapping, presented in Figure 6.4, indicates that the groundwater generally flows from southeast to the northwest across the project area, with groundwater levels falling from 120 m AHD in the southeast to less than 110 m AHD in the northwest across the project area and surrounds. Groundwater levels are highest in the southeastern corner of the GHD investigation area, where the Tertiary and Quaternary sedimentary aquifers are thin to non-existent, and the relatively

Source: Supporting Study 11.

Plate 6.1

Trial pit showing approximate depth from ground level and the nature of the Parilla Sands.

impermeable bedrock aquifer dominates. Local groundwater mounding has been observed beneath Lake Buloke during and following flood events (Supporting Study 10).

Temporal variations in water level are generally in the order of 1 m, with many bores displaying little seasonal recharge response suggesting that there is very little direct groundwater recharge across much of the GHD investigation area. Recharge in the Avon–Richardson catchment, particularly in the lower reaches, is largely derived from flood events, when the lower floodplains and lakes are inundated.

Groundwater-Surface Water Interaction

A number of surface water features in the region are understood to be connected to the water table aquifer system. The majority of groundwater recharge in the Avon–Richardson catchment is from large surface water flood events, particularly from those that fill the region's lake features such as Lake Buloke and Lake Cope Cope.

Lake Buloke and Lake Cope Cope

These features are terminal surface water features that are close to the water table. Following inundation with fresh surface water from flood events, floodwaters provide a significant source of recharge to the underlying aquifer system. However, these lakes are often subject to salt accumulation resulting from a lack of flushing with fresh surface water and the effects of evaporation of shallow, saline groundwater.

Lake Batyo Catyo

Groundwater levels around the lake are shallow and the lake is expected to be a recharge feature during most periods as water levels in the lake are held above the regional groundwater levels.

Avon and Richardson Rivers

Along many reaches of these rivers, particularly the lower Richardson River, groundwater depths are relatively shallow (<3 m below the ground surface) (see Figure 6.4) and groundwater baseflow is known to occur along these stretches under low flow conditions (i.e., the river is 'gaining' water from groundwater), with saline pools forming in dry conditions. Salinity problems are common in these low-lying areas due to groundwater discharge.

The groundwater contours in Figure 6.4 indicate that, east of the project area, the water table may be generally recharged by the Richardson River, while further north towards Lake Buloke, the contours suggest the baseflow is occurring in the river. The regional groundwater quality information does not indicate any freshening of groundwater below the Richardson River (see Figure 6.6); however, some localised groundwater monitoring indicates recharge from the river may be occurring intermittently.

Dunmunkle Creek

This creek appears to be well above the water table and it is therefore likely that, when sporadic surface flows occur, the groundwater receives recharge from Dunmunkle Creek.

6.2.2 Issues

Beneficial Uses

The Groundwater SEPP (EPA,1997) identifies three beneficial uses for groundwater in the region (see Section 6.2.1). Of these, aquatic ecosystems are considered to be the only potential beneficial use that could realistically be affected by mining activities; should project activities affect the groundwater quality, local surface water features supporting aquatic ecosystems may be affected by baseflow from the groundwater.

It is highly unlikely that altered groundwater quality would affect industrial water uses or buildings and structures. The groundwater has a low yield and high salinity rendering it unsuitable for industrial purposes and buildings and structures are not affected by groundwater due to the depth (generally greater than 5 m) (see Figure 6.4).

Dewatering

Dewatering is required in the mine pits due to the inflow of groundwater that will result when extracting the portion of ore that sits below the water table. Groundwater extraction will cause drawdown on the local groundwater. The lowering of the groundwater level (i.e., the drawdown) could affect neighbouring bore users by reducing yield and pumping rates.

Dewatering could also affect groundwater discharge to local surface water features (i.e., baseflow), should the drawdown cone intersect neighbouring watercourses.

Tailing Emplacement

During ore processing, additional saline water is incorporated with the tailing, particularly the fines tailing, which is eventually emplaced into an open cell. A proportion of this additional water will be lost via evaporation and seepage while the rest will be permanently bound in the fines tailing layer. The seepage water will initially be collected; however, as consolidation continues in the long-term, it is expected that some water will move back into the aquifer system. The potential impacts of the replacement of fines tailing into the cells are:

- Soil salinisation.
- Altered groundwater quality.
- Increased baseflow to surface water features.

Soil salinisation resulting from shallow saline groundwater levels could result from:

- Placement of the saturated fines tailing within 3 m of the ground surface.
- Placement of the saturated (saline) overburden within 3 m of the ground surface.
- Seepage from the fines tailing layer during consolidation.
- Development of a perched water table due to restricted vertical groundwater movement at the fines tailing layer.

The fines tailing layer will be bound with saline process water and is estimated to have a 45 to 55% solids content. Fines tailing will be placed above the natural water table and is expected to act as a perched water table. Therefore, if the fines tailing layer was placed within 3 m of the ground surface, there is the potential for soil salinisation and resulting affects on revegetation.

A conservative estimate indicates that, over a 5-year period, the fines tailing layer will consolidate from 50% solids to 55% solids. During this period, excess groundwater recharges to the water table may elevate the level of the water table.

Regional groundwater movement across the project area could also be impacted if the low permeability fines tailing were placed below the natural water table.

Seepage from the TSF

During the first 12 months of operations, tailing will be placed in the purpose-built TSF to allow the collection of saline seepage water and decant water. Seepage from the tailing stored within the TSF could affect the groundwater quality.

6.2.3 Avoidance, Mitigation and Management Measures

Groundwater Levels

A groundwater monitoring network has been established around the perimeter and within the project area. Currently, groundwater levels are monitored and recorded on a monthly basis and this program will continue during operation and after closure of the mine.

DMS has installed six observation bores along the Richardson River that will be monitored on a regular basis during the mine life as a prudent measure, given that groundwater levels along the Richardson River are not expected to vary as a result of mining activities.

Following rehabilitation, groundwater levels within the mining cells will be monitored. Two methods are being considered: leaving a number of cased sumps in the mining cells to provide monitoring points (i.e., one every five cells) or the installation of a monitoring bore in the centre of each cell (e.g., approximately 25 bores over the mine life) from which annual monitoring will be conducted.

Soil Salinisation

As discussed in Section 4.5.3, tailing trials will be conducted during the pre-production phase. These trials will be used to verify GHD's modelling predictions about the length of time required for the tailing to become dry enough for overburden emplacement. Furthermore, overburden will be monitored during removal to determine whether it is saline (from close to or below the water table) or non-saline. The thickness of non-saline overburden will be recorded at each location. Saline overburden will be returned to the mine void and, at each location, will be covered with non-saline overburden of at least the original thickness (see Section 6.14.3).

The elevation of the top of the fines tailing layer in each cell will be surveyed and recorded prior to final rehabilitation. The depth of the fines tailing layer below ground level will also be measured and confirmed to ensure the it remains at a minimum depth of approximately 7 m below surface level, to ensure soil salinisation does not result.

Following rehabilitation, overburden will be compacted in layers using trucks and, potentially, scrapers to reinstate the low, vertical-permeability nature of the overburden, and observation bores will be installed and screened just above the fines tailing layer. This will help to ensure that the highly unlikely scenario of a perched groundwater forming above the fines tailing layer does not occur. The observation bores will be installed around the centre of the project area where the fines tailing layer is at the minimum depth of approximately 7 m.

The initial TSF will be built in accordance with DPI guidelines (DPI 2004a), which will ensure the capture of both salt and tailing solids. Overburden stockpiles will be built directly on to overburden to ensure no contamination of topsoil or subsoil occurs. In addition to this, cut-off drains and sedimentation dams will capture any runoff, saline or otherwise.

Groundwater Quality

Groundwater sampling will be conducted from the existing network of monitoring bores. Quarterly salinity monitoring will be undertaken in the closest two monitoring bores to the operating mine and yearly salinity monitoring will be conducted in the remaining monitoring bores.

Process water salinity is expected to be lower than the groundwater salinity in the project area (regardless of whether water is purchased from GWMWater or extracted from the Avon Deep Lead). Process water salinity and the groundwater salinity from the proposed extraction bore or GWMWater distribution system will be recorded on a daily basis to ensure that water salinity levels are as expected.

Excess Groundwater

The maximum groundwater inflow rate to the pit is predicted to be 52 L/sec. Should the maximum rate occur, dewatering at a rate of 52 L/sec may be required, producing a greater volume of groundwater at the mine site. In this situation, less make-up water would be purchased from external resources.

6.2.4 Residual Impact Assessment

Variations in Groundwater Levels

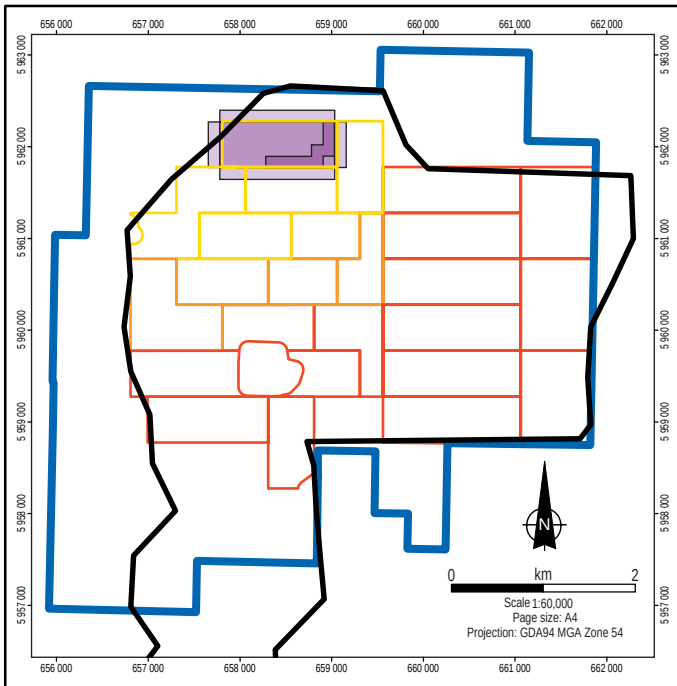
Dewatering of two mining cells at any one time would result in a drawdown of the local groundwater levels. Due to the low permeability of the aquifer, it is predicted that drawdown will be restricted to a 2.5 km radius from the project area (Figure 6.7). None of the watercourses lie within this boundary. The lower Richardson River is approximately 4 km southeast of the project area at its closest point and Dunmunkle Creek is approximately 3 km northwest; hence, the drawdown cone is not predicted to intersect any watercourses. Similarly the drawdown cone does not reach any existing groundwater users and, therefore, no impacts are expected on the yields of existing bores.

Mining activities are not expected to increase areas of land salinisation or discharge of saline groundwater to the Richardson River. Additional groundwater recharge from fines tailing over a five year period is not expected to cause an elevation in groundwater levels as the layer will be relatively impermeable and mine dewatering will mitigate the impact of additional recharge.

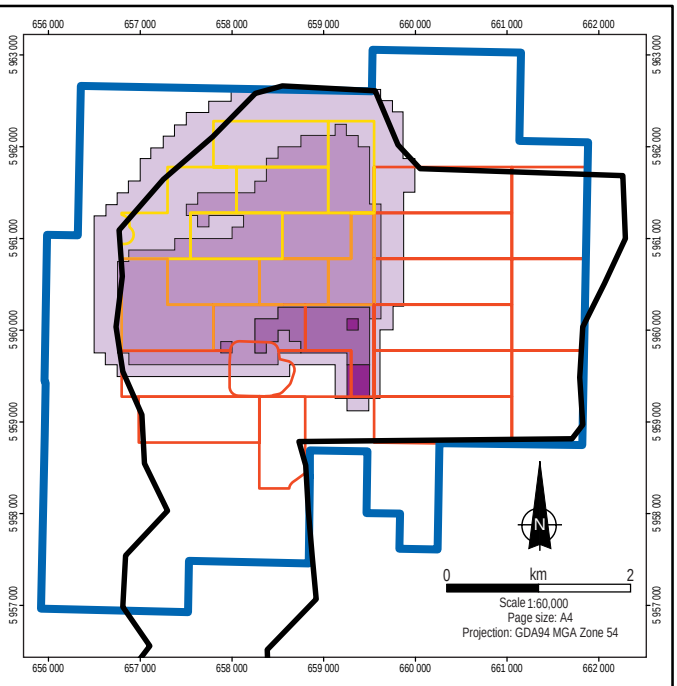
Fines tailing will be placed above the natural water table, where possible, to prevent regional flows being affected by their low permeability.

Perched Water Table

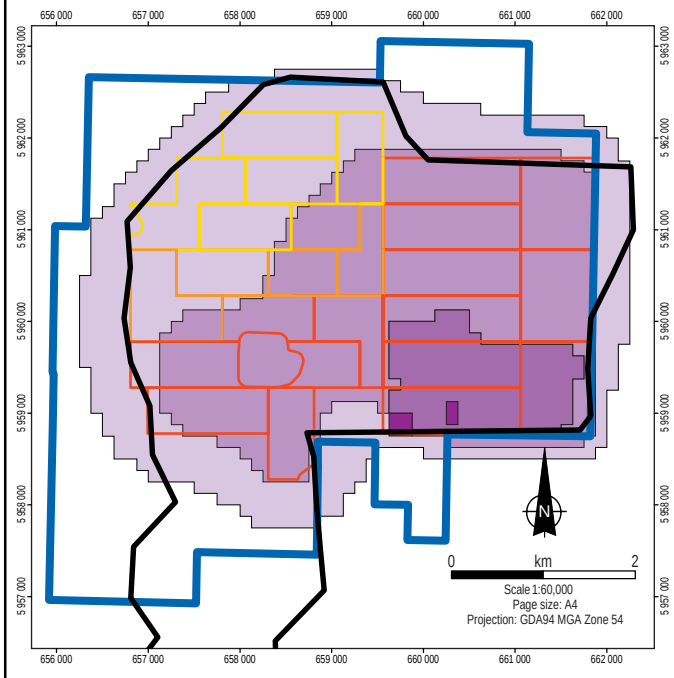
The rehabilitated overburden is expected to have similar low permeability properties to the original material, and overlies a low-permeability fines tailing unit at depth. The groundwater recharge in the area is very low, due to the high evaporation rates compared to rainfall, and, therefore, it is considered unlikely that a perched water table of any significance would form. In addition, the average, annual



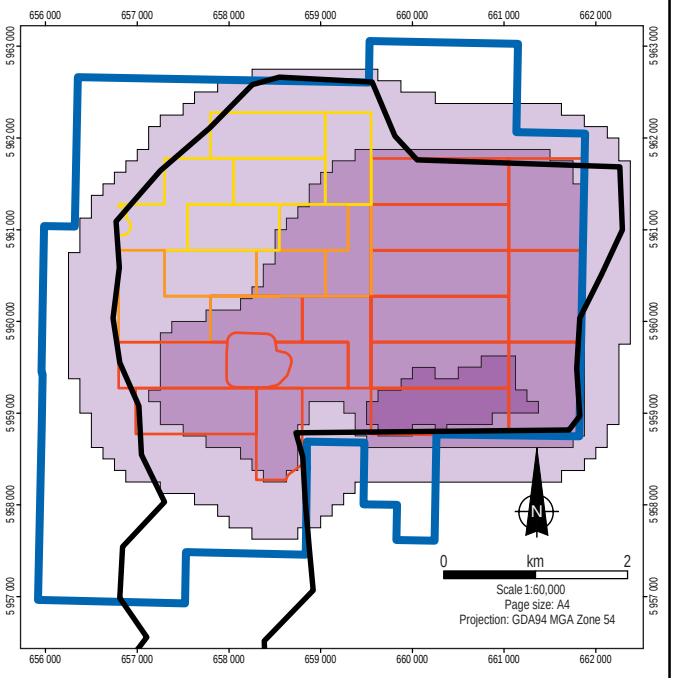
After 1 year mining



After 10 years mining



At the end of mining



2 years post-mine closure

LEGEND

- Project area
- Global resource

25 year mine plan

- Years 1-5
- Years 6-10
- Years 11-25

Change in groundwater level (m)

(positive indicates lowering of level)

- < 0.1
- 0.11 - 1
- 1.1 - 5
- 5.1 - 10
- 10.1 - 20

Source:
Shire boundaries from ABS 2006,
Roads, rivers,railway, lakes and populated places from GEODATA TOPO 250k (Optimum scale 250k)

coffey natural systems	Date: **25.09.2007** MXD: 972_DonaldMineralSandsGIS File Name: **972_05_F06.07_GIS_AI**	**DMS Pty Limited** **Donald Mineral Sands Project**	DMS A Subsidiary of Astron Limited	**Predicted changes in groundwater level**	Figure No: **6.7**

groundwater recharge is extremely low (at an average of 6 mm/year with some years at 10 to 20 mm/year and other periods of nil recharge) and the recorded hydrograph fluctuations in water table level in the order of 1 m (even under the wettest years). Considering the worse-case scenario, where the fines tailing layer would restrict all vertical groundwater movement and a perched water table would form, it is unlikely that the perched water table would be greater than 1 m high and given that the slimes will be at a minimum depth of 7.6 m from the ground surface, a perched water table of 1 m would not cause any detrimental impacts at the ground surface.

Variations in Groundwater Salinity

Both make-up water options consider acquiring water for processing that is less saline than the groundwater in the project area. Hence, despite adding to the salt load, make-up water will dilute the process water electrical conductivity levels, which is why the water salinity in the tailing is expected to be marginally lower than the local groundwater salinity. The additional salt load will be bound in the fines tailing layer and existing beneficial groundwater uses will not be affected.

Dewatering in the mine pits could result in a reduction of saline baseflow to ephemeral rivers or lakes in the region and, potentially, helping to reduce salinity issues (see Section 6.1.2). Similarly, a reduction in groundwater levels in areas where the water table is less than 3 m deep may also help to reduce soil salinisation and will be beneficial in reducing salinity impacts. However, the reduced capacity of the aquifer to recharge surface waterbodies, such as Lake Buloke, could potentially affect the biota adapted to the saline environment. These issues will be investigated during the process of applying for groundwater extraction licences (see Section 6.1.2).

Stockpiling of Overburden and Tailing during the Initial Phase

During the first 12 months, overburden will be stockpiled rather than returned to the cell and tailing will be placed in the purpose-built TSF to allow the collection of saline seepage water and decant water. The TSF will have a compacted clay liner built in accordance with DPI guidelines and will protect the underlying surface from salinity impacts. Overburden stockpiles will be managed to prevent soil salinisation of the fertile layers of topsoil and subsoil.

6.3 Biodiversity and Habitat

Ecology Partners Pty Ltd (Ecology Partners) undertook a flora and fauna assessment of the project area, which is summarised below, in November and December 2005. This followed a preliminary flora and fauna assessment undertaken in September 2005. The full report is presented as Supporting Study 3.

Throughout this section, the following spatial definitions apply:

- *Region* refers to the Wimmera Bioregion.
- *Pipeline zones of supply* refer to the general zones within which water supply infrastructure corridors could potentially be located depending on the water supply that DMS is able to secure for their processing requirements (see sections 4.13 and 6.1). Both pipeline zones of supply are similar in terms of flora and fauna and have therefore been discussed together.

Throughout this section, the following non-spatial definitions apply:

- *Conservation status* refers to a species' status listed under the EPBC Act, FFG Act or on the DSE website (DSE, 2007a).
- *Conservation significance* is a site-based measure of quality of native vegetation that accounts for conservation status of the species or community present in the context of the quality of the surrounding environment. Conservation significance is evaluated on a geographic scale with four levels: national, state, regional and local. The definition and application of the criteria are detailed in Supporting Study 3.

6.3.1 Study Methods

The flora and fauna study methods are summarised below; further detail on the methods is provided in Supporting Study 3.

Flora

Taxonomy

The plant names and method of classification used in this report follow Ross and Walsh (2003), the 2005 Victorian Department of Sustainability and Environment (DSE) Flora Information System and the DSE ecological vegetation classes (EVC) benchmarks, as cited in Supporting Study 3.

Literature and Database Review

Data from the DSE Flora Information System and EVC benchmarks were reviewed and collated. The Department of Environment and Heritage protected matters search tool was also accessed.

DSE biodiversity interactive maps and the Museum of Victoria butterfly database were also examined for significant species, using methods such as the Bioinformatics search tool.

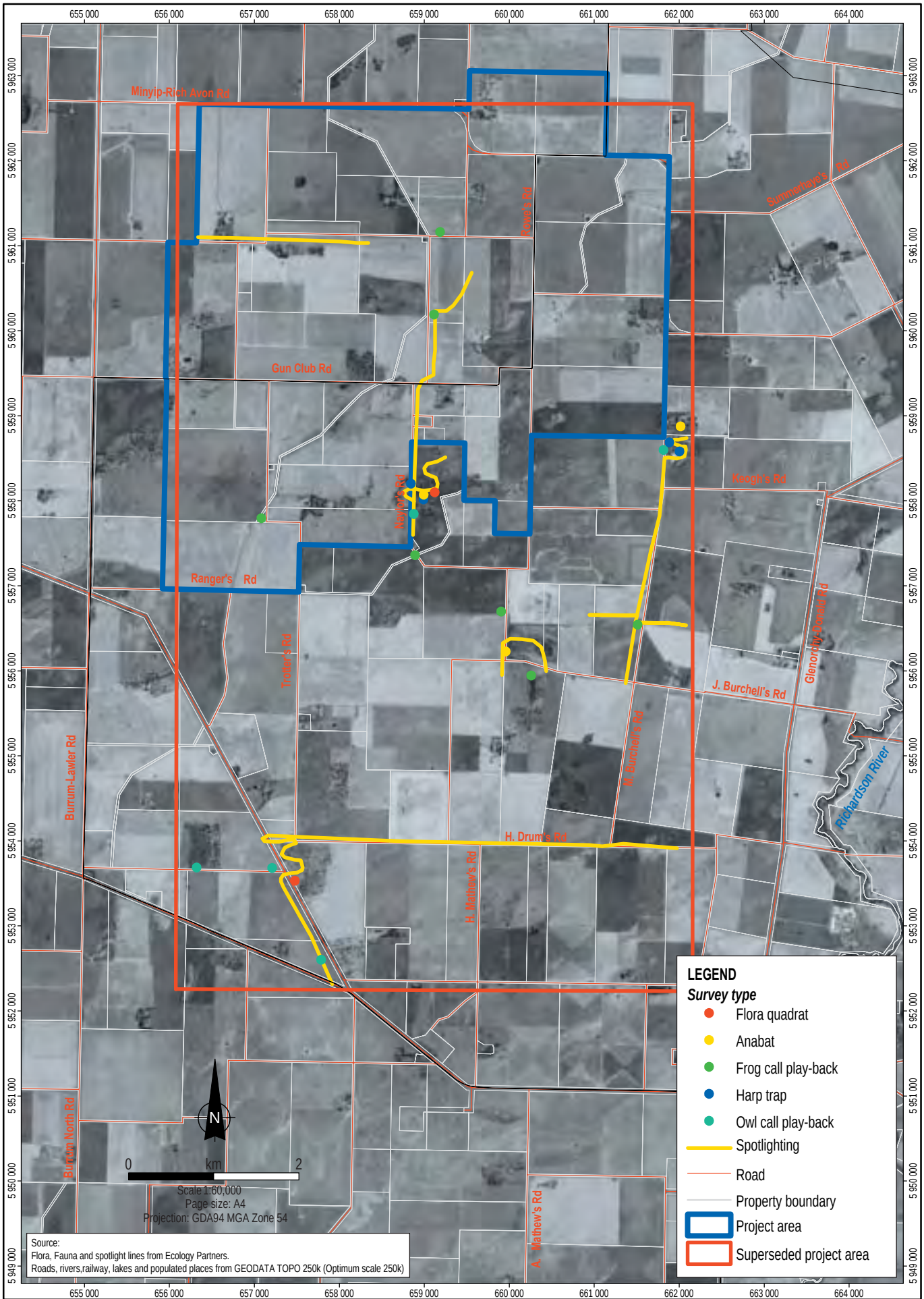
Field Survey

Ecology Partners undertook detailed botanical surveys of the superseded project area over a total of six days between late November and mid December 2005. During this time, the entire site was visually assessed, noting locations of remnant patches. All remnant patches, with the exception of one site, were assessed in detail noting species present. Access to the remaining site was restricted and, therefore, assessment had to be made using binoculars from the closest possible vantage point. Two vegetation quadrats (Figure 6.8) were also sampled, making observations of condition, composition and structure of vegetation communities and of adjoining roadside. A GPS hand-held unit was used to obtain an accurate location of significant flora species in the superseded project area. From this, a detailed flora list of the superseded project area was collated.

As part of the investigation of the proposed road upgrades for vehicle and machinery access between the project area and Minyip railway, a vegetation assessment was later conducted between 25 to 27 October 2006 along the two haul routes options described in Section 4.13.6. An area of approximately 8 m was surveyed for the two route options.

Water Supply Pipeline Route Options

The GWMWater system pipeline and the Avon Deep Lead are the two water supply options being considered by DMS. For the purposes of the study, it has been assumed that both require new pipelines in a general zone of supply.



coffey natural systems

Date: 25.09.2007
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F06.08_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Flora and fauna survey coverage

Figure No: 6.8

which a water supply infrastructure corridor could be located. A preliminary assessment (desktop study) of the existing environment and potential areas for avoidance in these two pipeline zones of supply was undertaken by Goldfields Revegetation Pty Ltd in August 2007 (Supporting Study 12).

Net Gain Assessment

A net gain assessment was undertaken by Ecology Partners in October 2006 and is presented as Supporting Study 4. Potential impacts of the proposal on indigenous vegetation were the subject of this assessment in accordance with the Victorian Government's Native Vegetation Management Framework (the Framework). The Framework uses a qualitative and quantitative measurement, known as the habitat hectare, to enable the application of net gain. This measure is applied to calculate the potential losses and gains of native vegetation. The net gain assessment considers vegetation patches with an indigenous canopy layer greater than 20% and/or an indigenous understorey cover of at least 25%. The primary goal of the Framework is to achieve (DNRE, 2002):

> a reversal, across the entire landscape, of the long-term decline in the extent and quality of native vegetation, leading to a net gain.

Net gain is implemented through the *Planning and Environment Act 1987*, under Amendment VC 19 to the Victoria Planning Provisions and applies to all Victorian planning schemes except the Port of Melbourne.

There is a three-step approach to ensuring net gain:

- Avoiding adverse impacts to indigenous vegetation.
- If impacts cannot be avoided, minimising impacts through appropriate consideration in planning processes and expert input into project design and management.
- Offsetting unavoidable impacts.

Under the Framework, net gain losses and offsets are assessed in terms of:

- Habitat hectares, a measurement of the quality and quantity of indigenous vegetation for each EVC, provided that indigenous species represent at least 20% of the canopy and/or 25% of the understorey layer of vegetation.
- Tree protection and/or replacement for the removal of large, medium and other trees. This applies to patches of indigenous vegetation as defined above for large trees as well as areas of land containing scattered trees that cannot be described as patches of indigenous vegetation (e.g., scattered trees in a paddock).
- The temporal nature of the loss (e.g., mining followed by rehabilitation), as described in the Framework (DNRE, 2002).
- Revegetation for land or water protection.
- Improvements in the quality or extent of indigenous vegetation in a selected 'offset area'.

Limitations

The flora surveys conducted for the project included only vascular flora (ferns, conifers and flowering plants).

The spring and early summer period is an optimal time for a flora survey in grassy woodland environments as most plants are spring flowering. Many of the species in these environments may be missed by surveys outside this time. Data was collected by two Ecology Partners surveys; a preliminary survey in early spring 2005 and a larger survey in late spring to early summer 2005. A substantial data set already exists within the DSE Flora Information System. More species may have been recorded if the region was not experiencing one of the worst droughts on record and with longer surveys. However, since most of the site has been highly modified and surveys were conducted at optimal times, the survey findings are not expected to be adversely affected.

In addition, access to one property in the project area was restricted; therefore, assessment had to be made using binoculars from the closest possible vantage point.

Vertebrate Fauna

Taxonomy

Common and scientific names for terrestrial and aquatic vertebrates (mammals, birds, reptiles, amphibians, fish) follow the Atlas of Victorian Wildlife (AVW Database).

Literature and Database Review

Fauna records were obtained from a search of the AVW Database maintained by the DSE. The AVW Database listed the fauna species found in a search area within 10 km either side of the site.

Species for which no documented records in the local area exist but for which potential habitat occurs within the superseded project area, as predicted by the Environmental Protection and Biodiversity Conservation Act Protected Matters Search Tool (EPBC Database) have also been considered.

Field Survey

Ecology Partners conducted a detailed field survey between 6 and 9 December 2005 during mild conditions. A range of fauna survey techniques was used, including harp trapping, Anabat Z-caim recording, spotlighting, call playback (owl and frog) and active searching. Field survey coverage is shown in Figure 6.8.

A fauna assessment was later conducted between 25 to 27 October 2006 along the proposed access roads between the project area and the Minyip railway. Fauna species were identified within 8 m of either side of the existing pavement.

Water Supply Pipeline Route Options

Fauna records for the two pipeline zones of supply were obtained from a search of the DSE/Viridans Biological Database as outlined in Supporting Study 12.

Limitations

The fauna surveys conducted for the project were primarily concerned with terrestrial vertebrates (mammals, reptiles, birds and frogs). The timing of the surveys, in spring, their duration and the prevailing weather conditions were considered suitable for detecting most fauna present in the superseded project area. Reptiles were; however, found to be inactive and some species present would have been missed. Subsequent communications with DSE have identified a number of threatened or regionally significant reptiles that may be within the project area (Peterson, pers. comm., 2007). Fauna

species detection was also limited by the severe drought conditions and restricted access to some properties.

Several fauna survey techniques were undertaken over a small number of days and nights, making it difficult to quantitatively assess the relative use of habitats by particular species, and accurately determine the overall importance of habitats for certain fauna species. A more complete species list could be obtained with additional surveys at other times of the year. A greater level of survey effort would also provide a better understanding of the use of the site by those species that were recorded during the present survey (e.g., how many individuals and which parts of the site are most important for given species).

Overall, the current fauna survey was considered sufficient to detect the presence or habitat of most fauna species in the superseded project area. Recommendations, such as additional surveying or application of a precautionary approach, have been made to overcome any limitations applying to certain fauna species or groups.

6.3.2 Existing Conditions

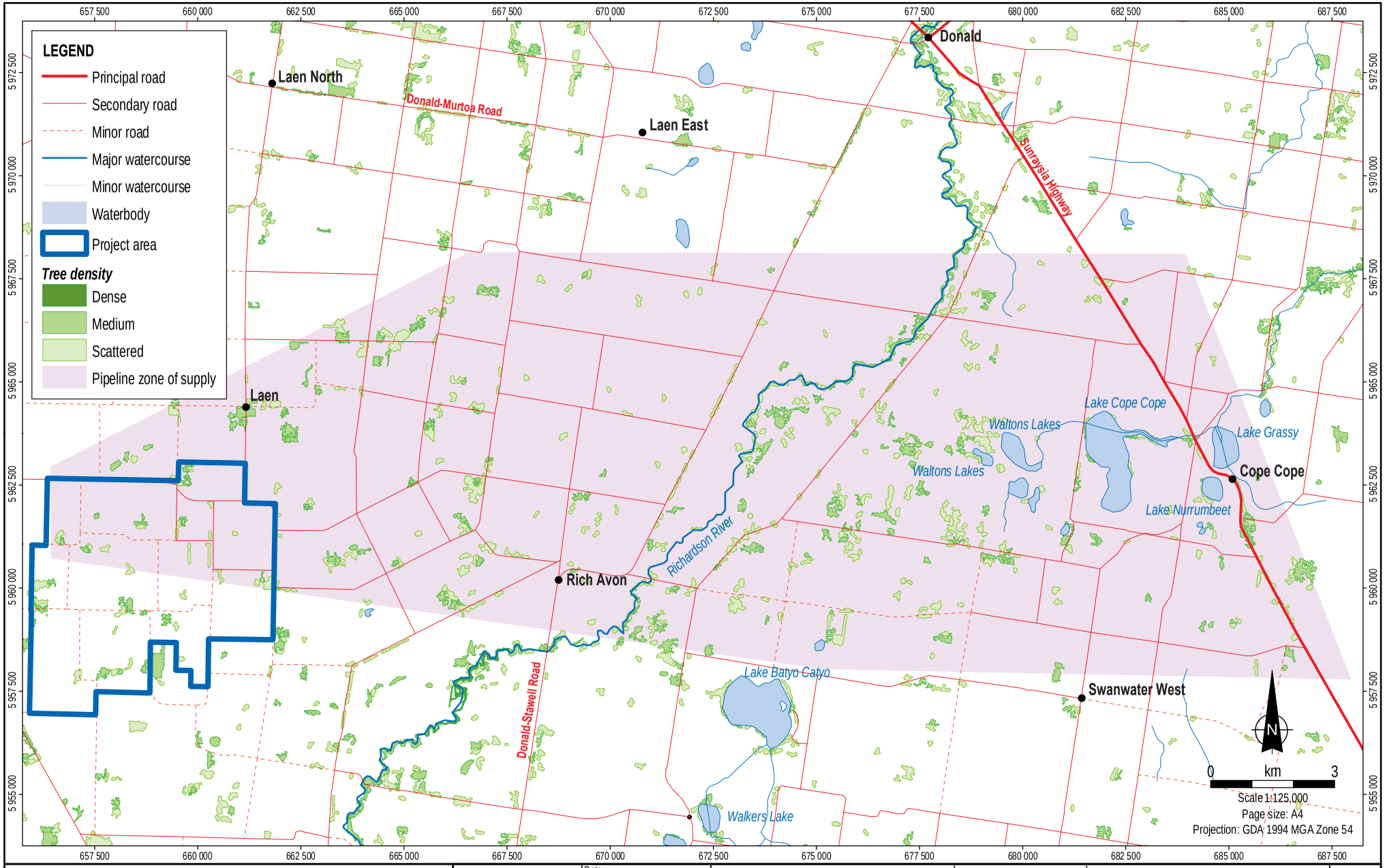
The superseded project area is within the Wimmera Bioregion of Victoria, approximately 240 km northwest of Melbourne. The majority of the project area is located in the Shire of Northern Grampians with the northwest part of the project area located in the Shire of Yarriambiack. As the superseded project area has largely been cleared for agriculture, only scattered patches of original vegetation cover remain. The areas of native vegetation vary in condition from relatively intact native vegetation with few weeds, to stands of trees with a completely exotic understorey. Areas of pasture occasionally support mature, hollow-bearing eucalypts.

Flora

Of the total of 154 plant species were recorded in the superseded project area, 102 species (approximately 66%) are native and 52 species (approximately 34%) are introduced. Database searches identified a further three significant flora species as potentially occurring within 10 km of the superseded project area, two of which have a low likelihood of occurring within the superseded project area. Clearing has reduced native vegetation in the pipeline zones of supply to less than 5% of the area (Figure 6.9) and is largely confined to drainage lines, wetlands and road reserves.

Ecological Vegetation Classes

The superseded project area includes six ecological vegetation classes (EVCs) (Table 6.2). All EVCs identified in the superseded project area, roadside and pipeline zone of supply assessments, are classified as endangered in the Wimmera Bioregion.



Source:
Tree density from VICMAP digital (optimum scale 1:25,000)
Zone of supply digitised from "Avon Deep Lead and Envelope for Pipeline", Goldfields Revegetation Pty Ltd
Placenames, roads and rivers from GEODATA TOPO 250K (optiumum scale 1:250,000)

coffey natural systems

Date: 11.12.2007
MXD: DonaldMineralSandsGIS.mxd
File Name: 972_05_F06.09_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Tree densities in the Avon Deep Lead pipeline zone of supply

Figure No: 6.9

Table 6.2 Occurrence of EVCs

EVC Number		Occurrence			Conservation Status in Wimmera Bioregion
		Superseded Project Area	Roadside Assessments	Pipeline Zone of Supply	
803	Plains Woodland	Yes	Yes	Yes	Endangered
826	Plains Savannah	Yes	Yes	Yes	Endangered
66	Low Rises Woodland	Yes	No	Yes	Endangered
663	Black Box Lignum Woodland	Yes	Yes	Yes	Endangered
96	Ridged Plains Mallee	Yes	No	Yes	Endangered
132	Plains Grassland	No	Yes	No	Endangered
679	Drainage-line Woodland	No	No	Yes	Endangered

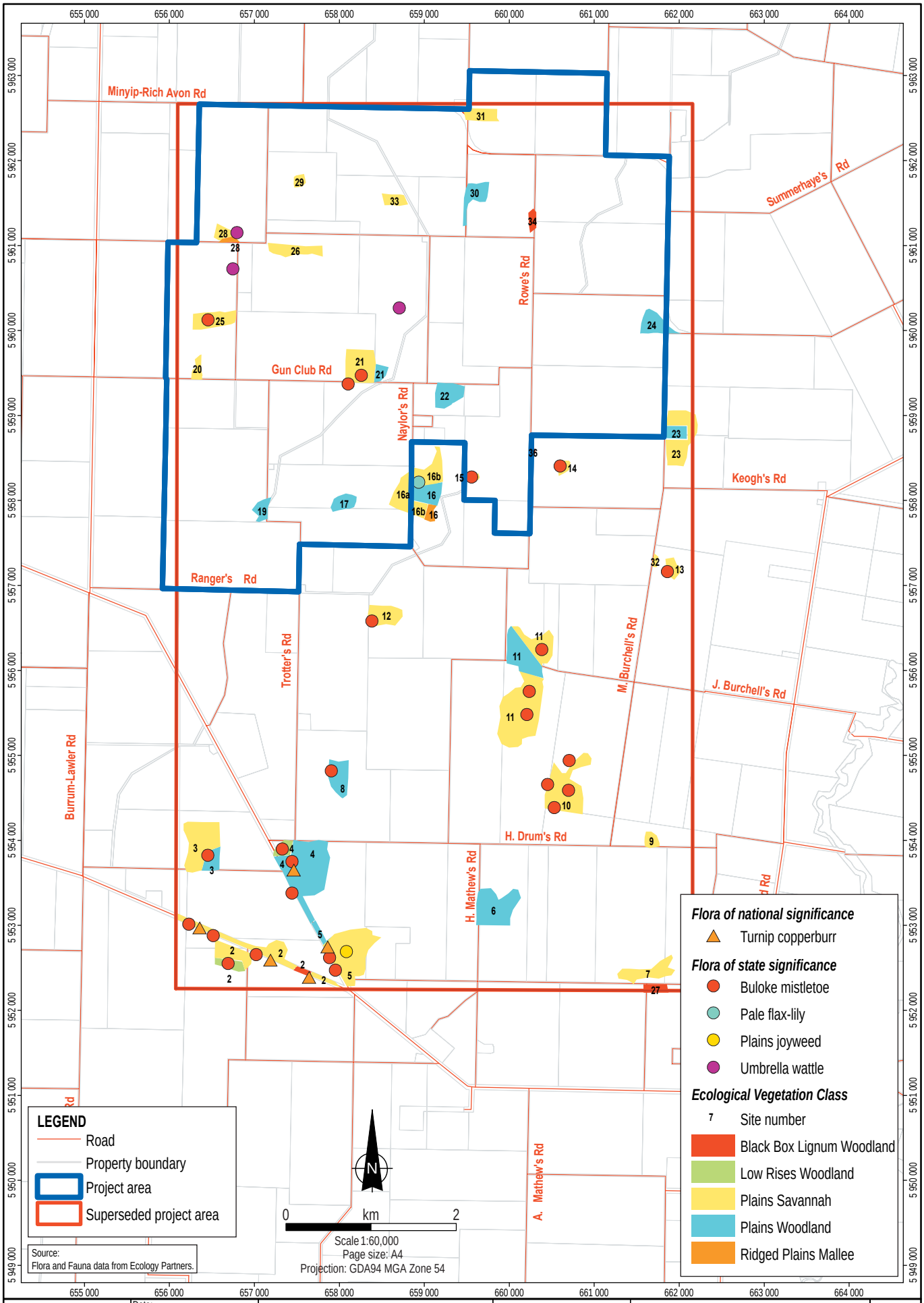
Distribution and Conservation Status

A significant population of the turnip copperburr, a species listed as endangered under the EPBC Act, was recorded in the southern portion of the superseded project area. No EPBC-listed species were recorded as occurring in the project area (Figure 6.10). Two EPBC-listed species, greencomb spider-orchid and slender darling-pea were identified as potentially occurring within the project area by the EPBC Act Protection Matters Search Tool; however, it is predicted that there is a low likelihood of either of these species occurring within the project area (see Table 6.3, below). Two FFG-listed species, the buloke mistletoe and the umbrella wattle, were identified in the project area.

Significant Vegetation Communities

The EPBC Act-listed threatened community 'Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions' applies to many buloke communities with a variety of compositions throughout New South Wales, Victoria and South Australia. As all of the EVCs in the project area, with the exception of the Black Box Lignum Woodland, are communities in which bulokes may be present, they are therefore included under this national listing (DEW, 2007). The DSE has also listed all the vegetation communities in the project area as being endangered in the Wimmera bioregion.

Several Buloke Woodland communities in the Wimmera Bioregion are also listed as threatened under the FFG Act and this most likely includes the Plains Savannah, Plains Woodland and Ridged Plains Mallee EVCs.



coffey natural systems

Date: 25.09.2007
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F06.10_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

National and state significant flora recorded in the superseded project area

Figure No: **6.10**

Table 6.3 Conservation status of plant species

Species	Common Name	Status	Known Location
Plants within project area			
Caladenia tensa	Greencomb spider-orchid.	E, v, L	Not recorded, and low likelihood of occurring within the project area.
Swainsona murrayana	Slender darling-pea.	V, e, L	Not recorded, and low likelihood of occurring within the project area.
Acacia oswaldii	Umbrella mulga.	v	Site 28.
Amyema linophyllum spp. Orientale	Buloke mistletoe.	v	Sites 16a, 21, 25 and 31.
Allocasuarina leuhmannii	Buloke.	l	Scattered throughout most sites.
Austrodanthonia bipartite	Leafy wallaby-grass.	R	Site 24.
Eucalyptus behriana	Slender-leaf mallee.	R	Site 28.
Goodenia glauca	Pale goodenia.	R	Site 31.
Plants within superseded project area (but outside the project area)			
Sclerolaena napiformis	Turnip copperburr.	E, v, L	Sites 2, 4 and 5.
Alternathera sp 1	Plains joyweed.	k	Site 5.
Dianella sp. aff. Longifolia (Riverina)	Pale flax-lily.	v	Site 16b.
Chrysocephalum apiculatum s.l.-Wimmera fine l.	Wimmera common everlasting.	-	Sites 5 and 16b.
Enneapogon nigricans	Nigger-heads.	-	Sites 16b and Naylors Road.
Eremophila longifolia	Berrigan.	-	Site 16b.
Eutaxia microphylla var. *diffusa*	Spreading eutaxia.	-	Sites 2 and 5.
Eucalyptus behriana	Slender-leaf mallee.	R	Site 16b.
Goodenia glauca	Pale goodenia.	R	Sites 3, 8 and 16.
Leiocarpa panaetioides	Woolly buttons.	-	Site 2.
Maireana excavata	Bottle bluebush.	-	Sites 5, 16b.
Opercularia ovata	Broad-leaf stinkweed.	-	Site 2.
Ptilotus erubescens	Hairy tails.	-	Sites 2 and 4.

Notes: CE = critically endangered, E = endangered, V = vulnerable (EPBC Act), e = endangered, v = vulnerable, k = poorly known (DSE, 2005; as cited in Supporting Study 3), l = listed under the FFG Act, R = regionally significant.

Large Old Trees

Approximately 2,062 large old trees occur within the superseded project area including 1,921 large old trees recorded as existing in EVC polygons and 141 large old trees recorded as existing as scattered tress within cleared paddocks.

Weeds

A total of 48 exotic species were identified during the surveys. Key weed species that were identified include:

- Great brome, *Bromus diandrus*.
- Saffron thistle, *Carthamus lanatus*.
- Spear thistle, *Cirsium vulgare*.
- African box-thorn, *Lycium ferocissimum*.
- Horehound, *Marrubium vulgare*.
- Peppercorn, *Schinus molle*.
- Bathurst burr, *Xanthium spinosum*.

Habitat Types

Five broad habitat types were identified in the superseded project area (Figure 6.11) and these are discussed below.

Modified Woodland/Remnant Trees (Plains Woodland and Plains Savannah EVCs)

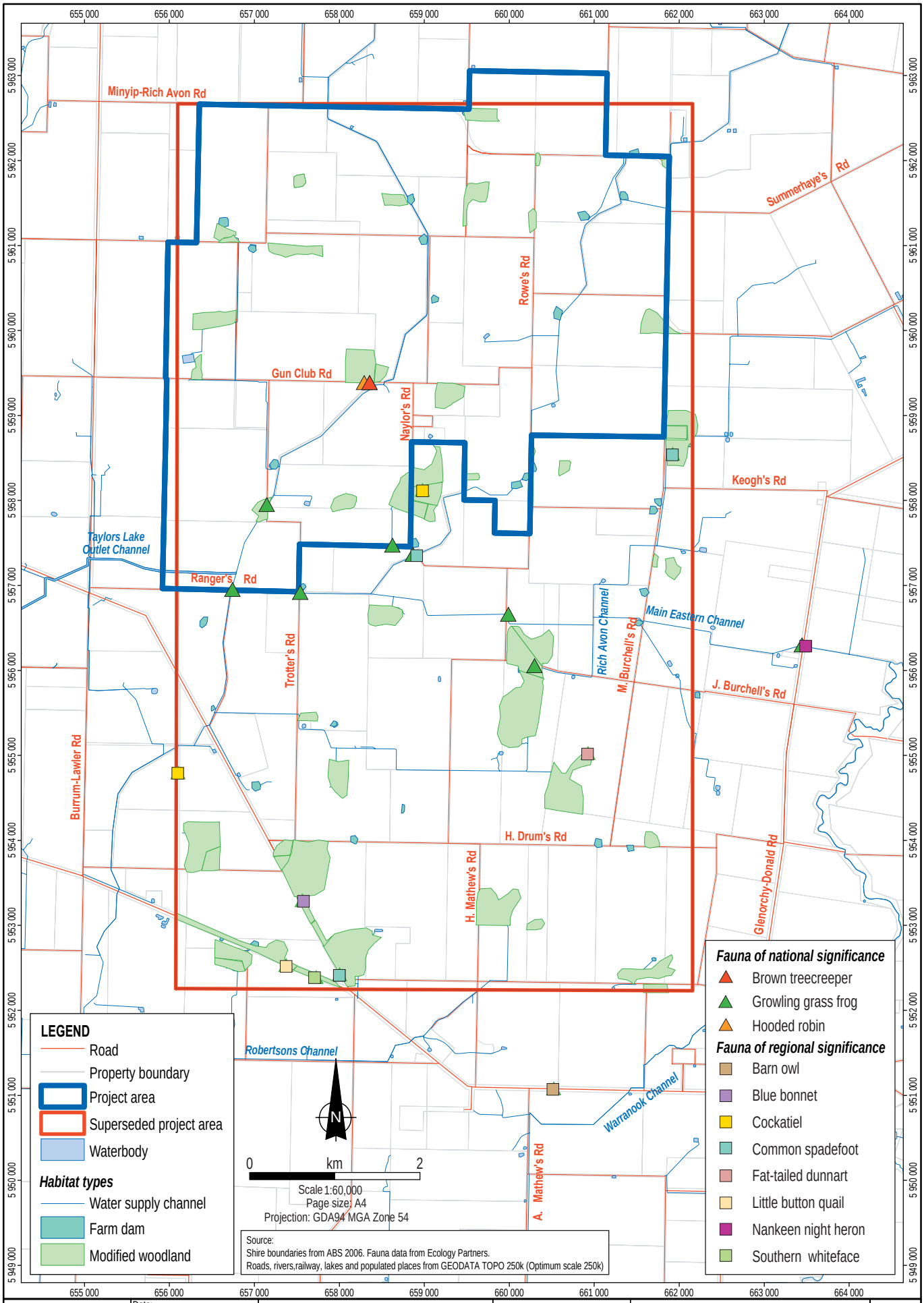
Sporadically located across the superseded project area, this habitat type is of moderate to high value for fauna. Although the majority of remnants are floristically and structurally deficient, these patches are likely to act as ‘stepping stones’ of habitat for mobile species adapted to modified environments (predominately birds). Most of the remnants are unfenced and grazed by stock, and have no apparent management or enhancement actions in place. Due to the modified nature of most of these remnants, few native fauna are likely to use this habitat. Larger remnants are; however, likely to support a suite of significant woodland birds and some birds of prey. A small number of ground-dwelling fauna such as reptiles and native frogs are expected to persist in areas, particularly where there is adequate cover.

Planted Vegetation

An assortment of Australian native and exotic trees and shrubs has been planted, principally around the homesteads throughout the superseded project area. The habitat value for this type ranges from low for juvenile or immature plantings, to moderate for mature specimens. Many of these trees are mature, reaching a height of up to 20 m and support hollows. For birds, the trees provide an important foraging resource and low growing shrubs provide nesting and foraging habitat.

Water Supply Channels

A number of permanent water supply channels exist throughout the superseded project area. Parts of these water supply channels are considered to be of a high habitat value for the EPBC-listed growling grass frog, and a moderate habitat value for other fauna species including water birds. As part of the



coffey natural systems

Date: 25.09.2007
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F06.11_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Significant fauna within the superseded project area

Figure No: 6.11

Wimmera Mallee Pipeline Project, a strategy for decommissioning channels across the Wimmera-Mallee area is under development. Part of this strategy will be identifying the need for retention of any sections of the channel; otherwise, it is anticipated that channels in the Wimmera Mallee Pipeline Project area will be decommissioned. Construction of the Wimmera Mallee Pipeline Project is expected to be completed before 2010; however, decommissioning is likely to occur over a longer period.

Artificial Water Bodies (Farm Dams)

Several artificial water bodies exist within the superseded project area and these are considered to be of low to moderate habitat value for fauna. They currently support low levels of emergent macrophytes and aquatic vegetation, with few refuge sites such as logs or rocks. Both waterbirds and frogs are expected to use this habitat.

Exotic Grass/Crops

Occurring throughout much of the superseded project area where native vegetation has been removed, this habitat is considered to be of low habitat value for fauna. Few native species are known to use this habitat, principally bird species adapted to modified habitats. Although introduced grass and crops does not provide important habitat for fauna per se, it does provide dispersal opportunities (cover) for reptiles, frogs and other species into more optimal habitats throughout the local area.

Notable Fauna Habitat Values

Two notable fauna habitat values existing in the superseded project area are hollow-bearing trees and wildlife corridors.

Hollow-bearing Trees

A total of 28 fauna species dependent upon hollows (e.g., parrots, bats) and 11 species that are likely to use hollows occasionally (i.e., partially dependent) were either recorded during the surveys or have previously been recorded in the local area. Due to extensive clearing of woodland habitat in the superseded project area and across the landscape, tree hollows, which are important in the life cycle of many woodland birds and mammals, are likely to be scarce.

Wildlife Corridors

Wildlife corridors and ‘stepping stones’ of vegetation have numerous benefits to native fauna populations, particularly in modified landscapes where much of the surrounding vegetation is restricted to linear strips along roadsides or streams. Key benefits are associated with protecting ecosystem functionality, providing habitat and maintaining species richness and diversity. Although remnant native vegetation in the superseded project area is not contiguous with larger areas of habitat in the local area and therefore does not technically constitute a wildlife corridor, it does; however, act as important stepping stones providing habitat and facilitating movement of species throughout the landscape. Further, irrigation drainage channels act as important habitat and dispersal corridors for the EPBC-listed growling grass frog.

Fauna

Fauna Species

A total of 99 fauna species were observed during field surveys. Database searches identified an additional 90 species that had been recorded in the area and the EPBC Act search identified another eight species as occurring, or potentially occurring, within 10 km of the superseded project area. Results of the fauna surveys and database searches for the superseded project area are presented in Table 6.4. Significant fauna observed during the survey are provided in Figure 6.11.

Table 6.4 Fauna species in the superseded project area

Method	Total	Exotic
Mammals		
Current field surveys^	14	4
Atlas of Victoria	2	1
PMST*	3	-
Birds		
Current field surveys	72	6
Atlas of Victoria	85	-
PMST	3	-
Reptiles		
Current field surveys	6	-
PMST	1	-
Frogs		
Current field surveys	5	-
PMST	1	-
Fish		
Current field surveys	1	-
PMST	1	-
Invertebrates		
MoV database	3	-
Total	**197**	**11**

^Current field surveys include those undertaken in 2005.

*PMST EPBC Act Protected Matters Search Tool. This tool provides fauna species that occur or have the potential to occur within the superseded project area.

In addition to this, the DSE/Viridans Biological Database lists 201 species for the pipeline zones of supply.

Significant Fauna Species

Two nationally significant fauna (growling grass frog and hooded robin) were recorded in the superseded project area during the survey. Although the hooded robin is not listed as threatened under the EPBC Act, or by the DSE, it is currently listed as lower-risk near-threatened under ‘The Action Plan

for Australian Birds'. In addition, two species recorded in the local area were documented in the Atlas of Victorian Wildlife and the EPBC Act Protected Matters Search Tool identified seven species as occurring or potentially occurring within a 10-km radius of the superseded project area. A total of 5 reptile species, one of national significance, one of state significance and three of regional significance, were also identified as potential occurring within the project area (Peterson, pers. comm., 2007). National and state significant species identified as occurring or potentially occurring in the superseded project area are presented in Table 6.5.

In the pipeline zones of supply, 21 species listed by state or commonwealth agencies were identified by the DSE/Viridans Biological Databases. One of these was the growling grass frog and the remainder were birds.

Significant Fauna Communities

The superseded project area is within the geographic area of the Threatened Woodland Bird Community and supports suitable habitat (box-ironbark, yellow box, cypress pine and other woodlands) and assemblage of birds that define this community. Four woodland dependent birds listed in this threatened community were recorded during the surveys (hooded robin, brown treecreeper, bush stone-curlew and diamond firetail). This community is listed as threatened on Schedule 2 of the FFG Act.

6.3.3 Issues

Potential issues for habitat and biodiversity as a result of construction and operation of the project include:

- Vegetation and habitat loss in the project area and along the haul route.
- Habitat fragmentation.
- Increased noise disturbance in fauna habitats.
- Loss of hollow-bearing trees.
- Sedimentation of water supply channels.
- Increased number of weeds.
- Impacts on significant flora species and communities.
- Impacts on significant fauna.

Based on the proposed development and vegetation clearance strategy (i.e., preferred mining scenario) there is an estimated 14.82 habitat hectares proposed to be cleared in the project area, including:

- 9.38 habitat hectares of Plains Woodland.
- 4.34 habitat hectares of Plains Savannah.
- 1.10 habitat hectares of Black Box Lignum Woodland.
- 516 large old trees in remnant vegetation patches.
- 141 scattered large old trees.
- 38 scattered medium old trees.

Table 6.5 Conservation status of fauna species

Species	Common Name	Status	Known Location
Nationally significant fauna			
Dasyurus maculatus maculatus	Spot-tailed quoll (southeast mainland population)	V, e, L	No suitable habitat for this species within the superseded project area.
Isodon obesulus obesulus	Southern brown bandicoot	V, nt	No suitable habitat for this species within the superseded project area.
Nyctophilus timoriensis (south-eastern form)	Greater long-eared bat	V, v, L	Superseded project area unlikely to constitute important habitat for this species.
Pedionomus torquatus	Plains wanderer	V, cr, L	Species is unlikely to regularly use habitats in the superseded project area.
Lathamus discolor	Swift parrot	E, e, L	Small numbers may use trees within the superseded project area (particularly planted natives) on extremely rare occasions during winter. However, this species is not likely to reside within the superseded project area for extended periods.
Rostratula australis	Australian painted snipe	V, cr, L	No important habitat for this species in the superseded project area, though it may be a rare visitor.
Delma impar	Striped legless lizard	V, e, L	Has been located in degraded plains grassland/woodland remnants on roads and rail reserves 11 km to the south of the project area. No suitable habitat for this species within the superseded project area.
Litoria raniformis	Growling grass frog	V, e, L	Several adult frogs and a large number of tadpoles were detected during the current survey in water supply channels and farm dams. These habitats are considered important for the long-term persistence of this species in the superseded project area, and possibly in the local area.
Xanthomyza phrygia	Regent honeyeater	E, cr, L	No suitable habitat for this species within the superseded project area.
Maccullochella peelii peelii	Murray cod	V, e, L	No suitable habitat for this species within the superseded project area.
Melanodryas cucullata	Hooded robin	#nt, nt	Several birds were observed in remnant woodland patches including sites 4, 5, 10, 16b and 21. Expected to be a resident in larger patches of remnant woodland habitat in the superseded project area.
Rallus pectoralis	Lewin's rail	#nt, v	May be a vagrant visitor to the area. Habitats in the superseded project area provide marginal foraging habitat for the species.

Table 6.5 Conservation status of fauna species (cont'd)

Species	Common Name	Status	Known Location
State significant fauna			
Climacteris picumnus victoriae	Brown treecreeper	#nt, nt	Recorded during survey in the majority of larger remnant woodland sites during the surveys and also within Plains Woodland remnants along the roadside of haul route option 1. Sites possessing a high cover of remnant tress and levels of coarse woody debris on the ground are likely to be important for the long-term persistence of this species in the superseded project area and in the local area.
Turnix pyrrhothorax	Red-chested button-quail	v, L	Species is unlikely to regularly use habitats in the superseded project area.
Porzana pusilla	Baillon's crake	v, L	May be a rare summer visitor to the superseded project area, particularly along water supply channels.
Charadrius australis	Inland dotterel	V	Although it is likely to be a rare visitor to the site, there is no important or limiting habitat for this species in the superseded project area.
Burchinus grallarius	Bush stone-curlew	e, L	At least one individual has previously been recorded in the vicinity of the superseded project area. The superseded project area does not appear to support a population of this species.
Grus rubicunda	Brolga	v, L	Although individuals may on occasions reside in the superseded project area, there is no suitable breeding habitat or habitat considered important for the long-term survival of the species in the area.
Platalea regia	Royal spoonbill	V	Marginal habitat for this species (farm dams and water supply channels) exists. Species is; however, unlikely to regularly use habitats in the superseded project area.
Ardea alba	Great egret	v, L	Marginal habitat for this species (farm dams and water supply channels) exists. Species may use the superseded project area on an occasional basis.
Anas rhynchotis	Australasian shoveler	v	Marginal habitat for this species (farm dams and water supply channels) exists. Species may use the superseded project area on an occasional basis.
Aythaya australis	Hardhead	v	Marginal habitat for this species (farm dams and water supply channels) exists. Species may use the superseded project area on an occasional basis.
Biziura lobata	Musk duck	v	No suitable habitat for this species within the superseded project area.

Table 6.5 Conservation status of fauna species (cont'd)

Species	Common Name	Status	Known Location
State significant fauna (cont'd)			
Falco subniger	Black falcon	v	Although it is likely to be a rare visitor to the site, there is no important foraging or nesting habitat for this species in the superseded project area.
Ninox connivens	Barking owl	e, L	Although it is likely to be a rare visitor to the site, there is no important or limiting habitat for this species in the superseded project area.
Stagonopleura guttata	Diamond firetail	v, L	Recorded during survey within Plains Woodland remnants along roadside access option 1. May be a resident or occasional visitor to sites possessing woodland habitat supporting a relatively dense understorey in the superseded project area.
Pygopus schraderi	Hooded scaly-foot	L	Only historic (pre 1900s) recordings exist. However, due to recent observations of the regionally significant tessellated gecko and curl snake, surveys for the hooded scaly-foot will be undertaken by DSE in 2008 (Peterson, pers. comm.,2007).

E = Endangered, V = Vulnerable, CD = Conservation Dependent (EPBC Act).

= National Action Plan, nt = lower risk – near threatened.

cr = critically endangered, e = endangered, v = vulnerable, nt = lower risk – near threatened (DSE, 2003; as cited in Supporting Study 3)

L = Listed under the FFG Act.

Approximately 13.72 habitat hectares out of a total of 39.85 habitat hectares of Plains Woodland/Plains Savannah (which is equivalent to the EPBC-listed threatened community 'Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions) are proposed to be cleared. There is not expected to be any clearance of Low Rises Woodland and Ridged Plains Mallee.

6.3.4 Avoidance, Mitigation and Management Measures

Impacts to habitat and biodiversity will be avoided by implementing the following measures:

- Mining will be undertaken in the northern section of the superseded project area to avoid sites of national and state conservation significance, including the EPBC-listed turnip copperburr, located in the south of the superseded project area.
- The mine plan will avoid site 16a, which is of state significance, and will maintain a buffer zone of approximately 100 m around this site.
- Pipes and other infrastructure will be preferentially placed in areas devoid of remnant vegetation. Where this cannot be achieved, pipes will be directionally drilled underground to avoid impacts to native vegetation and fauna habitat.
- Any required clearing will be managed to prevent potential damage to retained vegetation through soil and root disturbance, falling trees and branches, or other damage such as spills.
- Stockpiles and infrastructure will be located on cleared land to reduce impacts on remnant vegetation.
- All staff and contractors to undertake environmental care inductions that will include awareness of the location of sites of ecological significance to be retained throughout the project.

Drainage and Sediment Control

Sediment and drainage control will feature in the work plan to be developed prior to construction to ensure potential damage is minimised to adjacent vegetation, water supply channels and other waterbodies. This will include provisions for monitoring and maintenance of sediment control measures and will address the potential movement of litter, sediment, weed seeds, hydrocarbons and other chemical pollutants from reaching water supply channels or other waterbodies. This is discussed further in Section 6.1.

Significant Flora Species

Subject to necessary approvals, salvage and propagation of significant species for replanting in areas of suitable protected habitat will be undertaken in preparation for rehabilitation. Management of the use of herbicides for weed control will reduce the potential for non-target organisms. Should it be selected, the use of haul route option 1 will mean a slight increase in vegetation clearance requirements.

Growling Grass Frog

Any impacts on the populations of the growling grass frog should be considered in the context of the potential decommissioning of water supply channels in the project area as part of the Wimmera Mallee Pipeline Project. Although growling grass frogs were also found in a farm dam in the project area, most farm dams in the project area are fed by the water supply channel and will be therefore be affected by

the potential channel decommissioning. If the water supply channels are not decommissioned prior to the mining, three main options will be considered to reduce the impact on the species. These include:

- Preparation and implementation of a detailed species conservation management plan including provisions for salvage, translocation and monitoring protocols.
- Contribution to the conservation of suitable other sites known to support a population of the growling grass frog.
- Contribution to the conservation objectives/actions outlined in the species Draft Flora and Fauna Guarantee Action Statement.

Each of these options is discussed in more detail in Supporting Study 3. A co-operative approach (with GWMWater and DSE) to the management of growling grass frog populations in the project area will be implemented to minimise the potential impacts on frog populations.

Hollow-dependent Fauna Species

Salvage of hollow-dependent fauna and relocation measures will be implemented immediately prior to and during any clearance of hollow-bearing trees in the project area in accordance with a fauna relocation plan. Relocation sites will be predetermined based on their suitability for hosting hollow-dependent species. If salvage activities uncover any species undergoing a critical life stage (i.e., bats with lactating young), then salvage of that species will be postponed until that life stage is over. A minimum buffer of 30 m will be put in place, within which machinery and personnel are excluded.

Weed Management

A weed management plan will be implemented to address pre-mining identification of weeds, minimising the disturbance footprint and, where necessary, machinery wash-down procedures.

Monitoring

Prior to mine construction, a further vegetation survey will be undertaken to provide a comprehensive list of species in the project area. Continued monitoring of significant flora and fauna species and weed and pest fauna species will be undertaken in accordance with a vegetation monitoring program.

Road Upgrades

Road upgrades outside of the project area will be carried out under normal local government planning processes administered under the Planning and Environment Act.

Water Supply Pipeline Route Options

Construction of the pipeline will be of short duration, and the area disturbed will be narrow and will use well-established practices to ensure successful rehabilitation. Due to the sparse distribution of trees in the pipeline zones of supply, it will not be necessary to remove any mature trees (see Figure 6.9). Disturbance of vegetation will be limited to areas where it is unavoidable, such as road crossings, and therefore the long-term impact on habitat is negligible. Road reserves will be considered carefully, with appropriate attention being given to ensure sensitive areas with native flora and fauna are avoided or effectively managed. Similarly, the effect on local fauna will be of limited duration and intensity. A more detailed survey will be undertaken following final route selection.

Potential pipeline routes will be assessed and the following vegetation qualities considered:

- EVC and conservation status.
- Condition of the vegetation (habitat hectare score).
- Species present (trees, shrubs, grasses etc.), and ability to propagate for revegetation.
- Weeds (potential for project activities to encourage the spread of weeds).
- Necessity for vegetation clearance: does the pipe laying require actual removal of vegetation or is damage likely (e.g., excavation within drip line of trees).
- Likelihood of successful revegetation.

To ensure ground-disturbing activities associated with pipe laying have a minimal impact and rehabilitation is successful, the following techniques will be implemented:

- Sufficient topsoil will be stripped to provide access for delivery vehicles, trenching equipment and spoil, otherwise topsoil may be damaged by compaction and/or contaminated by subsoil.
- Backfill will be compacted to its original density to prevent settlement. If the ground is dry, as it would typically be in summer, then effective compaction will require the addition of water. To ensure settlement is negligible, the steps below will be followed:
  - Place backfill in several layers at a suitable moisture content and compact each layer.
  - Remove any excess material e.g., subsoil, saline clay, stones etc., as spreading it over the easement will adversely affect revegetation.
  - If the soil type will benefit, spread gypsum over the disturbed area.
- Topsoil will be spread carefully and evenly over the stripped area. Soil will not be handled when too wet or too dry, preventing damage to the soil structure.
- Shallow ripping, to approximately 400 mm depth over the affected area, will offset the compaction caused by the passage of vehicles and earth moving equipment (which can occur even when soil is dry).

Implementing Net Gain

Avoidance and minimisation of vegetation clearance in the project area has been achieved by locating the mine away from sensitive vegetation in the southern section of the superseded project area and by tailoring the mine plan to avoid large old trees and remnant areas in the project area as shown in Table 6.6 and Table 6.7 below and Figure 6.12.

Table 6.6 Large old trees present in the superseded project area

EVC	Number of Impacted Large Old Trees	Total of Large Old Trees within Project Area	% of Total Large Old Trees Impacted
Plains Woodland	216	597	36%
Plains Savannah	284	1,263	22%
Low Rises Woodland	0	0	Not applicable
Black Box Lignum Woodland	16	16	100%
Ridged Plains Mallee	0	45	0
Plains Grassland	0	0	Not applicable
Single-paddock trees (no EVC)	141	141	100%
Total	657	2,062	32%

Table 6.7 Area of each EVC impacted as a result of the project

EVC	EVC Conservation Significance	Impacted Area (Habitat Hectares)	Balance Remaining within Project Area	% of Total Area Impacted
Plains Woodland	High.	9.38	15.28	38
Plains Savannah	High.	4.34	10.85	29
Low Rises Woodland	Very High.	0	0	Not applicable.
Black Box Lignum Woodland	Very High.	1.10	0	100
Ridged Plains Mallee	Very High.	0	0.60	0
Plains Grassland	Not applicable.	0	0	Not applicable.
Total		14.82	26.73	36

Offsets

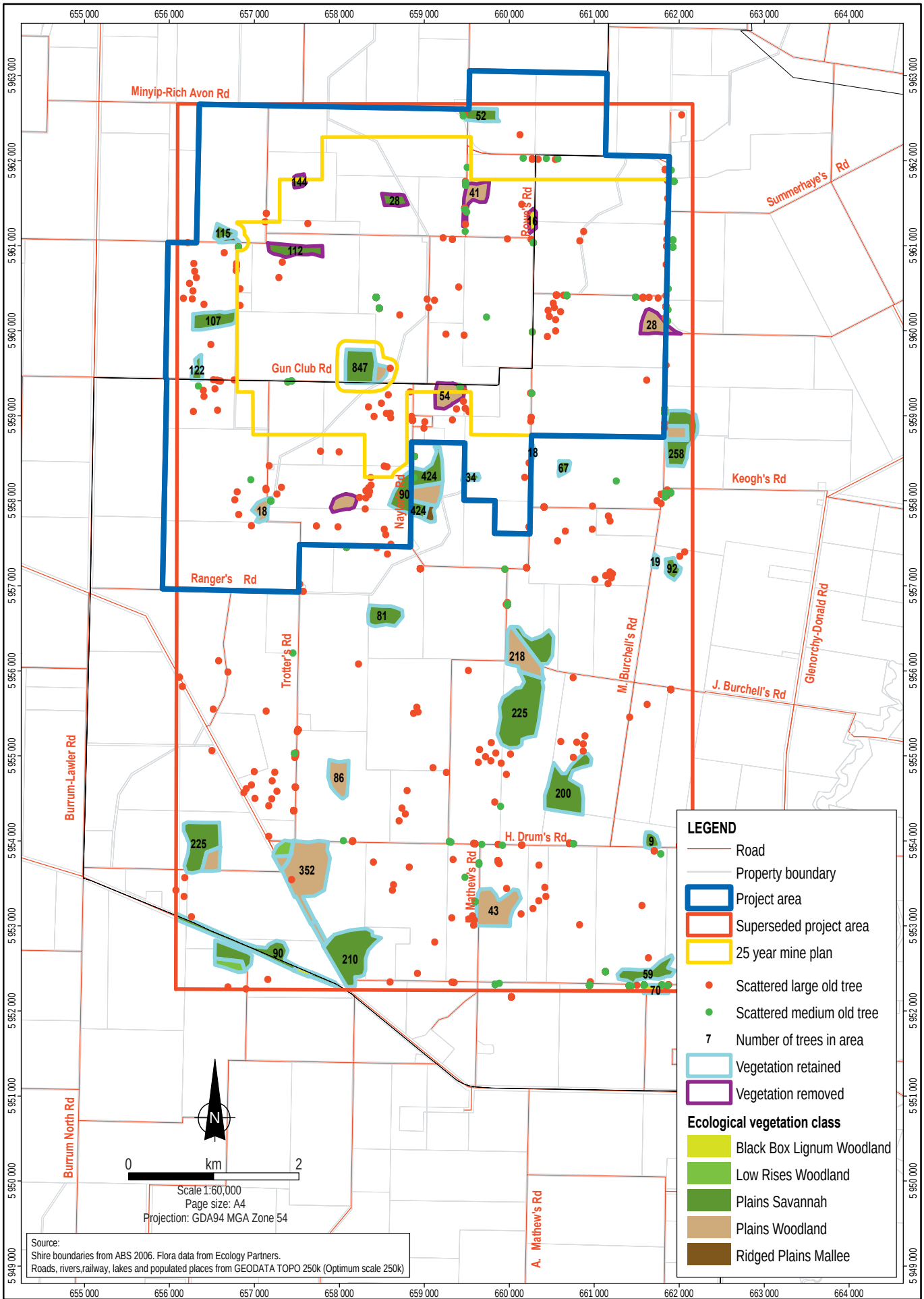
Based on the above unavoidable impacts and accounting for the capacity to revegetate following mining activities in the project area, offset requirements of the Native Vegetation Framework are as follows:

- 12.31 habitat hectares of Plains Woodland.
- 6.06 habitat hectares of Plains Savannah.
- 1.95 habitat hectares of Black Box Lignum Woodland.

Additional requirements include:

- Protection of 3,268 large old trees.
- Recruitment or planting of 17,320 new trees, mostly from Plains Woodland and Plains Savannah.

Preparation of a project specific offset management plan will be undertaken prior to the start of site works. The potential achievement of offsets has; however, been investigated and could be achieved in the project area as follows (indicative habitat hectares used):



coffey natural systems

Date: 25.09.2007
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F06.12_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Net gain assesment

Figure No: 6.12

- Habitat hectare offsets (these calculations assume a minimum habitat score of 12 out of 100 for any rehabilitation in accordance with the DSE habitat scoring methods (DSE, 2004a).
  - 5.28 habitat hectares from rehabilitation of cleared remnant areas.
  - 3.33 habitat hectares from revegetation in new areas (not cleared remnant areas).
  - 11.40 habitat hectares from management of remnant patches retained in the project area.
  - A small additional offset of 0.31 habitat hectares, which could be sourced from some of the more significant sites in the superseded project area, will also be required.
- Scattered tree offsets.
  - 1,405 large old trees protected by managing retained vegetation in the project area.
  - 1,744 large old trees projected by managing vegetation in the superseded project area, subject to relevant stakeholder agreement.

If both of these measures were implemented, a further 119 large old trees would need to be protected off site.

The project will result in the loss of native vegetation that will have to be compensated for in accordance with the Framework. The need for net gain offsets has been reduced by excluding the most significant vegetation sites from the mine plan. Preliminary net gain investigations illustrate that habitat hectare targets could largely be achieved within the project area. Improved management of retained remnant patches within the project area could achieve almost half of the tree targets. Several sites assessed in the superseded project area (sites 2, 3, 4, 5, 11 and 16b) and the DSE's Bush Broker scheme offer additional opportunities to achieve the tree targets, along with additional habitat gains, should some of the retained remnants in the project area be unsuitable as offset sites. A final offset management plan will be developed in consultation with DSE.

The following principles will be adhered to in the preparation of the offset management plan in consultation with DSE:

- Existing remnants and sites where threatened species are present will be protected and/or avoided in preference to clearing.
- Where possible, large old trees will be retained. Where this is not possible, clearance will include stockpiling logs for revegetation activities.
- Appropriately sized buffers will be placed around remnants within the mining area.
- Offsets will be designed to enhance, enlarge and link remnants where possible, and to recreate the range of local EVCs occurring at the site.
- Measures will be undertaken to support the persistence of threatened flora and fauna in the landscape.

6.3.5 Residual Impact Assessment

Residual impacts at the project area are low since the majority of the site is devoid of remnant native vegetation and is of negligible conservation significance. Restoration and rehabilitation of the mined areas will be carried out progressively as the mine advances. The progressive rehabilitation plan is

summarised in Section 6.14, Rehabilitation. When mining operations are complete, the mine void will be filled and the existing topography restored. It is expected that fauna species will become accustomed to any new or increased noise. The consistency of the new noise environment and the absence of sudden, unpredictable noises (such as blasting) means fauna should adapt to mining in a manner similar to agricultural machinery. No additional adverse impacts on biodiversity and habitat are anticipated following the mine's closure.

Section 6.3.4, described the management and mitigation measures that will ensure 'over a specified area and period of time, loss of native vegetation and habitat….(is) more than offset by commensurate gains' (DNRE, 2002) and that a net gain of habitat quality and quantity, protection and management is achieved and non-habitat providing populations of significant plant species are also protected.

EPBC Act Implications

The Commonwealth Minister for Environment and Water Resources declared the project a 'controlled action' under the EPBC Act as 'threatened species or ecological communities (Section 18 and Section 18A - significant impacts on a listed threatened species or a listed threatened ecological community)' are present in the area. In particular, the decision was based on a possibility of significant impacts on the listed threatened ecological community, the buloke woodlands. Implications of the project on matters of national conservation significance are discussed below.

Threatened Ecological Communities

For an endangered ecological community, such as the buloke woodlands, the DEWHA states an action is likely to have a significant impact if there is a real chance or possibility that it will:

- reduce the extent of an ecological community;
- fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;
- adversely affect habitat critical to the survival of an ecological community;
- modify or destroy abiotic (non-living) factors (such as water, nutrients or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;
- cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
    - assisting invasive species, that are harmful to the listed ecological community, to become established; or
    - causing regular mobilization of fertilizers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or
- interfere with the recovery of the local community.

As detailed in Section 6.3.2, all of the EVCs in the project area, except for the Black Box Lignum Woodland, are communities that could be included under the national listing for 'Buloke Woodlands'. The project will have an impact on these EVCs, as it will cause a reduction in the extent of this

ecological community in the project area for the duration of the project. A total of 13.72 habitat hectares of these EVCs will be impacted as a result of the project. In order to reduce the impact on this community, a total of 26.73 habitat hectares will be retained on site and offset requirements of the Native Vegetation Framework (18.37 habitat hectares of these EVCs) will be achieved in accordance with the Offsets Management Plan.

Listed Threatened Species

Approval from the Commonwealth Environment Minister is required if an action will or is likely to have a significant impact on an endangered or critically endangered species. A significant population of the turnip copperburr was located during current surveys in the southern section of the superseded project area. Potential significant impacts to this species have been avoided by locating the project area in the northern section of the superseded project area.

For listed vulnerable species, approval is required if an action will or is likely to have a significant impact on an 'important population' or critical habitat for that species. The DEWHA states:

> An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:
>
> • key source populations either for breeding or dispersal;
>
> • populations that are necessary for maintaining genetic diversity; and/or
>
> • populations that are near the limit of the species range.

An action has, will have or is likely to have a significant impact on a vulnerable species if it will:

> • lead to a long-term decrease in the size of an important population of a species;
>
> • reduce the area of occupancy of an important population;
>
> • fragment an existing important population into two or more populations;
>
> • adversely affect habitat critical to the survival of a species;
>
> • disrupt the breeding cycle of an important population;
>
> • modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
>
> • result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
>
> • introduce disease that may cause the species to decline; or
>
> • interfere substantially with the recovery of the species.

Current surveys indicate that the project area may support an important population of the growling grass frog. This is due to the strong likelihood that irrigation channels and farm dams in the area support a source population for breeding and dispersal of this species. Owing to the presence of the species and known breeding habitat in the project area, the proposed mine may lead to a significant impact under the provisions of the EPBC Act if channels and farm dams are directly or indirectly impacted by the proposed project. As discussed in Section 6.3.4 above, any impacts on the populations of the growling grass frog should be considered in the context of the potential decommissioning of

water supply channels in the project area as part of the Wimmera Mallee Pipeline Project. If the water supply channels are not decommissioned prior to the mining, three main options will be considered to reduce the impact on the species. These include:

- Preparation and implementation of a detailed species conservation management plan including provisions for salvage, translocation and monitoring protocols.
- Contribution to the conservation of suitable other sites known to support a population of the growling grass frog.
- Contribution to the conservation objectives/actions outlined in the species Draft Flora and Fauna Guarantee Action Statement.

Each of these options is discussed in more detail in Supporting Study 3. A co-operative approach (with GWMWater and DSE) to the management of growling grass frog populations in the project area will be implemented to minimise the potential impacts on frog populations. Residual impacts on the growling grass frog population from the Wimmera Mallee Pipeline Project and/or the mine will depend on the success of the management option implemented and will be considered in more detail in the species conservation management plan.

6.4 Air Quality

Heggies Pty Ltd (Heggies) has assessed the air quality implications of the Donald Mineral Sands Project. The study is reproduced in Supporting Study 1 and its results are summarised below.

6.4.1 Existing Conditions

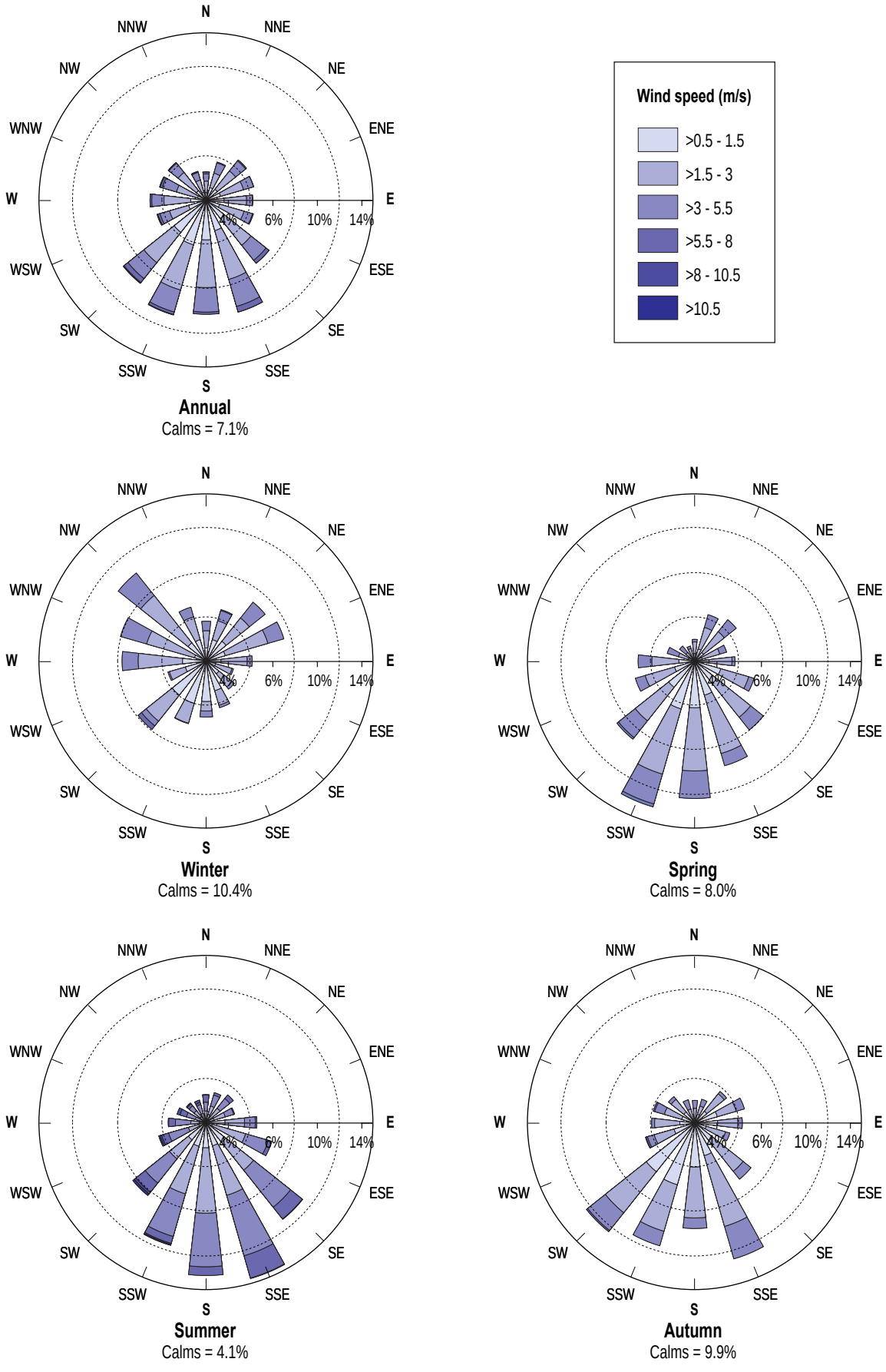
Meteorology

Local meteorological data for the project area has been obtained from the following sites (see Figure 6.3 for site locations):

- Longerenong, 40 km southwest of the project area.
- Charlton, 45 km northeast of the project area.

A meteorological dataset was supplied by the Victorian EPA (recorded between July 2004 and June 2005) and demonstrates that annual wind direction is predominately from the south-southeast to southwest, although some seasonal variation occurs (Figure 6.13). The annual average wind speed is between 1.5 and 8 m/s, i.e., light to moderate. The prevailing winds in the summer months are generally from the southeast to southwest while winds in the winter months occur largely from the west with some northwesterly components.

The stability class of the air mass, used to categorise the rate at which a plume will disperse and required for modelling, is calculated from meteorological observations. The most frequently occurring stability class in the study area is D (on a scale of A to F, where A equates to rapid dispersal and F equates to slow dispersal), occurring about 46% of the time.



Source: Appendix D in supporting study 1.

coffey natural systems	Job No: 972	DMS Pty Limited	DMS A Subsidiary of Astron Limited	Annual and seasonal wind roses representative of the project area, July 2004 - June 2005	Figure No: 6.13
	File Name: 972_05_F06.13_HB	Donald Mineral Sands Project			

Topography of Project Area

The project area is predominately flat, with surface elevations ranging from 126 to 132 m AHD. Terrain surrounding the project area and extending to neighbouring residences is also moderately flat in nature. Subsequently, the implications of topography when assessing the atmospheric dispersion of project-related emissions have not been considered.

Background Air Quality

Dust Deposition

As there are no site-specific dust monitoring data available for the project, existing air quality has been characterised using dust deposition data from Iluka Resources Limited (Iluka). Iluka currently operates a mineral sands mine near Douglas, approximately 110 km southwest of the project area and has established five dust deposition gauges surrounding its operations.

Background dust levels were measured from May 2005 to September 2006 and indicate a dust fall generally in the range of 1.6 to 3.2 g/m^2/month, which is typical of rural conditions. Each of the monitoring sites displayed a number of high to very high levels of dust deposition, and this is believed to be due to the occurrence of local influences, e.g., birds, vandalism of samples or nearby agricultural operations.

The dust deposition location DDG5 (as cited in Supporting Study 1) was identified by Iluka as the most representative monitoring location for background dust deposition levels. A value of 1.6 g/m^2/month has therefore been adopted for the purposes of atmospheric dispersion modelling.

Particulate Matter (PM)

As there are no site-specific particulate matter monitoring data available for the project, in accordance with advice from the EPA, indicative background levels for the region have been obtained from the EPA monitoring station located at Bendigo, approximately 130 km east-southeast of the project area.

Ambient concentrations of PM_{10} and $PM_{2.5}$ were assessed using EPA air quality monitoring data[3] recorded from July 2004 to June 2005. Results indicate that the highest 24-hour-average PM_{10} concentration was 55.7 µg/m^3 (recorded on 28 April 2005), below the project-related criterion of 60 µg/m^3. The annual average 24-hour PM_{10} concentration recorded was 19 µg/m^3.

Similarly, the highest 24-hour-average $PM_{2.5}$ concentration was 22.3 µg/m^3 (also recorded on 28 April 2005), well below the project-related criterion of 36 µg/m^3. The annual average 24-hour $PM_{2.5}$ concentration recorded was 7.5 µg/m^3.

Nitrogen Dioxide, Carbon Monoxide and Polycyclic Aromatic Hydrocarbons (PAHs)

Diesel fuel will be used to power on-site equipment and vehicles, therefore nitrogen dioxide (NO_2), carbon monoxide (CO) and PAHs have been modelled when assessing the atmospheric dispersion of project-related emissions.

[3] It has been assumed that background levels of PM_{10} and $PM_{2.5}$ vary on a daily basis.

Background concentrations for these pollutants were derived using 70th percentile annual concentrations and were recorded at the Bendigo monitoring station. Average (1-hour) background concentrations assumed for the project were 7 ppb (13 µg/m^3) for NO_2 and 0.1 ppb (114 µg/m^3) for CO. As agreed with the Victorian EPA, a negligible background concentration for PAH was assumed.

Respirable Crystalline Silica (RCS)

As agreed with the Victorian EPA, an annual background concentration of 1.7 µg/m^3 was assumed for RCS.

6.4.2 Assessment Method

Modelling Approach

The Gaussian plume dispersion model AUSPLUME (detailed in Supporting Study 1) considers factors such as meteorology and topography and was used to assess the air quality impacts from the project on the surrounding area. In particular, air quality emissions were predicted for the following two scenarios[4]:

- Year 2 Extraction, where ore extraction occurs within the northern region of the project area, located closest to receptor R2 (Figure 6.14).
- Year 24 Extraction, where ore extraction occurs within the eastern region of the project area, located closest to receptor R5 (see Figure 6.14).

The potential impacts of the project during these two scenarios have been modelled for two separate methods of ROM ore transportation from the pit to the processing plant. The two methods are via haul truck and slurry pumping.

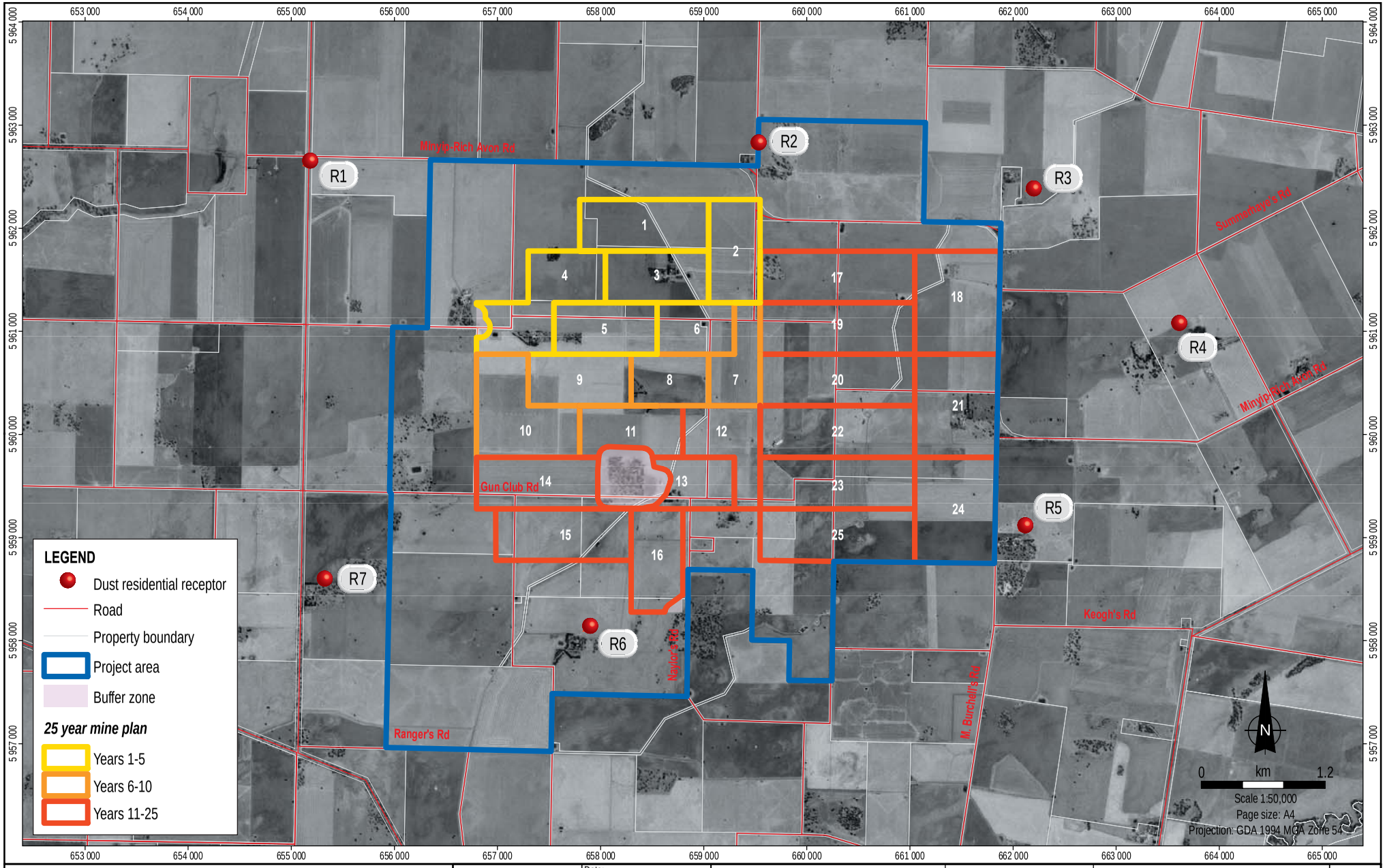
The results have been summarised below; however, DMS has committed to pumping the ore directly from the in-pit trommel to the processing plant and will therefore not further consider truck haulage.

An emission inventory associated with the two modelled scenarios has been derived to reflect a worst-case scenario of airborne emissions over a 24-hour period, and mean average operational conditions for annual assessment. Mine planning information used to produce this inventory includes the relative locations of mining and waste emplacement, locations of haul routes, truck sizes, the types of equipment used to load ore and overburden and the likely moisture content of ore, overburden and soils as well as the silt content of these materials.

Site Establishment Phase

Prior to the commencement of full mining operations, there will be a period of site establishment. This period is expected to occur within the first two years of the 25-year project life and will involve the clearing of sections of the existing land for the construction of access and internal haul roads and on-site infrastructure.

[4] These scenarios were modelled as they represent different operating conditions over the life of the project and consider the location of mining and processing activities, the processing plant and the proximity of these factors to the closest sensitive residential receptor.



	coffey natural systems	Date: 30.10.2007 MXD: File Name: 972_05_F06.14_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Location of sensitive residential receptors	Figure No: 6.14

As the emissions generated during the site establishment phase will not be as significant as those generated during normal mining operations, this phase has been omitted when assessing the impacts of project-related air quality emissions on the surrounding area.

Train Loading Facility

If HMC transport by train is utilised, it will be delivered by truck to one of two possible sites for the rail siding, to the west of the project area (see Figure 6.24 in Section 6.9). The exact location of the siding has yet to be determined; therefore, both locations (Scenario 1: North and Scenario 2: South) have been assessed. The two methods considered for product delivery and handling included:

- Container transfer, where the final HMC product is delivered to the siding from the processing plant by truck, containerised, then transferred to the train via a gantry crane. As containerisation of the HMC will occur within a shed, it is anticipated that this will not affect local air quality. Consequently, dispersion modelling for potential air quality impacts has not been conducted for this method.
- Bulk handling where, as for the first method, trucks will unload the HMC into stockpiles within a large shed. Loaders will then load the product onto conveyors before it is transferred to the train wagons via a hopper.

Assessment Criteria

Air quality in Victoria is regulated by the EPA using procedures and assessment criteria set out in the State Environment Protection Policy (SEPP) (Ambient Air Quality) and the SEPP (Air Quality Management), as cited in Supporting Study 1.

A new draft air quality management protocol (DPEMMEI) has recently been released by the EPA (EPA, 2006), which specifies objectives for air quality that take into account all emission sources, both related and unrelated to the project. The assessment criteria for mining and extractive industries are listed in Table 6.8.

Table 6.8 EPA assessment criteria for mining and extractive industries

Pollutant	Maximum Acceptable Level or Concentration: Total from All Sources	Averaging Period
Particulate matter <10 µm	60 µg/m^3.	24 hours.
Particulate matter <2.5 µm	36 µg/m^3.	24 hours.
Nuisance dust	4 g/m^2/month (no more than 2 g/m^2/month above background).	Monthly average.
Respirable crystalline silica	3 µg/m^3.	Annual average.
Carbon monoxide (CO)	29 ppm (33.1 mg/m^3).	1 hour.
Nitrogen dioxide (NO_2)	0.14 ppm (263.2 mg/m^3).	1 hour.
PAHs	0.3 ng/m^{3*}.	Annual average.

Source: (EPA, 2006).

* Adopted from the California EPA Office for Environmental Heath Hazard Assessment Reference Exposure Levels.

The draft protocol (EPA, 2006) also requires that, depending on location, air quality assessments consider the potential effects of PAHs, radioactive isotopes, arsenic and heavy metals such as antimony and lead. DMS will monitor air quality in accordance with this protocol and in consultation with the EPA and DPI.

6.4.3 Issues

Potential, credible, project-related air quality issues are discussed below. It should be noted that these do not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by DMS during all stages of the project development (see Section 6.4.4), and which will result in the residual impacts discussed in Section 6.4.5.

Decrease in Air Quality Due to Dust Emissions

The main potential air quality issue that will result from construction and operation of the project is the liberation of particulate matter with consequent adverse impacts to human health and amenity. Specifically, the main sources of dust associated with the proposed mining operation will include:

- Topsoil and subsoil stripping.
- Overburden removal and stockpiling.
- Overburden removal and emplacement directly as backfill.
- Transport of HMC to the rail siding.
- General vehicle movements over unsealed roads.
- Wind erosion from exposed surfaces (e.g., soil and stockpiles).

Decrease in Air Quality Due to Combustion Emissions

Emissions of combustion products such as CO, NO_2, PAHs and particulate matter from fuel combustion of fixed on-site sources (i.e., plant, machinery and vehicles) will occur and has the potential to adversely impact local air quality, with subsequent adverse impacts to human health and amenity.

Greenhouse gases are addressed in Section 6.5.

6.4.4 Avoidance, Mitigation and Management Measures

The following management and mitigation measures will be employed to control air quality impacts:

- Processing of ore as a slurry.
- Using water or dust suppressants on trafficked areas (i.e., internal haul roads), exposed surfaces and similar to reduce emissions.
- Maintaining roads to minimise wind erosion.
- Using speed limits on internal mine roads.
- Using signage to ensure traffic is kept to designated roadways.
- Using covered transport of products.
- Progressively rehabilitating final surfaces as they become available.
- Prompt vegetation of all overburden stockpiles.

- Establishing vegetated earth bunds around the processing plant and along selected sections of haul roads to protect from wind erosion.
- Enclosure of conveyors at the processing plant.
- Enclosure of conveyor transfer points. Product stockpiles will be enclosed at the rail siding.
- Using slurry pumping to transport ore from the pit to the processing plant.
- Fitting machinery with the appropriate emission control equipment and maintaining and servicing them frequently.

6.4.5 Residual Impact Assessment

Assessment of residual air quality impacts has been based on the comparison of modelled results with the assessment criteria described in Section 6.4.2.

Decrease in Air Quality Due to Dust Emissions

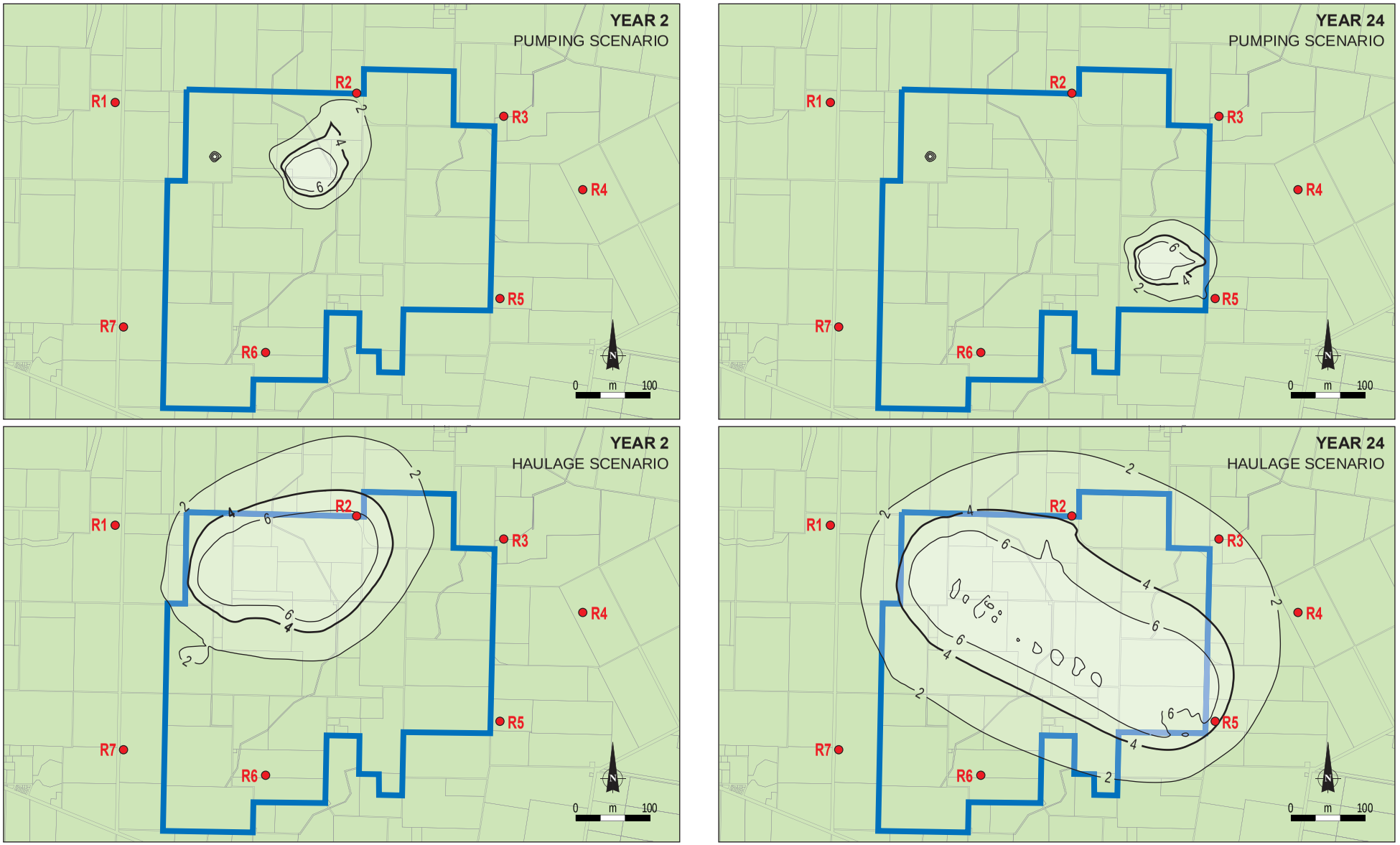
Taking into account appropriate emission control technology, emissions of particulate matter (PM_{10}, $PM_{2.5}$ and dust) and hydrocarbons will occur, but in negligible quantities and are not expected to have adverse impacts on surrounding air quality in Years 2 and 24 for the slurry pumping scenario. Conversely, for the haulage scenario, various exceedances of project criterion for particulate matter and hydrocarbons are predicted for both the Year 2 and Year 24 scenarios.

Maximum predicted worst-case dust deposition concentrations for the pumping scenario, averaged over a monthly period, are presented in Figure 6.15 and predict no exceedances of the DPEMMEI objective (4 g/m^2/month, as cited in Table 6.8), as all sensitive residential receptors are located in areas between 1.7 and 3.1 g/m^2/month. However, this is not the case for the haulage scenario as the project criteria of 4 g/m^2/month is exceeded at Residence 2 in the Year 2 scenario and at Residence 5 in the Year 24 scenario. When the background concentration is added to the concentration attributable to the project, project criterion of 4 g/m^2/month is also exceeded at Residence 2 in the Year 24 haulage scenario.

Maximum 24-hour average ground level PM_{10} concentrations (Figure 6.16) are less than DPEMMEI criterion of 60 µg/m^3 (as cited in Table 6.8) for all sensitive receptors in Years 2 and 24 for the pumping scenario. The modelled PM_{10} air concentrations for the haulage scenario exceed the 60-µg/m^3 criterion at Residence 2 in the Year 2 scenario and at Residence 5 in the Year 24 scenario.

When trucking ore, Residence 5 in the Year 24 scenario exceeds the project criterion (36 µg/m^3, as cited in Table 6.8) for maximum 24-hour average $PM_{2.5}$ concentration (Figure 6.17) when the background concentration is added to the concentration attributable to the project; however, no exceedances are predicted for the pumping scenario as all sensitive residential receptors are located in areas between 22.3 and 23.5 µg/m^3, well below project criteria.

Modelling predicts RCS concentrations associated with the project to exceed the project goal of 3 µg/m^3 (when the background concentration is added to the concentration attributable to the project) for both modelling scenarios when ROM ore is transported via haul truck. The concentration solely attributable to the project does not; however, exceed project goals for either the haulage or pumping scenarios (Figure 6.18). Annual average RCS concentrations associated with the project when ROM ore is pumped to the processing plant, are less than 2.4 µg/m^3, therefore satisfying the project criteria.



Note:
Predicted average monthly dust deposition concentrations (increment only) due to emissions from the project - g/m^2/month

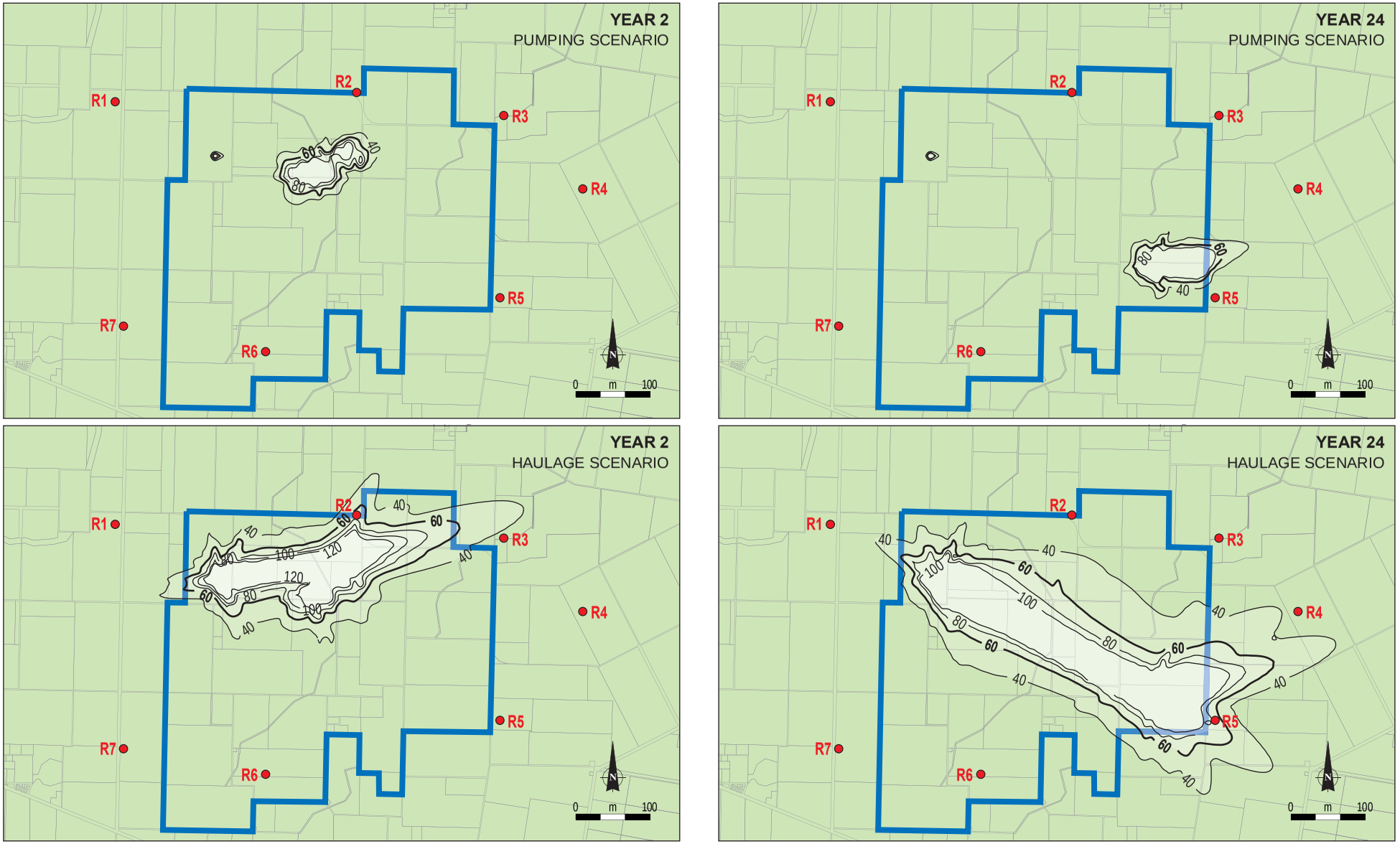
coffey natural systems

Job No: 972	DMS Pty Limited
File Name: 972_05_F06.15_HB	Donald Mineral Sands Project

DMS A Subsidiary of Ashton Limited

Predicted dust deposition concentrations

Figure No: 6.15



Note:
Predicted 24-hour maximum PM_{10} concentrations (increment only) due to emissions from the project - µg/m^3

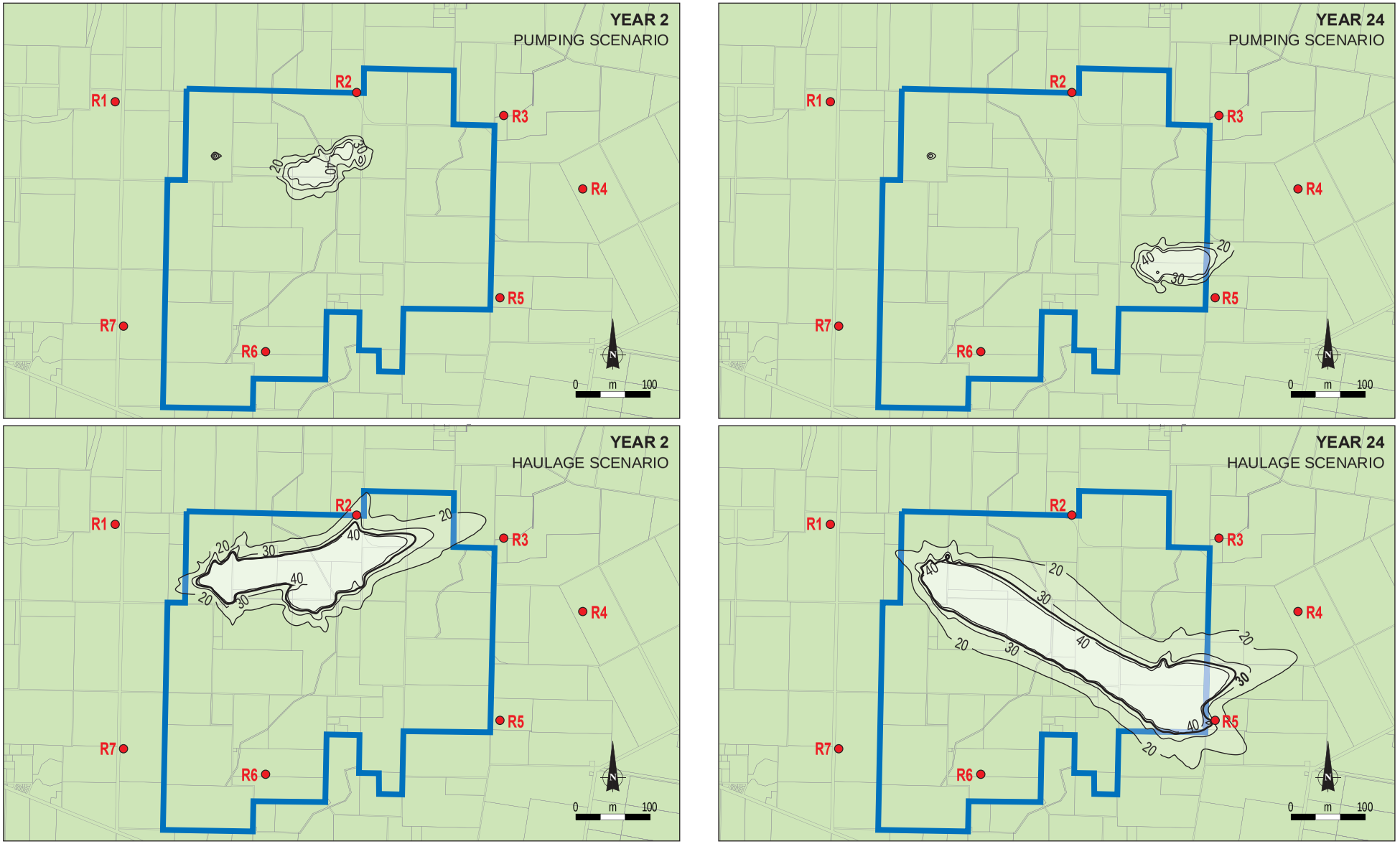
coffey natural systems

Job No: 972	DMS Pty Limited
File Name: 972_05_F06.16_HB	Donald Mineral Sands Project

DMS A Subsidiary of Ashton Limited

Predicted PM_{10} concentrations

Figure No: 6.16



Note:
Predicted 24-hour maximum $PM_{2.5}$ concentrations (increment only) due to emissions from the project - µg/m^3

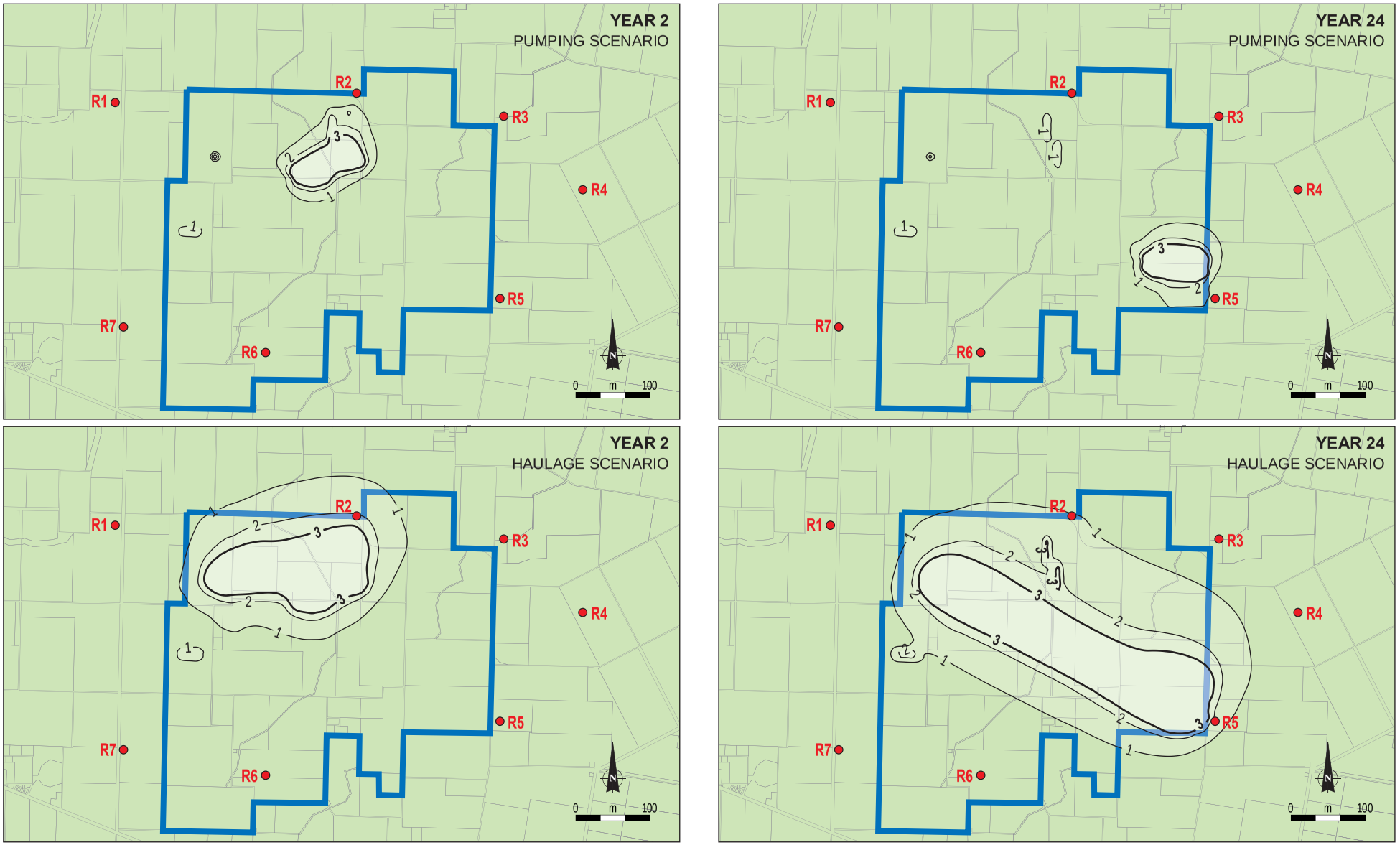
coffey natural systems

Job No: 972	DMS Pty Limited
File Name: 972_05_F06.17_HB	Donald Mineral Sands Project

DMS A Subsidiary of Ashton Limited

Predicted $PM_{2.5}$ concentrations

Figure No: 6.17



Note:
Predicted annual average RCS concentrations (increment only) due to emissions from the project - µg/m^3

coffey natural systems

Job No: 972	DMS Pty Limited	Figure No: 6.18
File Name: 972_05_F06.18_HB	Donald Mineral Sands Project	Predicted RCS concentrations

DMS A Subsidiary of Astron Limited

The model predictions also indicate that CO, NO_2 and PAH emissions from on-site combustion sources within the project area will satisfy all project air quality criteria (see Table 6.8).

Complete dust suppression in this type of operation, and in this particular setting, is not feasible; however, the mining and processing of the heavy mineral ore are wet operations and should generate negligible dust. Modelling results show that the consequences of this dust generation in terms of the various assessment criteria will be negligible for the slurry pumping scenario, DMS's preferred option. DMS will; however, monitor air quality in accordance with the DPEMMEI and in consultation with EPA and DPI, to confirm modelling results.

Dust Impacts on Vegetation and Drinking Water

The impact of dust on vegetation is dependent on the rate of dust deposition and the chemical composition of the dust. Farmer (1993), as cited in Supporting Study 1 found that dust may affect photosynthesis, respiration, transpiration and allow the penetration of phytotoxic pollutants.

There is no single minimum dust deposition rate where impacts are experienced in Victoria; however, the New South Wales Department of Environment and Climate Change (DECC) typically mandate within operational conditions of consent for extractive industries. Therefore, it is recommended that DPEMMEI criterion of 4 g/m^2/month is not exceeded on more than 25% of any privately owned land. As noted in Figure 6.15, DPEMMEI criterion is not exceeded on more than 25% of privately owned land, thus a significant impact on vegetation is not expected. DPI typically applies the same criteria for dustfall (4 g/m^2/month) in Victoria.

As project criterion is not exceeded for the pumping scenario (see Figure 6.15), it is also not anticipated that dust deposition on roofs will significantly impact the water supply obtained from rainwater tanks. As outlined in *Guidance on Use of Rainwater Tanks* (Commonwealth of Australia, 2004) the first flush of water during a rain event may contain higher than average amounts of accumulated dust, bird and animal droppings, vegetation and other debris. Investigations have proven that water quality improves after the initial 5 L of water has passed through the downpipe. It is also suggested that the first 20 to 25 L can be diverted or discarded to maintain a high water quality.

Train Loading Facility

The model predictions indicate that both scenarios (Scenario 1: North and Scenario 2: South) will satisfy project criterion (as cited in Table 6.8), for maximum predicted worst-case dust deposition concentrations, maximum 24-hour average PM_{10} concentrations and maximum 24-hour average $PM_{2.5}$ concentrations when transferring ore through the bulk handling method.

Decrease in Air Quality Due to Combustion Emissions

Even in large mines, the rate of emissions of NO_2, CO and PAH are small compared with the emissions from traffic in an urban setting. For example, the traffic travelling on 3 km of arterial road carrying say 60,000 vehicles per day and consuming 6,000 L of fuel per day would not normally cause exceedances of the ambient air quality criteria in Table 6.8. In practice, emissions of these pollutants from mineral sand mines, which would span a similar distance, are negligible and the equipment too widely dispersed for these to cause exceedances of project criterion.

Whilst the likelihood of a nominal decrease in air quality due to combustion emissions is virtually certain, the impacts will be highly localised and hence the consequences are negligible.

6.5 Greenhouse Gas Emissions

Characterisation and impact assessment of greenhouse gas emissions associated with the Donald Mineral Sands Project were undertaken by Heggies Pty Ltd. The results of this investigation are provided in Supporting Study 1 and are summarised below.

6.5.1 Existing Conditions

Greenhouse gases identified under the Kyoto Protocol United Nations Framework Convention on Climate Change are:

- Carbon dioxide (CO2).
- Hydrofluorocarbons (HFCs).
- Methane (CH4).
- Nitrous oxide (N2O).
- Perfluorocarbons (PFCs).
- Sulphur hexafluoride (SF_6).

Although total CO_2-e emissions for Australia in 2005 were estimated at 559.1 Mt (AGO, 2007), the most recent verified source of CO_2-e emissions for Australia (551.9 Mt) was recorded in 1990 and reported in the National Greenhouse Inventory 2004 (AGO, 2006). Project related greenhouse gas emissions have therefore been compared to the 1990 estimate.

Compared with other states and territories, Victoria is the third highest contributor to Australia's greenhouse gas emissions owing to its dependence on brown coal for fuel. Brown coal fuels more than 90% of Victoria's electricity production, contains a high moisture content and generates low fuel conversion efficiencies and high emissions intensity per unit of electricity produced compared to other carbon-based energy sources (e.g., black coal and natural gas).

6.5.2 Assessment Method

Estimates of greenhouse gases have been projected over a 25-year operational period. The method used to assess these gases incorporates:

- Review of direct and indirect greenhouse policies and legislation that are in place at federal, state and local level and are of relevance to this project.
- Use of accepted protocols for calculation of greenhouse gas emissions for activities associated with this project and alternative energy generators (e.g., wind, solar and tidal power).
- Calculation of greenhouse gas emissions over the following periods[5]:
  - Year 2 Extraction, where ore extraction occurs within the northern region of the project area (see Figure 6.14). Emissions have been modelled for both methods of ROM ore transportation

[5] These periods were modelled as they represent different operating conditions over the life of the project and consider the location of mining and processing activities, the processing plant and the proximity of these factors to the closest sensitive residential receptor.

from the pit to the processing plant, i.e., via haul truck (haulage) and slurry pumping (no haulage).

- Year 24 Extraction, where ore extraction occurs within the eastern region of the project are (see Figure 6.14). Emissions have been modelled for both methods of ROM ore transportation from the pit to the processing plant, i.e., via haul truck (haulage) and slurry pumping (no haulage).
- Project life, 25 years.

- Identification of protocols for ongoing management of greenhouse gas emissions arising from the project.
- Identification and evaluation of opportunities to reduce greenhouse gas emissions.

The EPA has published guidance on how greenhouse gas emissions should be managed, including actions that businesses need to take to demonstrate compliance with the SEPP (Air Quality Management) regulations (EPA, 2001).

As part of the approvals under the MRSD Act, DMS will be required to prepare an environmental management plan (EMP). The EMP will detail the measures undertaken to minimise emissions to the environment, as required by the Protocol for Environmental Management - Greenhouse Gas Emissions and Energy Efficiency in Industry (EPA, 2002).

The Protocol requires applicants to annually document:

- An energy consumption estimate.
- A direct greenhouse gas emissions estimate.
- The mitigation measures required to reduce greenhouse gas emissions.

DMS will also participate in the Energy Efficiency Opportunities program, where they will identify, document and report on cost effective energy savings opportunities.

DMS will complete an environment and resource efficiency plan (EREP) for the anticipated greenhouse gas emissions associated with the project when required by the EPA (EPA, 2007).

6.5.3 Issues

Greenhouse gases included in the emissions inventory developed for the project are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) and are reported on a carbon dioxide equivalent (CO_2-e) basis.

Of these, CO_2 and N_2O are the most significant greenhouse gases for the project. These gases are the main products of combustion of diesel used in earthmoving equipment and from the generation of electricity.

Other greenhouse gases that may be emitted as a result of on-site excavation operations include carbon monoxide (CO), oxides of nitrogen (NO_x) and non-methane volatile organic compounds (NMVOCs)[6]. These products are produced by incomplete fuel combustion, reactions between air and

[6] These gases are short-lived, making it difficult to quantify their global radiative-forcing impacts and global warming potential. For this reason, they have not been included in further calculations.

fuel constituents during fuel combustion, and post-combustion reactions. Minor fugitive emissions of NMVOCs may also be expected during fuel evaporation.

Electricity Consumption for the Project

The estimated annual electrical power consumption for the project is 24.4 GWh, based on an operating schedule of 24 hours a day for the entire year. This equates to emissions of approximately 35,311 t of CO_2-equivalent per year[7] and 882.5 kt of CO_2-equivalent emissions over the 25-year life of the project.

Electricity will be sourced from the grid and used to power the processing plant and ancillary site facilities; however, electricity consumed by the trommel will be provided by an onsite diesel generator, which is included in the calculations below.

Diesel Combustion for the Project

The estimated diesel fuel consumption for the project is shown in Table 6.9.

Table 6.9 Estimated annual diesel fuel consumption

Year	Other Vehicles (ML)	Material Movements (ML)			Total (ML)	Total (t CO_2-e)
		ROM ore		HMC Transport to Train Loading Facility[1]		
		Haulage	Slurry Pumping			
Year 2 (Haulage)	8.4	8.7	0.3	0.2	17.6	47,500
Year 2 (No Haulage)	7.5	1.6	2.0	0.2	11.3	30,400
Year 24 (Haulage)	9.1	9.5	0.3	0.2	19.0	51,400
Year 24 (No Haulage)	8.1	2.4	2.0	0.2	12.7	34,300
Project Life[2]	226.7	236.5	7.9	4.6	475.7	1,285,000

Emission factors obtained from AGO Factors and Methods Workbook (December 2005).
[1] Applying a diesel consumption rate of 0.58 L/km.
[2] Based on continual Year-24 haulage as a worst-case scenario.

Greenhouse Gas Emissions for the Project

The estimated total greenhouse gas emissions for the project over the total mine life is shown in Table 6.10.

[7] Calculated by applying the Victorian greenhouse gas coefficient of 1.444 kg CO_2-equivalent/kWh.

Table 6.10 Estimated greenhouse gas emissions for the project over the total mine life

Year	Predicted Greenhouse Gas Emissions t CO_2-e			Percentage Comparison with Australian 1990 Emissions[1]
	Electricity	Diesel	Total	
Year 2 (Haulage)	35,300	47,500	82,800	0.015
Year 2 (No Haulage)	35,300	30,400	65,700	0.012
Year 24 (Haulage)	35,300	51,400	86,700	0.016
Year 24 (No Haulage)	35,300	34,300	69,600	0.013
Project Life[2]	882,500	1,285,000	2,167,500	-

[1] National Greenhouse Inventory 2004, (AGO, 2006) (most recent verified source).
[2] Based on continual Year-24 haulage as a worst-case scenario.

The total greenhouse gas emissions estimated for the project during Year 2 operations is 82,800 and 65,700 t CO_2-e respectively for the haulage and pumping scenarios. Conversely, the total greenhouse gas emissions estimated for the project during Year 24 operations is 86,700 and 69,600 t CO_2-e respectively for the haulage and pumping scenarios. During the 25 years of operations, the project is estimated to release a total of 2,167,500 t CO_2-e based on a worst-case haulage scenario.

Greenhouse Gas Emissions for the Transportation of Heavy Mineral Concentrate

A range of transport options is being considered by DMS for the transport of HMC to port. For the purposes of the greenhouse gas emission assessment, the four scenarios[8] involving two ports are:

- Truck to rail siding, rail to the Port of Portland.
- Truck to rail siding, rail to the Port of Geelong.
- Truck the entire distance from mine to the Port of Portland.
- Truck the entire distance from mine to the Port of Geelong.

HMC product will be delivered by truck to one of two possible sites for the rail siding, both of which are located to the west of the project area near Minyip (see Figure 6.24 in Section 6.9). Once at the rail siding, the HMC will be delivered by rail to either the Port of Geelong or the Port of Portland. Alternatively, the HMC will be delivered directly by truck from the project site to either the Port of Geelong or the Port of Portland.

The estimated annual total greenhouse gas emissions for the transportation of HMC is shown in Table 6.11.

During the 25 years of operations, the project is estimated to release a total of 116,340 and 107,115 t CO_2-e based on the transportation of HMC by rail to Geelong and Portland, respectively. Conversely, the total greenhouse gas emissions estimated for project when trucking directly from the project site to Geelong and Portland is 221,298 and 270,855 t CO_2-e, respectively.

[8] Due to the similar distances, the emissions for transport to the Port of Melbourne will be very similar to those for the Port of Geelong. Differences due to containerisation versus transport in bulk have not been considered.

Table 6.11 Estimated annual greenhouse gas emissions for the transportation of HMC

Destination	Geelong, Victoria			Portland, Victoria		
Transportation Method	**Project Site to Rail Siding**	**Rail from Minyip (rail siding)**	**Road from Project Site**	**Project Site to Rail Siding**	**Rail from Minyip (rail siding)**	**Road from Project Site**
Round trip distance (km)	870[1]	586	518	870[1]	534	634
Diesel consumption rate (L/km)	0.6	3.6	0.6	0.6	3.6	0.6
Annual diesel consumption (ML)	1.7[2]		3.3	1.6[2]		4.0
Annual CO_2-e emissions (t)	4,653		8,851	4,284		10,834
Percentage comparison with Australian 1990 emissions[3]	0.00084		0.0016	0.00078		0.0020

[1] Based on round-trip distance of approximately 29 km between the project site and the rail siding near Minyip (30 trips daily).
[2] Based on two diesel locomotives per train load and one train per day.
[3] National Greenhouse Inventory 2004, (AGO, 2006).

6.5.4 Avoidance, Mitigation and Management Measures

DMS recognises the importance of pursuing strategies to address greenhouse gas emissions from its operations. The Donald Mineral Sands Project is consistent with Victorian Government policy on greenhouse gas emissions and will be developed cognisant of prevailing environmental, health and safety standards.

DMS will therefore apply a range of measures to reduce greenhouse gas emissions during the construction and operational phases of the project. These include:

- Developing and applying policies and procedures for energy efficient mine operation. This includes consideration of Commonwealth initiatives such as the Greenhouse Gas Abatement Program, where substantial emission reductions through cost-effective abatement will contribute toward meeting Australia's Kyoto Protocol targets.
- Minimising haul distances and the use of haul trucks by using slurry pumping for ore transport from the pit to the processing plant.
- Monitoring energy consumption (e.g., diesel and electricity) and calculating greenhouse gas emissions.
- Identifying and assessing economically viable opportunities for improvement.
- Considering the use of alternative fuels (e.g., biodiesel) and technologies.
- Ensuring that vehicles (company-owned and contractors) are well maintained and correctly sized to maximise their fuel efficiency and minimise emissions.
- Reducing vehicle idling time.

- Considering the use of renewable energy technologies (e.g., wind, solar and biomass) when sourcing electricity from the grid.

6.5.5 Residual Impact Assessment

The increase in Australia's net greenhouse gas emissions, as shown in Table 6.10, as a result of the mining activities at Donald is low. The increase in emissions as a result of the transportation of HMC to port, as shown in Table 6.11, is also low.

Comparison with the 1990 estimate of 551.9 Mt shows that the project will represent a maximum annual increase in emissions of approximately 0.016% relative to Australia's total emissions. Conversely, the greenhouse gas emissions calculated for each transportation method of HMC (i.e., road and rail) would present a maximum annual increase in CO_2-e of up to 0.00084% for the rail scenario and 0.002% for the road scenario, relative to Australian 1990 emissions.

Although emissions of greenhouse gases due to project development is virtually certain to occur, the impact of this increase is unlikely to be noticeable.

6.6 Noise

The noise impacts of the Donald Mineral Sands project were assessed by Heggies Pty Ltd in Supporting Study 6 and are summarised below.

6.6.1 Existing Conditions

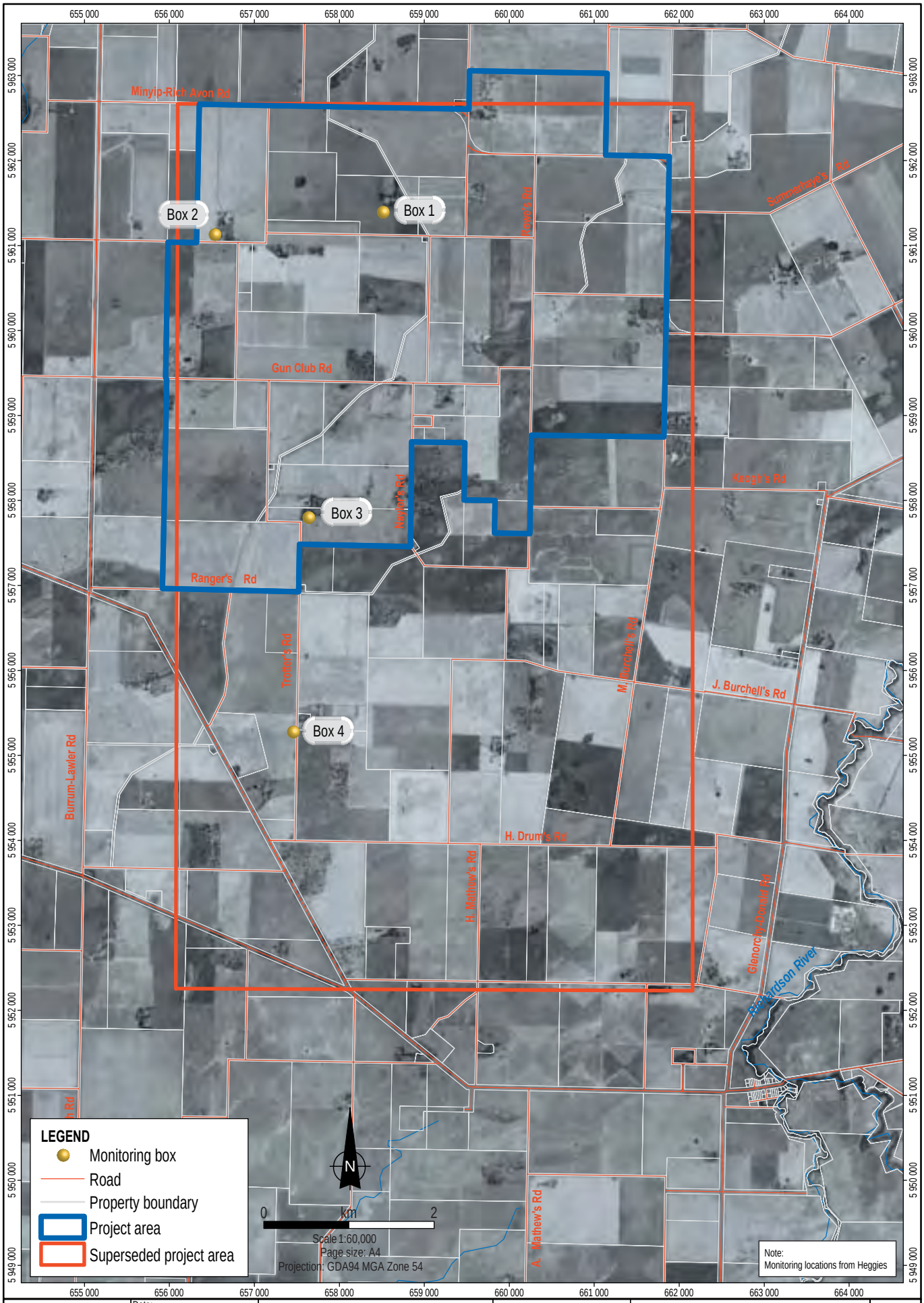
To characterise the existing noise environment four reference sites (shown in Figure 6.19) were selected as receiver-monitoring locations and unattended monitors measured the background noise at these locations for seven days during October 2006. Short-term, attended, octave band measurements were also conducted on deployment of the unattended monitors and during the night period on 3 October 2006.

The background level for any particular site during any particular period (i.e., day, evening or night) is defined by the EPA as the average L_{A90} recorded at that site for the relevant period, where L_{A90} is the level of noise exceeded for 90% of the sample time. The lowest measurement results from the attended and unattended noise monitoring are shown in the following tables (Table 6.12 and Table 6.13).

Table 6.12 Unattended ambient noise environment, October 2006

	Lowest Average Background (L_{A90}) Noise Level (db(A))		
Monitoring Location	**Day***	**Evening***	**Night***
Box 1	51	29	27
Box 2	31	29	21**
Box 3	36	30	30**
Box 4	32	34	30**

Notes: *Day = 07:00 to 18:00, Evening = 18:00 to 22:00 and Night = 22:00 to 07:00. **Close to noise floor of test instrument.



coffey natural systems

Date: 25.09.2007
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F06.19_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Noise monitoring locations

Figure No: 6.19

Table 6.13 Attended ambient noise monitoring, October 2006

	Lowest Average Background (L_{A90}) Noise Level (db(A))	
Monitoring Location	**Day***	**Night***
Box 1	27	17**
Box 2	25	Not recorded.
Box 3	28	16**
Box 4	22	14

Notes: *Day = 07:00 to 18:00 and Night = 22:00 to 07:00. **Close to noise floor of test instrument.

In general, the ambient background noise level at the monitoring locations comprised noise from birds, insects and farm animals. Noise from roads or other industries was not obvious at any of the monitoring locations.

Results from both long and short term monitoring suggest particularly low background noise levels were experienced at all monitoring locations over the monitoring period. It was noted that the noise environment in country farming areas can be quite variable throughout the year according to the seasons and that the survey was undertaken during a relatively quiet period of the year when no sowing or harvesting took place. During peak times of sowing and harvest, farm machinery can be a significant source of noise across the region, throughout the day and night. Typical farm machinery includes heavy tractors, road trucks and headers and these are accepted as part of life in the area. The loudness of a range of example events is presented in Table 6.14 for comparison.

Table 6.14 Examples of the loudness of common events

Sound	dB
Thunderclap, air raid siren (1 m)	130
Jet takeoff (70 m)	120
Rock concert, night club	110
Heavy truck (15 m), city traffic	90
Alarm clock (1 m), hair dryer	80
Noisy restaurant, business office	70
Air conditioning unit, conversational speech	60
Light traffic (50 m), average home	50
Living room, quiet office	40
Library, soft whisper (5 m)	30
Broadcasting studio, rustling leaves	20
Hearing threshold	0

Noise Criteria

There are several noise guidelines that are relevant to the project and its activities and these are described below.

There are no specific noise policies applicable to country and rural Victoria in relation to operational noise. An indicative guide is the EPA's Interim Guidelines for Control of Noise from Industry in Country

Victoria N3/89 (N3/89). In October 2000, the EPA released the Draft Recommended Maximum Community Noise Levels for Commerce Industry and Trade Premises in Regional Victoria for comment. Once fully developed, these will replace the Interim Guidelines. In this case; however, it is anticipated that the criteria under both the Interim Guidelines and the Draft Recommendations would be similar.

The EPA Technical Guideline (TG 302/92) provides assessment criteria for construction noise depending on the time of day.

There are two relevant studies in relation to sleep disturbance criteria for night period operations: the World Health Organisation (WHO) Guidelines and the results from the Griefahn study. While these criteria may be considered stringent, they can be considered for the DMS project for single vehicle pass-bys and loading operations that may occur along the haul road at night.

Taking these guidelines into consideration, the consequential noise criteria are as shown in Table 6.15 below.

Table 6.15 Relevant guidelines for project activities

Activity	Relevant Guidelines	Time	Criteria
Construction Noise	EPA Technical Guideline TG 302/92.	7.00 am to 6.00 pm Monday to Friday. 7.00 am to 1.00 pm Saturday.	No criteria.
		6.00 pm to 10.00 pm Monday to Friday. 1.00 pm to 10.00 pm Saturday. 7.00 am to 10.00pm Sundays and public holidays.	Background level + 10 dBA for up to 18 months. Background level + 5 dBA if longer than 18 months.
		10.00 pm to 7.00 am Monday to Sunday.	Inaudible within a habitable room of any residential premises.
Operational Noise	EPA Interim Guidelines N3/89. Draft EPA Recommendations 2000.	Day. Evening. Night.	45 dBA* 37 dBA* 32 dBA*
Sleep disturbance#	WHO Criteria.	Continuous noise. Intermittent noise.	No greater than 30 dBA. No greater than 45 dBA for an individual event.

* These are minimum criteria to be applied when background levels are found to be very low. #Sleep disturbance criteria are internal i.e., at the ear of the receiver as opposed to outside the residential premises. An internal level of 45 dBA equates to approximately 60 dBA outside.

For the project, the particularly low noise levels experienced at all monitoring locations over particular periods indicates that N3/89 (see Table 6.12 and Table 6.13) will be applicable to the project and that there is very little masking of future noise sources at residential premises.

Modelling

In order to assess potential noise impacts associated with project activities, mathematical modelling was carried out. SoundPLAN computer models of noise impacts of the mine pit operations, ore treatment plant and haul road were generated using the noise prediction algorithms published by CONCAWE (Conservation of Clean Air and Water – Europe). The three dimensional model allows for the generation of noise contours incorporating ground and atmospheric absorption, barrier affects due to hills or other features in the area and height of sources and receivers. Given the typically large distances between receivers and noise sources, meteorological conditions will have a significant impact on final receiver noise levels. All predictions were therefore conducted under both neutral and worst-case weather conditions (further described below). The following events were modelled:

- Construction noise, including road upgrades, wet concentrator plant and loading area construction and any potential site clearing.
- Mine operation: four scenarios were modelled. The size and layout of the mine are; however, assumed to be as described in Chapter 4.
- Wet concentrator plant: modelled once assuming full capacity.
- Haul road: two proposed haul rote options (north and south) were modelled.
- Train loading: two train loading sites (north and south) and two train transfer methods (container transfer and bulk handling) were assessed.
- Reversing beepers.

6.6.2 Issues

As discussed in Section 4.1, the project involves a ‘moving pit’, meaning that, as the cycle of clearance, mining and rehabilitation proceeds, affects on some of the community and environment will vary across the project area. The project will generate noise, principally from earthmoving equipment during construction, removal of topsoil and overburden, ongoing mining operations, and the wet concentrator plant. Mining noise will occur 24 hours per day, 7 days per week. For residences in the core of the project area (D4, 5, 6, 7, 8, 11 and 23) and two residences on the edge of the project area (D2 and 10), the impacts associated with the project will go on for most, if not all, of the project life. The extent to which noise will be an issue for local residents will depend on several factors, including:

- The existing noise environment.
- The proximity of residences and habitat to mine-related activities.
- Variable factors such as weather and wind direction.
- Individual sensitivity to noise.
- The duration of project-derived noise.
- The timing of project-derived noise.
- The effectiveness of noise mitigation and management procedures carried out by DMS.

Construction Noise

Noise sources associated with the initial construction of the mine will generally be no more than actual mine-operation equipment as there will be less mining equipment. Based on the construction noise criteria presented in Table 6.15 above, no specific noise criteria are applicable to construction noise

during the specified day period except Sundays. For evening operations (up until 10.00 pm), applicable noise criteria would be approximately 35 to 40 dBA, which could be achieved at a buffer distance of 1,000 m. There are six receivers currently within 1,000 m of the construction area, (D1 D2, D4, D5, D6 and D23). The noise criterion for the night period during construction is inaudibility at any residential receiver. This cannot be achieved at any of these receivers.

Mine Operation

Noise sources during mine operation will be transient in nature over the 25-year mining period, reflecting the moving pit scenario described in Chapter 4. Initial site clearing works will not require significant buffer distances to comply with noise criteria. However, during the excavation and transport of ore and overburden, the project will be unable to meet the noise criteria at several residences.

A summary of the results of modelling are provided in Table 6.16 below. From this table it is clear that N3/89 guidelines will not be met at several of the nearby residents.

Table 6.16 Modelling results of mine operation

Residence	Closest Distance to Open Pit	Noise Level	Criteria*
Neutral conditions			
Group 1			
D2, D4, D5, D6, D7, D10, D11 and D23.	Within 650 m.	> 45 dBA at all times.	Exceeds day, evening and night criteria.
Group 2			
D3 and D9.	650 m to 1.8 km.	33 to 38 dBA.	Exceeds evening criteria at D3. Night period criteria exceeded at both locations.
Worst case conditions			
Group 1			
D2, D3, D4, D5, D6, D7, D8, D10, D11 and D23.	Within 800 m.	> 45 dBA at all times.	Exceeds day, evening and night criteria.
Group 2			
D24, D26, D25, D22, D13, D9, and D1.	1.8 to 2.5 km.	33 to 38 dBA.	Marginally exceeds evening criteria at D1. Night period criteria exceeded at all locations.

*N3/89 Criteria: Day = 45 dBA, Evening = 37 dBA, Night = 32 dBA.

Neutral Conditions

Neutral conditions refers to ‘normal’ atmospheric conditions (e.g., with temperature increasing as a function of altitude and with no significant stratification of the atmosphere) with no significant component of wind between the source and receiver. The EPA obtained an annual stability class

distribution with hourly recordings of atmospheric stability in the Longerenong area (Supporting Study 1). The distribution showed that stability classes A through to D, which are typically associated with unstable atmospheric conditions (i.e., with no stratification and very little likelihood of temperature inversions), represented approximately 70% of the total year. In regards to wind conditions, the dominant winds in the area appear to have a south–south-westerly component and therefore, receivers to the south and west would be less likely to experience wind enhanced noise levels (see Figure 6.13).

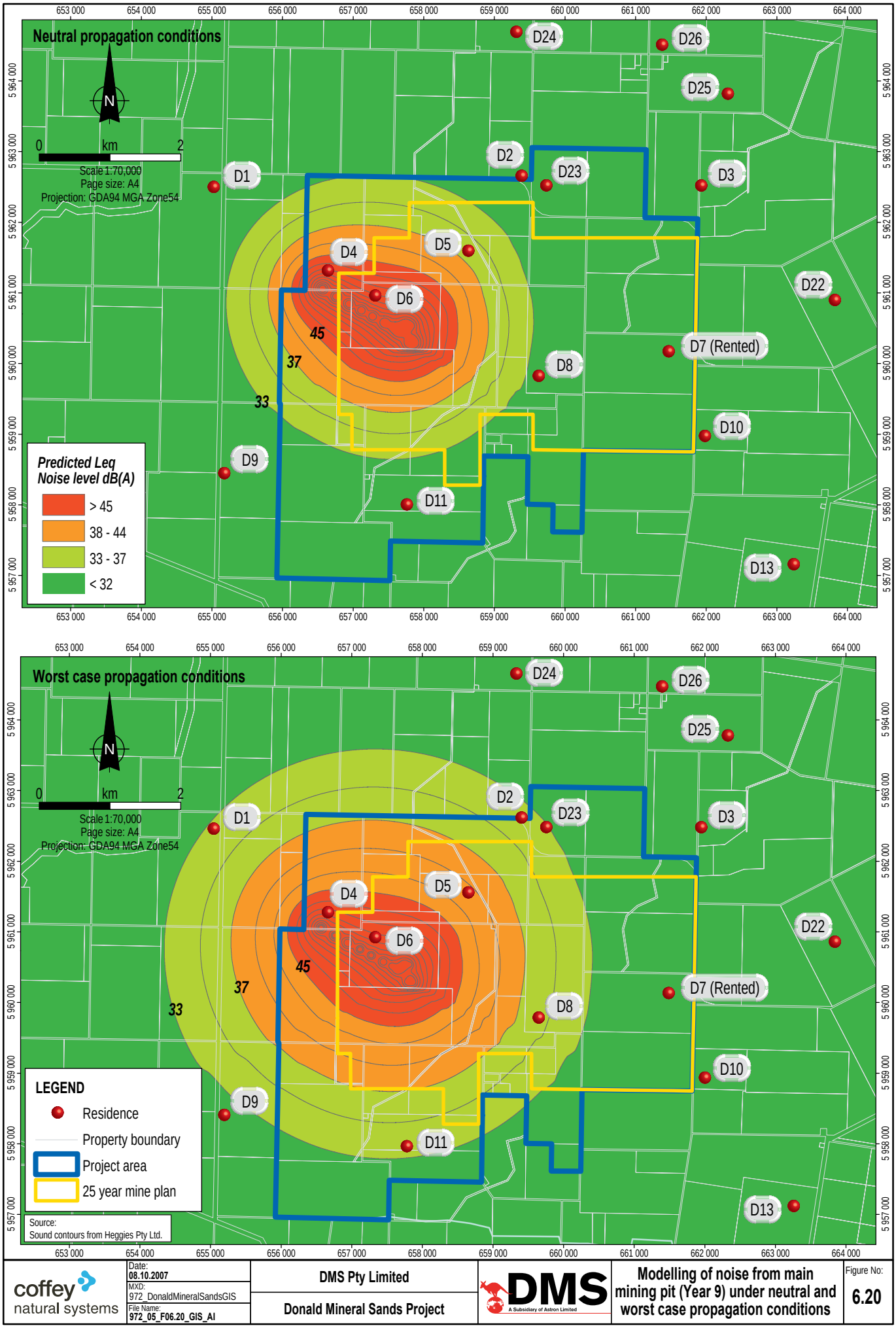
Noise levels generated by the project under neutral conditions will exceed N3/89 guidelines during all (day, evening and night) periods at nine residents when the mine is operating in their vicinity (this number may be less at any given time if accessing the ore necessitates relocating or dismantling the residence). N3/89 night guidelines will be exceeded at an additional two residences when the mine is operating in their vicinity. Of these, there is one residence in which evening criteria will also be exceeded. For three residences in the core of the project area (D5, 6 and 8), the impacts associated with the project will go on for most of the project life.

Worst-case Conditions

Worst-case conditions may occur due to wind direction (blowing from source to receiver) or from temperature inversions. The dominant winds in the area appear to have a south–south-westerly component and therefore, receivers to the north, north-east and east of the project area would experience worst case conditions for the most extended periods (see Figure 6.13). Temperature inversions occur when a layer of warm air overlays a layer of cold air which sits above the ground. When this occurs, sound waves, which would normally travel up into the air, are reflected back to the ground causing increased noise levels at distant locations. Temperature inversions occur during highly stable atmospheric conditions typically associated with clear skies and light winds.

The EPA annual stability class distribution (Supporting Study 1) showed that the most stable conditions (stability class F), which would lead to temperature inversions, occurred for approximately 11.3% of the time throughout the year. The next least stable conditions occurred for approximately 20.0% of the time throughout the year. Although 11.3% of the time of a year equates to approximately 41 days, temperature inversions will not normally occur for a continuous duration of 24 hours and will instead most likely occur during the night, especially during the colder months.

Modelling of noise from the main mining pit under the most likely scenario shows that noise levels generated by the project under worst-case conditions will exceed N3/89 guidelines during all periods at ten residences when the mine is operating in their vicinity (this number may be less at any given time if accessing the ore necessitates relocating or dismantling the residence) (Figure 6.20 neutral and worst case). N3/89 night guidelines will be exceeded at an additional seven residences when the mine is operating in their vicinity. Of these, there is one residence in which evening criteria will also be marginally exceeded. For the seven residences in the core of the project area (D4, 5, 6, 7, 8, 11 and 23) and two residences on the edge of the project area (D2 and 10), the impacts associated with the project will go on for most, if not all, of the project life.



coffey natural systems	Date: 08.10.2007 MXD: 972_DonaldMineralSandsGIS File Name: 972_05_F06.20_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Modelling of noise from main mining pit (Year 9) under neutral and worst case propagation conditions	Figure No: 6.20

Ore Treatment Plant

One residence, D4 is less than 100 m from the ore treatment plant and a second residence D1 is approximately 1.2 km to 1.3 km away from the ore treatment plant. The noise emissions from the wet concentrator plant are significantly less than those from the large heavy machinery associated with the mine site. The noise contours suggest the following distances are required to achieve the appropriate N3/89 noise criteria:

- Day, 45 dBA 400 m.
- Evening, 37 dBA 700 m.
- Night, 32 dBA 1,200 m.

With haul trucks on the site, emissions would be above the predicted contour levels; however, the above provides a guide as to the siting of the ore treatment plant.

Haul Route

Predicted maximum noise emissions as a function of distance were calculated to help determine the preferred haul route from two potential options (north and south as shown on Figure 6.24 (see Section 6.9) as haul route 1 and 2, respectively). The results showed that, in order to obtain an external maximum below 60 dBA, a 150-m-buffer distance from the road is required. Based on this, the north haul route is the preferred route as it has only one (compared to four) receivers approximately 150 m from the road.

Rail Siding Location

Two potential locations (north and south as shown on Figure 6.24 (see Section 6.9) as options 1 and 2, respectively) were considered for the rail siding location. The nearest receivers for the north and south options were 750 m and 1,250 m from the sites, respectively. Predicted noise levels at each receiver for the two proposed loading methods are provided in Table 6.17 below.

Table 6.17 shows that, using the container transfer method, the N3/89 guidelines criteria for day, evening and night would be met at the nearest resident (1,250 m) for the south option, whilst night and possibly evening criteria would be compromised at the nearest resident (750 m) for the north option. In contrast, the day period noise criteria would be met at either location using the bulk handling method, but evening and night period criteria would; however, be exceeded at both sites.

Reversing Beepers

Assessment of noise from reversing beepers as a function of distance showed that a buffer distance of 500 m is required to obtain a sound level of 32 dBA under worst-case conditions (21 dBA under neutral), which would meet the N3/89 criteria. To avoid nuisance, it would; however, be ideal if reversing beepers were below N3/89 (e.g., 25 dBA), which is effectively achieved at approximately 1,000 m.

Table 6.17 Predicted train loading operation noise levels

Equipment	Predicted Noise Level	
	North Option (750 m from nearest receiver) (dBA)	**South Option (1,250 m from nearest receiver) (dBA)**
Container Transfer Method		
Gantry crane (motor, gearbox)	27	20
Truck on site	38	31
Impact sounds*	60	53
Bulk Handling		
Front-end loader (CAT 990) operating within building	40	35
Conveyor system / drive etc	40	35
Truck on site (unshielded)	38	31
Combined level (all of above)	44	39

Key: Yellow – does not comply with evening or night criteria and blue – does not comply with night criteria.

*N3/89 generally relates to continuous noise and may not adequately assess impact sounds. The Griefahn or WHO criteria could be applied to single event impact sounds during the night. These require an external maximum of 60 dBA, which is met.

6.6.3 Avoidance, Mitigation and Management Measures

As a result of identifying the potential impacts on the amenity of these residences, DMS has examined a range of options to avoid, reduce or mitigate noise emissions from project activities.

Construction Noise and Mine Operation

Management measures to be implemented depend on negotiations between DMS and the individual residents but could include:

- Building upgrades specific to the receiving building (though not strictly in accordance with the provisions of the EPA guidelines, which apply to the outside of receivers).
- Temporary relocation of some residents.
- Relocation or delay of works in a particular area to minimise noise emissions, in response to complaints received by the Mine Manager or delegate on company contact line.
- Selective construction activities during night time periods to ensure inaudibility at receivers.

As the mining operation involves a ‘moving pit’, noise criteria at individual residences will not be exceeded for the entire 25-year period, but will only be exceeded during the years when the mine works are at the closest corresponding locations.

Ore Treatment Plant

The company would prefer to purchase the property of D4 as the site for the ore treatment plant. Building upgrades to D1 may be required to ensure night-time amenity is not compromised due to noise from the ore treatment plant.

Haul Route

The northern option (haul route option 1) is preferable over the southern due to the fewer number of residences potentially affected by night noise disturbance.

Rail Siding Location

If the container transfer method is to be implemented at the northern option, barriers such as shipping containers will be installed in order to meet N3/89 guidelines at the closest residential receiver. If the bulk handling method is to be implemented, the following mitigation measures will be implemented to ensure N3/89 guidelines are not exceeded at either the northern or southern location:

- Noise barriers of materials such as earth, wood, hay bales or shipping containers.
- Acoustic shrouds over the main conveyor drive system.
- Upgrades to the metal clad building.

Reversing Beepers

Buffer distances required for reversing beepers are less than those required for mine operation and so management measures will be the same as those discussed above for mine operation. Broad spectrum reversing beepers will also be used. For train loading operations, the use of barriers or shielding at night will be implemented to ensure guidelines are met at the nearest residents.

6.6.4 Residual Impact Assessment

Six residences (D1 D2, D4, D5, D6 and D23) are expected to be able to hear night-time construction noise. As such, this exceeds the N3/89 guidelines for construction noise. Ten residents will experience noise exceeding N3/89 guidelines when the mine is operating in their vicinity. Of these residences, seven in the core of the project area (D4, 5, 6, 7, 8, 11 and 23) and two on the edge of the project area (D2 and 10), will experience impacts associated with the project for most, if not all, of the project life. N3/89 night guidelines will be exceeded at an additional seven residences when the mine is operating in their vicinity. In order to minimise affects on local residents, DMS has examined a range of options to avoid or minimise impacts. This has only been partially successful and DMS now seeks to negotiate with potentially affected people and come to a mutually agreeable outcome. This may involve compensation, purchase of the property, temporary relocation, changes to operating practices or modifications to the house to minimise noise intrusion.

Residents closest to the train-loading locations should not experience any noise levels above the guidelines once mitigation measures have been implemented.

6.7 Radiation

Australian Radiation Services Pty. Ltd. (ARS) has conducted the radiation impact assessment for the project. The radiation impact assessment report is provided as Supporting Study 7 and a summary is provided below.

6.7.1 Existing Conditions

Radiation Characterisation

Uranium and thorium are present in rocks and soils in trace amounts together with radioactive potassium. These elements result in external and internal irradiation of people due to incorporation of these elements in building materials, and into food and drinking water, which results in internal exposures to radiation. Uranium and thorium are considered to be the key radionuclides. Radon gas, from decay of radium, is a significant source of natural radiation.

All heavy mineral sands orebodies contain traces of the natural radioactive elements, uranium and thorium, together with their decay products. However, the only component of mineral sands that is significantly radioactive is the mineral monazite. The content of uranium and thorium in monazite is considerably higher than that in the other main minerals, namely ilmenite, rutile and zircon. Therefore, analysis of the distribution of radioactivity throughout the mining and processing of the mineral sands focused on the partitioning of monazite at the various stages. The DMS orebody comprises less than 1% monazite. Monazite will not be separated from the heavy mineral assemblage during the ore treatment process.

Ore mined for the project will undergo the following:

- Separation into oversize and undersize materials at the mining unit plant within the open pit.
- Initial wet gravity processing of the undersize fraction of the mined ore in the WCP to produce HMC.
- Separating the magnetic and non-magnetic components of the HMC using wet high-intensity magnetic separators (WHIMS).
- The magnetic and non-magnetic HMC will be transported to port for export.

The non-magnetic concentrate will contain the majority of the monazite present in the ore. As a result, it is expected that the backfill will contain less than 5% of the monazite contained in the undisturbed ore (Kruger, pers. comm., 2007).

Background Radiation

Radiation exposure (or dose) is measured in terms of the energy absorbed by the tissue in the body and is expressed in gray (Gy), where one gray is equal to one joule of energy deposited per kilogram of mass.

External Gamma Radiation

The average external dose rate in the project area was calculated to be 0.08 µGy/hour (with a range of ~0.04 to ~0.13 µGy/hour). Figure 6.21 shows the position of each measurement location. For comparison, the global average of absorbed dose rate in air, i.e., the external dose rate, is approximately 0.059 µGy/hour. The dose rates in the project area reflect the relatively low levels of natural uranium and thorium and other naturally occurring gamma ray emitters in the surface soil throughout the project area and environs. The elevated levels of radioactivity associated with the heavy mineral deposits are not reflected in the dose rates at the surface, despite measurements being taken directly over the orebody. This is mainly due to the fact that ore deposits are generally 5 to 20 m below

the surface and gamma ray attenuation by the overlying soil will effectively reduce the radiation field to ambient levels.

The unit used to measure the quantity of a radioactive material is called the becquerel (Bq). One becquerel is defined as the activity of a quantity of radioactive material in which one nucleus decays per second.

Soil

A survey of the project area revealed that the range for the average radioactive concentrations of uranium and thorium in surface soil is low (8 to 32 Bq/kg and 10 to 40 Bq/kg, respectively) in comparison to the range for the average global background levels (16 to 100 Bq/kg and 17 to 60 Bq/kg, respectively). The other main radioactive constituent of soil is potassium-40 (K-40) and its average concentration throughout the project area ranges from 40 to 420 Bq/kg, compared to the global average of 140 to 850 Bq/kg.

Groundwater

Elevated levels of naturally occurring radionuclides in groundwater exist in the area as part of a natural phenomenon that exists where saline groundwater occurs. Elevated levels are not necessarily due to the presence of mineral sand deposits. There may be some seasonal and regional variations and these variations, together with the generally elevated radium concentrations found naturally, must be considered when assessing possible long-term impacts of mining or mineral processing on the groundwater conditions in the area.

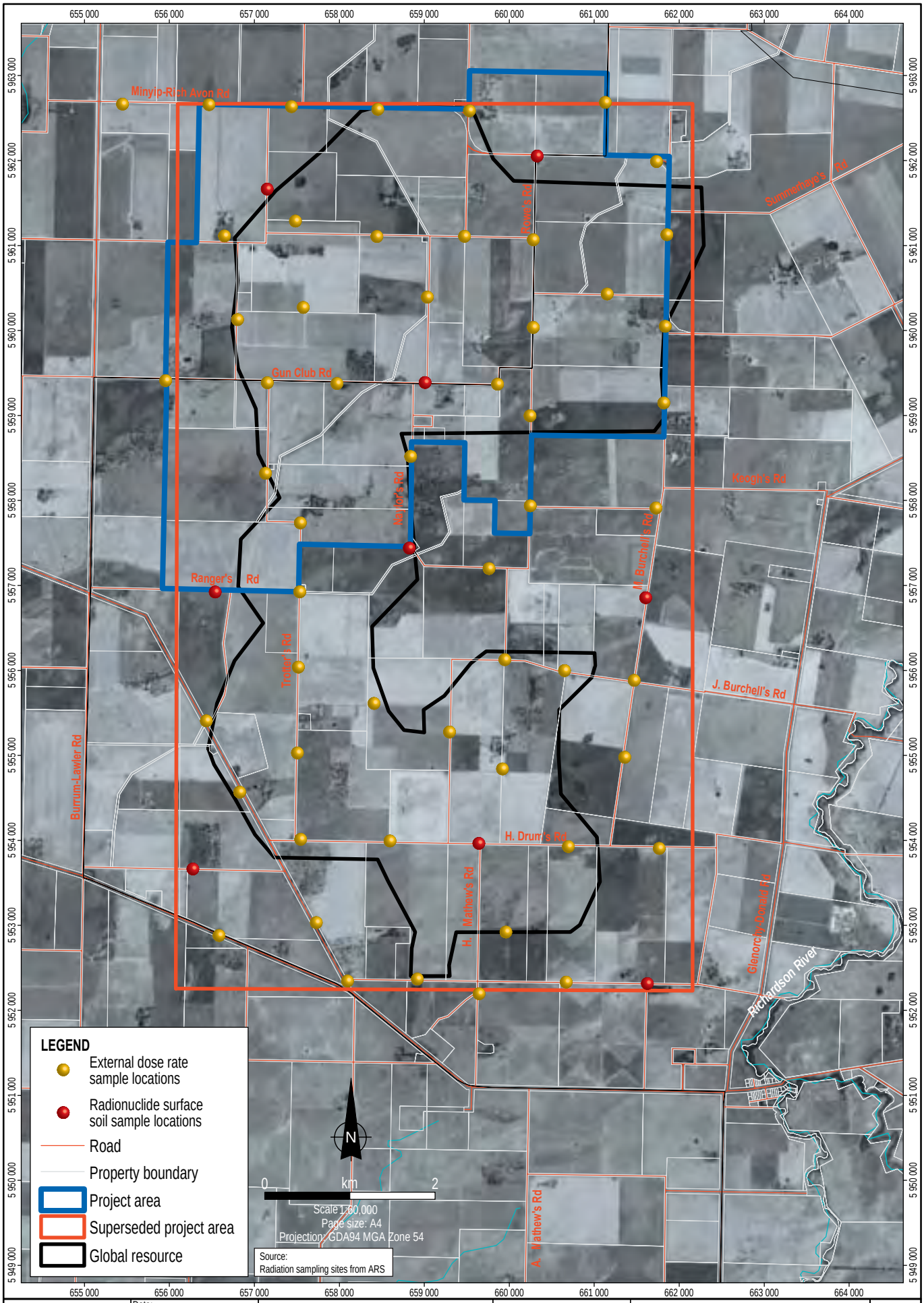
Samples of groundwater were taken for analysis of radiological characteristics from bores in the vicinity of the project area (Figure 6.22). The main radioactive constituent identified was radium (i.e., radioisotopes of radium), the decay product of the natural uranium and thorium series. Radium is quite soluble in saline groundwater compared to other long-lived natural radionuclides. Levels of radium in the groundwater are variable throughout the project area but, overall, they were relatively low. Radium-226 levels in the area sampled ranged from 0.092 to 0.314 Bq/L. The radionuclide content in drinking water supplies elsewhere indicate that, in particular, radium-226 levels in bore water supplies can exceed 1.5 Bq/L and in extreme cases, levels of up to 49 Bq/L have been recorded (Supporting Study 7).

Radiation Exposure Guidelines

Radiation exposure of people is measured in units of ‘effective dose’ called sieverts (Sv). The sievert takes account of the radiation energy deposited in the body, the sensitivity of the part of the body exposed, and the type of radiation. Exposure is commonly measured in millisieverts (mSv), equal to one thousandth of a sievert. The typical exposure of natural background levels in Australia is 1.5 mSv/year.

The recommended upper dose limits adopted for use in Australia by the National Health and Medical Research Council (NHMRC) are:

- 20 mSv/year (averaged over 5 years) for workers exposed to radiation as an unavoidable part of their job.
- 1 mSv/year for members of the public.



coffey natural systems

Date: 26.09.2007
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F06.21_GIS_AI

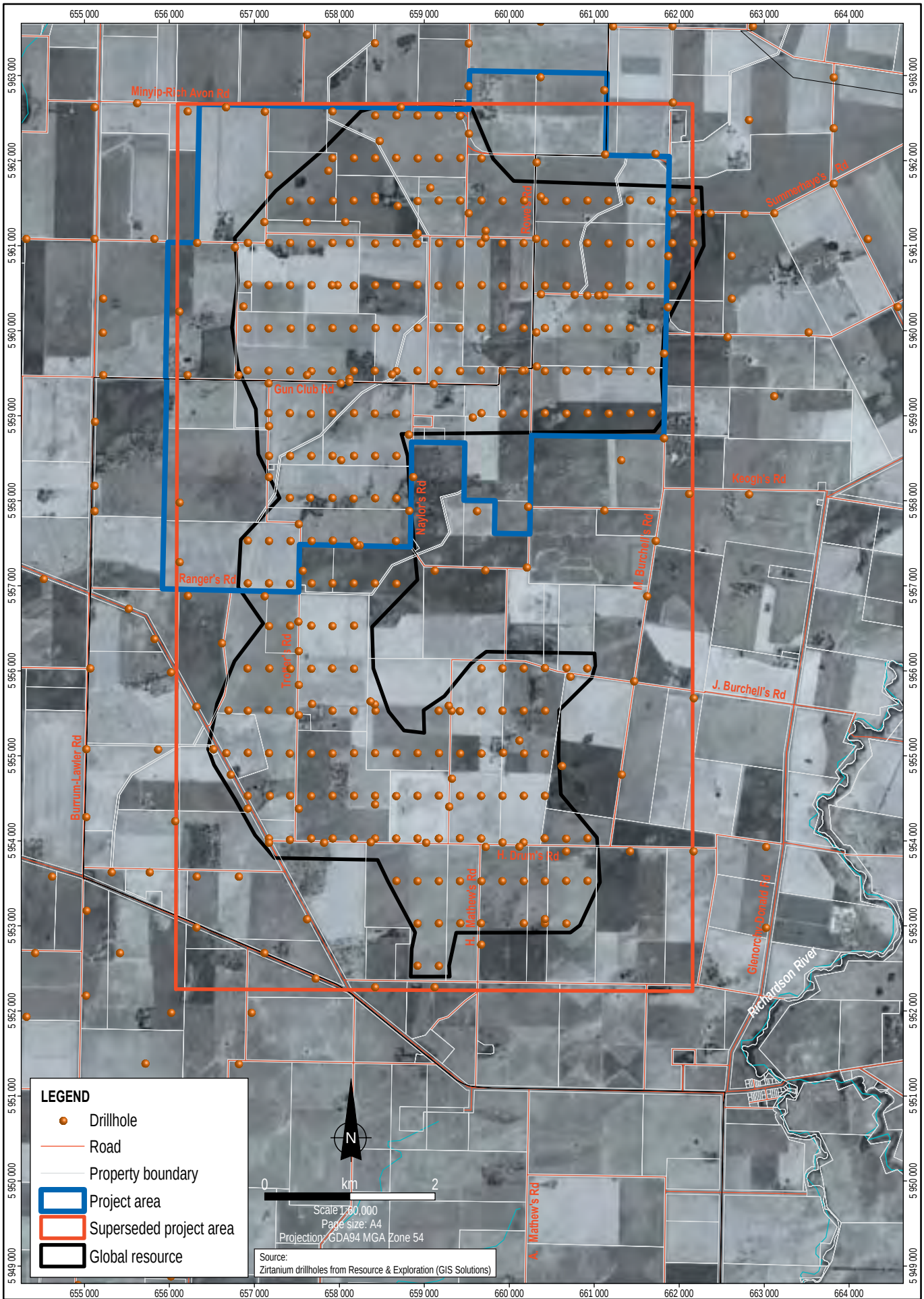
DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Sample locations for background radiation levels (from natural sources)

Figure No: 6.21



coffey natural systems

Date: 26.09.2007
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F06.22_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Bore sampling locations for the groundwater radiological characterisation

Figure No: 6.22

The dose limit of 20 mSv/year for occupational exposure would apply to those workers who are exposed as a result of working directly with radiation or radioactive materials. This limit is the sum of all exposures, both from external radiation and of radioactive materials. Exposure of employees, who have no direct involvement in the mining and processing operations, should be limited to the same as members of the public and subject to the same annual dose limit.

6.7.2 Issues

Potential exposure pathways to members of the public include off-site releases of dusts or radon gas, contamination of food and water supplies due to the migration of radionuclides from the mine site during mining operations or following the disposal of tailing. Radioactivity associated with the various heavy minerals or tailing may also have the potential to be dispersed in the environment during processing operations.

Exposure Pathways

Radiation exposure arises through three principal pathways: external irradiation, inhalation and ingestion. The specific potential exposure pathways for the project are:

- External exposure from the orebody during mining, separation of heavy minerals, stockpiled ore or from mineral concentrates.
- External exposure during transport of ore or mineral concentrates.
- Internal exposure from the inhalation of contaminated air or ingestion of contaminated food or water.

The assessment of potential internal and external exposure to radiation due to mine materials only calculated potential exposures from the primary ore. Given that this will lead to the highest doses expected, the estimates are believed to be conservative. Based on this assumption, the radiation assessment determined:

- The most potentially exposed site workers, i.e., those involved in handling HMC during processing, would receive a total external dose of 1.6 mSv/year. The estimate was very conservative, based on the assumption that the worker was exposed for 2,000 hours/year (based on 40 hours/week and 50 weeks/year) with no allowance made for protective shielding.
- A conservative estimate for the effective dose to workers from potential exposure to radionuclides associated with the inhalation of dust was calculated (which included the assumption that the radionuclide content in the dust would be the same as that in the respective mineral sand ore or intermediate product, despite the average particle size of the heavy minerals being an order of magnitude greater and therefore likely to have a much higher radionuclide content). The estimated annual dose from inhalation ranged from 0.01 to 1.6 mSv, i.e., well below the occupational exposure limit of 20mSv/year. With most of the orebody situated below the water table, the ore will remain damp when mined and dust levels will be suppressed as a consequence. The highest doses from dust exposure will arise from handling materials containing significant levels of monazite, e.g., the WHIMS non-magnetics.
- In the open, any radon gas released from an orebody or stockpile will be rapidly diluted in the atmosphere and dispersed. Therefore, it is likely that, in the open pit, radon levels will be close to

ambient levels and this exposure pathway will not result in levels above the dose limit for members of the public (1 mSv/year).

Groundwater Contamination

Radionuclide constituents are highly inert and bound strongly in the mineral structure. Physical methods have been proposed to separate the heavy minerals in the ore (see Section 4.6), and tailing returned to the pit will not be subject to chemical treatment. Consequentially, the tailing will not be chemically altered (apart from concentration changes in various stages of processing the mineral) and the solubility of uranium and thorium (and the other radioactive elements in the decay series) will remain unchanged. As a result, the backfill material, which has less than 5% of the original monazite and was at least partially below the groundwater table, should not affect groundwater quality due to mobilisation of radionuclides. Furthermore, over the long term, any local movement of radionuclides through the aquifer would be very slow.

Transport

The transport of mineral sand materials, either off site or within the project area, will be conducted in compliance with the ARPANSA Code of Practice for Safe Transport of Radioactive Material (ARPANSA, 2008) due to the fact that the uranium and thorium concentrations in magnetic and non-magnetic concentrates are likely to exceed the exemption limits of 1 Bq/g, a limit which is specified in the code. This code places requirements on the packaging and containment of consignments to ensure that there is no possibility of losses of material during transport. In addition, the code sets limits for radiation levels on the outside of packages and transport containers to ensure the radiological safety of drivers and others in the vicinity of a consignment.

Transport of heavy mineral products or waste during project operations will meet the radiation limits for external surfaces of packages or overpacks (10 mSv/hour, assuming an ‘exclusive use’ consignment), and the dose rate limit of 0.4 mSv/hour at 1 m from the external surfaces of the load.

The effective annual dose for truck drivers transporting HMC to the railhead was estimated between 0.32 mSv and 0.44 mSv for magnetic and non-magnetic HMC respectively (see Supporting Study 7). This is based on four hours per driver per day and would not materially vary if this were made up of a single, long trip or multiple, shorter trips.

Dose estimates for workers involved in handling operations during transport indicate that annual doses up to 0.49 mSv are possible, depending on the type of material involved. Therefore, the total annual dose to either an individual truck driver or a worker resulting from transport of heavy mineral intermediate products or tailing and other material derived from the project, will be below the public exposure limit of 1 mSv/year (i.e., well below the occupational exposure of 20 mSv/year limit for workers).

It is clear from the summary of estimated exposure dose levels shown in Table 6.18, that the upper dose level that workers could be exposed to, are an order of magnitude less than the upper dose limit adopted in Australia (20 mSv/year).

Table 6.18 Upper radiation dose limits adopted in Australia

Exposure Pathway	Exposure to Workers (mSv/year)	Exposure to Members of the Public (mSv/year)
Upper dose limit*	**20#**	**1**
Handling HMC during processing	1.6	N/A
Inhalation of radionuclides associated with dust	0.01 to 1.6	<1
Radon gas released from the orebody	Ambient levels	Ambient levels
Transporting HMC to the railhead	0.32	N/A
Transporting HMC and non-magnetic materials	0.44	N/A

* The recommended upper dose limits adopted for use in Australia by the National Health and Medical Research Council (NHMRC).

Averaged over five years for workers exposed to radiation as an unavoidable part of their job.

Members of the Public

Assessment of exposure to the workers through inhalation of dust during mining or in handling monazite-containing materials has revealed that exposure would not lead to doses significantly above the public limit, even with the application of very conservative assumptions. Therefore, any off-site releases of dust during mining or processing operations would lead to trivial doses to members of the public given the substantial dilution with atmospheric dispersion. Furthermore, the primary processing of mineral sands uses wet separation techniques and the level of dust generated would be expected to be very low.

It is highly unlikely that there will be significant radiation exposure to members of the public during transport of these materials.

Project Area Biota

The off-site dust deposition exposure pathway is likely to lead to trivial doses to crops and other biota given the radionuclide concentration in the source, the inertness of the monazite mineral and the very low environmental transfer factors for the key radionuclides of radium and thorium.

6.7.3 Avoidance, Mitigation and Management Measures

Under the *Radiation Act 2005* DMS will negotiate with the Department of Human Services (DHS) regarding the need to apply for a licence. The primary condition of a licence under the Act will be reference to the ARPANSA Code of Practice and Safety Guide on Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005). A Radiation Management Plan will be prepared for the project that includes a distinct and separate section to address the management of radioactive waste.

The Radiation Management Plan will include the following:

- A description of the background levels of radiation in the project area.
- Identification of exposure sources and pathways.
- Identification of workers or members of the public most at risk.
- An estimate of the potential health impacts of each stage of the mining process.
- Measures to control radiation exposures for workers including:
  - Provision of engineering controls e.g., ventilation, dust control, shielding etc.
  - Application of standard operating procedures for handling and transport of radioactive materials, use of radiation sources, and industrial gauges containing such sources.
  - Limitation of occupancy within certain areas, or restriction of time for certain activities, to minimise exposure times for workers.
  - Warning signs and labels within certain areas.
  - Provision of adequate facilities for personal hygiene.
  - The provision and use of personal protection equipment (PPE).
  - Monitoring programs to demonstrate compliance with regulatory standards, dose estimation, effectiveness of engineering controls, etc. The scale of the monitoring program will depend on the level of potential exposure.
  - Monitoring techniques such as personal dose monitoring or area monitoring, dust sampling, area monitoring for dust, etc., depending on the potential exposure.
- Appropriate training of workers in the radiological aspects of operations, which may include:
  - Training in measures adopted to reduce or minimise radiation exposures.
  - Job specific training and additional training for supervisors.
  - Induction programs.
  - Documentation of training programs and records of employee participation.
  - Specific on-going training and professional development of radiation safety personnel.

The radioactive waste management will control potential exposures to members of the public from the handling, storage and disposal of radioactive tailing and overburden generated during mining and mineral processing. This section of the Radiation Management Plan will provide:

- An outline of the processes generating waste and a description of the waste.
- A description of the environment into which the waste will be discharged or disposed.
- A description of the proposed system for waste management including the facilities and procedures involved in the handling, treatment, storage and disposal of radioactive waste.
- Prediction of environmental concentrations of radionuclides and radiation doses to people from the proposed waste management practices, including demonstration that the radiation protection requirements of the Code will be met now and in the future, as determined by the DHS.

Depending on the radioactivity levels in the waste streams, these measures may include:

- Engineering controls for containment of residues or minimisation of off-site releases of material.

- Operational environmental monitoring including groundwater monitoring, airborne dust levels or radon in air.
- Contingency measures in the case of failures in operational processes or equipment.

The Radiation Management Plan will make provision for reporting to DHS, to project management and workers. Reporting will cover personal monitoring results, environmental monitoring results and assessments, incident reports and other operational issues and worker dose records. A quality assurance program will be implemented to ensure confidence in the radiation controls and associated radiation measurements and to review effectiveness of procedures and to promote continued improvement. A schedule for reporting on the operation and results of monitoring and assessments will be prepared.

6.7.4 Residual Impact Assessment

Radionuclide concentrations (uranium and thorium) in the tailing and overburden returned to the mine pit will be considerably less than the radionuclide content in the unmined ore. Soil replaced in the mine pit will attenuate gamma radiation such that the external radiation levels at the surface will be consistent with, if not lower than, current background radiation levels.

Ore processing will be conducted using gravity-based separation, leaving the tailing chemically unaltered. Consequently, the potential for migration of radioactivity to the groundwater in the area would be similar (if not less) to that in the presence of the existing ore deposits.

If not sufficiently managed, residual impacts from radiation could potentially arise from:

- Disposal of tailing and overburden in the mining pit.
- Increased radiation levels above a rehabilitated mined area.
- Increased radiation levels through migration of radionuclides into groundwater.

However, due to the nature of the DMS orebody (of very low radionuclide concentrations), its location (beneath the water table thus minimising the spread of radionuclides as dust) and the proposed mining method (slurry transport and wet processing without chemical alteration, and the export of monazite as part of the non-magnetic concentrate), the radiation residual impacts resulting from the project will be negligible and, potentially, less than currently exists.

6.8 Visual

The visual impacts of the Donald Mineral Sands project were assessed by EDAW Pty Ltd. This is presented in Supporting Study 13 and summarised below.

6.8.1 Assessment Method

The assessment method is based on the Visual Management System developed by the US Forestry Service (Forest Service USDA as cited in Supporting Study 13) whereby the visual impact resulting from a combination of visual modification and viewer (or visual) sensitivity (Supporting Study 13) is assessed. The degree of visual modification is assessed in the context of the visual sensitivity of surrounding land use areas from which the project is visible and the sensitivity of land users (Table 6.19).

Table 6.19 Visual impact matrix

		Viewer Sensitivity		
		H	**M**	**L**
Visual Modification	H	H	H	M
	M	H	M	L
	L	M	L	L
	VL	L	VL	VL

VL = very low, L = low, M = medium, H = high.

Throughout this section, the following spatial definitions are used:

- Regional setting – beyond 5 km from the project area.
- Subregional setting – between 1 km and 5 km from the project area:
  - Distant subregional setting – between 2.5 and 5 km from the project area.
  - Near subregional setting – between 1 and 2.5 km from the project area.
- Local setting – within 1 km of the project area.

Visual Modification

The level of visual modification as a result of the project is measured as an expression of the visual interaction, or the level of visual contrast between the major components of the project and the existing visual environment. As described in Section 4.5 and Section 4.6, major components of the project comprise:

- Site office and workshop buildings.
- Overburden and soil stockpiles.
- Pit.
- Water storage ponds.
- Wet concentrator plant.
- Related project ancillaries (e.g., telecommunications, water supply pipeline and power supply).
- Tailing dams.
- Sources of lighting.

A high degree of visual modification will result if the major components contrast strongly with the existing landscape.

A low or very low degree of visual modification will occur if there is little, or minimal, visual contrast and a high level of integration of form, line, shape, pattern, colour or texture values between the project and the environment in which it sits. In this situation, the project may be noticeable, but not markedly in contrast with the existing modified landscape.

Throughout the visual catchment (or zone of visual influence), the degree of modification will generally decrease as the distance from the project area to various viewing locations increases.

Absorptive Capability

Landscape absorptive quality is closely related to that of visual modification. It is generally applied at a broader scale than visual modification and is an assessment of how well a landscape setting is able to accommodate change. The key factors considered in determining absorptive capability are topography and vegetation. In areas of flatter topography, overlooking is not possible and a quite low and thin band of vegetation is able to screen views to a development from a given viewing location. In areas of undulating or elevated topography, overlooking can occur and vegetation needs to be higher and denser to achieve effective screening. Intervening undulating topography also has the potential to block views in certain landscapes.

Visual Sensitivity

As each individual has a different perspective on what is, or is not, visually appealing, determining the visual impacts from key vantage points (or viewpoints) is essentially subjective. Residents tend to be highly sensitive to changes in the visual setting when the changes occur close to their homes and are highly visible. In contrast, in areas subject to constant and significant change, land users tend have a low sensitivity to change, even when changes occur a short distance away and are highly visible.

Landscape Character Significance

A search of the following organisational databases was undertaken to identify the cultural significance of the landscape character within the project region:

- National Trust.
- Heritage Council.
- Commonwealth National Estate Register.
- Local planning schemes.

6.8.2 Existing Conditions

The regional landscape surrounding the project area is generally flat to slightly undulating with topography varying by 12 m (from 126 reduced level (RL) to 138 RL) across the project area.

Most of the regional landscape has been cleared for broad-acre crop production and grazing. Remnant vegetation is generally confined to road reserves and small sections of private land. *Casuarinas* and small eucalypts, 5 to 10 m high, comprise the dominant vegetation.

The region comprises a number of distinct land-use types and landscape units of varying levels of landscape quality. The landscape type of the broader region is described as Murray Basin Plains – Wimmera Subtype (Leonard and Hammond, 1984 as cited in Supporting Study 13). The Wimmera landscape is generally flat, with rectilinear patterning created by broadscale, almost treeless agricultural land uses or road reserves lined by remnant vegetation, with occasional tree-lined streams.

The soil colour is generally grey with occasional patches of red to brown soils.

The scenic quality level for the study area is considered to be moderate due to:

- The landform being slightly undulating, with a sense of spatial definition present.
- The vegetation patterns being moderately defined, with little diversity and a moderate degree of contrast with the surrounding landscape.

- Intermittent watercourses being present.

The landscape within the local to near subregional setting is generally flat and effectively absorbs the project components due to the ability of head-high, intervening vegetation to screen views. The landscape settings of the site and its subregional and regional surroundings (the primary areas subject to visual impact) have the following absorptive capabilities:

- Topography – high capability.
- Existing vegetation – moderate to high capability.
- Cleared agricultural areas – generally low capability.

Within Yarriambiack Shire, an Environmental Significance Overlay (ESO) exists for a number of areas of roadside and remnant vegetation. No other citations or controls occur within the project area. Viewing locations in the subregional and local setting include:

- Minyip–Banyena Road: the busiest local road within the subregional visual catchment and therefore the most visually sensitive. Other local roads carry very low volumes of traffic, often providing access for farm equipment to paddocks. Minyip-Banyena Road traverses the subregional visual catchment of the project area at approximately 45 degrees to the alignment of the edge of the project area boundary, ranging from 5 km from, and to within 1 km of the edge of the mining licence area.
- The settlements of Dunmunkle East and Rich Avon West: comprise a loose grouping of a small number of rural residences.
- Rural residences within the subregional setting: includes a number within the project areas boundary, i.e., D15, D14, D18, D12, D20, D13, D17, D16 and D22.
- Rural residences within the local setting: includes six within the mining licence area, i.e., D2, D23, D3, D4, D5, D6, D7, D8, D9, D10 and D11[9].
- Local roads within the local setting: numerous unsealed local roads of varying standard occur (see Section 6.9.1).

6.8.3 Issues

As discussed in Section 4.1, the project involves a ‘moving pit’, meaning that, as the cycle of clearance, mining and rehabilitation proceeds, impacts on the community and environment will vary across the project area.

As the project will require the removal of several residents in the mining licence area prior to project initiation, discussed further in Section 6.10.4, the discussion of visual impacts which follows focuses only on those residents outside of the mine plan which will not be removed prior to the initiation of work.

The extent to which changes to visual amenity will be an issue for local residents will depend on:

[9] Subject to landholder agreement, residences D4, D5, D6 D7 and D8 will be vacant from project onset (Section 6.10.4 [Social impacts].

- The level of visual modification.
- Viewer sensitivity (including sensitivity to night lighting).
- The duration of project-derived visual impact.
- The timing of project-derived visual impacts.
- The effectiveness of mitigation and management procedures carried out by DMS.

Within the local and near subregional settings, vegetation that often surrounds the “home yards” of rural residences screens views to the project. Views of the project from parts of properties used for production purposes will often be unrestricted. It should be noted that agricultural land is a low viewer sensitivity area, compared to rural residences that are rated as high viewer sensitivity areas.

Five rural residences will experience a high visual impact, 10 residences will experience a moderate to high visual impact and one residence will experience a moderate visual impact (Table 6.20). See also Figure 1.2.

Table 6.20 Visual modification and viewer sensitivity

Setting	Viewing Location	Level of Visual Modification	Viewer Sensitivity	Visual Impact
Regional (beyond 5 km radius)	Rural residences	L	VL	VL
Subregional (1 to 5 km radius)	Settlements of Dunmunkle East and Rich Avon West	M-H	VL-L	L-M
	Minyip–Banyena Road	VL-L	M	L-VL
	Rural residences (D1, D15, D14, D18, D12, D20, D13, D17, D16 and D22)	M-H	M	M-H
Local (within 1 km radius)	Local roads	M	H	H
	Rural residences (D2, D23, D3, D10, D11)	H	H	H
	Rural residences (D9)	M	H	M

The highest sensitivity viewpoints are confined to locations within the local and near subregional setting.

During operations, lighting will originate from two sources:

- Lighting of the project area. This will mostly be visible as a soft glow during darkness. Reflection off the cloud base will make lighting within the project area more apparent in cloudy conditions than in clear conditions. The main source of light will be the WCP.
- Vehicle lighting. Residences along primary road routes, such as Minyip–Rich Avon Road will be particularly susceptible.

The impact of vehicle lighting is considered to be potentially greater than the impact of night lighting of the operations. Overall, whether lighting at night is acceptable or not is difficult to assess given that individuals have different levels of sensitivity.

6.8.4 Avoidance, Mitigation and Management Measures

The project will be completed over 25 years; however, affects on individual residences will occur over relatively short periods (three to five years). In addition, the project will be located in a setting with few highly impacted viewing locations. As a result, impacts will be able to be effectively ameliorated during operations by selecting construction materials that blend with the landscape and foreground screening and perimeter planting.

Wet Concentrator Plant Area

Where operationally feasible, areas around the WCP will be mounded and planted out. The mounding will provide immediate lower level screening while the plantings, over time, will progressively screen the upper portion of the WCP. Where possible, stockpiles will be positioned to screen the WCP and internal pit operations.

Perimeter Screening

Sections of the mining licence area perimeter adjacent to sensitive viewing locations will be planted out to provide screening that ameliorates views. By the time mining activities commence, the plantings will be of sufficient height to provide effective amelioration. In locations where mining activities are to take place within the short term, mounding could be undertaken in conjunction with plantings to provide an immediate effect. Outer batters will be planted out.

Foreground Screening

At affected residences, planting and/or mounding will be undertaken as soon as possible. This process will be subject to consultation with the occupants, as the establishment of a foreground visual screen may be perceived to be as much of a visual impact as the project itself.

Construction Material Selection

Buildings will be clad with non-reflective materials of a colour that mimics those found in the Wimmera landscape, e.g., bluish/olive greens or greys.

Progressive Restoration of the Reinstated Pit Surface

Where possible, soils will be put back in their original location to maintain soil profiles and avoid surface colour contrast created by lighter subsoils and clays.

Final landform shaping and vegetation restoration of the reinstated pits will reinforce and mimic, where possible, other existing elements within the landscape, including the slightly undulating form of the agricultural landscape.

Regular slopes and sharp transition angles will be varied and rounded to provide a more natural appearance. Areas of replaced indigenous vegetation, such as road reserves, will use indigenous species of local provenance to ensure consistency of colour and texture. Visual impacts will continue to be reduced from the time that the progressive rehabilitation works are implemented. Given the relatively dry environment, growth rates will depend on rainfall.

Management of Potential Lighting Impacts

Where possible, the operations will be staged so that activities do not occur on the outer faces of

overburden stockpiles, or areas directly visible from nearby adjacent residences at night. Where possible, shielding of fixed or stationary light sources will be used to reduce light spill.

6.8.5 Residual Impact Assessment

The project will result in a significant modification to the existing landscape. Project staging will break the project area into a number of small, discrete sections; resulting in high visual impacts which are confined to the local setting. These impacts are likely to last for three to five years at the following residences:

- Two residences (D2 and D23) in the first 1 to 5 years and users of Minyip–Rich Avon Road (Plate 6.2).
- No residences in years 6 to 10.
- Six residences (D2, D23, D3, D9, D10, D11) in years 11 to 25 and users of Burrum–Lawler Road (plates 6.3, 6.4 and 6.5).

Impacts on remaining residences are medium to high or medium.

Early progress on the establishment of perimeter and foreground screening at affected sensitive viewing locations will significantly reduce the visual impact of the project.

Progressive landscape remediation works will reduce the duration of the visual impacts.

After completion of progressive rehabilitation works at each discrete section, primarily consisting of surface shaping and cover crop re-establishment, which could take up to two years, the visual impact will be very low at all viewing locations.

6.9 Roads, Traffic and Transport

Roads, traffic and transport for the DMS project has been investigated by Grogan Richards Pty Ltd. Supplementary traffic advice related to road transport routes has also been provided by Grogan Richards. These studies are presented in Supporting Study 8a and Supporting Study 8b and the results are summarised below.

6.9.1 Existing Conditions

The road network adjacent to and within the project area includes one Class B Declared Main Road under the control of VicRoads, local roads under the control of Yarriambiack and Northern Grampian shire councils and private roads (Figure 6.23). The internal road network consists of mine haul and access roads.

Road Condition

The condition of roads within the project area varies from poor to average (Table 6.21). No roads within the project area are in good condition.

Plate 6.2
View south from Minyip-Rich Avon Road during the first three years of mining until perimeter and foreground screening is established. This view is similar to the view that will be experienced by users of Minyip-Rich Avon Road and Residences D2 and D23.

Source: EDAW, 2007.

Plate 6.3
Existing view north, adjacent to Residence D8. This view is similar to the view that is currently experienced at Residences D10 and D11.

Source: EDAW, 2007.

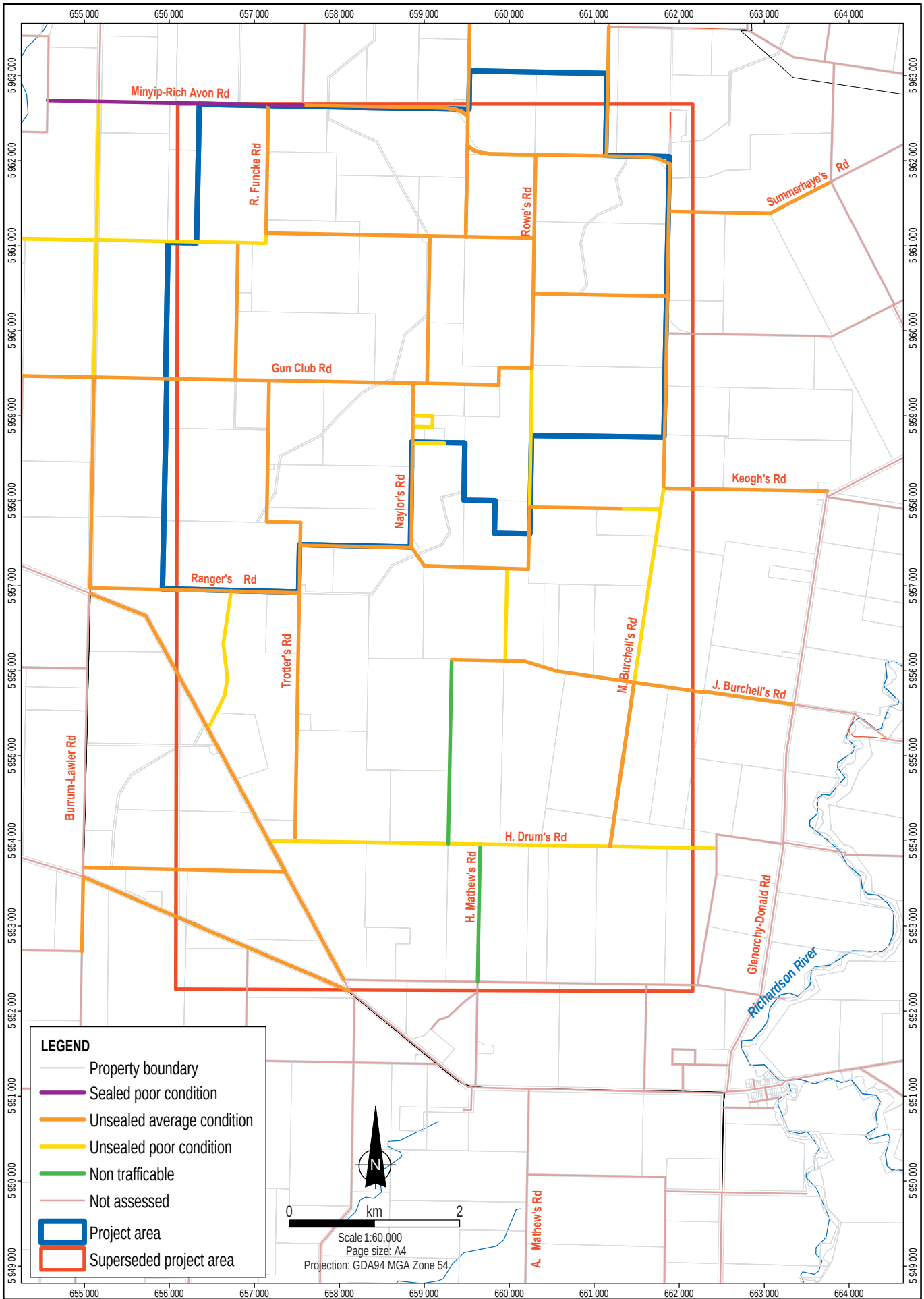
Plate 6.4
View north adjacent to Residence D8, in the last five years of mining. This view is similar to the view that will be experienced at Residences D10 and D11.

Source: EDAW, 2007.

Plate 6.5

View east from Burrum-Lawler Road towards the proposed plant and office location. Process dams are to the right. This view is similar to the view that will be experienced by users of Burrum-Lawler Road.

Source: EDAW, 2007.



coffey natural systems

Date: 25.09.2007
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F06.23_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Existing road condition in project area

Figure No: 6.23

Table 6.21 Local roads within the project area

Road Name	Orientation	Function	Condition	Width	Road Reserve Size	Other Comments
Rangers Road	East to west	• Connects Burrum–Lawler in the east with Trotter's Road in the west. • Facilitates the movement of farm equipment.	Unsealed, average condition	5.7 m	Small	A creek runs along the south side.
Trotter's Road	North to south	• Connects Gun Club Road in the north with H. Drum's Road in the south. • Provides access to two properties and facilitates movement of farm machinery.	Average	7.4 m	Medium	
Rowe's Road	North to south	• Connects Minyip–Rich Avon Road in the north with Hannah's Road in the south. • Facilitates movement of farm machinery.	Average	3.3 to 4.6 m	Medium	
Maloney Road	East to west	• Connects M. Burchell's Road in the west with Rowe's Road in the east. • Provides access to two properties and facilitates movement of farm machinery.	Unsealed, poor – average condition	4.7 m	Medium	Winding.
Minyip–Rich Avon Road	East to west	• Connects Burrum–Lawler in the east with numerous north–south orientated roads and M. Burchell's Road in the southeast. • Provides access to four properties and facilitates movement of farm machinery.	Sealed and unsealed, poor – average condition	3.8 – 6.2 m	Small	Creek crossings, used by school buses.

Table 6.21 Local roads within the project area (cont'd)

Road Name	Orientation	Function	Condition	Width	Road Reserve Size	Other Comments
R. Funcke Road	North to south	• Connects Minyip–Rich Avon Road in the north with Gun Club Road in the south. • Facilitates movement of farm machinery.	Unsealed, average condition	4.6 m	Small	
Donald–Laen Road	North to south	• Connects Minyip–Rich Avon Road in the south with Donald–Murtoa Road in the north. • Facilitates movement of farm machinery.	Unsealed, average condition	6 m	Medium	Used by school buses.

A number of small, unnamed roads also occur within the project area. These roads range in condition from poor to average and have small- to medium-sized roadside reserves.

Typical examples of unsealed, average condition and sealed, poor condition roads that occur within the project area are represented in Plate 6.6 and Plate 6.7 respectively.

A full inventory of roads is provided in Appendix A of Supporting Study 8a.

Intersections

Fifty intersections occur within the project area. Intersections that cannot be negotiated by heavy vehicles[10] are classified as constrained, while intersections that that can be negotiated by heavy vehicles are classified as unconstrained (Figure 6.24). Seven intersections within the project area are constrained.

Existing Traffic Volumes

Existing traffic volumes are summarised in Table 6.22. Data from the Shire of Yarriambiack was used to characterise existing road use within 20 km of the project area.

[10] Supporting study 8a considers 'heavy vehicles' to be rigid trucks and semi trailer trucks with a tare weight greater than 3 tonnes or with a length exceeding 8.8 metres.

Plate 6.6
Typical example of unsealed, average condition road in the project area.

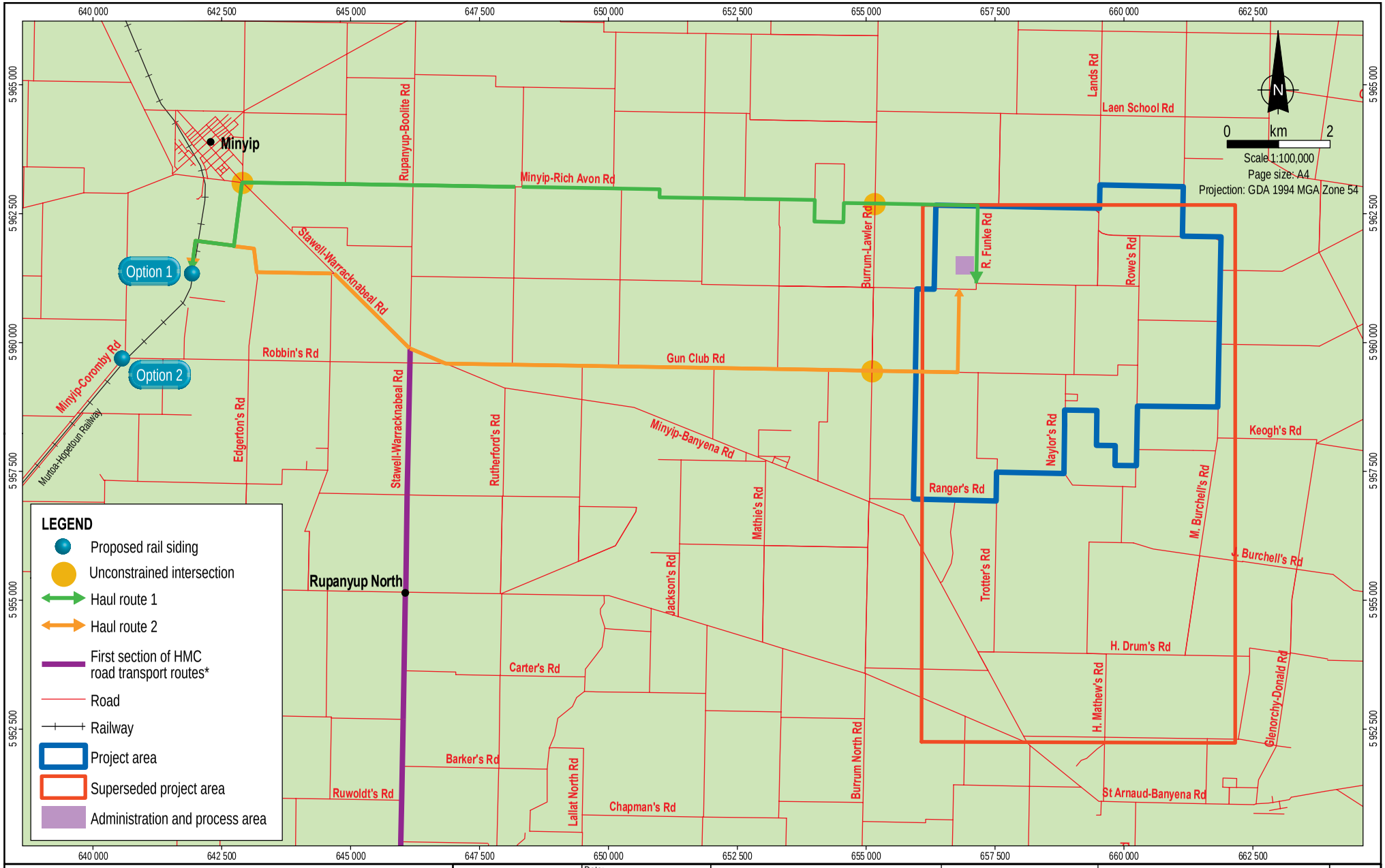
Source: Grogan Richards, 2007.

Plate 6.7
Typical example of sealed, poor condition road in the project area.

Source: Grogan Richards, 2007.

Plate 6.8
Minyip-Rich Avon Road, an unsealed, average condition road.

Source: Grogan Richards, 2007.



* See Figure 4.6.

coffey natural systems

Date: 22.10.07
MXD: 972_DonaldMineralSandsGIS
File Name: 972_05_F06.24_GIS_AI

DMS Pty Limited

Donald Mineral Sands Project

DMS A Subsidiary of Astron Limited

Proposed haul routes - project area to railway siding south of Minyip

Figure No: 6.24

Table 6.22 Existing traffic volumes within the study area

Road	Year of Data	Average Number of Vehicles/day	Heavy Vehicles
Donald–Murtoa Road	1998	298	20.3%
Donald–Murtoa Road	2003	852	14.4%
Minyip–Rich Avon Road	1998	85	11.4%
Minyip–Rich Avon Road	2006	21	14.3%
Stawell–Warracknabeal Road	1995	172	31%
Stawell–Warracknabeal Road	2003	661	17.7%
Stawell–Warracknabeal Road	2007	340	35%
Banyena–Pimpinio Road	2002	71	11%
Minyip–Banyena Road	1998	105	24.1%
Burrum North Road	2006	19	10.5%

Source: Supporting studies 8a and 8b.

The Donald–Murtoa Road and Stawell–Warracknabeal roads are the most trafficked roads, carrying between 700 and 800 vehicles per day. All other roads carry significantly fewer vehicles (generally less than 100 vehicles per day).

Heavy-vehicle percentages range from 10% to 30% of total volumes. This is typical of roads primarily used as long-haul transport routes. During harvest times, commercial traffic in the region increases marginally.

School Buses

A number of school bus routes operate in the vicinity of the project area. One school bus route uses Minyip–Rich Avon Road and will be intercepted by the project (see Figure 6.23). School buses operate between 7.30 a.m. to 9.00 a.m. and 3.00 p.m. to 5.00 p.m. Monday to Friday, during the school year.

Road Transport Options

Three road transport options are proposed for the transport of HMC for the project to the ports of Portland, Melbourne, or Geelong (the final port location is still to be determined):

- Truck from the project area to a port via Horsham, in bulk.
- Truck from the project area to a port via Horsham, in containers.
- Truck from the project area to the train loading facility south of Minyip.

Truck to Port

This option requires HMC to be bulk carried to the relevant port via Horsham using the state road network. This is the most likely option as it does not require double handling of HMC.

Truck and Containers

If this option was selected, HMC would be bulk carried to Horsham to be containerised at a dedicated facility and transported to the port using the state road network. This option is unlikely, but cannot be discounted.

Train Loading Facility

If this option was selected, a rail siding south of Minyip would be built and used to provide rail links to port. Minyip is located 319 kilometres by rail from Melbourne (via Ballan) and is on the Murtoa to Hopetoun spur, and forms part of the greater freight rail link managed and operated by Pacific National. A weekly freight service currently operates on the line. More frequent services operate from Murtoa to the south and southeast.

Preliminary discussions regarding the methods available to provide rail transportation to and from the Minyip rail siding have indicated that there are two train configuration sub-options:

- Dedicated freight train option. This option runs a dedicated train that terminates at the siding, which exclusively carries DMS HMC.
- Existing freight train option. This option attaches extra wagons to existing freight services, carrying containers of HMC. This option is unlikely, but cannot be discounted.

Utilising the existing freight services will result in weekly deliveries to the chosen port. Indicative layouts of the two sub-options are provided in Figure 6.25. As a whole, the train-loading option is also unlikely, but cannot be discounted.

Potential Road Transport Route (Local Area)

Two road transport routes are likely to be used between the project area and Stawell–Warracknabeal Road and the railway siding south of Minyip (see Figure 6.24):

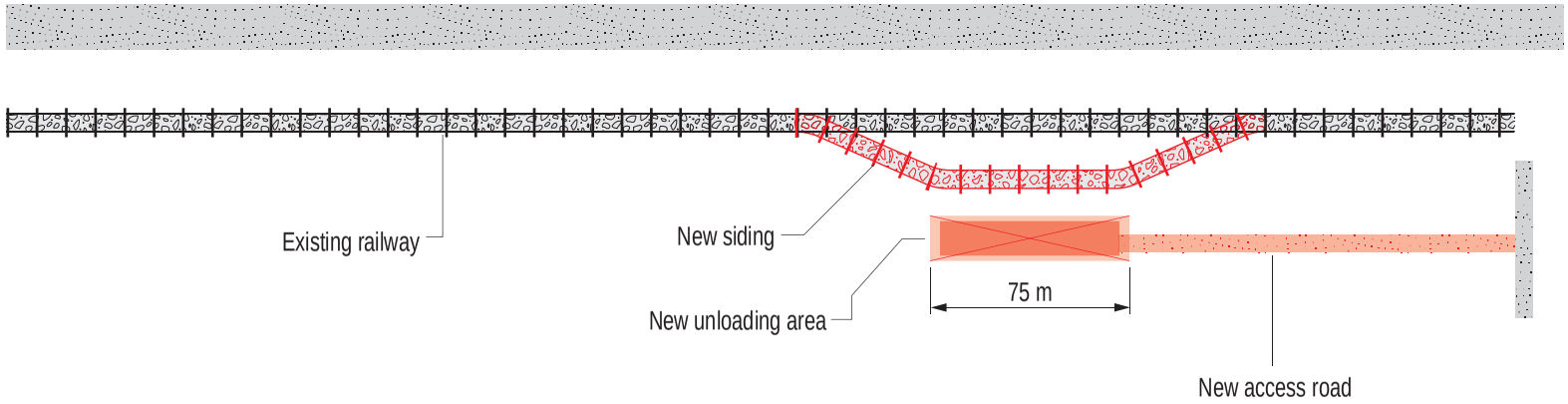
- Option 1: This route assumes the processing plant is located in the northwest corner of the project area. This route follows R. Funcke Road to its intersection with Minyip–Rich Avon Road, then proceeds west along Minyip–Rich Avon Road to Stawell–Warracknabeal Road.
- Option 2: This route follows Gun Club Road to its intersection with Minyip–Banyena Road. Minyip–Banyena Road is followed for a short distance to Stawell–Warracknabeal Road.

The condition of local roads likely to be used as a road transport routes is summarised in Table 6.21 and detailed below:

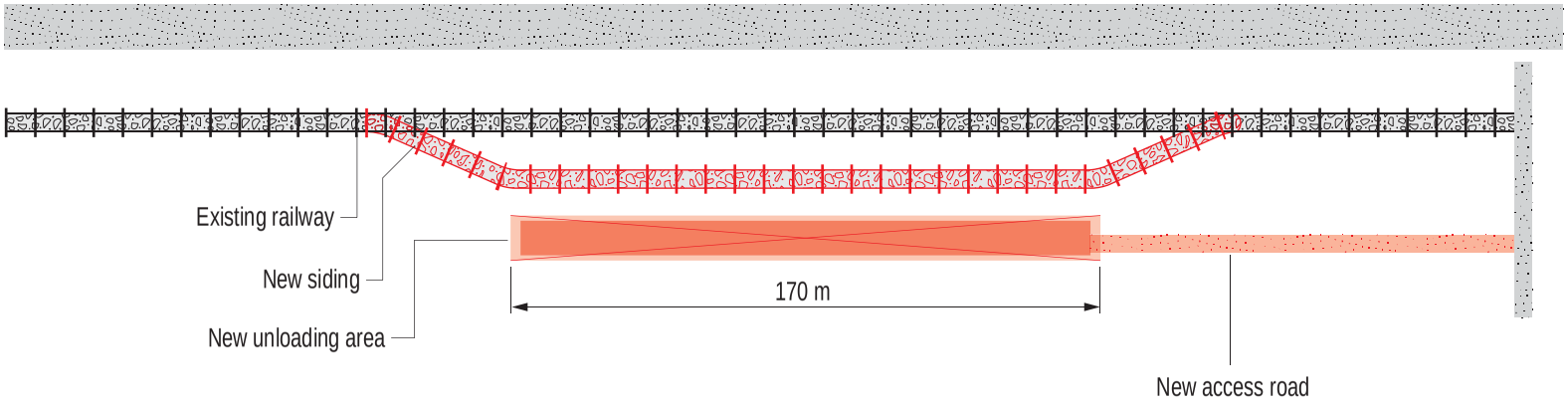
Minyip–Rich Avon Road

The condition of this road varies across its length but is generally sealed and in average condition. The Minyip–Rich Avon Road is generally aligned east to west, and forms the northern boundary of the project area. Towards the northwest corner of the project area, the Minyip–Rich Avon Road has a 3.9-m-wide pavement in poor condition, with gravel shoulders (Plate 6.8). Existing traffic volumes on Minyip–Rich Avon Road are provided in Table 6.22.

Existing Freight Train Option



Dedicated Freight Train Option



	coffey natural systems	Job No: 972	DMS Pty Limited	DMS A Subsidiary of Astron Limited	Existing (top) and dedicated (bottom) freight train options (typical layouts)	Figure No: 6.25
		File Name: 972_05_F06.25_HB	Donald Mineral Sands Project			

Minyip–Banyena Road

The condition of this road is average with a sealed pavement. The Minyip–Banyena Road is generally aligned southeast to northwest and has a 4.2 to 4.5-m-wide pavement with gravel shoulders (see Plate 6.6).

Stawell–Warracknabeal Road

This is classified as a Class B Declared Main Road (arterial road) under the control of VicRoads. The Stawell–Warracknabeal Road provides a main connection between Glenorchy in the south and Warracknabeal in the north (via Rupanyup and Minyip). The Stawell–Warracknabeal Road provides for one traffic lane in each direction, is 6.6 m wide on average and has a sealed pavement with gravel shoulders.

Gun Club Road

This road is generally aligned east to west and primarily provides access to local properties. The condition of Gun Club Road is generally poor. Gun Club Road is 3.6 m wide and generally has an unsealed pavement (Plate 6.9).

R. Funcke Road

This is a local road initially aligned east to west; however, it changes direction in the northwest corner of the project area to be aligned north to south. R. Funcke Road is an unsealed road in generally poor condition, predominantly providing access to local properties, and has a 4.6 metre wide pavement (Plate 6.10).

Additional Road Transport Route Roads

Depending on the chosen port, the following road transport routes are likely to be used (see Figure 4.6):

- Portland route:
  - Stawell–Warracknabeal Road to Rupanyup.
  - Wimmera Highway to north of Horsham, via Murtoa.
  - Henty Highway to Portland, via Horsham, Cavendish, Hamilton, Branxholme and Heywood.

This journey is approximately 290 km long and will take approximately 3 hours and 30 minutes (one way).

- Geelong route:
  - Stawell–Warracknabeal Road to Rupanyup.
  - Wimmera Highway to north of Horsham, via Murtoa.
  - Henty Highway, to Horsham.
  - Western Highway to Ballarat via Stawell, Ararat and Beaufort.
  - Midland Highway to Geelong via Meredith and Lethbridge.

This journey is approximately 350 km long and will take approximately 4 hours and 10 minutes (one way).

Plate 6.9
Gun Club Road looking east.
Source: Grogan Richards, 2007.

Plate 6.10
R. Funcke Road looking north.
Source: Grogan Richards, 2007.

- Melbourne route:
  - As above; however, the Western Highway would be taken all the way to Melbourne.

This journey is approximately 370 km long and will take approximately 4 hours and 15 minutes (one way).

Road transport route roads currently carry a significant level of daily traffic (between approximately 1,000 and 20,000 vehicles) with the exception of Stawell–Warracknabeal Road, which carries a reasonable level of daily traffic (340 vehicles) (Table 6.23).

Table 6.23 Existing traffic volumes on road transport route roads

Road	Location	Average Number of Vehicles/day	Heavy Vehicles
Henty Highway	Riverside	3,000	14%
Henty Highway	Horsham	1,000	20%
Henty Highway	Heywood	2,900	20%
Western Highway	Stawell	5,200	34%
Western Highway	Beaufort	5,400	34%
Western Highway	Ballarat	3,500	40%
Western Highway	Bacchus Marsh	19,800	20%
Midland Highway	Clarendon	3,500	19%
Midland Highway	Meredith	2,800	16%
Wimmera Highway	Rupanyup	1,250	22%
Stawell – Warracknabeal Road	Rupanyup	340	35%

Source: Supporting Study 8b.

Internal Roads

As described in Section 4.7.3, Road Access and Transport, internal haul roads will be located throughout the project area to enable the movement of ore and mine wastes throughout the project area. Haul roads will be constructed using materials capable of coping with heavy loads and will be of a sufficient width to be used by the haul fleet.

Access Roads

Access roads will link plant components on site and provide access to the existing road network. Access roads will be used by mine construction and operations staff, contractors, delivery personnel, and trucks taking HMC to the railway siding. The main access road will be unsealed. If necessary, R. Funcke Road will be upgraded (widened and sealed) to cope with increased traffic.

The local road network provides strong north to south and east to west linkages throughout the project area and numerous potential access points to the project area for both light and heavy vehicles.

Traffic Generation

Mine traffic will include HMC transport trucks, employee and visitor vehicles, fuel trucks, service vehicles and construction vehicles. Off-road vehicles associated with the mine operation will travel within the site.

It is predicted that the mine will generate between 215 and 272 vehicle movements per day (Table 6.24). During both construction and operations, Stawell–Warracknabeal Road will carry the most traffic.

The supporting study is based on In addition to the roads used by haul trucks, a number of other roads will be used by employees, service vehicles, and visitors accessing the project area. Burrum–Lawler Road, a local, unsealed road in generally poor condition, and Banyena–Pimpinio Road, a sealed road in average condition, will be most often used (see Table 6.24).

Table 6.24 Projected traffic volumes

Road	Existing	Project Related Vehicles		Proportion Heavy Vehicles		Total**	
		Construction	Operations	Construction	Operations	Construction	Operations
Minyip–Rich Avon Road*	85	43	100	11	62	128	185
Minyip–Banyena Road	105	43	39	11	2	148	144
Stawell–Warrack-nabeal Road	172	43	100	11	62	215	272
Gun Club Road*	<20	43	100	11	62	63	120
R. Funcke Road*	<20	43	100	11	62	63	120
Burrum–Lawler Road	20	187	74	47	4	207	94
Banyena–Pimpinio Road	71	115	37	29	2	186	108

* These projections assume worst case and are the total of predicted volumes across the entire length of road.

** Based on predicted staff numbers and estimated truck transport of HMC.

Construction

As described in Section 6.12, DMS will appoint a construction contractor to undertake construction of the project, which is expected to last approximately 8 to 12 months. The construction workforce is estimated to be approximately 100 to 120 people operating on a 12-hour shift roster 7 a.m. until 7 p.m., 5 days a week and from 7 a.m. until 1 p.m. on Saturdays (Supporting Study 9).

Bulk materials for road pavements and plant foundations will be delivered to the site in 20- to 30- t dump trucks. The earthmoving plant will be transported to site using low-loaders. The deliveries will be made during daylight hours via the local road network and the site access road.

Operations

As described in Section 6.12, the operations workforce is likely to comprise approximately 75 people. Technical and administrative staff and managers will work 8.30 a.m. to 5.30 p.m., Monday to Friday. The majority of the operations workforce (mine and transport workers) will operate on a 4-days-on, 4-days-off roster, based on 12-hour shifts, 24 hours a day, 7 days a week.

On average, HMC will be hauled at a rate of 8,200 t per week or 1,175 t of per day. B-double configuration trucks, with a net carrying load of approximately 40 t, will be used to transport approximately 398,000 tpa of HMC. Approximately 30 round trips between the mine and port facilities and/or the rail siding will be made each day.

Approximately six trucks of materials and equipment will be transported to the site each day. In addition, diesel fuel will be regularly delivered to the site. Other contractors, including sewage disposal contractors, will regularly visit the project area.

Traffic Distribution

The project area is located within 30 km of five townships (Minyip to the northwest, Donald to the northeast, Marnoo to the southeast, and Rupanyup and Murtoa to the southwest). For the purposes of the EES, it is assumed that traffic associated with staff and service supply vehicles traveling to and from the project area are evenly distributed throughout the road network.

Traffic associated with haulage will use road transport routes (see Figure 6.24, 4.6 and Road Transport Routes above).

6.9.2 Issues

Potential issues as a result of the project are:

- Between 215 and 272 extra vehicles will use local roads in the vicinity of the project area. Increases in traffic as a result of employees commuting to and from work, visitors to the operation, delivery of supplies and HMC haulage will be perceptible to landholders within and near the project area. Project-related traffic is anticipated along:
  - Minyip–Rich Avon Road.
  - Minyip–Banyena Road.
  - Stawell–Warracknabeal Road (expected to be heavily trafficked during construction and operations).
  - Gun Club Road.
  - R. Funcke Road.
  - Burrum–Lawler Road (expected to be heavily trafficked by non-haul vehicles during construction).

  - Banyena–Pimpinio Road (expected to be heavily trafficked by non-haul vehicles during construction).

- Additional heavy vehicle traffic movements. On average, 66 heavy vehicle traffic movements per day will occur on local roads (or State highways if a road transport route is chosen), which is equal to approximately 2 to 3 heavy vehicles per hour.
- Changed traffic conditions:
  - If two vehicles meet on the Minyip–Rich Avon, Minyip–Banyena, Gun Club or R. Funcke roads, the existing road width would necessitate one vehicle to move across to the gravel shoulder while the other vehicle passes. If more vehicles are using local roads, trip times have the potential to increase.
  - Some local roads within the project area will be temporarily inaccessible at different times throughout the life of the project. These changes may inconvenience local road users by disrupting preferred routes, limiting access to private property via certain roads and extending trip times.
- On sections of some local roads, road usage and wear and tear will increase as a result of mine traffic. Poor functional performance results in decreased safety and operational efficiency and increasing road and vehicle maintenance requirements. Typical examples of deterioration include:
  - Rutting: a longitudinal deformation of a pavement surface formed by the wheels of vehicles. Both sealed or unsealed roads can be affected.
  - Deformation: a depression in a road surface outside of the constructed (intended) profile.
  - Cracking: a fracture in the road surface.
  - Corrugations: transverse undulations, closely and regularly spaced, with wave lengths of less than 2 m.
  - Depressions: localised area within a pavement where elevations are lower than the surrounding area.
  - Potholes: a steep-sided or bowl-shaped cavity extending into layers below the wearing course.

6.9.3 Avoidance, Mitigation and Management Measures

Road Design and Construction

The following minimum road pavements standards has been requested by the Yarriambiack Shire Council and will be implemented on sections of the road transport route as required:

- Minimum sealed width of 6.6 m.
- Minimum gravel shoulder width of 2.0 m.
- Minimum gravel shoulder depth of 150 mm.
- Minimum pavement depth of 400 mm.
- Top 150 mm of pavement to be stabilised with ‘roadment’ or similar.
- 10-mm primerseal.
- 14-mm final seal.

- Centre and edge line-marking to be provided.

A stringent monitoring program will be developed and implemented in conjunction with the council.

Intersections will be suitably treated to ensure that safe and efficient access is available for vehicles entering and exiting the site with minimal impacts on through traffic in accordance with the VicRoads Road Design Guidelines, and the AustRoads Guide to Traffic Engineering Practices Part 5 – Intersections at Grade.

These treatments will be subject to detailed investigation prior to project onset but could involve:

- The provision of auxiliary turn lanes on the Stawell–Warracknabeal Road.
- Flaring of the minor roads at the intersection.
- Appropriate advanced warning signage.
- Detailed sight distance assessment.

All intersections within the project area, and those located on the road transport route, will be designed and constructed to accommodate the full turning movements of heavy vehicles and treated appropriately, if required. Typical treatments to be implemented at main intersections with arterial roads, and within the project area as required (depending on the intensity of activity at the intersection) are:

- Unchannelised and unflared. These are typically the minimum form of treatment adopted at low volume intersections on local roads where traffic is controlled by STOP or GIVEWAY signs or the T–junction rule. Carriageways simply intersect with an appropriate corner radius without widening of the intersecting roads.
- Unchannelised and flared. This treatment is typically applied to the less important intersections on arterial roads. In rural areas, the treatment may be limited to the provision of a short, additional lane or pavement widening to allow through traffic to bypass a vehicle waiting to turn right, primarily for safety reasons.
- Channelised intersections. These are generally provided at important intersections on arterial roads, where some or all of the traffic movements may be separated and delineated by raised islands, pavement markings and other devices. Channelised intersections may also be flared as is common at signalled intersections where additional lanes may be needed to provide greater capacity.
- Redesign of the intersection, particularly where the road transport route crosses Stawell–Warracknabeal Road, and which will be approved by VicRoads.

In conjunction with Northern Grampians, Yarriambiack and Buloke shire councils, DMS will monitor roads that are expected to be heavily trafficked during construction (employees travelling to and from the project area and services vehicles etc.). Monitoring of road conditions and usage patterns during the first 18 months of operations (after construction has been completed) will be undertaken to establish which, if any, roads need to be upgraded.

Traffic Management Plan

Before construction starts, a Traffic Management Plan will be developed for the project in consultation with relevant councils (including Buloke Council) and emergency services. DMS will meet with councils and emergency services every six months during construction and the first 18 months of operation. The

Traffic Management Plan will set out construction traffic operational procedures and restrictions to minimise impacts on the existing road network and its users. Key aspects of the Traffic Management Plan are summarised below:

- Hours of operation on local and arterial roads.
- Speed restrictions.
  - On sealed roads within the project area, vehicles will not exceed 80 km/h and 60 km/h for light and heavy vehicles respectively.
  - On unsealed roads within the project area, vehicles will not exceed 60 km/h and 40 km/h for light and heavy vehicles respectively, to improve safety and limit traffic-related dust.
  - On roads outside of the project area, speed restrictions will be strictly enforced. If DMS requires a speed reduction, consultation with the relevant council and/or VicRoads will be held prior to enforcement of any reductions.
- Road upgrades. All roads that will be trafficked by mine related vehicles will be upgraded to at least an 'unsealed average condition' road for dust suppression, and to reduce heavy vehicle maintenance. Where necessary, road transport routes and main access roads into the mine site will be upgraded to the minimum standard recommended by the relevant council for a 6.6-m sealed road. Road upgrades will be funded by DMS. Maintenance is to be conducted as described below.
- The CFA and other emergency service providers will have full access throughout the project area, and will be made aware of all road closures, road upgrades, and maintenance activities, particularly during fire season (November to March).

Interactions between heavy vehicles such as harvest vehicles, grain trucks and school buses are commonplace on country roads. In the event that a haul trucks are perceived to be compromising school bus safety, DMS will consider avoiding school bus routes between 7.30 a.m. to 9.00 a.m. and 3.30 p.m. to 5.00 p.m. during the school year.

Road Closures

Road closures will be facilitated by the relevant council in conjunction with DSE in accordance with the *Local Government Act 1989.* Stakeholder consultation will be undertaken prior to finalisation of arrangements for the road closure. The road closure treatment procedure is summarised below:

- Advise local government, DSE, adjoining landholders, VicRoads and other interested agencies and stakeholders of planned road closures so that their views can be sought and dealt with accordingly and consent obtained where necessary.
- Plan and implement an alternate route, including the installation of signage advising of a road closure and provision of maps. Roads to be monitored and maintained to cater for additional traffic will be identified.
- Road closures are likely to be temporary (less than 18 months). In the event that road closures are long term (longer than 18 months), detailed investigations into impacts on travels times and bus routes will be undertaken, and minimum guidelines with respect to time implemented.

Additional Traffic Management Measures

In addition to the Traffic Management Plan, the following will be implemented to minimise impacts on the road network and road network users during construction and operations:

- Over-dimensional loads will be transferred in accordance with VicRoads and/or council requirements and, if necessary, will include escorts to lift power lines. Over-dimensional loads will be transported during times of the day specified by VicRoads. The most appropriate route for over-dimensional loads will be determined in consultation with VicRoads once actual delivery details are known.
- In the event that a road upgrade results in the decommissioning of an existing bus stop, the stop will be reinstated as a sealed wayside bus stop, supplemented with appropriate signage.
- Road safety rules and procedures will be enforced for all employees and contractors during construction and operations.

Road Maintenance

Optimising the functional design of a road involves defining the amount and frequency of maintenance in consultation with the relevant authority (council or VicRoads). If required, a detailed pavement design will be undertaken by a suitably qualified practitioner to ensure the functional design of the pavement uses the appropriate wearing course materials and optimises longevity and utility of the pavement.

Yarriambiack and Northern Grampians shire councils have indicated that all maintenance works will be undertaken by the relevant councils, with financial contributions to the maintenance provided by DMS at a tonne per day rate or similar (the rate is to be determined in negotiations between DMS and the relevant councils). It is expected that the rate will reflect a reasonable annual cost figure based on the estimated production. No variations to the road transport routes prior to the consent of relevant shires will be permitted.

It is anticipated that no financial contribution from DMS toward maintenance of State highways will be required.

6.9.4 Residual Impact Assessment

Increased traffic on State highways is predicted to be imperceptible given existing traffic volumes (see Table 6.23). The heavy vehicle component of traffic is expected to be satisfactorily accommodated on the Stawell–Warracknabeal Road and highways if the road transport route option is adopted (Supporting Study 8b).

No cumulative impacts are expected as a result of other mining projects in northwest Victoria (i.e., Iluka's Douglas Mine) as these vehicles were included in traffic counts undertaken in 2007 (see Table 6.23).

During construction and operation of the project, there will be discernible changes in traffic conditions on five local roads as a result of between 215 and 272 extra vehicle movements per day (less than 30% of which will be heavy vehicles).

One vehicle moving into the gravel shoulder while the other vehicle passes occurs regularly on country roads in Victoria, and is considered to be a safe and satisfactory operation, with minimal impacts on local traffic movements. Additionally, due to the width of the shoulders on Minyip–Rich Avon Road,

vehicles do not need to come to a complete stop when allowing another to pass and the likely change in travel times is expected to be minimal.

Due to the low level of traffic currently carried by local roads and the expected magnitude and duration of the harvest time traffic, cumulative impacts will be negligible and will not generate a significant change to existing conditions.

The traffic generated by the project can be suitably managed so as not to impact on the operation of the existing local road network. Any road closures will be managed appropriately so as to minimise the impact on existing road users and landholders.

Impacts on roads and any associated inconvenience or delay for road users will be short-term (a few years) and temporary in nature. Road closures will be managed to ensure that access to all properties is maintained.

If undertaken, road upgrades will ultimately improve the condition of roads, which is likely to balance out to some extent inconvenience as a result of changed traffic conditions.

Should the rail option be pursued, the rail siding south of Minyip will be built/upgraded to accommodate transport of HMC from road to rail as well as normal rail freight activities (especially grain transport). Existing transport arrangements are not likely to be affected.

6.10 Cultural Heritage

Impacts on cultural heritage from the Donald Mineral Sands project were assessed by Sinclair Knight Merz in Supporting Study 2 and are summarised below.

6.10.1 Existing Conditions

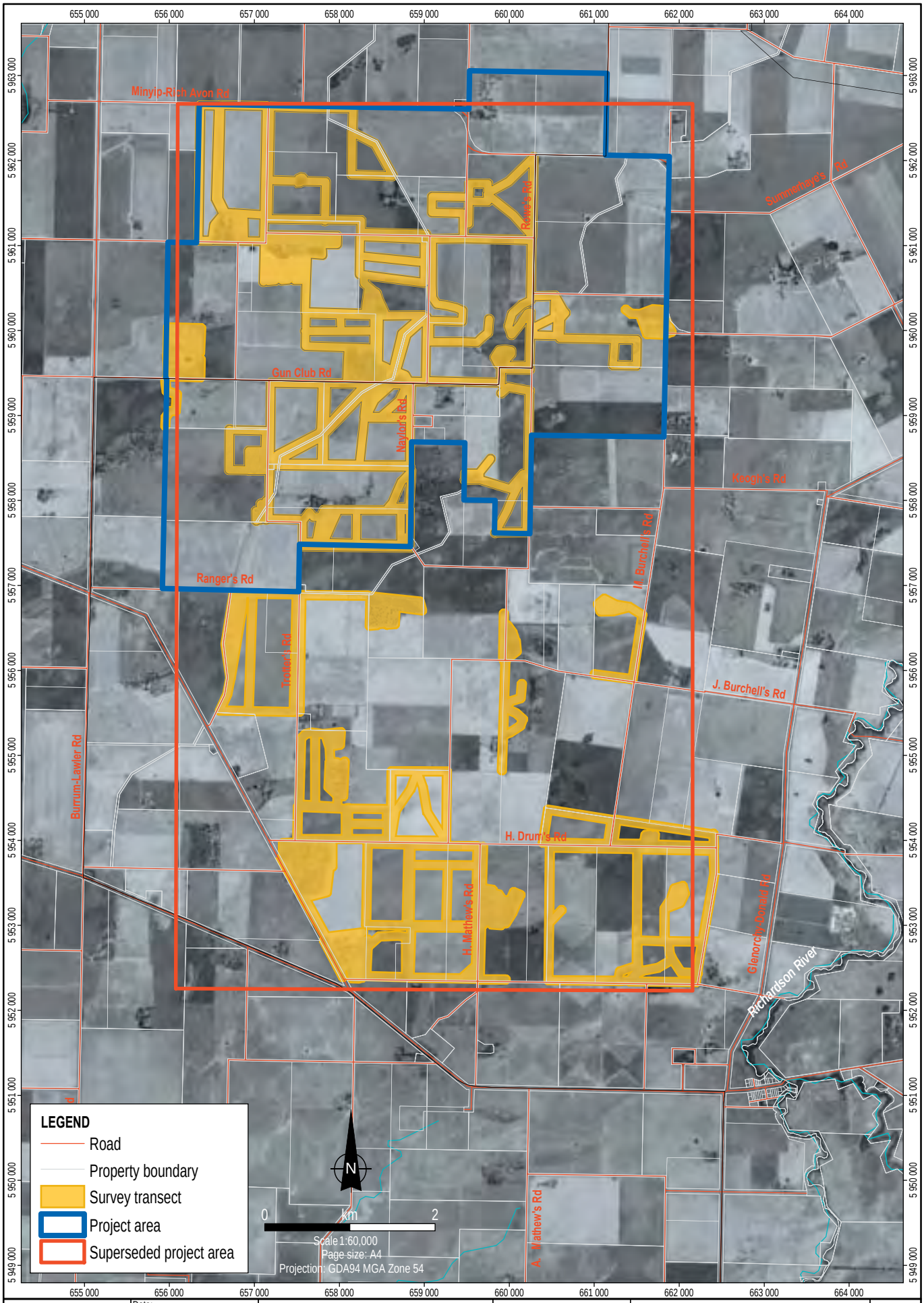
Assessment Method

The following databases were examined for previously recorded cultural heritage in the superseded project area, which includes the current project area (see Section 1.1):

- National Trust of Victoria – Register.
- Yarriambiack and Northern Grampians Planning Schemes – Heritage Overlay (2006).
- Heritage Victoria – Heritage Inventory and Heritage Register.
- Aboriginal Affairs Victoria (AAV) – Register.

A field survey was undertaken in the superseded project area between 3 and 7 October 2006. The survey achieved 21% coverage of the superseded project area including both northern and southern sections (Figure 6.26). All landforms were sampled during the survey. Due to drought conditions, ground surface visibility (exposure) was moderate to high across the superseded project area, even on land containing crops. When ground surface visibility conditions and vegetation cover are taken into account, the survey coverage is reduced to approximately 13.5%[11]. In the project area the survey achieved survey coverage of approximately 27% which, when accounting for survey conditions, is

[11] Ground surface visibility and vegetation cover were estimated at 80% each.



coffey natural systems	Date: 25.09.2007 MXD: 972_DonaldMineralSandsGIS File Name: 972_05_F06.26_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Cultural heritage survey coverage	Figure No: 6.26

equivalent to approximately 17.3%. Ten percent ground coverage is generally considered to be an acceptable level of survey coverage.

Aboriginal Cultural Heritage

Previous assessments referred to in Supporting Study 2 did not identify any existing cultural heritage values in the project area. Several archaeological assessments have been undertaken close to the project area; however, none have been undertaken in the project area itself. Fifty-two sites were recorded in the superseded project area, comprising 37 artefact scatters and 15 scar trees (Figure 6.27 and plates 6.11 to 6.13). Artefact scatters comprised flaked quartz chips and were predominately associated with sandy rises that overlook box depressions or swamps in the landscape. Due to the soil cover, it is likely that subsurface deposits exist, although these will generally not be in situ due to disturbance through clearing and ongoing cropping. Landholder consultation confirmed that wind and ploughing activities occasionally reveals further artefacts. Although the origin of the quartz found in the artefact scatters is unknown, possible sources in the area include the St. Arnaud area, 60 km to the southwest, and in the bed of the Wimmera River in the south. In the project area, 21 artefact scatters and 11 scar trees were recorded.

Scientific Significance

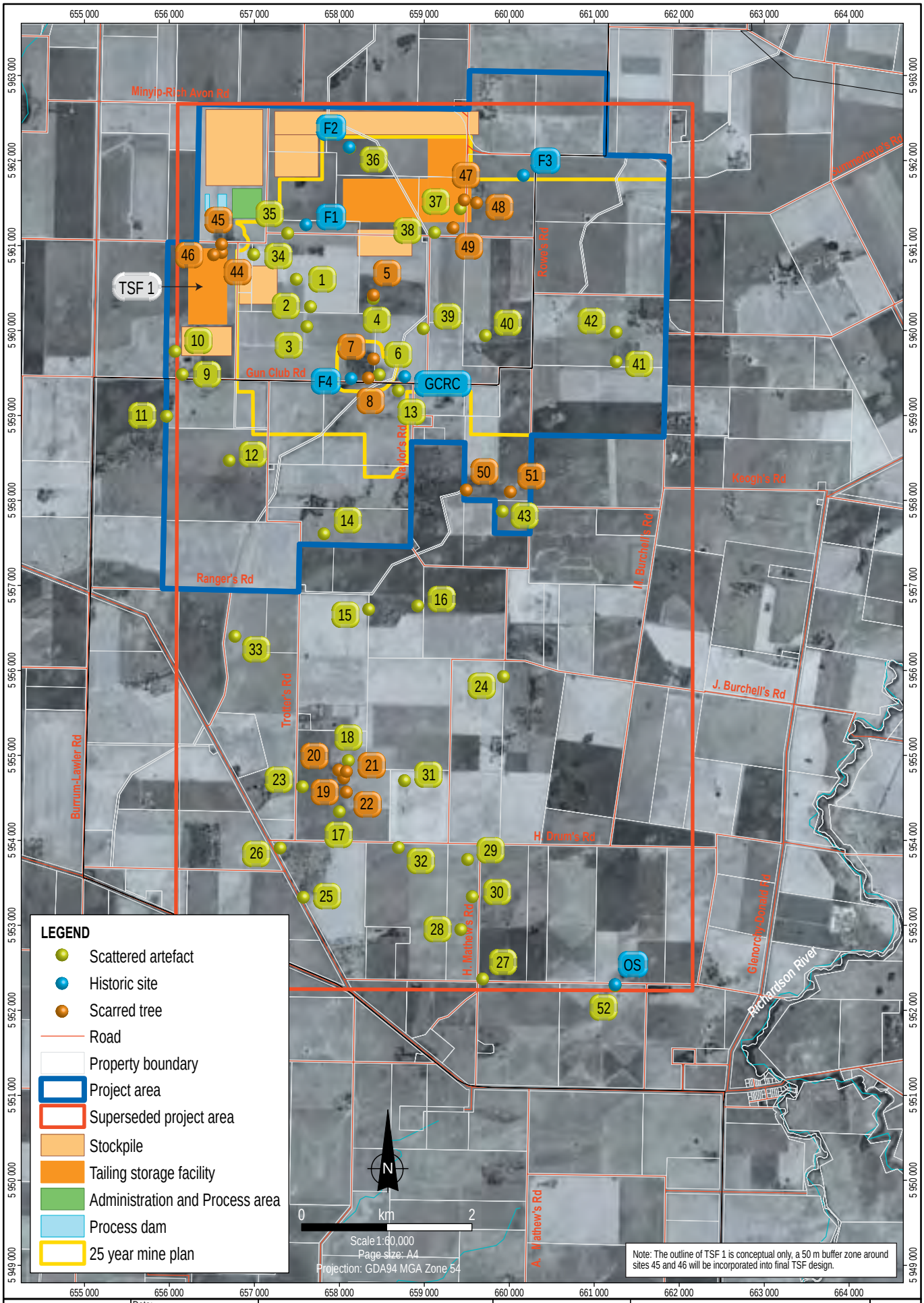
The scientific significance of the Aboriginal cultural heritage sites located during the field survey is presented in Table 6.25. Scientific significance is based on:

- Site integrity.
- Site structure.
- Site contents.
- Representativeness.

Table 6.25 Scientific significance of Aboriginal cultural heritage sites

Type of Site	Number of Sites				
	Scientific Significance				
	Low	Low to Moderate	Moderate	Moderate to High	High
Superseded project area					
Artefact scatter	-	30	6	1	-
Scar tree	-	9	5	1	-
Project area					
Artefact scatter	-	20	1	-	-
Scar tree	-	5	5	1	-

Consultation with the Barengi Gadjin Land Council has established that all of these sites are of high significance to the Aboriginal community (Harradine G., pers. comm., 2006). Consultation activities to date are described in Chapter 5.



coffey natural systems	Date: 25.09.2007 MXD: 972_DonaldMineralSandsGIS File Name: 972_05_F06.27_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Cultural heritage sites in the project area	Figure No: 6.27

Plate 6.11
Stone artefacts.
Source: SKM, 2007.

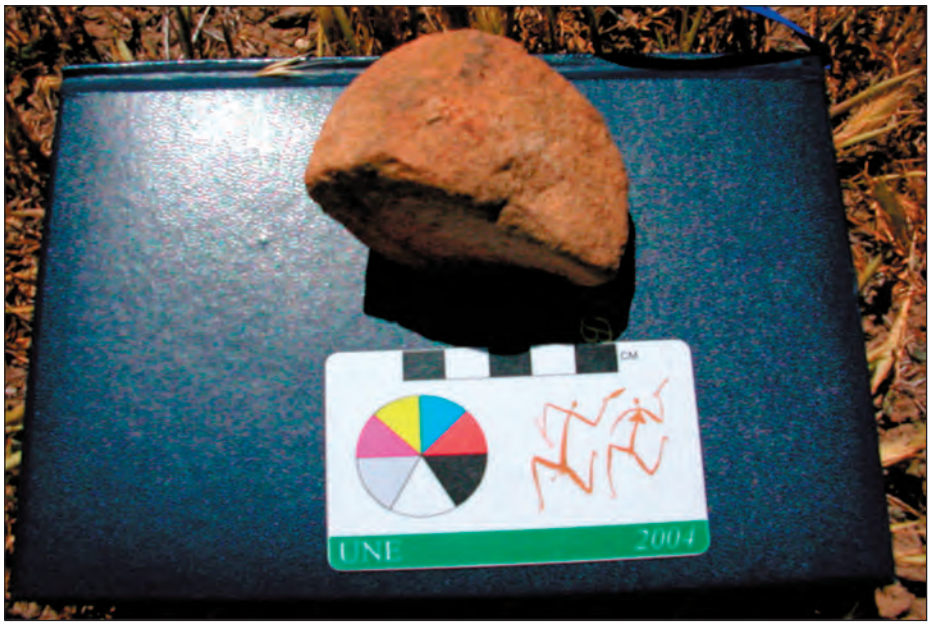


Plate 6.12
Anvil stone.
Source: SKM, 2007.

Source: SKM, 2007.

Plate 6.13
Scar tree.

Native Title

In 2005, a consent determination was made in the Wimmera Regions (Federal Court File No. VID6002/1998), which recognised the Wotjobaluk, Jaadwa, Jadawadjali, Wergaia and Japagalk people's non-exclusive native title rights over a part of their original claim area (known as Area A). Native title rights were determined not to exist in the remainder of the claim area (Area B). Area A is approximately 26,900 ha (approximately 2 to 3 % of the original claim area) and is limited to some Crown reserves along the banks of the Wimmera River. The project area is not within Area A.

In November 2005 the Wotjobaluk, Jaadwa, Jadawadjali, Wergaia and Japagalk people's and the BGLCAC entered into an indigenous land use agreement (ILUA) with the State and Federal governments. The ILUA describes the consultation process about future dealings in the determined area and includes a clause that states the parties consent to all future acts over Area B within which the project area is located. The Donald Mineral Sands Project would be considered a future act meaning that, for the purpose of mining developments under the MRSD Act, native title does not exist.

Non-Aboriginal Cultural Heritage

A total of six post-European contact historic sites were located and recorded during the survey in the superseded project area (see Figure 6.27). These sites comprise three artefact scatters, one rural structure (shed) and one rural house with an associated artefact scatter. While the house and associated artefact scatter is outside the project area, the remaining five sites are within the project area.

An assessment of the significance of non-Aboriginal sites is based on both historical and scientific criteria. Historical significance was rated as low, moderate or high based on the Heritage Victoria criteria for significance. Scientific significance was assessed by two main criteria: research potential and representativeness. Significance of the non-Aboriginal sites is presented in Table 6.26 below.

Table 6.26 Scientific and historical significance on non-Aboriginal cultural heritage sites

Site Name (Heritage Victoria Inventory No.)	Site Type	Historical Significance	Scientific Significance
Funcke 1 (H7425-0003)	Artefact scatter	Low	Moderate
Funcke 2 (H7425-0004)	Artefact scatter	Low	Moderate
Funcke 3 (H7425-0005)	Artefact scatter	Low	Moderate
Funcke 4 (H7425-0002)	Rural structure (shed)	Moderate	High
Gun Club Road complex (H7425-0001)	Artefact scatter	Low	Moderate
O'Shannessy 1 (H7424-0006)	Rural house ruins and associated artefact scatter	Low to moderate	High

6.10.2 Issues

Aboriginal Cultural Heritage

Eighteen known Aboriginal cultural heritage sites, which are listed in Table 6.27, will be disturbed if the project proceeds.

Table 6.27 Aboriginal sites to be disturbed

Site Name	AAV Site Number	Site Type
DMS 1	7425-0046	Artefact scatter
DMS 2	7425-0047	Artefact scatter
DMS 3	7425-0048	Artefact scatter
DMS 4	7425-0049	Artefact scatter
DMS 5	7425-0050	Scarred tree
DMS 13	7425-0057	Artefact scatter
DMS 34	7425-0058	Artefact scatter
DMS 35	7425-0059	Artefact scatter
DMS 36	7425-0060	Artefact scatter
DMS 37	7425-0061	Artefact scatter
DMS 38	7425-0062	Artefact scatter
DMS 39	7425-0063	Artefact scatter
DMS 40	7425-0064	Artefact scatter
DMS 41	7425-0065	Artefact scatter
DMS 42	7425-0066	Artefact scatter
DMS 47	7425-0070	Scarred tree
DMS 48	7425-0071	Scarred tree
DMS 49	7425-0067	Scarred tree

The remaining 14 identified sites will not be disturbed by the project.

There is a potential for as yet, unidentified sites of cultural heritage to be disturbed during earthmoving activities. As no subsurface testing was undertaken as part of the initial field survey, there is also a potential for burials to be located within the sandy rises. It is predicted that further stone artefacts could occur, predominately on elevated sandy landforms adjacent to box depressions that dominate the landscape. The potential of finding further scar trees is considered low as the current survey included inspection of all stands of mature box trees.

Due to the finalisation of the mine plan after the completion of the current heritage survey, the current heritage assessment only provided 17.3% coverage of the project area. There is, therefore, potential for further unknown cultural heritage sites of unknown significance to be present in the project area. Further archaeological survey of the project area will be undertaken to more accurately ascertain the number, context and content of sites likely to be impacted by the proposed development.

In May 2007, the *Aboriginal Heritage Act 2006* came into force replacing the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cwlth) and the *Aboriginal Relics Preservation Act 1972* (Vic) (see Chapter 2), under which the current cultural heritage assessment was conducted. The Aboriginal Heritage Act requires that a Cultural Heritage Management Plan (CHMP) be prepared for projects that require an EES. As the cultural heritage assessment (Supporting Study 2) was largely completed before the new Act, it does not currently satisfy the requirements of the new regulations but meets the needs of the assessment guidelines for this EES issued by DSE in 2006 (before the new Act came into force). A CHMP will therefore be prepared as outlined in Section 6.10.3.

Non-Aboriginal Cultural Heritage

Five sites of non-Aboriginal cultural heritage were located in the project area and will be impacted by the project activities. One of these sites, the rural shed F4 (H7425-0002), is of moderate historical and high scientific significance while the remaining three sites are of low historical and moderate scientific significance (see Table 6.26). Due to the moderate scientific significance of the remaining sites, salvage of these sites is not recommended.

6.10.3 Avoidance, Management and Mitigation

Aboriginal Cultural Heritage

The mine plan does not extend over the entire project area and therefore some sites in the project area will not be disturbed. The mine footprint has been tailored to avoid certain patches of remnant vegetation (site 21) that includes three Aboriginal cultural heritage sites (DMS 6, 7 and 8) that are each located more than 100 m from the area directly disturbed by mining (see Figure 6.27). The tailing dam will be sited so that scar tree sites DMS 44, 45 and 46 will be avoided by a buffer zone of at least 50 m. As the mine activity area is directly linked to the location and extent of the mineral sands deposit, further opportunities to avoid impacts are limited.

Additional management measures for these sites will include:

- Erecting markers and signs to clearly identify cultural heritage ‘no-go zone’ sites.
- Fencing during construction and operations, with a buffer zone of at least 50 m.
- Provision of maps with physical barriers and ‘no-go zones’ clearly marked.
- Provision of awareness training during all site inductions.

Following discussion with DPCD and AAV, it has been agreed that, following the conclusion of the EES process and before other statutory decisions are received, further fieldwork will be undertaken and a CHMP will be prepared in accordance with the Aboriginal Heritage Act and the Aboriginal Heritage Regulations. This will involve consultation with the relevant Registered Aboriginal Parties (RAP) or other agreed Aboriginal stakeholders. To date, there has been no RAP appointed for the area; as such DMS is currently negotiating with AAV and all involved Aboriginal parties. The current cultural heritage assessment will form the foundation of the CHMP.

Further fieldwork of those areas not included in the baseline survey and subsurface testing of a range of landforms where sites have been identified will also be undertaken to establish the nature, content, context and extent of these sites, prior to operations commencing. This additional work will expand the known area of Aboriginal cultural material and reduce the likelihood of uncovering unknown sites during ground-disturbing works. Consultation with the RAP in developing the CHMP will determine the specific mitigation measures and management procedures to be undertaken by DMS prior to and during operations, which could include salvage. In addition to this, all staff and contractors will be given a site-specific cultural awareness induction (see Chapter 7) to ensure that they are aware of the general location of cultural heritage sites, the type of historic material that they may encounter and procedural requirements in the event of suspected cultural material being discovered.

If suspected Aboriginal cultural heritage material is located during development activities, an appropriate management response will be formulated in line with the approved CHMP.

Non-Aboriginal Cultural Heritage

As with Aboriginal cultural heritage, opportunities to avoid impacts on non-Aboriginal cultural heritage are limited. Two sites, F4 (H7425-0002) and F3 (H7425-0005) will; however, not be disturbed. F4, is over 100 m within the remnant vegetation patch, site 21, and F3 is 60 m from the mine plan. The remaining three sites will be disturbed by the project.

All archaeological sites and objects are protected under the *Heritage Act 1995*. Prior to any disturbance, an application for consent to disturb a historical site will be lodged with Heritage Victoria (under Section 129 of the Heritage Act). All contractors and subcontractors will participate in site-specific cultural awareness induction (see above).

If suspected non-Aboriginal historic material is located during development activities, all works within a specified distance will cease until an archaeologist has undertaken archaeological assessment of the area. This assessment will include documenting any cultural heritage material and formulating an appropriate management response. The site will be immediately registered with Heritage Victoria. Works can still proceed away from the affected areas (subject to adherence to specified separation distances). The separation distances will be negotiated with stakeholders as part of consent to disturb agreements, prior to work commencing on site.

6.10.4 Residual Impact Assessment

The project's activities will result in the disturbance of 18 Aboriginal and 3 non-Aboriginal cultural heritage sites. There is also potential for as yet, unidentified sites of cultural heritage to be disturbed during earthmoving activities. All Aboriginal sites of cultural heritage will be managed in accordance with any measures, including contingencies, outlined in the CHMP. Heritage Victoria will be notified of any new non-Aboriginal cultural heritage sites.

6.11 Land Use and Infrastructure Planning

6.11.1 Existing Conditions

Land Use

The project area lies within a region known as the Wimmera. The majority of the project area is located in the Shire of Northern Grampians, with the remaining area situated within the Shire of Yarriambiack (see Figure 6.2).

The regional landscape surrounding the development area is generally flat to slightly undulating with topography varying by 12 m, from 126 RL to 138 RL across the project area (Supporting study 13). Most of the regional landscape has been cleared for broad-acre crop production and grazing, with dryland agriculture and light industry associated with the production and processing of farm products being characteristic of the study area. Remnant vegetation is generally confined to road reservations or occasional flora reserves, although it does also occur on private land. *Casuarinas* and small eucalypts, 5 to 10 m high, comprise the dominant vegetation. Less than 5% of the area carries remnant native vegetation, but five EVCs are present, all of which are classified as endangered by the Department of Sustainability and Environment (DSE) (Supporting Study 5).

Dryland Agriculture

The predominance of dryland agriculture in the region is fairly typical of land use in the west of rural

Victoria. Dryland agriculture relies on rainfall for the provision of water for crops and pastures. The project area is primarily cleared farmland, largely used for cereal crop production, including wheat, barley and legumes, while sheep and beef cattle farming are subsidiary.

Planning Scheme Zones

The project area is generally zoned FZ (Farming Zone) within the Northern Grampians Shire and the Yarriambiack Shire, for which the relevant zone numbers are 1 and 43, respectively. The purposes of the Farming Zone, whilst implementing the State Planning Policy Framework and the Local Planning Policy Framework, including the Municipal Strategic Statement and local planning policies, are:

- To provide use of the land for agriculture.
- To encourage retention of productive agricultural land.
- To ensure that non-agricultural uses, particularly dwellings, do not adversely affect the use of land for agriculture.
- To encourage use and development of land based on comprehensive and sustainable land management practices and infrastructure provision.
- To protect and enhance natural resources and the biodiversity of the area.

The Farming Zone is subject to Clause 52.08-2 of the *Planning and Environment (Planning Schemes) Act 1987*, which requires a permit to use or develop land for mining. A permit is not required if an EES is prepared or if the mining is in accordance with an existing mining licence.

Within the Yarriambiack Shire, an Environmental Significance Overlay Schedule 3 (ESO3) exists for a number of areas of roadside and remnant vegetation (Supporting study 13 and DSE, 2007). The purposes of the ESOs are to identify areas where the development of the land may be affected by environmental constraints and to ensure that development is compatible with identified environmental values. A permit is required to carry out most types of modification within an ESO (i.e., removal of vegetation, construction of a building, etc.). ESO3 specifically relates to channel and reservoir protection, for which the environmental objectives are:

- To maintain and enhance the quality and supply irrigation and domestic water throughout the Wimmera region.
- To protect water reservoirs and channels from potential sources of pollution.
- To control the development of land in the vicinity of water supply reservoirs and supply channels.
- To prevent unauthorised diversion of water into or from water channels.

ESO3 also requires that a permit be obtained for the construction of a fence located within 20 m of the toe of a channel.

Infrastructure

Roads

The project is accessible via a network of highways and sealed secondary roads servicing farms and rural communities in the Horsham, Warracknabeal, Donald and Rupanyup regions. The roads in the project area consist of average to poor, sealed and unsealed roads (Supporting Study 8). Separate

roads for light vehicles and haul trucks will be constructed adjacent to the pit to minimise the risk of accidents.

Rail

The Hopetoun to Horsham Railway line, which links the project to the ports of Geelong and Portland is located about 15 km from the project area,. A new railhead will be constructed outside Minyip enabling HMC to be loaded for transport to Portland, Geelong or Melbourne.

Electricity

The distributor of electricity in southwest Victoria, Powercor Australia, will supply DMS with its power requirements (see Section 4.7.1). The project area will be supplied with electricity from the local transmission grid via a new 66-kV transmission line from Horsham Terminal Station to a new substation, the location of which is yet to be determined, and then distributed along 11-kV or 22-kV overhead lines from the substation to the mine site (where the voltage will be lowered to 415 kV).

A contractor will erect the new power line, which will be constructed in accordance with relevant regulations that are governed by the Minister for Energy and Resources in conjunction with the regulations applying to Powercor. Protection on the private power line will be set and graded to the level of Powercor protection in the area. This will allow for sequential tripping of the mine site without affecting other local users.

Water

There are two options for supply of the project's water requirements (see Section 4.10.3); however, the final decision has yet to be made. Water will be obtained from either the supplier of domestic water in the project area, GWMWater, which uses water obtained from the Grampians catchment and numerous reservoirs via the Wimmera Mallee channel system, or water sourced from an underground saline aquifer approximately 25 km east of the project area (the Avon Deep Lead). Both supply options will require a thorough assessment by GWMWater in accordance with the requirements of the *Water Act 1989*.

6.11.2 Issues

The majority of the land in the project area has been cleared of vegetation, apart from linear remnants along road reserves and occasional patches within property boundaries, and is currently being used for agricultural purposes. As described above, the project area is primarily located in an area that is classified as Farming Zone, within which mining may occur provided approval is sought through an EES or planning permit. Potential land use issues associated with the construction and operation of the proposed mine include:

- Soil contamination, for example, spillage of diesel during refuelling or due to equipment failure.
- Soil erosion, for example, from roads or stockpiles.
- Decrease in available agricultural area.

Potential infrastructure issues associated with the construction and operation of the proposed mine development include:

- Interruption to roads and services during construction or operation of the mine due to increased traffic loads, road closures and changed school bus routes.

- General wear on roads through the project area.
- Competition for water supply.

6.11.3 Avoidance, Management and Mitigation Measures

Soil Contamination

To minimise the potential for chemical and fuel spills and to ensure that spills are cleaned up and contaminated soils are remediated, management procedures (Chapter 7) will be implemented. These measures include:

- Appropriate storage and handling areas and implementation of handling and transport procedures. DMS will comply with all relevant statutory requirements including Dangerous Goods (Storage and Handling) (NOHSC:2017. 2001) Australian Standard 1940 - The Storage and Handling of Flammable and Combustible Liquids (AS, 1940-2004) and material safety data sheets. When necessary, DMS will seek advice from appropriate authorities.
- Spill response procedures.
- Inspection of construction material and vehicles brought to site to ensure that it is clean (i.e., free from weeds, leaking hydrocarbons, metals and dust).
- Site personnel will receive appropriate training including environmental awareness.
- Soils will be assessed prior to mine closure for contamination and appropriate remediation measures taken, where necessary.

Soil Erosion

Soil erosion will be minimised by restricting vegetation clearing to the project footprint, undertaking progressive rehabilitation, utilising erosion controls (e.g., drains, brush matting) where appropriate and controlling surface water runoff. This is also discussed in the surface water section (see Section 6.1).

Decrease in Available Agricultural Area

The temporary loss of land for agricultural use due to the project development will be mitigated by agreements made between DMS and landholders, which will include measures to be undertaken by DMS to minimise disruption to agricultural activities, compensation and details relating to final landform and land uses. Section 85 of the MRSD Act makes it clear that compensation must be paid for any loss or damage associated with approved mining works on a mining licence. This is discussed further in the socio-economic section (see Section 6.12). The loss of agricultural production will also result in a reduction in food production, which, although most likely inconsequential, will persist for the life of the mine.

Progressive rehabilitation during mining will be undertaken so that the area out of agricultural production is at its practicable minimum at any given time (Supporting Study 9). The integrity and quantities of stockpiled subsoil and topsoil will be maintained by protecting them from wind or water erosion, which may be achieved using such methods as cover crops, mulching and polymers (Supporting Study 5). Areas within the project area that will not be mined will be fenced off and farming continued or, if appropriate, incorporated into the early stages of the rehabilitation plan.

Interruption to Roads and Services

Landholders and land occupiers within and near the project area will be affected by localised increases in traffic. A Traffic Management Plan (Supporting Study 8) outlines the commitments that DMS will adopt to ensure minimal inconvenience to road users. The plan specifies hours of operation, speed limits for sealed and unsealed roads, road upgrades and fire access. In the event that a road upgrade results in the decommissioning of an existing school bus stop, the stop will be reinstated as a sealed wayside bus stop, supplemented with appropriate signage.

Localised road closures in the project area, which are generally unsealed roads and carry low daily traffic volumes, may be required; however, alternative travel routes will be provided. In the event of a road closure, the diversion of traffic and land access will be treated accordingly to ensure minimal impacts to existing road users and landholders. It is not expected that any road closure will be permanent in nature, and it is more likely to be a temporary measure for mine access. Road and traffic mitigation measures are discussed further in Section 6.9.

General Wear on Roads

The Traffic Management Plan (Supporting Study 8) is also intended to ensure that upgrades to road conditions and traffic management are implemented in a timely manner so that impacts to local road users are minimised. DMS will, in conjunction with the Yarriambiack Council, monitor road conditions and usage patterns over the first 18 months after construction has been completed to establish which, if any, roads need to be upgraded (see Section 6.9). The Yarriambiack Shire and the Northern Grampians Shire boundaries are located along roads within the project area and, as such, the ultimate maintenance and road standard arrangements will be subject to agreements between both shires and DMS. Financial contributions by DMS to the maintenance of roads will be negotiated with the shires (Supporting Study 8).

Some road users will benefit from upgraded roads but may also experience increased traffic on roads used by mine vehicles. This impact is expected to be manageable with on-going community consultation, road maintenance, and monitoring of roads and traffic conditions.

Competition for Water Supply

Saline groundwater is one option for supplying the process water. Numerical modelling predicts aquifer drawdown impacts are restricted to within 2.5 km of the mining area and the drawdown cone is not predicted to intersect any adjacent surface waters or existing groundwater users. (Supporting Study 10). If water is sourced from groundwater, there are not expected to be any impacts on environmental flows.

The second water supply option, the GWMWater distribution system, draws the mine supply from the 20 GL available to industry after approximately 100 GL of water is expected to be saved as a result of the channelised distribution system. However, this water will not be available until the savings from the pipeline are achieved, at which time allocations of water for new developments will be made in proportions decided by Government. As such, the project is then subject to the same risk of supply as other existing users of GWMWater and should not increase the competition for existing water supplies.

6.11.4 Residual Impacts

Potential impacts to land use and infrastructure will be mitigated by aligning the DMS development to accommodate landholders and stakeholders; however, there are likely to be some localised impacts on land use and infrastructure, particularly during the construction phase of the project.

Residual impacts will be managed through consultation with affected property owners and occupiers to avoid or mitigate any potential disruption or losses. As a result, long-term adverse impacts to land use and infrastructure are not expected.

Soil Contamination

The implementation of mitigation and management measures as described in Section 6.1 will minimise the potential for the occurrence of significant soil contamination. Some localised, small scale contamination of soils (e.g., a burst hydraulic hose); however, is likely to occur and will require remediation.

Soil Erosion

The clearance of vegetation and/or construction activities may result in episodic soil erosion in the immediate project area. Minimising land clearance, the use of soil management techniques, control of surface water runoff and revegetation will minimise the extent of soil erosion.

Decrease in Available Agricultural Area

The temporary loss of land available for agriculture as a result of project development will impact on the land available for agricultural production and farm incomes. This loss, for which the estimated long-term average area out of production will be 342 ha for each year of the mine, will be internalised by DMS due to compensation provisions of the *Mineral Resources (Sustainable Development) Act 1990*. DMS will consult with affected landholders to determine a mutually agreeable method of compensation for any loss incurred by both owners and occupiers of the land. There will be a reduction in the output of agricultural products during the life of the mine; however, economic studies show that the value of mining is far in excess of agriculture (Supporting Study 9). Following closure and final rehabilitation of the mine, DMS believes that the project area will be successfully returned to its pre-mining land uses.

Interruption to Roads and Services

DMS will implement a Traffic Management Plan (Supporting Study 8), which outlines the measures that will be taken to ensure minimal inconvenience to road users. The overall impact of traffic within the local area is expected to be perceptible; however, these impacts are expected to be manageable with on-going community consultation, road maintenance, and monitoring of roads and traffic conditions. It is expected that any road closures will be temporary and not have a detrimental impact on access by existing road users due to the extensive road network within the DMS project area providing alternative travel routes.

General Wear on Roads

The increased light and heavy vehicle traffic through the project area and surrounds will accelerate road wear. As described in Section 6.9, financial contributions by DMS to the local shires, the upgrade of the haul road and the Traffic Management Plan will reduce impacts on the existing road network.

Competition for Water Supply

With mitigation measures in place, there are expected to be no adverse impacts on current water users. The groundwater drawdown cone is not predicted to intersect any adjacent surface waters or existing groundwater users, hence no impacts on yields of existing bores are expected. If water is supplied from GWMWater, the design of the final delivery system and GWMWater's allocation of water savings will incorporate measures to ensure that there are no impacts to existing water users.

6.12 Socio-economic Environment

A socio-economic assessment of the project has been undertaken by Enesar Consulting Pty Ltd (now known as Coffey Natural Systems). The results of this study are provided in Supporting Study 9 and are summarised below.

To characterise the socio-economic environment of the project, Enesar defined a study area (towns located within 50 km (or a 30 minute drive) from the centre of the project area) (see Figure 6.3) and analysed Australian Bureau of Statistics (ABS) 2001 and 2006 Census data (ABS, 2006; 2007a), regional reports and other data. Interviews with 10 community stakeholders and 12 affected landholders provided a local perspective of the project.

6.12.1 Existing Conditions

The project area is located largely within the ABS-defined Northern Grampians Local Government Area (LGA) on land zoned for farming. A smaller section is within the ABS-defined Yarriambiack LGA. The main economic base for the area is dryland agriculture and light industry associated with the production and processing of farm products.

Horsham, the major rural city associated with the project area, is located approximately 50 km west-southwest of the project area and has a full range of services and facilities.

Six families operate farms or own or live on land within the project area (see Figure 1.2). Each farm with land within the project area is approximately 810 ha in size. Two other residences, including one that is leased, occur within the project area. There are 13 additional neighbouring and nearby landholders located with 2 km of the project area.

Demography

Demographic indicators for local towns within the study area are based on ABS 2006 Census data and presented in Table 6.28.

Population trends in relevant shires from 1991 to 2006 and average annual change from 1986 to 2006 are presented in Table 6.29. Although the population of local towns within the study area increased between 2001 and 2006, overall the population in the Northern Grampians and Yarriambiack shires decreased. This is likely to be attributable to the declining population of other towns within the LGAs.

Table 6.28 Demographic indicators for local towns (2006 Census data)[1]

	Minyip	Murtoa	Donald	Rupanyup	St Arnaud	Warracknabeal	Horsham	Victoria	Australia
Person characteristics									
Population (total number)	578	912	1,698	625	2,272	2,626	13,481	4,932,422	19,855,288
Indigenous origin (%)	1.0	0.0	1.1	1.6	0.4	1.0	1.0	0.6	2.3
Australian citizen (%)	95.0	95.1	94.6	93.3	94.5	92.5	93.7	86.3	86.1
Age									
Population aged 55 years and over (%)	39.1	35.6	39.1	36.5	37.8	38.3	29.7	24.5	24.4
Median age	47	45	47	44	45	47	37	37	37
Countries of birth (main responses for selected region)									
Australia (%)	87.9	90.8	91.0	89.8	90.6	87.8	89.7	69.6	70.9
England (total number)	11	11	27	11	43	73	206	4.2 (%)	5.2 (%)
Germany (total number)	6	6	-	8	4	5	30	0.6 (%)	0.5 (%)
Italy (total number)	3	-	4	-	-	-	83	1.7 (%)	1.0 (%)
New Zealand (total number)	6	-	-	-	14	12	60	1.3 (%)	2.0 (%)
Main language spoken at home (main responses for selected region)									
English (%)	94.1	95.5	96.3	94.9	95.5	92.3	93.9	74.4	78.5
Religious affiliations (main responses for selected region)									
Anglican (%)	6.7	17.0	16.1	13.6	23.8	18.8	14.0	13.6	18.7
Catholic (%)	17.8	21.9	25.1	19.5	25.0	14.7	19.4	27.5	25.8
Lutheran (%)	20.6	18.3	0.8	5.6	0.8	9.7	9.9	0.9	1.3
No Religion (%)	12.1	11.8	13.9	15.5	15.8	13.6	16.3	20.4	18.7

Table 6.28 Demographic indicators for local towns (2006 Census data)[1] (cont'd)

	Minyip	Murtoa	Donald	Rupanyup	St Arnaud	Warracknabeal	Horsham	Victoria	Australia
Family characteristics									
Number of families (total number)	142	254	451	161	572	687	3,574	464,898	5,219,165
Couple families with children (%)	38.0	49.9	39.7	44.7	37.2	36.2	38.6	35.9	37.2
Dwelling characteristics									
Occupied private dwellings (total number)	237	365	670	233	948	1,042	5,403	1,781,666	5,472,521
Separate houses (%)	95.4	94.8	88.1	96.6	89.5	95.5	83.9	77.5	76.6
Semi-detached, row or terrace house, townhouse etc. (%)	3.4	<0.1	<0.1	<0.1	1.8	0.7	6.4	9.1	9.2
Flat, unit or apartment (%)	<0.1	2.7	8.2	1.7	7.3	3.1	10.3	12.6	13.0
Other dwellings (%)	1.3	1.6	3.7	1.7	1.7	0.4	0.4	0.7	<0.1
Tenure type - occupied private dwellings									
Fully owned (%)	59.5	55.3	53.6	60.1	49.8	54.9	37.5	36.1	34.0
Being purchased (%)	25.3	26.3	23.3	21.5	26.6	25.1	31.4	35.5	34.1
Rented (%)	6.3	15.6	17.5	11.6	20.1	16.0	28.0	24.6	28.1
Landlord type - occupied private dwellings being rented (including rent free accommodation)									
Rented from real estate agent (%)	0.0	5.8	2.1	0.0	3.6	7.9	15.3	14.1	14.3
Rented from state/territory housing (%)	0.0	1.9	5.7	2.6	5.4	3.1	6.2	3.0	4.3
Rented from other landlord (%)	1.7	1.1	1.6	1.3	0.9	2.2	0.5	0.8	1.4
Private dwelling vacancy rate (%)	17.0	15.6	13.4	17.6	13.0	9.4	9.9	10.3	9.9
Incomes									
Median weekly individual income ($)	322	350	333	344	341	360	423	456	466
Median weekly household income ($)	841	850	812	810	782	889	1,040	1,022	1,027

Table 6.28 Demographic indicators for local towns (2006 Census data)[1] (cont'd)

	Minyip	Murtoa	Donald	Rupanyup	St Arnaud	Warracknabeal	Horsham	Victoria	Australia
Labour force (population aged 15 years and over)									
In the labour force (total number)	210	380	701	250	972	1,097	6,538	2,404,608	9,607,987
Employed full-time (%)	50.0	58.7	59.8	59.2	58.2	57.2	57.9	60.1	60.7
Employed part-time (%)	31.4	30.8	31.5	25.6	31.3	30.9	30.1	28.4	27.9
Employed but did not state their hours worked (%)	6.7	1.3	2.4	4.8	2.4	2.8	1.9	2.7	2.6
Unemployed (%)	5.7	4.5	3.3	4.4	5.8	5.7	5.9	5.4	5.2
Not in the labour force (total number)	218	304	631	199	809	909	3,741	1,330,368	5,271,116
Occupation (population aged 15 years and over) most common occupations for employed persons									
Clerical and administrative workers (%)	-	-	8.7	9.2	10.8	-	13.1	14.8	15.0
Community and personal service workers (%)	10.1	-	-	-	-	12.0	-	-	8.8
Labourers (%)	11.6	14.0	15.6	10.9	19.9	13.5	-	-	10.5
Sales workers (%)	-	-	-	-	-	-	13.2	10.1	9.8
Managers (%)	34.3	24.2	26.0	39.7	14.6	20.0	12.8	13.5	-
Professionals (%)	10.6	13.8	10.9	14.6	12.8	12.8	17.1	20.8	19.8
Machinery operators and drivers (%)	11.1	11.0	-	-	-	-	-	-	6.6
Technicians and trades workers (%)	-	12.7	14.5	10.5	14.2	14.0	15.0	14.0	14.4

[1]Census information is not collated for towns with a population of less than 200 people, including numerous towns within the study area.

Table 6.29 Population trends in Northern Grampians and Yarriambiack shires

	Northern Grampians	Yarriambiack
Total population		
1991	13,130	8,941
1996	13,001	8,304
2001	12,700	7,758
2006	11,912	7,521
Average annual growth rate (%)		
1986-1991	0.40	-1.10
1991-1996	-0.20	-1.50
1996-2001	-0.50	-1.40
2001-2006	-6.20	-1.32

Source: ABS (2007b).

In 2006, the median age of the population of the Northern Grampians and Yarriambiack shires was 42 and 45 years, respectively, up from 38 and 41 years, respectively, in 2001. This is similar to the median age of the population of the local towns, except Horsham, which is lower (37 years). In local towns, more than 35.0% of the population is aged 55 and over, except Horsham (29.7%).

Occupations and Income

In 2006, the unemployment rate in local towns such as Minyip, St Arnaud, Warracknabeal and Horsham was higher (5.7%, 5.8%, 5.7% and 5.9 respectively) than the state as a whole (5.4%) and the rest of Australia (5.2%) (ABS, 2006). In Murtoa, Donald and Rupanyup, unemployment was low (4.5%, 3.3% and 4.4% respectively) (ABS, 2006). This may be due to a range of factors such as population size, the skills of local people and the availability of jobs in local towns.

In 2006, 5,431 people in Northern Grampians were in the labour force. Of these, 58.9% were employed full-time (down from 60.7% in 2001), 29.5% were employed part-time, (down from 30.2% in 2001), 2.7% were employed but did not state their hours worked (down from 2.9% in 2001) and 5.2% were unemployed (down from 6.2 in 2001). There were 3,745 people aged 15 years and over who were not in the labour force.

In 2006, 3,252 people in Yarriambiack Shire were in the labour force. Of these, 58.9 were employed full-time (down from 63.0% in 2001), 29.3% were employed part-time (down from 30.2% in 2001), 3.4% were employed but did not state their hours worked (up from 3.2% in 2001) and 4.2% were unemployed (up from 3.5% in 2001). There were 2,438 people aged 15 years and over who were not in the labour force.

Interviews indicated that some sectors find it difficult to recruit suitably qualified people to the local area (e.g., police officers, general practitioners, other health care professionals and tradesmen). It is believed that reasons for this include a lack of quality accommodation in local towns, the distance from major centres and a lack of work opportunities for partners.

The median weekly individual income for people in local towns in 2006 was between $322 (Minyip) and $423 (Horsham). This is lower than the state and national median weekly individual incomes, which are $456 and $466, respectively.

Being an agriculturally based economy, the disposable incomes of farmers in the local area vary depending on the success of crops and livestock production. The Australian Bureau of Agricultural and Resource Economics (ABARE) estimated that between 2005/06 and 2006/07, production of Victorian winter crops fell by between 26% and 45% (ABARE, 2006 as cited in Supporting Study 9). Shire revenues in the Northern Grampians and Yarriambiack shires have similarly decreased since 2001.

Accommodation

In 2006 the private dwelling vacancy rate in local towns was between 9.4% in Warracknabeal and 17.6% in Rupanyup. Contrary to expectations, (State Revenue Office, pers. comm.,2006) vacancy rates have varied little since the 2001 census.

Of the occupied dwellings, between 37.5% (Horsham) and 60.1% (Rupanyup) were fully owned, between 21.5% (Rupanyup) and 31.4% (Horsham) were being purchased and between 6.3% (Minyip) and 28.0% (Horsham) were being rented.

In October 2006, 199 properties in the study area were listed on www.realestate.com.au (2006) as for sale. In October 2006, Elders Real Estate based in Warracknabeal had no rental properties available in any of the surrounding towns and approximately 15 houses for sale. This is considerably less than three to four years ago (between census years) when Elders Real Estate had numerous properties for rent and approximately 80 to 90 properties for sale (Elders Real Estate, pers. comm., 2006, as cited in Supporting Study 9).

Temporary accommodation within the study area consists of hotels, motels and caravan parks (Table 6.30). Temporary accommodation increases with population size, with Horsham having the largest availability of accommodation. Vacancy rates vary considerably and are dependant on tourism, special events (e.g., weddings and reunions) or construction activities in the local district (e.g., a new facility).

Table 6.30 Temporary accommodation in the study area (excluding Horsham)

Town	Type of Accommodation	Premises	Rooms
Minyip	Hotels	2	16
	Motels	0	0
	Caravan parks	0	0
Warracknabeal	Hotels	4	20
	Motels	3	18
	Caravan parks	1	40 sites
Murtoa	Hotels	1	9
	Motels	0	0
	Caravan parks	0	0
Rupanyup	Hotels	1	6
	Motels	0	0
	Caravan parks	0	0

Table 6.30 Temporary accommodation in the study area (excluding Horsham) (cont'd)

Town	Type of Accommodation	Premises	Rooms
St Arnaud	Hotels	2	16
	Motels	4	40
	Caravan parks	1	37 sites
Donald	Hotels	3	13
	Motels	2	19
	Caravan parks	1	42 powered sites, 17 cabins

Source: www.donald.org.au (Donald Tourism Association, 2007) and www.yellowpages.com.au (Telstra Ltd, 2007) (verified with follow-up phone calls). Note: This summary excludes Horsham where numerous temporary accommodation options are available.

Infrastructure

Accommodation infrastructure to support the workforce is discussed in detail above. Water, electricity and roads infrastructure is discussed in detail in Section 6.11 and Section 6.9. In summary, an extensive road network exists within the vicinity of the project area. Electricity is supplied via a 55-km, 66-kV transmission line originating from Horsham, and water is predominantly supplied to local towns via the Wimmera Mallee channel system, from Grampians Wimmera Mallee storages in the Grampians (GWMWater, 2005).

Community Services and Facilities

Horsham is the main service centre for the district and provides a range of general and community services and facilities such as:

- A major hospital.
- Education facilities at primary, secondary and tertiary levels.
- Nursing homes.
- Shopping centres.
- Community centres.

Health services in the Northern Grampians Shire are supplied through private and public medical facilities in Stawell and St Arnaud. Emergency care is provided by helicopter and road ambulance services. The Horsham hospital provides a fully equipped radiology department and has numerous medical services. The Northern Grampians Shire has two aged-care facilities.

Public hospitals in the Yarriambiack Shire are located in Hopetoun and Warracknabeal. The Warracknabeal hospital is currently undergoing an upgrade. There are five medical centres in the shire that provide support to the hospitals. Any patient requiring specialist care is transferred to Horsham. Emergency care is provided by helicopter and road services. The township of Donald also has one hospital, one medical centre and one community health centre.

Dunmunkle Health Service services the towns of Murtoa, Minyip and Rupanyup and is the only public medical clinic in the West Vic Division of General Practitioners. All other medical clinics are privately run. The West Vic Division of General Practitioners has a very similar ratio of general practitioners per capita, of 1:1,396, to the rest of Australia, which has a ratio of 1:1,403.

There are a large number of educational facilities from primary to tertiary level in the local area. Secondary colleges are located in Hopetoun, Warracknabeal, Donald, St Arnaud and Murtoa. There are a number of private and public primary schools located throughout the shires.

An adequate number of police now operate in Horsham and local towns (John Hendrickson, pers. comm., 2006). Emergency services consist of air and road ambulance, fire brigade, State Emergency Service (SES) and Community Emergency Response teams (CERT).

6.12.2 Issues

The majority of the 22 people interviewed were aware of the project. There was a belief that the project would provide the following opportunities:

- Increased local investment.
- Increased population.
- Employment opportunities that would produce positive flow-on benefits for local businesses.

Overall, the main concerns expressed were:

- Fear of reduced participation in community events and volunteer organisations.
- Shortages in the local workforce if people start working for the mine.
- Temporary disruption of existing infrastructure.
- Increased pressure on regional water resources.
- Fear of reduced service provision (including general and specialised medical services).
- Uncertainty about when and if the project is going to proceed.
- Uncertainty about whether the boom and bust nature of mining would enable the full economic benefits of the project to be realised.
- Reduced community cohesion.

Other broader issues that are of concern include the availability of accommodation to support the construction and operations workforces[12], population changes in the local towns, infrastructure and services to support the project, amenity values such as air quality, noise, visual and landscape, human health and power and water supply capabilities.

During the first 25 years of mining, the following is predicted:

- Total capital investment of $93 million (associated with the mine site).
- Total, unescalated revenues of $1,635 million (25 years).
- Annual operating expenditure of $30 to $40 million ($750 million to $1000 million over 25 years).
- Annual Government royalties of $1.8 million (over $50 million over 25 years).
- Annual salaries for operational employees and contractors of approximately $6.5 million.
- Generation of income tax.
- Construction workforce of approximately 100 to 120 people (8 to 12 months).

[12] Employees will be expected to arrange their own accommodation in the surrounding area. If adequate accommodation is unavailable in local towns, the majority of non-local mining personnel are likely to be accommodated in Horsham and travel to the mine on a daily basis.

- Operations workforce of approximately 75 people (approximately 39 DMS staff and 36 mining and transport contractors).

Like all commodities, mineral sands mining experiences cycles in demand; nevertheless, the introduction of this new industry to the area will diversify the local economy and should provide a further buffer to the local community during downturns in the agricultural markets.

The economic return from mining at any given time is dependent on a wide range of factors, particularly global commodity prices. As for any long-term business proposal, this inevitably results in some uncertainties about future economic returns. However, should mining proceed, the gross operating margin from mining would be between $635 and $885 million over the nominal 25-year life of the mine, compared to the $4 million representing the opportunity cost of lost agriculture from 342 ha unavailable for agricultural production each year of the mine life.

6.12.3 Avoidance, Mitigation and Management Measures

Table 6.31 lists the main concerns of the community and summarises the mitigation measures that will be implemented. Monitoring of issues will be undertaken as part of mine operations.

Table 6.31 Mitigation measures to address the main concerns of local stakeholders

Main Concerns of Local Stakeholders	Mitigation Measures
Fear of reduced participation in community events and volunteer organisations (due to population changes).	• Rehouse impacted landholders within the local area, if possible where desired by landholders. • Place information relating to local events on company notice boards, etc. • Develop initiatives that encourage mine employees to participate in community initiatives such as the CFA and sports clubs. • Participate in corporate sponsorship of local events and organisations (already occurring). • Actively participate in staff retention programs so that mine staff remain in the local area for as long as possible. • Manage rosters so that participation in community initiatives can be accommodated.
Shortages in the local workforce if people start working for the mine (i.e., changes to local employment market).	• Discuss training and skill requirements with the local registered training organisations, including the TAFE, local schools and VET providers, to maximise ongoing local employment. • Hold supplier briefings so that local businesses can diversify to provide services and products to the mine. • Facilitate vocational training opportunities, such as work experience programs, in collaboration with the local high schools.
Temporary disruption of existing infrastructure.	• Liaise with the community to ensure they are aware of any planned interruptions. • Plan to ensure interruptions are as short as possible. • Consult with the community to determine where improvements can be made.

Table 6.31 Mitigation measures to address the main concerns of local stakeholders (cont'd)

Main Concerns of Local Stakeholders	Mitigation Measures
Increased pressure on regional water resources.	• Saline groundwater will be assessed to determine its potential to supply the mine's needs. • An alternative fresh water supply option (e.g., a reverse osmosis plant as well as buying water from GWMWater) will be investigated. The water industry is under review in Victoria and, ultimately, DMS's water supply will need to be consistent with government policy.
Fear of reduced service provision (including general and specialised medical services and increased enrolment in local educational facilities including childcare facilities, kindergartens, primary and secondary schools).	• Implement an occupational health and safety management plan. • Train mine personnel in first aid. • In coordination with both government and private healthcare providers, provide information on impacts (including through the EES) to the community, where possible. • Ensure that local schools are aware of potential increases so that business cases can be prepared to gain extra funding, if necessary.
Uncertainty about when and if the project is going to proceed.	• Frequent and ongoing consultation with landholders within the project area to provide as much information as possible to minimise uncertainty (already occurring). • Develop agreements with landholders that include: - Measures to be undertaken by DMS to minimise disruption to agricultural activities. - Compensation. - Details relating to final landform and land uses. • All mining activities will be operated within guidelines and policies (e.g., SEPPs) that minimise and regulate potential impacts.
Uncertainty about whether the full economic benefits of the projects will be realised.	• Provide project information to the community in a timely manner. • Provide service provider briefings to explain DMS procurement policies and processes. • Establish a website so that local business and potential employees can register interest in the project. A list of potential suppliers and employees will be sent to contractor companies once commissioned.
Reduced community cohesion.	• Provide project information to the community in a timely manner, which will help to quell divisive rumours. • Rehouse impacted landholders within the local area, if possible where desired by landholders.

6.12.4 Residual Impact Assessment

Economic

The economic benefits derived from export earnings, royalties and taxes will be felt most strongly at the state level. At the regional and local level, direct economic benefits will be derived from employment, local investment and purchases of goods and services.

The longevity of the project will enable the current industrial and economic base of the local area to diversify and increase the potential for other mineral sand mines and processing facilities to be developed in the region.

The project will provide an economic benefit to the district from wages and some increased support for local industries. This will have a flow-on effect on other local businesses and services. The Minerals

Council of Australia estimates that, for every job created in the Victorian mining industry, another job is created elsewhere within the Victorian economy as a result of the initial increase in demand for goods and services (MCA, 2005). Modelling using REMPLAN (a model built specifically for the Wimmera Development Region by La Trobe University) estimates that for every job created as result of the DMS project, the potential exists within the Wimmera region for between 2.4 and 3.4 additional jobs to be created (ERU, 2006). As described previously, the project will employ 75 people during operations. Based on these estimates as many as 291 flow-on jobs could be created. Of these, the greatest potential exists within the following industries:

- Electrical and mechanical trades.
- Supply of fuel and consumables.
- Service industries such as food, printing, stationery.

Tradespeople are becoming increasing difficult to recruit; however, the long life of the project (25 years initially) will provide long-term employment opportunities for suitably qualified persons, the benefits of which are likely to be felt both locally and regionally within Victoria.

As described in Section 4.1, Mining Overview, the practice of progressive backfilling and rehabilitation means that the pit does not continually increase in size; rather, only its location changes. As a result, impacts for most localities (for example, a residence) will vary over time. Nevertheless, for residences situated at D4, 5, 6, 7, 8, 11 and 23 and at the perimeter (D2 and D10) of the orebody, the impacts associated with the project will go on for most, if not all, of the project life. For residences at D4, 5, 6, 7, 8, 11 and 23, accessing the ore may necessitate relocating or dismantling the house (see Figure 1.2).

DMS estimates that the majority of five farms and sections of an additional four (approximately 1,712 ha) will be disturbed during the nominal 25-year mine life. Within the project area, continued agriculture would produce a gross margin (that is, revenue less costs) of $4 million over that period. Comparable margins of $750 million will be generated from mining even when conservative measures (farm land being out of production for five non-drought years) are applied. As described in Chapter 4, farmers will be compensated as required under Part 8 of the MRSD Act. The population increase during construction and operations will provide a larger customer base for the local hotel, bakery, cafes, supermarket and retail shops.

Population Changes and Employment

Mine employees living in the local area are predicted to contribute to a net population increase of between 0.8 and 0.9% (1% increase minus 0.1 to 0.2% due to loss of approximately 10 individuals from the local area during the nominal 25 years of mining).

Given the skilled labour shortages already apparent in most regional areas, (DOTARS, 2004), and that approximately 60% of people employed by the project are likely to come from existing sources of employment, some workforce shortages on farms or in local businesses may be experienced. The increase in employment opportunities; however, may encourage locals who have left the area to return, and young people to remain in the area.

Accommodation

As only a small number of quality houses are for sale in the local towns, workers may be precluded from settling locally until new housing is built. The real estate market may tighten as demand for quality housing grows. This has the potential to push house prices up. New houses are planned for

Warracknabeal and investment in affordable housing might be seen as a future business opportunity the shire (once all economic factors are considered), increasing the availability of temporary and permanent accommodation in the study area. If mine employees live in Horsham, benefits to other local towns will be reduced.

Infrastructure and Services

A greater number of enrolments is expected to benefit schools through an additional $3,000 to $5,000 per student per year, though the full benefit of this funding would not be felt if new students were of a similar age and additional teachers and classrooms were required.

Community Wellbeing

As described in Chapter 4, the net result of the moving pit location is that impacts on the community will ebb and flow depending on individual perception of the project and individual landholder decisions relating to compensation, leasing or purchasing other properties locally or repurchasing the property upon conclusion of mining activities.

The impact and duration of impacts on community wellbeing cannot be determined as they are based on personal experiences of, and individual attitudes towards, mining, which are likely to vary widely throughout the project area and beyond.

It is DMS's intention to relocate residents locally for the period that their property is occupied for, or affected by, mining purposes and so retain the community structure. Nevertheless, the choice to return, or leave permanently, rests with the landholder and the impacts on community wellbeing cannot be predicted.

6.13 Soils and Mine Materials

The information in the following sections have been largely drawn from a rehabilitation report for the project area that was undertaken by Dryland Agricultural Services and Goldfields Revegetation Pty Ltd in April 2007 (Supporting Study 5).

6.13.1 Existing Conditions

The existing landforms, soil distribution, soil textures, pH, as well as the location and amount of various nutrients and problematic components such as salt and boron have been characterised (see Supporting Study 5).

Landforms

The project area lies at an average elevation of approximately 130 m, with a slight fall to the east, towards the Richardson River and a slightly steeper fall to the north. Micro relief up to 6 m is provided by numerous low sandy rises that give the impression of a more undulating topography. Overland flow is the main method of drainage, as few defined drainage lines exist in the area. Silt deposits and soil gleying are evidence of water ponding on paddocks for long periods during wet years.

An area of lignum and black box swamp on the southeast boundary of the project area is one of several seasonal wetlands areas near the Avon River from which, in very wet years, water flows into the river overland.

Geology

Small sand dunes are widespread in the region, with the larger of these consistent with the Woorinen Formation, which was produced as the result of several episodes of erosion and deposition, each corresponding to an arid period during the late Pleistocene age. Smaller dunes, known as lunettes, are also common. Lunettes commonly consist of clay, though may also consist of sand or gypsum, and carbonate is typically present. The lunettes were formed by the erosion of Shepparton Formation clay and therefore contain significant clay with soils tending to be loam or clay loam, whilst other dunes are relatively sandy, suggesting a sediment source outside of the project area. The stratigraphy of the area is summarised in Table 6.32 below.

Table 6.32 Stratigraphy of the project area

Formation	Thickness	Age (Million Years)	Characteristics
Woorinen Formation (equivalent)	0 to 6 m	<0.1	Aeolian: red sand, variable clay content, carbonate common.
Shepparton Formation	5 to 20 m	2 to 0.05	Fluvial: sandy clay, minor sand
Parilla Sand	10 to 15 m	6 to 2	Marginal marine: fine to very fine sand, clayey, silty, host to heavy minerals.
Geera Clay	10 to 30 m	35 to 20	Marine: dark grey to black carbonaceous clay, calcareous, fossiliferous. Minor amounts of sulfide identified.
Renmark Group (Olney Formation)	10 to 30 m	60 to 40	Fluvial, paludal: thinly bedded poorly sorted sand, minor gravel, carbonaceous clay, minor lignite.
Avon Deep Lead (confined to area south of Donald)	12 to 20 m	About 60	Fluvial (river channel): quartz sand, gravel.
Palaeozoic basement	Variable	> 500	Metamorphosed marine sediments: slate, sandstone.

Soil Systems

Soils in the project area are derived from fluvial sediments of the Shepparton Formation and from aeolian sediments, which are common in the Wimmera region. In the Wimmera and Mallee, salt (sodium chloride), gypsum (calcium sulfate dihydrate) and calcium carbonate are present in all soil types and boron may also be present. Boron is toxic to some legumes at 8 parts per million (ppm) and to cereals at around twice this level.

Site-specific soil information has been obtained from the excavation of 18 drill studies in the project area that identified three soil system types: the Murra Warra, Kalkee and Donald soil systems. The soils of the Murra Warra and Kalkee represent the low undulating plains whilst dunes and lunettes are represented in the Donald system. These soil systems are described in more detail below.

The Murra Warra soil system is the most dominant soil system, making up 80% of the project area. The topsoil is thin (100 to 150 mm), self-mulching, and has an approximately neutral pH. It overlies hard, sodic subsoil, which, like the underlying overburden, has a high level of soluble salts and boron. Boron

levels within 1 m of the surface in the eight sites of the Murra Warra soil system sampled range from 6.6 ppm to 42 ppm.

The Kalkee soil system covers approximately 5% of the project area and is regarded as the best soil for agriculture. The vertosols formed from the Shepparton Formation alluvial sediments are self-mulching, cracking clay soils of the Wimmera. The soil profile is deep and can exceed 1.5 m. Topsoil is typically neutral to alkaline with alkalinity increasing with depth, commonly exceeding a pH of 9. Minor amounts of hard carbonate may be present and gypsum is common. Two variants of Kalkee soils, K1 and K2, have been identified. K1 predominantly consists of grey clays, whilst K2 also includes brown and red clays. Analyses presented by Badawy (1984) (as cited in Supporting Study 5) show similar alkalinity and soluble salt levels for both K1 and K2 variants. Limited analyses for the current study show that the level of salts in the subsoil and underlying material are somewhat higher in the K1 form. Boron levels within 900 cm of the surface were recorded at two sites of K1 soils (<5 ppm and 46 ppm) and two sites of K2 soils (<5 ppm and 57 ppm).

The remaining 15% of the project area consists of the Donald soil system, which has been described as ‘Donald lakes and lunettes’ (Robinson et al, 2006, as cited in Supporting Study 5). In the project area; however, the aeolian landforms consist of distinct dunes and lake-lunette clusters, in which the lakes/swamps are small and the lunette dunes commonly indistinct. All dunes comprise hard, alkaline red and mottled duplex soils, with heavier clay soils in the lakes/swamps of the lunettes. Carbonate is common throughout the profile.

Predictably, the more permeable soils of the Donald dunes are lower in soluble salts and boron than the other soils of the project areas. Four sites in total were sampled in the Donald system. At one site (BYA 1), boron levels were below detection level (5 ppm) down to 4 m. At another site (ZW 12), where the sandy loam topsoil of the Donald system overlies Murra Warra clay, moderate levels of soluble salts and boron levels of 10 ppm were found within 1 m of the surface.

6.13.2 Issues

Donald Soil System

The Donald soil system is a complex system, which, unlike the other landforms, consists of several distinctly different landforms and corresponding soils, such as lunettes, lakes, swamps and linear dunes. Because of this complexity, these separate units must be mapped immediately prior to mining to ensure that detailed plans for soil management and rehabilitation can be prepared.

Acid Generation

Acid-forming soils are soils containing sulfide minerals, such as pyrite, which are stable under anoxic conditions. When these minerals are exposed to air and moisture, they oxidise producing sulfuric acid, which can make the soil acidic. Soils in the project area are nearly all alkaline, with pH ranging from 6.8 to greater than 9.

Where sulfide minerals are found at depths greater than the soil profile, the term acid rock drainage is used. The Geera Clay, which underlies the host formation, was deposited under strongly reducing conditions and minor amounts of sulfide have been identified. The top of the Geera Clay is typically oxidised with iron present either as an oxide or hydrated oxide.

Soil Compaction

Soil compaction and decline of soil structure may occur during movement of machinery and handling of soils during the life of the project, especially in wet conditions. Compacted soils severely reduce the survival and growth potential of plants. Compacted subsoils may also be more susceptible to waterlogging in wet periods, and decreased water holding capacity in dry periods.

Soil Swell and Drainage

Once disturbed, loose soil will swell in volume. Although some compaction may occur when soil is returned to the mine pit, mining will cause a permanent rise in the ground level along the mine path, probably in order of 10% of the mined depth (i.e., 1 to 2 m). Careful drainage planning for rehabilitation will need to be undertaken to ensure that this does not impede long-term drainage, which could cause widespread flooding.

Salinity and Other Soil Conditions Detrimental to Plant Growth

High levels of soluble salts and boron (above 8 ppm being toxic to legumes) are present at relatively shallow depths in both Kalkee and Murra Warra soils. To prevent contamination of the root zone during soil replacement, intervals of salt and boron rich soils will need to be carefully identified prior to mining. A loss of soil structure from mining disturbances may reduce permeability and root penetration and may increase the risk of erosion following rehabilitation. Disturbance of the soil may also cause reduced fertility through the oxidation of organic carbon and the liberation of nitrogen, particularly during stockpiling.

6.13.3 Avoidance, Mitigation and Management Measures

All excavated materials will be managed according to their position in the soil profile, the land unit classification and their geochemical properties according to the Rehabilitation Plan (Section 6.14).

In order to provide close control of the stripping depth of each soil unit, the following management measures will be implemented:

- Ensure detailed sampling and assay of soil and overburden during pre mine drilling.
- Map soil types, with particular emphasis on sandy rises (including volumes) and other components of the Donald system to ensure appropriate collection, stockpiling and reuse.
- Interpret sampling and assay data and include it in mine planning.
- Prepare detailed stripping and stockpiling plans covering all affected areas.
- Prepare detailed plans for replacement of overburden and soil, including management of potential drainage effects.
- Handle soil (especially topsoil) precisely using a scoop, elevating scraper or by windrowing.
- Provide continuous supervision during the stripping process.

The following management measures will be implemented to reduce damage to soil structure, biota, leaching of nutrients and erosion:

- Stockpile initial overburden, topsoil and subsoil separately.

- Keep stockpiles of topsoil to less than 2 m high.
- Handle soil when moist, not wet or dry.
- Vegetate stockpiles, including the initial overburden stockpile, to control erosion with appropriate species reflecting rehabilitation objectives.
- Ensure stockpiles are appropriately located and stripped of topsoil or subsoil if necessary.
- Avoid handling soils of the Donald landform when the soil is dry and weather is windy, as this will reduce impacts from wind erosion.
- Contain drainage from stockpiles, haul roads and other disturbed areas away from stockpiles.
- Ensure careful placement of soil units during rehabilitation. A conceptual plan of the restored soil profile is provided in Figure 6.28.
- Ensure subsoil and topsoil depths are consistent across the site.
- Replace topsoil and subsoil in late autumn/early winter, to ensure to the water content of the soils is not too heavy.
- Ensure soils are sown with a cover crop immediately after replacement to prevent wind erosion.
- Ensure appropriate species such as native grasses and acacia are used for initial revegetation to avoid erosion.
- Ensure mining does not penetrate the Geera Clay, which has the potential for acid formation.
- Monitor soil pH to ensure retention of alkaline conditions.

6.13.4 Residual Impact Assessment

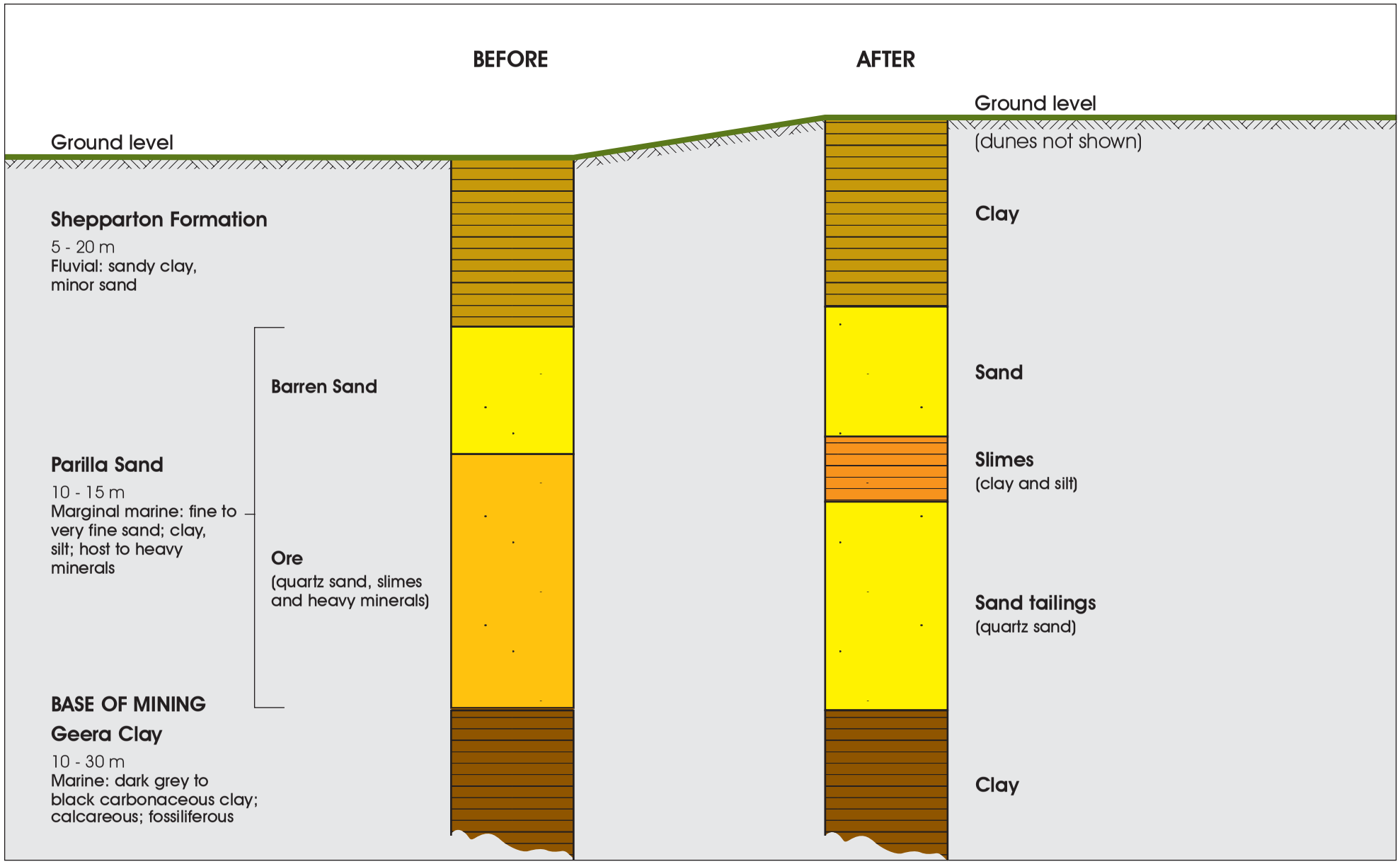
A primary objective of the rehabilitation program is that soils be restored to at least their current condition in terms of the viability of agriculture as well as native vegetation and faunal populations. Rehabilitation criteria will be established for specific areas and regular monitoring and maintenance will be undertaken to ensure that the criteria are met.

Donald Soil Systems

While some wind erosion will be unavoidable, the use of cover crops and the timing of topsoil stripping, during mining and rehabilitation will reduce potential effects of wind erosion.

Acid Generation

Mining will not penetrate the Geera Clay, therefore, any sulfides that may be present will not be exposed to air and the risk of acid formation. In addition, in the project area, the top of the Geera Clay is typically oxidised with iron present as either an oxide or hydrated oxide, so the soil study concludes that there is no potential for acid formation.



Note: Not to scale	coffey natural systems	Job No: 972 File Name: 972_05_F06.28_HB	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Restored soil and mine materials profile	Figure No: 6.28

Soil Compaction

While some soil compaction will be unavoidable, most compaction arising from the day-to-day use of mine machinery will affect only overburden below the soil horizon. Such compaction is not seen as damaging in any way to future land use. Measures such as soil ripping undertaken during restoration works are expected to alleviate any long-term effects of stockpile compaction.

Soil Swell and Drainage

Although some compaction will occur, mining will cause a permanent rise in the ground level along the mine path. DMS sees this as a high priority and will provide detailed procedures for drainage planning in the Rehabilitation Plan to ensure that soil swell does not impede drainage. Drainage planning objectives are further defined in Section 6.1.

Salinity and Other Soil Conditions Detrimental to Plant Growth

While excessive salt and boron in the soil has the potential to severely limit certain plant growth, appropriate handling of subsurface materials could potentially improve existing land capability. Burying such materials below the root zone, for example, during reclamation and rehabilitation works as described in Section 6.14, will reduce their impacts on both agricultural and native species.

Improved Conditions

Through appropriate rehabilitation, there is the potential to improve the soils in the project area with improved root and water penetration, texture and salt content. The realisation of these aims will depend on the development and implementation of an appropriate rehabilitation plan discussed further in Section 6.14.

6.14 Rehabilitation

This section addresses the potential issues and identifies mitigation measures in relation to rehabilitation in the project area and along any water supply pipeline. Information has been largely drawn from a rehabilitation report prepared for the Donald Mineral Sands project by Dryland Agricultural Services and Goldfields Revegetation Pty Ltd in April 2007 (Supporting Study 5).

6.14.1 Existing Conditions

Landforms, geology and soil systems have been discussed in Section 6.13.1 of this report, and are relevant to this section. Similarly, surface water is discussed in Section 6.1.1 and flora in Section 6.3.2. The following is an explanation of additional existing conditions relevant to rehabilitation.

Agriculture

In the past 15 years, farming practices have moved towards continuous cropping, stubble retention, minimum tillage and controlled traffic of agriculture across the Wimmera. Boron tolerance is also being incorporated into crops previously affected by boron (which is commonly found in soils of the eastern Wimmera). Furthermore, wheat and barley varieties of cereals are now either resistant to, or tolerant of, cereal cyst nematode (CCN); however, grass weeds remain a significant problem for farmers if they are not managed effectively.

Farming has successfully continued in the Wimmera despite the past decade being one of the driest on record. Only 3 years in the past 10 have seen yields that meet the long-term average or surpass it. Severe frosts, failure of spring rains, or very late starts to the season have decreased the yield potential in the other years.

Stock and domestic water supplies have been limited on all farms. Farmers have therefore been unable to take full advantage of the good returns being obtained for lambs, which are fattened on the stubbles remaining after harvest, and grain residues.

The area is suited to prime lamb production, due to good weather conditions in summer and autumn, abundant quantities of high quality feed and the anticipated supply of good quality water once the GWMWater Pipeline is constructed.

A number of different crops can be grown in the Wimmera and include wheat, barley, oats, triticale, rye, canola, field pea, faba bean, broad bean, desi chickpea, kabuli chickpea, red lentil, green lentil, fenugreek, safflower and vetch. Farming land located in the project area may also be used to grow oats for export hay, lucerne for grazing and the stubbles of the crops is used for grazing ewes and wethers, and fattening lambs.

The soil types present largely determines the viability of crops. For example, the Kalkee Type 1 and 2 soils (see Section 6.13.1) are too alkaline to support lupin production. Also, it is likely that boron will be at levels too toxic for grain legumes and cereals at depths below 600 mm in most of the soils associated with the flood plains. Toxic boron levels may also be found on the lunette soils and remnant dunes.

Although the farms located in the project area do not contain the soil types or land forms with the highest productivity potential in the Wimmera, they do have the capacity to support a broad range of enterprises. The budgeted gross margins of these farms appear to be sustainable in a positive market environment.

Native Vegetation

Existing conditions in relation to native vegetation are detailed in Section 6.3.2.

6.14.2 Issues

Alteration of Soil Diversity and Landform

Most farms contain both undulating plains with clay soils and low sandy rises. This contrast of soil types can be useful, as the sandy soils may perform better in drier years than the clay soils and also the very wet years, as it is more permeable. However, clay soils tend to be the more productive when rainfall is intermediate. Some of the farmers in the area would prefer the sandy rises to be removed, or the profile reduced, during rehabilitation. In contrast, other farmers would prefer the soils and topographic diversity be maintained to provide opportunities to diversify cropping.

Contamination of the Root Zone

In both the Kalkee and Murra Wurra soils, there are high levels of soluble salts present at relatively shallow depths. Boron levels are also high, with levels toxic to legumes and many cereals. As soils are generally heavy and rainfall relatively low, the peaks of both salt and boron occur at relatively shallow depths, close to the base of (or within) the normal root zone for annual crops. There is the potential for contamination of the root zone to occur when soil is replaced.

Excessive Swelling and Settlement, and Impeded Drainage

There is the potential for rehabilitation to be unsuccessful if the soil and overburden are not managed correctly, which can lead to excessive swelling and settlement of soils.

If some degree of compaction is achieved during backfilling of material, it is estimated that the net swell for the project will be approximately 10% or less, or 1 to 2 m. It is also estimated that the long-term settlement will be insignificant.

The change in elevation has the potential to impede surface water drainage, and cause flooding in wet years.

Increased Weed Density and Distribution

There are at least three significant weed species in the area: *Cardarbria draba* (hoary cress), *Rhaphanus raphanistrum* (wild radish) and *Myagrum perfoliatum* (musk), which, if not managed correctly, may spread within the project area, and potentially beyond.

Alteration to Native Vegetation

During the flora survey that was conducted for the project area, five EVCs were identified: Plains Woodlands, Plains Savannah, Low Rises Woodland, Ridged Plains Mallee and Black Box Lignum Woodland. These EVCs are all considered endangered. As most of the project area has been cleared for agriculture, only small remnants (i.e., less than 5%) of native vegetation remain, and are mainly located on sand dunes. The remnants are generally in poor condition and are disconnected. There is the potential that development of the mine will further reduce the amount and quality of native vegetation in the project area.

6.14.3 Avoidance, Mitigation and Management Measures

Proposed Rehabilitation Method

The following is an outline of the proposed rehabilitation method. Adoption of this method will minimise potential adverse affects, as listed in Section 6.14.2.

- Re-establish some of the larger dunes (approximately 5% of the total mined area (i.e., 200 ha)). These may not necessarily be in the original locations.
- Eliminate small dunes and lake-lunette complexes, burying sand below subsoil in Murra Warra or Kalkee clay soil areas and leaving a clay plain (approximately 10% of total mined area (i.e., 400 ha)).
- Establish several wetland areas for flood control. Their size and location will be derived from hydrological investigations combined with mine planning (approximately 5% of total mined area (i.e., 200 ha)), but are likely to be in an existing, weakly defined drainage line in the central north of the project area.

This strategy involves rehabilitation of large areas across a number of farms and also the establishment of drainage lines, wetlands and vegetation zones. This process will work most effectively if a project-wide approach can be applied, rather than applying the approach to individual farms. All farmers must be adequately compensated under legislation; however, whether they desire to sell their properties, or

enter into a lease arrangement with DMS is a matter for negotiation between the individual landholders and the company. Either approach will allow a successful rehabilitation result to be achieved.

After the initial six to 12 months, when soil and overburden will be stockpiled and tailing stored in the TSF, tailing will be placed directly in the mined areas. Topsoil and subsoil stockpiles will be protected from wind and water erosion by ensuring they are less than 2 m and 5 m in height, respectively. They will be vegetated using local EVC species for native topsoils and sterile species such as rye corn for cropping topsoils.

Gypsum application rates will be trialled on all soils except the self-mulching clays of the Kalkee system. Gypsum will improve the soil structure, and will therefore be of benefit for crop establishment and production. Further to this, DMS, in consultation with representatives from DPI's Grains Innovation Park and local non-government agricultural research organisations, will undertake cropping trials to optimise soil management and chemical application rates.

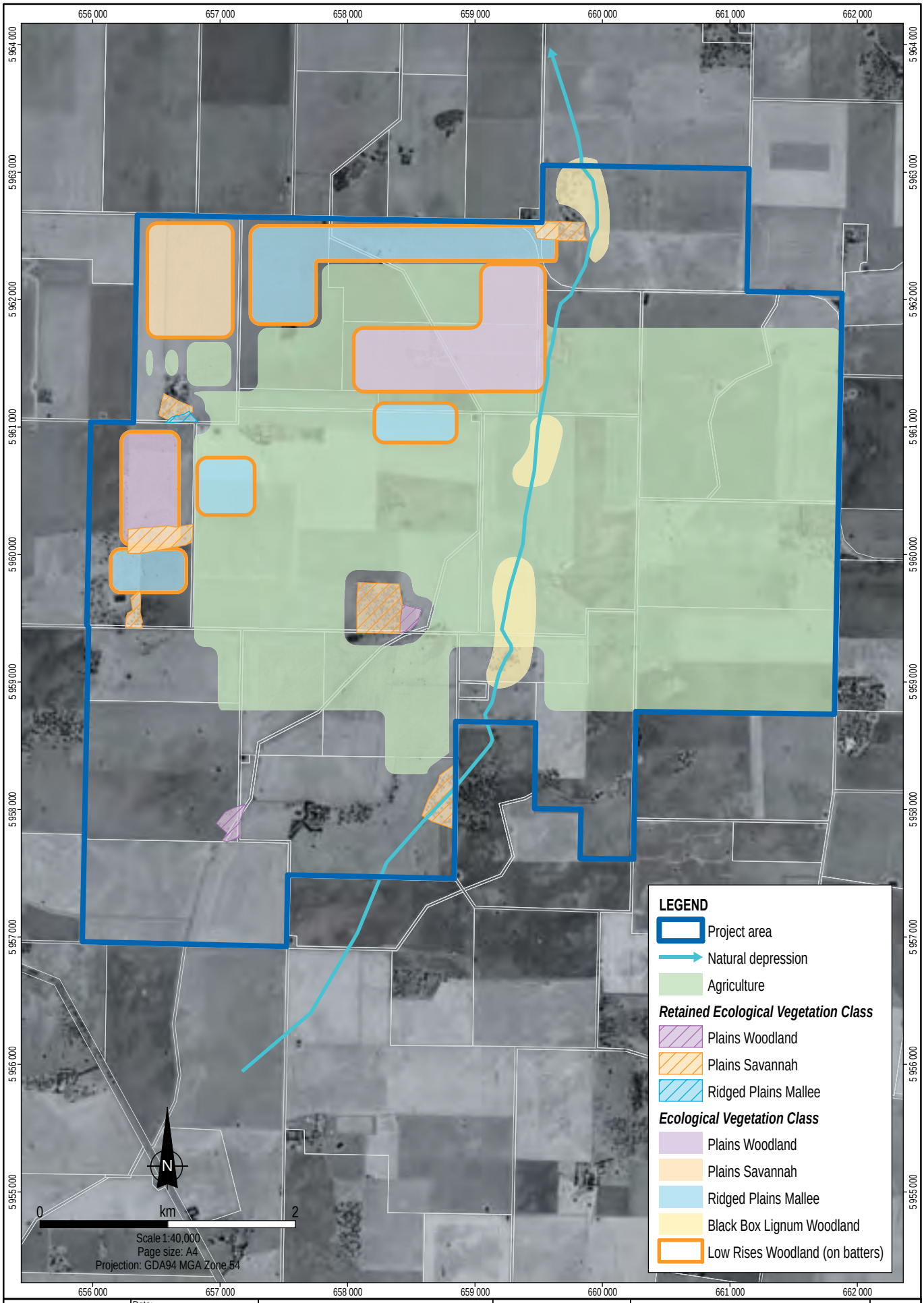
Once the subsoil and topsoil has been replaced into the pit, a crop or pasture will be sown as soon as possible to reactivate the biological processes in the soil, provide root paths through the soil, and provide an opportunity for harvesting hay or introducing livestock. This will be repeated in the second year. By the third year, each affected paddock will be returned to a normal cropping program, operating under normal applications of fertilisers and herbicides. In order to ensure the rates are still appropriate for the modified soil profile, trials by an agricultural scientist will be used to confirm the optimal applications rates of both soil conditioners (such as gypsum) and fertilisers (such as phosphorus).

The TSF will be approximately 5 m above the natural ground level, and the outer batter of the embankment will be relatively steep (approximately 30^{o}). As this is too steep for agricultural activities, the area will be planted with native grass species. However, the slope will be reduced to a 1V:3H batter (approximately 18^{o} on the outer wall). The TSF will contain damp sand and clay, so it is unlikely that leakage as a result of opportunistic self-sowing, deeper rooting trees will occur. Planting of trees and shrubs at the ground level around the TSF and on top of the TSF will also provide a visual improvement by breaking up the profile of the embankment. The TSF design and management will comply with the DPI Environmental Guidelines for Management of Tailings Storage Facilities.

More specifically, the following steps will be adopted during rehabilitation of the TSF:

- Free water will be pumped out.
- The surface of the tailing will be levelled.
- The surface will be covered with subsoil (minimum 1 m) from the Murra Warra system, domed slightly to allow for settlement.
- Topsoil (approximately 200 mm) from the Murra Warra system will be spread.
- Contour ripping (i.e., cross-ripping) to 300 to 400 mm deep.
- Revegetation with grasses and some trees and shrubs.

A conceptual rehabilitation plan highlighting the areas that are likely to become native vegetation and agricultural land is shown in Figure 6.29. This concept plan will be finalised during the Offset Management Plan and Work Plan processes under the MRSD Act prior to the start of site works.



coffey natural systems	Date: 18.10.07 MXD: 972_DonaldMineralSandsGIS File Name: 972_05_F06.29_GIS_AI	DMS Pty Limited Donald Mineral Sands Project	DMS A Subsidiary of Astron Limited	Conceptual mine closure rehabilitation	Figure No: 6.29

Pipeline Route

Given the relatively small area that will be affected within any paddock, rehabilitation of the pipeline route is likely to be relatively simple, involving ripping and, if appropriate, the application of gypsum. Careful backfilling and topsoil management will be carried out, as these activities are critical to minimising the impact of disturbance. Native vegetation to be re-established is likely to be mainly native grasses and other groundcovers, as the chosen route should avoid trees. Groundcovers can be established from seed or by planting seedlings. However, where the pipeline route passes through a well-vegetated area, this can be lifted like turf by a front-end loader and re-laid following construction. Provided this is done carefully and the 'turf' watered in, the revegetation will be successful. While effective, this procedure is only really feasible for small areas. Alternatively, rehabilitation may involve reverting back to grazing or cropping. In this instance, the rehabilitation regime will be developed in cooperation with the landholder.

Topsoil Treatment

The differences between rehabilitation of native vegetation and agricultural land relates directly to the management of topsoil. Topsoil sourced from these two distinct areas will be stored separately and used in separate applications during rehabilitation. For example, topsoil sourced from agricultural land will only be used in the rehabilitation of agricultural land, whereas topsoil sourced from land supporting native vegetation will be preferentially used in the establishment of the native EVCs, but may also be used in the establishment of agricultural land. Separation of these soils is an important part of weed management. Agricultural weeds will readily germinate in establishing native vegetation and therefore contaminate such areas; however, native vegetation will not successfully grow in establishing agricultural land, as the land will most likely be regularly disturbed. To assist in this process, the EVCs and topsoils will be mapped prior to any disturbance to ensure the protection of establishing EVCs and native vegetation in general.

Propagation

All propagules (i.e., seeds, cuttings or diversions) will be sourced from within the project area or the immediate surroundings (i.e., within 10 km). Depending on seed availability, some direct seeding may be feasible, otherwise tube stock will be produced. Stockpile plantings may also be used as 'seed orchards' for growing and collecting seed to reduce the pressure on surrounding areas of native vegetation. DMS will explore the option of registering the plantings as ones that will be harvested in the future, to ensure the vegetation can be disturbed when the soil is reinstated. Where propagation is not feasible, 'plant rescue' will be adopted. This will involve digging up plants and transplanting them to the revegetation site (or nursery, if the site is not ready for revegetation). Local experience and knowledge (e.g., from DSE, DPI, CMA, Landcare and Greening Australia) will be drawn upon when considered the timing of planting.

Buloke mistletoe is a hemi-parasite, hosted by buloke. Re-establishing the mistletoe will require careful reintroduction onto young, established bulokes, a few years after the initial rehabilitation works. DMS will investigate relevant research (such as that undertaken by Greening Australia at the Gumbinnen revegetation site north of Nhill) to determine the most successful method of reintroduction.

Monitoring

Monitoring with respect to rehabilitation has three main objectives: to ensure there is no preventable erosion, that weeds are controlled, and that the establishment of plants meets specified criteria (i.e., numbers, plant densities and species). The following monitoring schedule will be adopted to determine the level of success and progress of rehabilitation:

- At a minimum, quarterly site inspections, with a focus on erosion, weed invasion, vermin and vandalism, crop and pasture establishment and development will be carried out. Remedial action will be taken if necessary.
- After 18 months to 2 years, a survey of vegetation establishment, agricultural production and diversity, erosion and any other soil factors including drainage will be completed.
- After 2 years, quarterly inspections will be extended to half-yearly inspections.
- Two years after the first formal inspection, a more thorough survey of both flora and fauna (with particular emphasis on biodiversity and stability of the ecosystem) will be done. A review of farm performance and productivity will also be done.
- The monitoring process described above will be carried out as each parcel of land or farm unit is rehabilitated, which may take between three and five years depending on weather conditions. At this time, the land will be reintroduced to full-scale agriculture.

Weeds have been identified as part of the flora and fauna survey, which provides a baseline for ongoing monitoring of weeds.

Alteration of Soil Diversity and Landform

The proposed rehabilitation method (see Section 6.14.3 (Proposed Rehabilitation Method)) will ensure an approximation of the landscape will be restored, by consolidating dunes and lunettes into fewer, larger areas. Slightly elevated areas will be reconstructed with a sandy soil profile, which will provide suitable conditions for revegetation with indigenous species requiring well-drained sites. Care will be taken to minimise the risk of erosion and the application of rye corn may assist in stabilising the sand. The heavy soils of the black box wetlands will provide the best soil types for the construction of new wetlands during rehabilitation.

Contamination of the Root Zone

To minimise the potential for contamination of the root zones, detailed soil mapping will be taken to identify the salt and boron rich intervals before mining commences. If necessary, subsoil will be stripped from areas intended for overburden, for example, if high levels of boron or other toxic substances are identified. Furthermore, overburden will be monitored during removal to determine whether it is saline (from close to or below the water table) or non-saline. The thickness of non-saline overburden will be recorded at each location. Saline overburden will be returned to the mine void and, at each location, will be covered with non-saline overburden of at least the original thickness. The principle of stockpiling topsoil on topsoil, subsoil on subsoil stripped of topsoil and overburden stockpiled on areas stripped of topsoil and subsoil will be adopted to further minimise the likelihood of contamination.

Excessive Swelling and Settlement, and Impeded Drainage

Detailed surveying of the project area will occur prior to mining to assist in planning drainage, so that drainage is not impeded by mining activities.

Runoff within the pit will be collected then pumped out to the nearest (possibly realigned) drainage line via a sedimentation pond. Due to the absence of permanent waterflows, impacts to downstream flow will be minimal. Furthermore, the area disturbed at any one time is small compared with the size of the total contributing catchment.

Also, as there is a natural depression within the mine site (see Figure 6.1), this will be used for the diversion. Where the mine path intersects this depression, the flow that would normally drain along this depression will be diverted by the channel, which will be created progressively during mining. This diversion channel will also be designed to reduce surface water flow to some extent (through the use of sedimentation ponds) and mimic existing conditions so water can be released to approximate the natural flow regime, and, as far as possible, maintaining the existing balance of flows to Dunmunkle Creek and the Avon–Richardson system (Supporting Study 10).

Furthermore, one or more wetlands will be created to assist in controlling drainage, and the swelling that is likely to occur will be managed to ensure water movement in times of heavy rainfall will not be impeded.

To further ensure the soil and overburden are managed successfully, the following steps will be adhered to:

- Pre-mining:
  - Sample and analyse soils and uppermost overburden during pre-mine drilling.
  - Map soil types and topsoil depths, with particular emphasis on sandy rises and other components of the Donald land systems.
  - Prepare detailed stripping plans and stockpiling plans early in the project.
  - Prepare detailed plans for replacement of overburden and soil, including management of potential drainage effects.
- Mining:
  - Provide adequate supervision of stripping and stockpiling (as required).
  - Ensure tailing are managed so that settlement is even.
  - Replace overburden, ensuring it is spread and compacted evenly and that any toxic material is placed below the subsoil.
  - Smooth the top of the overburden, ensuring a maximum relief of 100 mm.
  - Replace subsoil and smooth the surface, ensuring a maximum relief of 50 mm.
  - Replace topsoil and smooth the surface.
  - Shallow rip (to approximately 500 mm depth) backfilled areas and areas affected by compaction.

Topsoil and subsoil will be replaced in late autumn and early winter (before the soils become too wet to handle with precision) and late spring and early summer (when the soils are moist and conditions are drying).

Increased Weed Density and Distribution

In general, the viability of seeds will be reduced by long periods of soil stockpiling. Therefore, it is likely that fewer weeds will germinate upon stockpile disturbance, and there will be a greater opportunity to manage the growing plants. If further weed control methods are necessary, local experience and knowledge (e.g., from DSE, CMA and Greening Australia) will be considered in developing site-specific action plans.

In addition, the Department of Primary Industries 'Biosecurity Guidelines for Movement of Equipment Contractors Between Farms' will be implemented through the development and implementation of a weed management plan. These protocols outline ways to minimise the risk of transferring disease agents or pests by ensuring equipment, machinery and personnel are clean and free, for example, of soil, faeces, plants, weeds or seeds before arriving on the mine site (DPI, 2006).

Alteration to Native Vegetation

As mentioned in Section 6.14.2, Alteration to Native Vegetation, native vegetation in the project area is in disconnected patches, which restricts movement of fauna and limits genetic diversity. The rehabilitation plan will improve the native vegetation in the project area, increase it in size to 20% of the project area, and will be established to provide some continuity of vegetation, which is of greater value than smaller, isolated patches. This will involve revegetating with indigenous species to re-establish the original EVCs where possible. If conditions are significantly different, the species selected will be from another EVC present in the area that has conditions similar to those post-mining.

Although there will be a short to medium term loss of native vegetation of habitat suitable for native fauna, including a loss of mature hollow-bearing trees, in the long term (i.e., over the 25 year life of the mine), there will be no overall loss to native vegetation, but rather a four-fold increase in the area of native vegetation to contribute to a 'net gain' in the extent and quality of vegetation that will be more beneficial to native fauna. This increase in vegetation to 20% of the project area is an estimation of what can be revegetated in terms of existing and predicted conditions (i.e., considering the extent of wetlands and lunettes). This is explained in further detail in Section 6.3.4. Furthermore, where large trees containing hollows have been removed, the logs will be stockpiled and placed in the ground in areas that are revegetated to assist in providing a faster habitat benefit. Disturbance and subsequent rehabilitation will be progressive over the mine life, therefore limiting the adverse effects for native fauna. DMS will consult with interested groups such as Landcare and Greening Australia to ensure they have an opportunity to provide input into the native vegetation offset plan.

6.14.4 Residual Impact Assessment

As described in Section 6.14.3, a model for rehabilitation has been developed for the project. This plan aims to fully restore the agricultural capability of disturbed areas and provides for an increase in the extent and quality of native vegetation. There will be many contributors to perceptions of 'success' for the project, and these will vary between stakeholders; however, rehabilitation, along with environmental and socio-economic aspects, is considered one of the main criteria.

The proposed rehabilitation will see an increase in the lateral extent of the endangered Black Box Lignum Woodland EVC in the project area, where it will be established in the northern diversion channel. This location is appropriate as it will assist in controlling site drainage and also because this species requires periodic inundation. The locations of these sites will be consistent with naturally occurring black box woodlands in the area and its needs in terms of area, potential water depths and periods of inundation. Detailed surveying of the terrain will also be undertaken for the project area, and this will assist in determining the most appropriate locations of the wetlands, to ensure they will be of appropriate capacity. In contrast, indigenous species of the Ridged Plains Mallee EVC will be established in slightly elevated areas with a sandy soil profile. Existing patches of vegetation will be retained, where possible.

Alteration of Soil Diversity and Landform

While the landform and soil diversity will be altered as a result of mining, the landscape will be restored with the dunes and lunettes consolidated into fewer, larger areas. This should satisfy the farmers in the area, as some sandy rises will be removed, but there will still be enough variation to sustain diversified cropping.

Contamination of the Root Zone

While there is the potential for contamination of root zones, the careful management of topsoil (including deeper burial of boron- or carbonate-rich layers), subsoil and overburden will reduce the likelihood of boron or other toxic substances adversely effecting and impeding the success of revegetation.

Excessive Swelling and Settlement, and Impeded Drainage

Although some swelling of soils will occur (i.e., approximately 10%), this will be minimised by careful planning and mapping in the pre-mining stage, and managing soil and overburden in the mining stage, including replacement of material in mined areas. Adopting such steps will also reduce the impact of settlement.

Finally, the use of drainage lines and the diversion channel will ensure that there will be minimal impact to the flow regime upstream or downstream of the mine site (Supporting Study 10), and drainage will be unimpeded.

Increased Weed Density and Distribution

Increasing the density and distribution of weeds is unlikely, given that material will be stockpiled for at least 1 to 2 years, therefore reducing the viability of seeds. Quarterly site inspections focussing on weed invasion will also take place to ensure any spread of weeds is noted and remedial action undertaken.

Alteration to Native Vegetation

Although native vegetation will be removed as a result of mining, there will be no overall loss to the extent of vegetation. Instead, there will be a four-fold increase in the area of native vegetation within the project area over the long term. The quality, and continuity of the vegetation will be improved, providing a more beneficial environment for fauna. The original EVCs will also be reinstated where possible.

7 ENVIRONMENTAL MANAGEMENT FRAMEWORK

7.1 Leading Practice Environmental Management

DMS will manage the Donald Mineral Sands Project to minimise risks to the environment and to achieve the set environmental objectives. Consistent with the company's environmental policy (see Section 7.2) and its commitment to the local and broader community, the company will operate and manage the project according to the principles of the Leading Practice Sustainable Development Management Program for the Mining industry (Commonwealth of Australia, 2006).

The Leading Practice Sustainable Development Program for the Mining Industry will be consistent with Enduring Value, the Australian Minerals Industry Framework for Sustainable Development, and with the Ministerial Council on Mineral and Petroleum Resources Vision for the resources sector to 2025. This framework builds on the Australian Minerals Industry Code for Environmental Management, developed in 1996 (DIISR and DRET, 2007).

The Leading Practice Sustainable Development Program for the Mining Industry initially includes handbooks based on the following themes:

- Community Engagement and Development.
- Mine Rehabilitation.
- Mine Closure and Completion.
- Stewardship.
- Biodiversity.
- Managing Acid and Metalliferous Drainage.
- Tailings Management.
- Working with Indigenous Communities.
- Cyanide Management.
- Water Management.
- Hazardous Materials Management.
- Particulate, Noise and Blast Management.
- Monitoring, Auditing and Performance.
- Risk Assessment and Management.

Enduring Value - the Australian Minerals Industry Framework for Sustainable Development aims to:

- Align with global industry initiatives and, in particular, provides critical guidance on the International Council on Mining and Metals (ICMM) Sustainable Development Framework Principles and their application at the operational level.
- Provide a vehicle for industry differentiation and leadership, building reputational capital with the community, government and the finance and insurance sectors.
- Assist the industry to operate in a manner which is attuned to the expectations of the community, and which seeks to maximise the long-term benefits to society that can be achieved through the effective management of Australia's natural resources.

The principles of the Australian Minerals Industry Code for Environmental Management are shown in Table 7.1.

Table 7.1 Principles of Australian Minerals Industry Code for Environmental Management

Principle	Elements and Activities
Accepting environmental responsibility for all our actions	Driving environmentally responsible behaviour throughout the organisation by: • Demonstrating management commitment. • Allocating clear roles, responsibilities, accountabilities and resources. • Providing necessary information, performance targets, training, resources and management support.
Strengthening our relationships with the community	Engaging the community about the environmental performance of our operations by: • Fostering openness and dialogue with employees and the community. • Respecting cultural and heritage values and facilitating cross-cultural awareness and understanding. • Consulting with the community on the environmental consequences of our activities. • Anticipating and responding to community concerns, aspirations and values.
Integrating environmental management into the way we work	Ensuring environmental management and related social issues are high priorities by: • Establishing environmental management systems consistent with current standards. • Incorporating environmental and related social considerations into the business planning process along with conventional economic factors. • Applying risk management techniques on a site-specific basis to achieve sound environmental outcomes over the life of the project. • Developing contingency plans to address any residual risk. • Ensuring resources are adequate to implement the environmental plans during operations and closure.
Minimising environmental impacts of our activities	Responsibly managing immediate and longer-term impacts by: • Assessing environmental and related community effects before and during exploration and project development. • Evaluating risks and alternative exploration and mining project concepts, taking into account community views and subsequent land use options. • Adopting a proactive and cautious approach to environmental risks throughout the life of each operation. • Applying ecological principles that recognise the importance of biodiversity conservation. • Planning for closure in the feasibility and design phases of a project and regularly reviewing plans to consider changes in site conditions, technology and community expectations.
Encouraging responsible production and use of our products	Pursuing cost-effective cleaner production and product stewardship by: • Setting and regularly reviewing environmental performance objectives and targets that build upon regulatory requirements and reinforce policy commitments. • Employing production processes that are efficient in their consumption of energy, materials and natural resources. • Minimising wastes through recycling, and by reusing process residues. • Safely disposing of any residual wastes and process residues. • Promoting the safe use, handling, recycling and disposal of our products through an understanding of their life cycle.

Table 7.1 Principles of Australian Minerals Industry Code for Environmental Management (cont'd)

Principle	Elements and Activities
Continually improving our environmental performance	Continually seeking ways to improve our environmental performance by: • Setting and regularly reviewing environmental performance objectives and targets that build upon regulatory requirements and reinforce policy commitments. • Monitoring and verifying environmental performance against established criteria so that progress can be measured. • Benchmarking against industry performance and addressing changing external expectations. • Researching the environmental aspects of our processes and products and developing better practices and innovative technologies.
Communicating our environmental performance	Being open and transparent in the effective disclosure of our environmental performance by: • Identifying interested parties and their information needs. • Providing timely and relevant information including publication of annual public environment reports on our activities and environmental performance. • Encouraging external involvement in monitoring, reviewing and verifying our environmental performance. • Continually reviewing and evaluating the effectiveness of our communications.

7.2 Environmental Management Policy

DMS is in the process of preparing corporate policies for several key aspects of the business. These include Occupational Health and Safety (OHS), environment, cultural heritage and community relations. At the time of writing, these had not been finalised.

7.3 Environmental Management System

DMS will develop an Environmental Management System (EMS) based on the set of internationally coordinated standards for EMS developed by the International Organisation for Standardisation (ISO), under the ISO 14000 framework.

The EMS will outline systems and procedures for the regular internal and external review of environmental performance for which measurable indicators are identified to enable:

- Evaluation against clearly defined objectives and targets aimed at continually improving environmental performance.
- Compliance with legislation.

An EMS manager will hold the responsibility and authority to represent the company on all environmental matters.

The project EMS will be set out in a manual that outlines and consolidates:

- DMS's environmental policy.
- DMS's environmental planning requirements, objectives and targets.

- EMS implementation and operation, including structure, responsibility, training, communication, documentation, operational control and emergency preparedness and response.
- Checking and corrective action, including monitoring, measurement and auditing.
- An annual EMS review to assess the suitability, adequacy and effectiveness of the system, and determine whether any changes in procedure, method or philosophy are required to improve the system.

Through the EMS, all personnel will be made aware of their environmental obligations and held accountable for their actions.

7.4 Environmental Management Plan

The *Mineral Resources (Sustainable Development)* (MRSD) *Act 1990* requires that a licencee proposing to work under a mining licence must submit a work plan, including environmental management, for the project.

The MRSD Act requires that the work plan include a rehabilitation plan describing the progressive rehabilitation of land disturbed by the project. Under Schedule 13 of the Mineral Resources Development Regulations 2002 (Schedule 13 Regulations), the work plan for a mining licence greater than 5 ha (such as that sought for the Donald Mineral Sands Project) must also:

- Identify the key environmental issues for the project and develop proposals for the management of environmental impacts, including measures for the mitigation, control or reduction of impacts.
- Include proposals for the management of wastes, including consideration of the principles of waste minimisation.
- Include a proposed monitoring program addressing the key environmental issues.
- Include a proposal for reporting outcomes of the plan to the local community.

The work plan for the Donald Mineral Sands Project will describe the specific procedures required to manage the environmental issues identified for the DMS site and to achieve the objectives and targets of the EMS (see Section 7.3). The work plan will comply with the requirements of the MRSD Act, Schedule 13 Regulations and be consistent with the document Guidelines for Environmental Management in Exploration and Mining 3: Rehabilitation Plans and other Environmental Aspects of Work Plans (DPI, 2004b).

DMS will also develop an Occupational Health and Safety Plan as required under Schedule 13 Regulations that demonstrates that the works are designed and operated so as to be safe and without risks to health.

The general scope of the proposed work plan is outlined in Table 7.2. The detail of the plan will include the steps required to meet all environmental commitments and conditions, and to implement all mitigation measures contained in this report (summarised in Section 7.5).

Table 7.2 Scope of environmental aspects of the Work Plan

Issue	Scope of Management and Monitoring
Land Management	• Handling of excavated material. • Erosion prevention. • Landform contouring.
Water Management	• Process water requirements. • Segregation of fresh and saline water processes. • Bunding of tailing storages. • Use of clean water diversions. • Installation of silt fencing. • Monitoring of ground and surface waters.
Flora and Fauna Protection	• Assessment of pre- and post-mining flora and fauna. • Provision of habitat corridors and protection of islands. • Weed management. • Monitoring of flora and fauna (including weeds).
Noise	• Measures to reduce noise at source and/or receptor. • Measures to reduce machinery noise generation. • Noise monitoring.
Air	• Watering of haul roads to reduce dust emissions. • Treatment of stockpiles and other exposed areas to reduce dust. • Ambient dust monitoring.
Transport	• Movement of trucks and other vehicles on local roads and mine access roads. • Upgrading of roads and intersections. • Road diversions. • Road safety. • Use of rail network (if required).
Waste Management	• Bunding of hydrocarbon storage areas. • Deposition of tailing to maximise drying and minimise contouring. • Handling and removal of effluent and domestic waste. • Hydrocarbon handling and disposal program. • Monitoring to detect escape of any contaminants.
Conservation	• Adopting a minimum disturbance philosophy. • Using an ecological approach to rehabilitation. • Preservation of significant areas including heritage and archaeological sites.
Rehabilitation	• Designated end use for disturbed areas. • Progressive rehabilitation program. • Proposed site decommissioning. • Monitoring of rehabilitation.
Safety Management	• Manage the risk of fire associated with site operation and identification of fire risk minimisation strategies, and fire management plans.

The management plan will also include a detailed outline of DMS's environmental monitoring program. The monitoring program will be designed to detect if the environmental impacts of the project are as predicted, if mitigation measures are effective and if compliance is being achieved with applicable

guidelines and standards. In particular, the monitoring program will outline the measurement of the environmental performance indicators identified in the EMS.

DMS will brief the project Environmental Review Committee (see Section 7.6) on any proposed new work to ensure their understanding before any work starts.

7.4.1 Environmental Monitoring Program

Table 7.3 provides initial information on the proposed environmental monitoring program, with greater detail to be presented in the project work plan. The locations of the monitoring sites will be determined following consultation with the DPI and the EPA.

7.5 Environmental Commitments

The environmental commitments and mitigation measures made by DMS for the Donald Mineral Sands Project are summarised in Table 7.4.

Table 7.3 Conceptual environmental management plan

Subject	Location	Monitoring Frequency	Measurement	Comments
Air Quality				
Dust deposition gauges	Up-gradient and down-gradient of the project area.	Monthly.	$g/m^2/m$.	Annually reporting these results to the public and relevant authorities. Monitored in accordance with DPEMMEI (EPA, 2006) and in consultation with EPA and DPI.
Wind erosion	Entire site.	Event based.	Visual assessment.	Annually reporting these results to the public and relevant authorities.
Weather station	A clear and elevated location close to the pit.	Continual.	Wind speed, wind direction, temperature, humidity and rainfall.	Annually reporting these results to the public and relevant authorities.
Greenhouse Gases				
Greenhouse gas emission calculation	Entire site.	Annually.	Fuel and electricity usage inventory.	
Operating efficiency	Entire site.	Annually.	Consumption rates of diesel-fuelled equipment.	
Cultural Heritage				
Artefacts	Entire disturbance area.	Progressive with site preparation.	Visual assessment.	
Landscape Characteristics				
Topography	Entire disturbance area.	As required (approximately monthly).	Grid survey control.	Detailed survey will feed into rehabilitation and mine planning.
Vegetation	Entire disturbance area.	Progressive assessment.	Transect or quadrat surveys.	Preliminary baseline completed.
Roads, Traffic and Transport				
Roads in the project areas and surrounds	Roads to be monitored and maintained to cater for additional traffic will be identified in coordination with relevant councils.	Monthly over the first 18 months following construction to establish which, if any, roads need to be upgraded.	Visual assessment of condition and traffic counts to determine usage pattern.	

Table 7.3 Conceptual environmental management plan (cont'd)

Subject	Location	Monitoring Frequency	Measurement	Comments
Social and Economic				
Community	Complaints register.	Weekly.	Number of community complaints and how they are addressed.	All complaints will receive at least an initial response within 24 hours.
Noise				
Machinery, residential, OHS	To be determined in consultation with DPI and EPA.	To be determined in consultation with DPI and EPA.	Sound pressure levels.	Tenders will set equipment noise specifications.
Radiation				
Ground surface	Entire disturbance area.	Progressive with site preparation and rehabilitation.	Scintillometer grid survey (gamma).	Baseline surface soil already undertaken in trial pit.
Orebody and tailing	Mine pit.	Progressive with operations.	Scintillometer grid survey (gamma).	
Groundwater	Sampling bores around the project area.	Half yearly.	Groundwater from monitoring bores.	Baseline sampling already conducted.
Mineral concentrate	Stockpile sites.	As required.	Scintillometer grid survey (gamma).	
Dust	Air sampling sites.	Baseline and quarterly.	Radionuclides.	Subject to review.
Soil				
Stockpile condition (height, vegetation and drainage)	Entire site.	Annual review.	Field survey.	

Table 7.3 Conceptual environmental management plan (cont'd)

Subject	Location	Monitoring Frequency	Measurement	Comments
Water Management				
Groundwater: • Regional water table	Sites to be determined.	Monthly.	Level, EC, pH.	Bores are already in place. Monitor end mining +3 yrs.
• Operational bores	Adjacent and within the mine pits.	Quarterly/annually.	Level, EC, pH.	Following rehabilitation, levels within the monitoring bores will be recorded. Observation bores will be installed and screened just above the fines tailing layer following rehabilitation. Quarterly monitoring to be undertaken in the closest two monitoring bores to the operating mine and yearly salinity monitoring will be conducted in the remaining monitoring bores.
Surface water: • Process water	Project area.	Daily.	EC, volume, pH.	
• Make-up water*	Supply point.	Daily.	EC, volume, pH.	Predicted EC levels to be confirmed by monitoring.
• Ephemeral streams	Entire disturbance area.	Event based.	EC, pH.	
Rehabilitation				
Vegetation	Viewer locations.	As required (approximately 6 monthly).	Visual assessment of plant health and replacement plantings if necessary.	As above.

*Make-up water potentially from GWMWater distribution system or Avon Deep Lead. Note: Level = Groundwater table level (AHD metres), EC = Electrical conductivity (mS/cm).

Table 7.4 Environmental commitments and mitigation measures

Reference	Commitment or Mitigation Measure
CHAPTER 4: PROJECT DESCRIPTION	
Mining Method	
4.5.1/4.5.3 /4.12	Rehabilitation of the land surface will follow the mining operation closely, thus limiting the extent of area disturbed at any one time.
4.5.5	Topsoil, subsoil and overburden will be separately stripped and stockpiled for later backfilling of the mine pit.
4.5.5	Stripped material will only be stockpiled on material similar to itself.
4.6.4	All concentrate stockpiles will be formed on constructed pads to avoid contamination and to allow for ease of loading.
4.6.4	The HMC will be covered to prevent any loss of material during transportation.
4.7.3	Haul roads will be constructed using overburden and local materials.
Infrastructure and Services	
4.4.2	Signage will be placed in the appropriate position on local roads for the duration of construction and mining operations.
4.5.4	Water will be used on access roads to suppress dust.
4.7.2	Sewage will be collected in a tank for removal and disposal off site by an approved contractor who will be required to comply with local government statutory requirements.
4.7.3	Mine access roads will be constructed adjacent to the pit.
4.7.3	DMS will assess road usage pattern and upgrade roads as necessary. These are expected to be Burrum–Lawler Road and Banyena–Pimpinio Road. The roads will be upgraded to the standard of the existing sealed roads.
4.7.4	The machinery wash-down bay will be fitted with grease traps, oily water separator and water recycling facility.
4.9.3	Safe storage will be provided at the site for diesel fuel. The fuel storage area will be arranged to comply with Australian Standards.
4.11.3	The premises will be signposted and a 24 hour security watch will operate. All visitors to the mine site and separation plant will have to be accompanied by a company employee at all times.
Safety Management	
4.9.2	Transportation of dangerous materials will be carried out in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail (FORS, 1998).
4.9.3, 4.11.2	DMS's handling and management of dangerous materials will comply with the relevant statutory requirements. The company will seek the advice of the appropriate authority where necessary. This will include identification of fire risk minimisation strategies, and fire management plans.
4.11.2	DMS will develop an Occupational Health and Safety Management Plan as well as an Environmental Management Plan (which will incorporate a Fire Management Plan).
4.11.2	DMS will ensure that a safe 'zero harm' culture is promoted on site.
4.11.3	DMS employees will undergo an induction tailored to their role on site, including cultural heritage, quality assurance, safety and environment, hydrocarbon spillage management, incident reporting systems and waste management.

Table 7.4 Environmental commitments and mitigation measures (cont'd)

Reference	Commitment or Mitigation Measure
CHAPTER 6: ENVIRONMENTAL IMPACT ASSESSMENT	
Surface Water and Water Supply	
6.1.3	All water in the pit or landing or constructed surfaces (roads, stockpiles, TSF and plant area) will be considered as 'dirty' and either added to the process water system or treated and used for dust suppression, if suitable.
6.1.3	'Clean' water will be diverted around the mine area by either existing drainage lines or purpose-built, temporary diversions. Diversion bunds will be designed to divert overland flow away from the active mine cells, to approximate natural flow regimes and to ensure runoff in the project area is contained during high rainfall events.
6.1.3	Settlement ponds will be constructed to capture runoff from stockpiles and rainfall that is pumped out of the mine pit, if not used for processing.
6.1.3	Flooding of mine pits will be avoided by installing flood levees around working areas to at least a 1% annual exceedence probability (AEP).
6.1.3	Measures to ensure the potential for a discharge of saline water, due to a break in the pipeline, does not occur will be investigated once a water supply source is secured (and the need for a pipeline is assured).
6.1.3	DMS will ensure adjacent lands will receive continued access to the stock and domestic water supply system.
6.1.3	Strategic route selection for the project water supply pipeline will ensure that sensitive areas are avoided where possible.
6.1.3	Rehabilitation will be designed to ensure the potential for erosion due to the elevated surface level is minimised.
Groundwater	
6.2.3	A groundwater monitoring program has been established to monitor groundwater levels and quality. This program will continue during operations and following mine closure.
6.2.3	Locations of overburden stockpiles (saline and non-saline) will be tracked to ensure the return of saline overburden to the mine pits is conducted such that the depth between the saline overburden from the surface is no less than the initial depth prior to operations.
Habitat and Biodiversity	
6.3.4	An offset management plan will be created in consultation with DSE once the mine plan has been finalised to ensure a net gain of native vegetation.
6.3.4	The offset management plan will adhere to the following principles: existing remnants and sites where threatened species are present will be protected and/or avoided in preference to clearing; where possible, large old trees will be retained and where this is not possible, clearance will include stockpiling logs for revegetation activities; appropriately sized buffers will be placed around remnants within the mining area; offsets will be designed to enhance, enlarge and link remnants where possible, and to recreate the range of local EVCs occurring at the site; and measures will be undertaken to support the persistence of threatened flora and fauna in the landscape.
6.3.4	A co-operative approach (with GWMWater) to the management of growling grass frog populations in the project area.

Table 7.4 Environmental commitments and mitigation measures (cont'd)

Reference	Commitment or Mitigation Measure
Habitat and Biodiversity (cont'd)	
6.3.3	Salvage of hollow-dependent fauna and relocation measures will be implemented immediately prior to and during any clearance of hollow-bearing trees in the project area.
6.3.4	Weed management plan will be implemented to address pre-mining identification of weeds, minimising the disturbance footprint and machinery clean-down procedures in accordance with DPI guidelines on weed hygiene.
6.3.4	Prior to mine construction a further vegetation survey will be undertaken to provide a comprehensive list of species in the project area.
6.3.4	Mature trees in the pipeline zone of supply will not be removed.
6.3.3	Vegetation survey of potential pipeline routes will be undertaken prior to route finalisation.
6.3.4	Salvage of hollow-dependent fauna and relocation measures will be implemented immediately prior to and during any clearance of hollow-bearing trees in the project area in accordance with the fauna relocation plan. Relocation sites will be predetermined and chosen on their suitability for hosting hollow-dependent species.
Air Quality	
6.4.4	Ore will be processed as a slurry.
6.4.4	Water or dust suppressants will be used on trafficked areas (i.e., internal haul roads), exposed surfaces and similar to reduce emissions.
6.4.4	Roads will be maintained to minimise wind erosion.
6.4.4	Speed limit will apply on internal mine roads.
6.4.4	Signage will be used to ensure traffic is kept to designated roadways.
6.4.4	HMC will be transported in covered trucks.
6.4.4	Final surfaces will be progressively rehabilitated as they become available.
6.4.4	Revegetation of all overburden stockpiles will be prompt.
6.4.4	Vegetated earth bunds will be established around the processing plant and along selected sections of haul roads to reduce from wind erosion.
6.4.4	Conveyors at the processing plant will be enclosed.
6.4.4	Conveyor transfer points will be covered. Product stockpiles will be enclosed at the rail siding.
6.4.4	Slurry pumping will be used to transport ore from the pit to the processing plant.
6.4.4	Fitting machinery with the appropriate emission control equipment and maintaining and servicing them frequently.
6.4.2	DMS will monitor air quality in accordance with the DPEMMEI and in consultation with the EPA and DPI.
Greenhouse Gases	
6.5.4	Policies and procedures will be developed and applied for energy-efficient mine operation.
6.5.4	Haul distances will be minimised and the use of haul trucks by pumping ROM ore directly from the pit to the processing plant.

Table 7.4 Environmental commitments and mitigation measures (cont'd)

Reference	Commitment or Mitigation Measure
Greenhouse Gases (cont'd)	
6.5.4	Energy consumption (e.g., diesel and electricity) will be monitored and greenhouse gas emissions will be calculated.
6.5.4	Economically viable opportunities for improvement will be identified and assessed.
6.5.4	The use of alternative fuels (e.g., biodiesel) and technologies will be considered.
6.5.2	DMS will annually document the following as required by The Protocol for Environmental Management - Greenhouse Gas Emissions and Energy Efficiency in Industry (EPA, 2002): • An energy consumption estimate. • A direct greenhouse gas emissions estimate. • The mitigation measures required to reduce greenhouse gas emissions.
6.5.4	Vehicles (company-owned and contractors) will be well maintained and correctly sized to maximise their fuel efficiency and minimise emissions.
6.5.4	Vehicle idling time will be minimised.
6.5.4	The use of renewable energy technologies (e.g., wind, solar and biomass) when sourcing electricity from the grid will be considered.
Noise	
6.6.3	If the container transfer method is used at the northern rail siding option, barriers such as shipping containers will be installed in order to meet N3/89 guidelines at the closest residential receiver. If the bulk handling method is used, the following mitigation measures will be implemented to ensure N3/89 guidelines are not exceeded at either location: • Noise barriers of materials such as earth, wood, hay bales or shipping containers. • Acoustic shrouds over the main conveyor drive system. • Upgrades to the metal clad building.
6.6.3	Noise management measures to be implemented depend on negotiations between DMS and the individual residents but could include: • Building upgrades (though not strictly in accordance with the provisions of the EPA guidelines). • Temporary relocation of some residents. • Relocation or delay works in a particular area to minimise noise emissions, in response to complaints. • Selective construction activities during night time periods to ensure inaudibility at receivers.
Visual	
6.8.4	Areas around the WCP will be mounded and vegetated.
6.8.4	Sections of the mining licence area perimeter adjacent to sensitive viewing locations will be vegetated to provide screening that ameliorates views.
6.8.4	Buildings will be clad with non-reflective materials of a colour that mimics those found in the Wimmera landscape, e.g., bluish/olive greens or greys.
6.8.4	At affected residences, planting and/or mounding will be undertaken as soon as possible. This process will be subject to consultation with the occupants, as the establishment of a foreground visual screen may be perceived to be as much of a visual impact as the project itself.

Table 7.4 Environmental commitments and mitigation measures (cont'd)

Reference	Commitment or Mitigation Measure
Visual (cont'd)	
6.8.4	Where possible, soils will be put back in their original location to maintain soil profiles and avoid surface colour contrast created by lighter subsoils and clays.
6.8.4	Regular slopes and sharp transition angles will be varied and rounded to provide a more natural appearance. Areas of replaced indigenous vegetation, such as road reserves, will use indigenous species of local provenance to ensure consistency of colour and texture.
6.8.4	Where possible, the operations will be staged so that activities do not occur on the outer faces of overburden stockpiles, or areas directly visible from nearby adjacent residences at night. Where possible, shielding of fixed or stationary light sources will be used to reduce light spill.
6.8.4	Final landform shaping and vegetation restoration of the reinstated pits will reinforce and mimic, where possible, other existing elements within the landscape, including the slightly undulating form of the agricultural landscape.
Roads, Traffic and Transport	
6.9.3	Minimum road pavements standards, as requested by the Yarriambiack Shire Council, will be implemented on the haul road.
6.9.3	A traffic monitoring program will be developed and implemented in conjunction with the relevant councils.
6.9.3	Intersections will be treated to ensure that safe and efficient access is available for vehicles entering and exiting the site with minimal impacts on through traffic.
6.9.3	All intersections within the project area, and those located on the haul route will be designed and constructed to accommodate the full turning movements of heavy vehicles, and treated appropriately if required.
6.9.3	If necessary, road upgrades to council requirements will be undertaken.
6.9.3	A Traffic Management Plan will be developed for the project in consultation with relevant councils and emergency services.
6.9.3	Road closures will be facilitated by the relevant council in conjunction with DSE in accordance with the *Local Government Act 1989*.
6.9.3	Over-dimensional loads will be transferred in accordance with VicRoads and/or council requirements and, if necessary, will include escorts to lift power lines. Over-dimensional loads will be transported during times of the day specified by VicRoads. The most appropriate route for over-dimensional loads will be determined in consultation with VicRoads once actual delivery details are known.
6.9.3	In the event that a road upgrade results in the decommissioning of an existing bus stop, the stop will be reinstated as a sealed wayside bus stop supplemented with appropriate signage.
6.3.4	Flora and fauna will be considered during haul route selection. An appropriately qualified consultant will be engaged to assess any potential impacts on flora and fauna prior to the onset of operations.
6.9.3	Road safety rules and procedures will be enforced for all employees and contractors during construction and operations.
6.9.3	Detailed pavement design will be undertaken by a suitably qualified practitioner to ensure the functional design of the pavement uses the appropriate wearing course materials and optimises longevity and utility of the pavement.

Table 7.4 Environmental commitments and mitigation measures (cont'd)

Reference	Commitment or Mitigation Measure
Cultural Heritage	
6.10.3	Following the conclusion of the EES process, further fieldwork will be undertaken and a CHMP will be prepared in accordance with the Aboriginal Heritage Act and the Aboriginal Heritage Regulations.
6.10.3	Several cultural heritage sites (Aboriginal and non-Aboriginal) will be avoided.
6.10.3	Markers and signs, along with fencing during construction and operations, will be used to clearly identify 'no go zones'. Maps will be provided to mine personnel showing physical barriers and 'no go zones' marked clearly.
6.10.3	All contractors and subcontractors will participate in site-specific induction to ensure that they are aware of the general location of historic sites, the type of historic material they may encounter and procedural requirements in the event of suspected cultural material being discovered.
6.10.3	If suspected non-Aboriginal historic material is located during development activities, all works within a specified distance will cease until an archaeologist has undertaken archaeological assessment of the area.
6.10.3	A 50 m buffer zone from sites Aboriginal sites 45 and 46 will be incorporated into design of TSF-1.
Land Use and Infrastructure Planning	
6.11.3	DMS will comply with all relevant statutory requirements including Dangerous Goods (Storage and Handling) (2002), Australian Standard 1940- The Storage and Handling of Flammable and Combustible Liquids (1993) and Material Safety Data Sheets. When necessary, DMS will seek advice from appropriate authorities.
6.11.3	Spill response procedures will be prepared.
6.11.3	Construction material and vehicles brought to site and will be inspected to ensure it is clean (free from weeds, leaking hydrocarbons, metals and excessive dust).
6.11.3	Site personnel will receive appropriate training including environmental awareness.
6.11.3	Soils will be assessed prior to mine closure for contamination and appropriate remediation measures taken where necessary.
6.11.3	DMS will minimise disruption to agricultural activities, compensation and details relating to final landform and land uses.
6.11.3	Progressive rehabilitation will be undertaken during mining so that the area removed from of agricultural production is at its practicable minimum at any given time.
Socio-economic Issues	
6.12.3	If possible and desired by affected landholders, landholders will be re-housed within the local area.
6.12.3	Information relating to local events will be placed on company notice boards etc.
6.12.3	Initiatives that encourage mine employees to participate in community initiatives such as the CFA and sports clubs will be developed.
6.12.3	Participation in corporate sponsorship of local events and organisations (already occurring) will be undertaken.

Table 7.4 Environmental commitments and mitigation measures (cont'd)

Reference	Commitment or Mitigation Measure
Socio-economic Issues (cont'd)	
6.12.3	Implementation of staff retention programs so that mine staff remain in the local area for as long as possible.
6.12.3	Training and skill requirements will be discussed with the local registered training organisations including the TAFE, local schools and VET providers to maximise ongoing local employment.
6.12.3	Supplier briefings will be held so that local businesses have a better opportunity of doing business with the mine.
6.12.3	Vocational training opportunities, such as work experience programs, in collaboration with the local high schools, will be facilitated.
6.12.3	Mine personnel will be trained in first aid.
6.12.3	Implementation of occupational health and safety management plan.
6.12.3	Local schools will be made aware of potential increases of school age children so that business cases can be prepared to gain extra funding if necessary.
6.12.3	Liaison with the community to ensure they are aware of any planned interruptions to services (e.g., water and electricity).
6.12.3	Interruptions to services will be minimised.
6.12.3	On-going community consultation will be undertaken.
6.12.3	In coordination with both government and private healthcare providers, information on impacts (including through the EES) to the community will be provided.
6.12.3	Frequent and ongoing consultation with landholders will be undertaken within the project area to provide as much information as possible to minimise uncertainty. Agreements with landholders will be developed which will include: • Measures to be undertaken by DMS to minimise disruption to agricultural activities. • Compensation. • Details relating to final landform and land uses.
6.12.3	Project information will be provided to the community in a timely manner.
Soils	
6.13.3	Detailed sampling and assay of soil and overburden will be undertaken during pre-mine drilling.
6.13.3	All soil types will be mapped, with particular emphasis on sandy rises (including volumes) and other components of the Donald system to ensure appropriate collection, stockpiling and reuse.
6.13.3	Interpreted sampling and assay data will be included in mine planning.
6.13.3	Detailed stripping and stockpiling plans covering all affected areas will be prepared.
6.13.3	Soil will be handled precisely using a scoop, elevating scraper or by windrowing.
6.13.3	Initial overburden, topsoil and subsoil (from the first 12 months of operation) will be stockpiled separately to reduce erosion, damage to soil structure and biota, and leaching of nutrients. Topsoil and subsoil will be revegetated as necessary.

Table 7.4 Environmental commitments and mitigation measures (cont'd)

Reference	Commitment or Mitigation Measure
Soils (cont'd)	
6.13.3	Stockpiles of topsoil will remain less than 2 m high.
6.13.3	Soil will be handled when moist, not wet or dry.
6.13.3	Stockpiles will be vegetated to control erosion with appropriate species reflecting rehabilitation objectives.
6.13.3	Stockpiles will be appropriately located and the footprint area stripped of topsoil or subsoil if necessary.
6.13.3	Handling soils of the Donald landform when the soil is dry and weather windy will be avoided to reduce impacts from wind erosion.
6.13.3	Drainage from stockpiles, haul roads and other disturbed areas will be contained away from stockpiles.
6.13.3	Soil units will be placed carefully during rehabilitation.
6.13.3	Topsoil and subsoil will be replaced in late autumn/early winter.
6.13.3	Soils will be sown with a cover crop immediately after replacement to reduce wind erosion.
6.13.3	Appropriate species such as native grasses and acacia will be used for initial stockpile (including overburden stockpile) revegetation to avoid erosion.
6.13.3	Mining will not penetrate the Geera Clay.
6.13.3	Soil pH will be monitored to ensure alkaline conditions remain.
Rehabilitation	
6.14.3	The proposed rehabilitation method will: • Re-establish some of the larger dunes. These may not necessarily be in the original locations. • Eliminate small dunes and lake-lunette complexes, burying sand below subsoil in Murra Warra or Kalkee clay soil areas, leaving a clay plain. • Establish several wetland areas for flood control. The strategy involves rehabilitation of large areas across a number of farms and also the establishment of drainage lines, wetlands and vegetation zones. In order to effectively manage this process, DMS propose to purchase the affected farms so that a project-wide approach can be applied.
6.14.3	Topsoil and subsoil stockpiles will be protected from wind and water erosion by ensuring they are less than 2 m and 5 m in height respectively, and are vegetated using local EVC species for native topsoils and sterile species.
6.14.3	DMS will consult with interested groups such as Landcare and Greening Australia to ensure they have an opportunity to provide input into the native vegetation offset plan.
6.14.3	Overburden will be monitored to determine whether it is saline (from close to or below the water table) or non-saline. The thickness of non-saline overburden will be recorded at each location. Saline overburden will be returned to the mine void and at each location will be covered with non-saline overburden of at least the original thickness.
6.14.3	Gypsum will be applied in accordance with the results of field trials.
6.14.3	Once the subsoil and topsoil has been replaced into the pit, a crop or pasture will be sown as soon as possible.

Table 7.4 Environmental commitments and mitigation measures (cont'd)

Reference	Commitment or Mitigation Measure
Rehabilitation (cont'd)	
6.14.3	The TSF will be rehabilitated by reducing the bund, spreading subsoil on subsoil, and ripping and planting with native species.
6.14.3	All propagules will be sourced from within the project area or the immediate surroundings. Stockpile plantings may also be used as 'seed orchards'.
6.14.3	Buloke mistletoe will be re-established onto young, established buloke, a few years after initial rehabilitation works.
6.14.3	Quarterly site inspections, with a focus on erosion, weed invasion, vermin and vandalism, crop and pasture establishment and development will be undertaken. After 18 months to 2 years, a survey of vegetation establishment, agricultural production and diversity, erosion and any other soil factors including drainage will be undertaken. After this time, half-yearly inspections will be carried out instead of quarterly inspections. Two years after the first formal inspection, a more thorough survey of flora and fauna will be done.
6.14.3	An approximation of the landscape will be restored, by consolidating dunes and lunettes into fewer, larger areas. Slightly elevated areas will be reconstructed with a sandy soil profile.
6.14.3	Detailed soil mapping will be taken to identify the salt and boron rich intervals before mining commences Subsoil will be stripped from areas intended for overburden if high levels of boron or toxic substances are identified.
6.14.3	The principle of stockpiling topsoil on topsoil, subsoil on subsoil stripped of topsoil and overburden stockpiled on areas stripped of topsoil and subsoil will be adopted to further minimise the likelihood of contamination.
6.14.3	Detailed surveying of the project area will occur prior to mining to assist in planning drainage, so that drainage is not impeded by mining activities.
6.14.3	As there is a natural depression within the mine site, this will be used for the diversion. Where the mine path intersects this depression, the flow that would normally drain along this depression will be diverted by the channel, which will be created in the first few years of mine development.
6.14.3	One or more wetlands will be created to assist in controlling drainage, and the swelling that is likely to occur will be managed to ensure water movement in times of heavy rainfall will not be impeded.
6.14.3	Detailed stripping plans and stockpiling plans will be prepared during pre-mining phase.
6.14.3	Where large trees containing hollows have been removed, the logs will be stockpiled and placed in the ground in areas that are revegetated to assist in providing a faster habitat benefit.
CHAPTER 7: ENVIRONMENTAL MANAGEMENT	
Leading Practice Sustainable Development Program for the Mining Industry	
7.1	DMS will become a signatory to Leading Practice Sustainable Development Program for the Mining Industry, which is consistent with Enduring value - Australian Minerals Industry Framework for Sustainable Development.

Table 7.4 Environmental commitments and mitigation measures (cont'd)

Reference	Commitment or Mitigation Measure
Environmental Management System	
7.3	DMS will adopt an Environmental Management System based on the set of internationally coordinated standards for EMS developed by the International Organisation for Standardisation (ISO), under the ISO 14000 framework.
Work Plan	
7.4	DMS will develop a work plan, which will include a rehabilitation and environmental management plans, including monitoring.
7.6	DMS will discuss project works with the Environmental Review Committee before work commences.
Environmental Review Committee	
7.6	An Environmental Review Committee (ERC) will be established to advise on the environmental management and monitoring of the mine and provide a forum for local community input into the environmental management of the mine.

7.6 Environmental Review Committee

It is expected that an Environmental Review Committee (ERC) will be established to advise on the environmental management and monitoring of the mine as part of the mining licence conditions for the project. The ERC will have an important role in the environmental management of the Donald Mineral Sands Project, by providing a forum for local community input into the environmental management of the mine. It will also facilitate the review of DMS's monitoring programs.

ERCs have been in operation for a number of Victorian mining operations since the late 1980s. More recently, a review of ERCs process discusses the function, structure and operation of ERCs (DPI, 2007). The core membership of an ERC includes the District Manager and a Regulation/Environmental Officer from DPI Minerals and Petroleum Division, company representatives, community representatives, local council and Crown land manager, as well as other government advisory bodies such as the EPA.

ERCs usually comprise between two to three community representatives. Community representatives can be determined by several means including nominations by Council, responses to advertisements in the local papers, and nominations at public meetings. The latter approach has proved most successful to date.

The main objectives of the ERC are to:

- Monitor the operator's compliance with the environmental management program established for the mine.
- Provide feedback to stakeholders on any environmental problems associated with the mining operation.
- Facilitate commitment in the various agencies to providing the necessary approvals to allow the project to proceed as expeditiously as possible.
- Provide a forum where the proponent can initiate discussion/negotiation on appropriate licence or permit conditions or other approvals.

ERCs also provide a forum for the operator to discuss and seek advice on the management of any complaints received concerning the operation and to discuss and seek advice regarding any proposed new work prior to formally informing the local community and regulators. It is expected that meetings will be held every 2 months for the first 6 months of project commissioning but less frequently from then on if agreed by majority vote.

8 REFERENCES

8.1 Publications

ABS. 2006. 2001 Census Data by Product Type. A WWW publication accessed in October 2006 at http://www8.abs.gov.au/ABSNavigation/prenav/ProductSelect?newproducttype=Community+Profiles&btnSelectProduct=Select+Location+%3E&areacode=&geography=&method=&productlabel=&producttype=&navmapdisplayed=true&javascript=true&breadcrumb=P&topholder=0&leftholder=0&currentaction=201&action=104&textversion=false. Australian Bureau of Statistics.

ABS. 2007a. 2006 Census Data by Product Type. A WWW publication accessed in September 2007 at http://www8.abs.gov.au/ABSNavigation/prenav/ProductSelect?newproducttype=Community+Profiles&btnSelectProduct=Select+Location+%3E&areacode=&geography=&method=&productlabel=&producttype=&navmapdisplayed=true&javascript=true&breadcrumb=P&topholder=0&leftholder=0&currentaction=201&action=104&textversion=false. Australian Bureau of Statistics.

ABS. 2007b. 2006 Census Data by Location. A WWW publication accessed in July 2007 at http://www.censusdata.abs.gov.au/ABSNavigation/prenav/SelectLocationOrTopic?viewBySelection=View+Census+Tables+by+Location&nextButton=Next+%3E&collection=Census&period=2006&areacode=&geography=&method=&productlabel=&producttype=Census+Tables&topic=&navmapdisplayed=true&javascript=true&breadcrumb=PO&topholder=0&leftholder=0&currentaction=601&action=104&textversion=false. Australian Bureau of Statistics.

AGO. 2006. National Greenhouse Gas Inventory 2004. Prepared by Australian Greenhouse Office, Canberra.

AGO. 2007. Media Release: Australia Steadies Greenhouse Emissions in 2005. A WWW publication accessed in June 2007 at http://www.environment.gov.au/minister/env/2007/pubs/mr02may207.pdf. Prepared by Australian Greenhouse Office.

ARPANSA. 2005. Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing. Radiation Protection Series No. 9. Australian Government. Australian Radiation Protection and Nuclear Safety Agency.

ARPANSA. 2008. Code of Practice. Safe Transport of Radioactive Material. Radiation Protection Series No. 2. Australian Radiation Protection and Nuclear Safety Agency. Australian Government.

AS. 1940-2004. The storage and handling of flammable and combustible liquids. Standards Australia Limited. SAI Global Limited.

BOM. 2007. Climate statistics for Australian locations. Monthly climate statistics. Donald. A www publication accessed on 29 March 2007 at http://www.bom.gov.au/climate/averages/tables/cw_078072_All.shtml.

Commonwealth of Australia. 2004. Guidance on the Use of Rainwater Tanks. Prepared by the Australian Government.

Commonwealth of Australia. 2006. Leading Practice Sustainable Development Program for the Mining Industry. October. Resources Division, Department of Industry, Tourism and Resources, Canberra.

DEH. 1992. National Strategy for Ecologically Sustainable Development (NSESD). A WWW publication accessed on 10 October 2007 at http://www.environment.gov.au/esd/national/nsesd/strategy /index.html.

DEH. 2001. National Framework for the Management and Monitoring of Australia's Native Vegetation. A WWW publication accessed on 24 July at http://www.environment.gov.au/land/publications/ nvf/index.html. Prepared by Department of Environment and Heritage.

DEH. 2006. EPBC Act Policy Statement 1.1. Significant Impact Guidelines. Matters of National Environmental Significance. A WWW publication accessed on 20 December 2007 at http://www. environment.gov.au/epbc/publications/nes-guidelines.html. Prepared by the Department of Environment and Heritage.

DEW. 1998. National Greenhouse Strategy: Strategic Framework for Advancing Australia's Greenhouse Response, Canberra. A WWW publication accessed on 24 July at http://www.greenhouse.gov.au/ government/ngs/index.html. Prepared by Department of the Environment and Water Resources.

DEW. 2007. Buloke grassy woodlands. A WWW publication accessed on 6 December 2007 at http:// www.environment.gov.au/biodiversity/threatened/communities/buloke-grassy-woodlands.htmlsummary-references on 6 December 2007.

DIISR and DRET. 2007. Leading Practice Sustainable Development Program for the Mining Industry. A WWW publication accessed on 9 January 2008 at http://www.industry.gov.au/content/itrinternet/ cmscontent.cfm?objectID=91159894-AA63-72C7-B69D0E808FE48D8A. Prepared by the Department of Innovation, Industry, Science and Research/Department of Industry, Tourism and Resource.

DNRE. 2002. Victoria's Native Vegetation Management: A Framework for Action. Prepared by Department of Natural Resources and Environment, Victoria.

Donald Tourism Association. 2007. Donald Business Directory. A WWW publication accessed on 1 November 2007 at www.donald.org.au.

DOTARS. 2004. Auslink White Paper. Prepared by Department of Transport and Regional Services, Canberra, ACT.

DPI. 2004a. Environmental Guidelines, Management of Tailing Storage Facilities. Prepared by Minerals & Petroleum Division, Victorian Department of Primary Industries.

DPI. 2004b. Guidelines for Environmental Management in Exploration and Mining 3. Rehabilitation Plans and Other Environmental Aspects of Work Plans. July. Prepared by Mineral and Petroleum Division, Victorian Department of Primary Industries.

DPI. 2006. Agriculture Notes. Biosecurity Guidelines for Movement of Equipment Contractors between farms. AG1171. ISSN 1329-8062. June. Prepared by Hugh Millar of Department of Primary Industries.

DPI. 2007. Review of Environmental Review Committees. Discussion paper on the function, structure, and operation of environmental review committees. September. Prepared by Department of Primary Industries.

DSE. 2007a. Ecological Vegetation Class (EVC) Benchmarks for each bioregion. A WWW publication accessed at http://www.dpi.vic.gov.au/dse/nrence.nsf/LinkView/43FE7DF24A1447D9CA256EE6007 EA8788062D358172E420C4A256DEA0012F71C accessed on 7 December 2007.

DSE. 2007b. Planning Schemes Online. A WWW publication accessed in September 2007 at http:// www.dse.vic.gov.au/planningschemes. Prepared by the Department of Sustainability and Environment, Victoria.

DSE. 2004a. Native Vegetation: sustaining a living landscape. Vegetation Quality Assessment Manual - Guidelines for applying the habitat hectares scoring method. A DSE publication accessed at http://www.dpi.vic.gov.au/DSE/nrence.nsf/LinkView/EBF7B20C008E24F5CA256F16001671778062D358172E420C4A256DEA0012F71C on 12 December 2007.

DSE. 2004b. Victorian Government White Paper. Securing Our Water Future Together. A WWW publication accessed in October 2007 at http://www.dse.vic.gov.au/DSE/wcmn202.nsf/LinkView/BBE70FB30CBF17D4CA256FFE0008644316E9B1815F549080CA256FFF000B04E4. Prepared by Department of Sustainability and Environment.

DSE. 2006. Assessment Guidelines for the Donald Mineral Sands Project Environment Effects Statement, Proponent Astron Limited. May. Prepared by Department of Sustainability and Environment.

DSE. 2007. Planning Schemes Online. A WWW publication accessed in September 2007 at http://www.dse.vic.gov.au/planningschemes. Prepared by Department of Sustainability and Environment, Victoria.

Enesar. 2006. Project Overview, Donald Mineral Sands Project. Preliminary document prepared by Enesar Consulting Pty Ltd for Donald Mineral Sands Pty Ltd.

Environment Australia. 1995/2003. Best Practice Management in Mining. A series of booklets produced by Environment Australia, Canberra.

EPA Victoria. 2002. Protocol for Environmental Management. Greenhouse Gas emissions and Energy Efficiency in Industry. Publication 824. January. Prepared by Environment Protection Authority, Victoria.

EPA. 1992. Publication 347, Bunding Guidelines. Prepared by the Environment Protection Authority, State Government of Victoria.

EPA. 1997. State Environment Protection Policy (Groundwaters of Victoria). As amended. Prepared by the Environment Protection Authority, State Government of Victoria.

EPA. 2001. State Environment Protection Policy (Air Quality Management). Prepared by Environment Protection Authority, Victoria.

EPA. 2006. Draft Protocol for Environmental Management - Mining and Extractive Industry (DPEMMEI). Prepared by Environment Protection Authority, Victoria.

EPA. 2007. Draft Guidelines Environment and Resource Efficiency Plans. Publication 1166. September. Prepared by the Environment Protection Authority.

ERU. 2006. REMPLAN: Regional economic modelling software. Developed by the Economic Research Unit at La Trobe University, Bendigo, Victoria.

FORS. 1998. Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG code). Federal Office of Road Safety. Sixth Edition. Canberra. Australian Government Publishing Service.

GWMWater. 2005. Water Supply for Towns Fact Sheet. Prepared by GWMWater.

IGT. 2005. Donald Project Area, Bulsk Sample Costean. April. A geotechnical report prepared by International Groundwater Technologies for Zirtanium Pty Ltd.

MCA. 2005. Minerals Council of Australia: Victorian Division. Victorian Mining, Industry Status. A WWW publication accessed on 1 May 2006 at http://www.minerals.org.au/victoria/about_industry/industry_status. Prepared by Minerals Council of Australia, Victorian Division.

NOHSC:2017. 2001. National Code for the Storage and Handling of Workplace Dangerous Goods. National Occupational Health & Safety Commission. Australian Government.

NRE. 2002. Victoria's Native Vegetation Management: A Framework for Action. Prepared by Department of Natural Resources and Environment.

Realestate.com.au. 2006. A WWW information source accessed on 9 October 2006 at http://www.realestate.com.au/.

Smart, J. 2006. Groundwater drilling, Donald Mineral Sands Project. Report (unpublished) prepared by John Smart of Goldfields Revegetation for Donald Mineral Sands Pty Ltd.

Telstra Ltd. 2006. Yellowpages directory. A WWW publication accessed on 1 November 2007 at www.yellowpages.com.au.

8.2 Personal Communications

Anonymous. State Revenue Office. Telephone conversation. 13 October 2006.

Baker, S., Water Sector Group, Department of Sustainability and Environment. Discussions in TRG 28 November 2007.

Harradine, G. Barengi Gadjin Land Council. Meeting at Minyip. 27 November 2006.

Hendrickson, John. Division Superintendent, Horsham District Police. Telephone conversation. 9 October 2006.

Kruger, A. Astron Limited. Comments in review of draft EES. 23 October 2007.

Morgan, J., GHD. Phone conversation on 6 December 2007.

Peterson, G., Threatened species project officer, Department of Sustainability and Environment. Email 10 December 2007.

Ryan, S. 1992. Hydrogeological characteristics of the Avon-Richardson catchment. Centre for Land Protection Research, Bendigo. Department of Conservation & Environment.

9 STUDY TEAM

Donald Mineral Sands Pty Limited appointed Coffey Natural Systems Pty Ltd (formerly Enesar Consulting Pty Ltd) to prepare this EES. This report draws on the work of a number of specialist consultants and their contributions are gratefully acknowledged.

The individuals listed in the following sections contributed to the preparation of the EES.

9.1 Donald Minerals Sands Pty Limited

R. McCullough	Project Director, Donald Mineral Sands Project
E. Vogel	Mining Manager
A. Kruger	Metallurgical Manager
S. Peters	Logistics and Water Development Manager

9.2 Consultants to Donald Mineral Sands Pty Limited

9.2.1 Coffey Natural Systems Pty Ltd

P. Towler	EES Project Director
G. Hamilton	EES Project Manager/EES report
S. Kenny	EES report
V. Alivanoglou	EES report
J. Wiltshire	EES report
E. Bell	EES report
M. Haywood	EES report
A. Jenkinson	EES report
M. Bruce	EES report
H. Blaszkiewicz	Drafting/GIS
F. Thomson	Drafting
G. Young	GIS
D. Smith	GIS
D. Oram	Information technology
J. Bant	Editing/administration
J. O'Neil	Formatting

9.2.2 Specialist Consultants

Australian Radiation Services

J. Young	Radiation
M. Cooper	Radiation
D. Billingsley	Radiation

Dryland Agricultural Services

J. Griffiths	Rehabilitation of agricultural land

Ecology Partners

A. Organ	Biodiversity and habitat
A. Hill	Biodiversity and habitat

EDAW

P. Haack	Visual

GHD

J. Morgan	Surface water, groundwater and water supply
K. Keam	Surface water, groundwater and water supply
J. Franklin	Surface water, groundwater and water supply
D. Mitchell	Surface water, groundwater and water supply
A. Lovell	Surface water, groundwater and water supply

Goldfields Revegetation

J. Smart	Rehabilitation
	Water supply options
	Preliminary assessment of impacts of water supply option on flora and fauna
M. Sprague	Rehabilitation
	Preliminary assessment of impacts of water supply option on flora and fauna

Grogan Richards

J. Walsh	Transport
V. Gnanakone	Transport

Heggies Australia

G. Reutersward	Noise
J. Antonopoulos	Noise
S. Fishwick	Air quality and greenhouse gases

Sinclair Knight Merz

V. Edmonds	Cultural heritage

Coffey Natural Systems

A. Sharp-Paul	Social and economic
S. Kenny	Social and economic

9.3 Other Project Consultants

JSA

J. Stuchbery Agriculture study

Robert Van de Graaf and Associates

R. Van De Graaf Rehabilitation

10 GLOSSARY

10.1 Units

kg/ha	kilograms per hectare.
t/ha	tonnes per hectare.
$\mu g/m^3$	micrograms (millionths of a gram) per cubic metre.
µm	micrometre (one millionth of a metre).
µSv/hr	micro-sievert per hour. An equivalent dose (expressed in sievert (Sv)) is the quantity used to compare the relative harmful effects of radiation on the human body.The levels of dose to humans arising from environmental or occupational exposures are usually expressed as a fraction of a sievert, namely micro- or milli-sievert (µSv or mSv).

10.2 Words

AAV	Aboriginal Affairs Victoria.
ablutions block	toilet and shower facilities.
aboriginal cultural heritage	monuments, architecture, artistry, archaeology, artifacts and other human works assocaited with indigenous Australians that have significant value from the point of view of history, art or science.
ABS	Australian Bureau of Statistics.
acid rock drainage	outflow of acidic (low pH) water resulting from the exposure of sulfide-bearing minerals to air and water, usually due to mining activities.
acid	having a pH less than 7.0.
aeolian	wind-driven processes.
AHD	Australian Height Datum.
alkaline	having a pH greater than 7.0.
alluvial	riverine or riverine sedimentary deposits.
ameliorate	to make or become better; improve.
anti-scalent	water treatment chemical that prevents the build up of precipitates.
ANZECC	Australia and New Zealand Environment and Conservation Council.
aquifer	a water-bearing layer of sediment or rock.
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency.
backfilling	any substance, as mortar, small stone, etc., used in filling a space between walls or part of a wall. The process of refilling an excavated void.
background	the existing condition.
background air quality	EPAV-defined numerical value (ug/m3), which represents the 70th percentile value of a set of PM_{10} montioring results collected over a period of time prior to mining operations.
beneficial use	the uses of a resource that are protected by state laws. For example, the beneficial uses of a water resource may include include aquatic life, recreation, human consumption, and fish or wildlife habitat.
biodiversity	the diversity of different species of plants, animals and microorganisms, including the genes they contain, in the ecosystem of which they are part.

bioregion	an area constituting a natural ecological community with characteristic flora, fauna, and environmental conditions and bounded by natural rather than artificial borders.
bore	a well, usually of less than 20 cm diameter, sunk into the ground and from which water is pumped.
becquerel (Bq)	becquerel. Unit of radioactivity, equal to one transformation per second.
buffer zone	the intervening distance that can ameliorate a potential impact.
bund	an artificial earth, rock or concrete embankment.
calcareous	composed of, containing, or characteristic of calcium carbonate, calcium, or limestone; chalky.
capital expenditure	money spent to acquire or upgrade physical assets such as buildings and machinery.
CNN	Cereal Cyst Nematode.
CO	carbon monoxide.
CO_2	carbon dioxide, a greenhouse gas.
CO_2-equivalent	a unit of greenhouse gas emissions calculated by multiplying the actual mass of emissions by the appropriate Global Warming Potential. This enables emissions of different gases to be added together and compared with carbon dioxide.
co-disposal	the deposition of different types of waste in one area.
conservation	the preservation and careful management of the environment and natural resources.
contour plots	map illustrating locations (loci) of equal value of, for example, airborne dust concentration.
conventional earthmoving equipment	equipment such as excavators, bulldozers, front-end loaders, scoops, scrapers and trucks used to move soil and rock.
cover crop	a quick-growing crop used to cover exposed ground, prevent erosion, and retard leaching.
crib room	facility set up with tables and chairs for meal breaks.
Crown land	land owned by the government (usually federal).
cryptogam	a plant lacking true flowers or seeds such as lichen, liverwort, moss or fungi.
crystalline silica	silicon dioxide. Fine airborne particles are a known health hazard.
cultural heritage management plan	a plan for the management of cultural heritage values.
dB	decibel: a measurement of sound that uses a logarithmic scale to express loudness as the logarithm of the ratio of the actual sound pressure to the sound pressure that relates to the limit of hearing.
dB(A)	decibels of sound adjusted so that the spectral composition of the sound relates to loudness as perceived by the human ear.
decommissioning	the process of removing a facility from operation.
DEH	Department of Environment and Heritage.
deposition	laying down of particulate material (e.g., sediment in a lake or tailing solids in a tailing storage).
Dewatering	removal of water from, for example, a mine pit or an aquifer.
DPI	Department of Primary Industries.
DPCD	Department of Planning and Community Development.

drainage line	a passage along which water intermittently concentrates and flows towards a stream, drainage plain or swamp during or following rain.
dryland agriculture	land use under semi arid conditions.
DSE	Department of Sustainability and Environment.
dust suppression	the process of limiting the dispersive capacity of dust particles, usually by spraying water or applying chemical binders.
earthworks	any operation in which earth has to be removed or filled in, as in cuttings, embankments, etc.
easement	a right held by the proponent to make use of the land, e.g., the installation and operation of a pipeline. Also referred to a right of way.
EC	electrical conductivity (EC), measured in µS/cm referenced to a temperature of 25^{o}C. A measure of the salinity of a water sample.
EES	Environment Effects Statement.
EES assessment guidelines	a document that sets out the scope of the environmental matters that need to be investigated and addressed in the environment effects statement.
effective dose	estimate of the stochastic effect that a non-uniform radiation dose has on a human.
emission	a discharge of a substance (e.g., dust) into the environment.
EPA/EPAV	Environment Protection Authority Victoria.
ephemeral	non-permanent.
ERC	Environmental Review Committee.
erosion	the natural or artificial wearing away of the land surface.
ESO	Environmental Significance Overlay.
EVC	Ecological Vegetation Class.
EVC benchmark	a standard vegetation-quality reference point relevant to the vegetation type that is applied in assessments. Represents the average characteristics of a mature and apparently long-undisturbed state of the same vegetation type. EVC benchmarks have been developed to assess the vegetation quality of the EVCs at the site scale in comparison to a 'benchmark' condition. Each EVC benchmark contains a range of information necessary for conducting a vegetation quality assessment.
exposure pathway	a means by which a contaminant may enter the human body.
fines	fine particles, usually below 53 micron, that naturally occur within mineral sand orebodies, which are well below the economic mineral particle size.
flocculant	chemical substance added to aid flocculation.
floodplain	a low-lying plain adjacent to a river subject to occasional or frequent flooding and formed by sediment deposition during flooding episodes.
freeboard	vertical distance from the normal water surface to the top of a confining wall.
freehold land	land ownership not subject to any limitations. Commonly known as private land.
FZ	farming zone.
g/m^2/M	grams per metre squared per month.
gamma radiation	electromagnetic radiation emitted during radioactive decay and having an extremely short wavelength.
geochemistry	the study of the chemical composition of the Earth and its rocks and minerals.
geology	the study of the solid earth.
geotechnical	a term currently employed to cover the fields of soil mechanics, rock mechanics, and engineering geology.

greenhouse gases	gases with the potential to cause climate change: carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulfur hexafluoride. Usually expressed in terms of global warming potential carbondioxide equivalent.
groundwater	all waters occurring below the land surface; the upper surface of the soils saturated by groundwater in any particular area is called the water table.
GWM	Grampians Wimmera Mallee.
GWMWater	Grampians Wimmera Mallee Water.
gypsum	$CaSO_4.2H_2O$; hydrated calcium sulfate.
habitat	the particular local environment occupied by an organism.
habitat corridor	a continuous strip of vegetation linking major flora and fauna habitats.
habitat hectare	a measure of the quality and quantity of vegetation.
haul road	roads used to transport mined materials.
hazardous materials	any solid, liquid, or gas that can harm people, other living organisms, property, or the environment.
heavy mineral concentrate (HMC)	an assemblage of titanium and zirconium minerals derived from the processing of a heavy mineral ore. It typically contains ilmenite, zircon, rutile and leucoxene.
high voltage (HV)	electrical circuits, in which the voltage used is the cause of particular safety concerns and insulation requirements.
hydrogeology	the study of subsurface water (groundwater).
hydrophobic	repelling, tending not to combine with, or incapable of dissolving in water.
illuminance	the luminous flux incident on a unit area.
infrastructure	the supporting installations and services that supply the needs of a project.
job safety analysis	systematic assessment of a job subdivided by tasks/steps in order to identify hazards, assess risks and select the best control.
kV	kilovolt. One thousand volts.
KW	kilowatt. One thousand watts.
LA_{90}	A given time-varying sound that exists more than 90% of the time.
LA_{eq}	the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.
landform	a specific feature of a landscape (such as a hill) or the general shape of the land.
landholder	the owner or occupier of freehold land.
lateritic	consisting of, containing, or characterised by, laterite; as, lateritic formations.
laydown area	an area where equipment, tools or materials are stored.
local government area (LGA)	a statistical area used by the ABS.
lunette	a small, circular or crescent-shaped land form.
mean	average; the sum of the data divided by the number of data points.
mine footprint	the area of a mine that encompasses mining activities and associated infrastructure.
mine materials	material removed during excavation of the mine pit (e.g., topsoil, waste rock, or ore).
mine void	the opening in the land surface created by the extraction of ore.
mine water balance	a description of the origin, use and destination of water in a mine.
mineral processing	the process of treating an ore to recover its valuable components.

mineral sand	sand containing a high concentration of titanium and zirconium minerals.
mining by-product	a secondary product resulting from mineral extraction processing of the ore. Commonly refers to tailing or non-mineralised materials.
mining licence	a licence for mining purposes granted under the Mineral Resources and Sustainable Development Act 1990 (MRSD Act).
mining unit plant (MUP)	the initial stage in the ore treatment process where ROM ore is screened then slurried with water.
model	a mathematical simulation of a natural system (such as the variation of particulate levels within a lake) used to predict how the system will change with time, particularly where external changes have been imposed upon it (such as from mining operations).
modelling scenario	a set of circumstances existing at a particular place and at a particular point in time, the numerical details of which are used in equations that then predict a quantifiable feature e.g., the quantity of dust or noise emission that might result from those circumstances.
monazite	a phosphate mineral that contains minor amounts of rare-earth elements such as cerium and thorium.
monitoring	systematic sampling and, if appropriate, sample analysis to record changes over time caused by impacts such as mining.
mSv	millisievert; one thousandth of a sievert. A measure of radiation.
Mt	megatonne. One million tonnes.
MW	megawatts.
MWh	megawatt hours.
N_2O	nitrous oxide.
native title	native title is a concept in the law of Australia that recognises the continued ownership of land by local Indigenous Australians.
native vegetation	trees, shrubs, herbs and grasses that have grown naturally in an area before European arrival.
net gain	overall gains in native vegetation are greater than overall losses and where individual losses are avoided where possible.
NO_2	nitrogen dioxide, a gas that is hazardous to health.
non-feeding breeding habitat	habitat where breeding does not take place.
NORM	naturally occurring radioactive material.
Wimmera Mallee pipeline	water distribution pipeline from the Murray River to west and southwest Victoria.
ore	a mineral or aggregate of minerals.
orebody	a solid mass of ore (both high and low grade) that is geologically distinct from the rock that surrounds it and that is commercially extractable.
overburden	all material that overlies a deposit of ore, but in the context of the descriptions in this project, does not include topsoil and subsoil which are dealt with separately.
oversize	particles excluded from a process due to excessive size.
oxidation	the process by which an element or compound undergoes a chemical reaction involving the removal of electrons; often involves reaction with oxygen to form an oxide (e.g., the rusting of iron).
Parilla Sands	a sequence of deltaic and estuarine sediments found in the Murray Basin. Known to contain economic occurrences of mineral sands.
pit migration rate	the rate a which the mine void progresses along the ore body.

PM_{10}	particles with a mean aerodynamic diameter of 10 µm or less. A health indicator for respirable dust capable of being inhaled into the lungs.
$PM_{2.5}$	particles with a mean aerodynamic diameter of 2.5 µm or less. A health indicator for respirable dust fine enough to penetrate deep into the lungs and alveoli.
pore water	interstitial water or subsurface water in an interstice, or pore.
precipitation	1. the process of changing from a dissolved compound into a solid, insoluble compound. 2. rain, hail and snow.
process water	water that is used in the production of, or comes in contact with, an end product.
progressive rehabilitation	rehabilitation conducted on a regular or scheduled basis (as opposed to after the cessation of mining).
project area	a delineated area in which all project components are contained. The activity area.
pyrite	a common, brass-coloured mineral (FeS_2) which produces sulfuric acid when oxidised.
radiation	energy that is radiated or transmitted in the form of rays or waves or particles.
radiation management plan	a plan for the prevention or management of the potential impacts of ionising radiation.
radioactive decay	the regular process by which radioactive isotopes break down into their decay products with a half-life which is specific to the isotope.
radioactive isotope	natural or artificially created isotope of a chemical element having an unstable nucleus that decays, emitting alpha, beta, or gamma rays until stability is reached.
radioactive waste management plan	a plan for the management of radioactive waste.
radioisotope	a naturally or artificially produced radioactive isotope of an element.
radionuclide	a nuclide that exhibits radioactivity.
Ramsar	United Nations convention for the protection of internationally important wetlands.
reduced level (RL)	elevation above mean sea level as defined by the Australian Height Datum.
rehabilitation	the process of reshaping and revegetating land to restore it to a stable landform and in accordance with criteria set out in the work plan.
remnant vegetation	native vegetation remaining after widespread clearing has taken place.
reverse osmosis plant	a facility for the desalination of water. Plant operations involve forcing water through a semipermeable membrane to remove solutes.
run of mine (ROM)	untreated ore.
runoff	that portion of precipitation (rain, hail and snow) that flows on the surface as water.
saline overburden	material that overlies an ore deposit that has high concentrations of sodium and chlorine.
salinisation	a pedogenetic process in which salts accumulate in the soil.
salinity	a measure of the salinity of total dissolved solids in water. The significance of salinity depends on the nature as well as the amount of dissolved solids.
screening	A method of sizing whereby graded products are produced and the individual particles in each group are categorized.
seepage	1. Subsurface movement of water. 2. Emergence of subsurface flow at the ground surface.
sensitivity mapping	the process of determining zones of archaeological sensitivity by examining the archaeological record, landforms and land management practices.

SEPP	State Environment Protection Policy.
slurry	a mixture of fluids and solids.
SO_2	sulphur dioxide, a gas that is hazardous to health.
socio-economic environment	the economic activity and social conditions which make up the surroundings of an individual or group of individuals.
sodic	having a high Na (sodium) content.
sodosols	soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon is sodic and not strongly acid.
stability class	category of atmospheric turbulence. There are six stability classes, named A,B,C,D,E and F, with A being the most unstable or most turbulent class and F being the most stable or least turbulent class.
stripping	removal of vegetation and/or topsoil.
subsoil	the layer or bed of earth beneath the topsoil.
sump	pit sunk to collect water.
surface hydrology	the study of surface water.
surface water	water flowing over or within a landscape (runoff, streams, lakes etc).
swale	a low or hollow place between ridges.
tailing	by-product of the metal extraction process consisting of crushed rock from which the metal has been extracted (the solid fraction or portion) and a liquid fraction or portion composed of water and residual chemicals used in the extraction process.
tailings storage facility	a storage facility for tailing.
taxonomy	the classification of organisms in an ordered system that indicates natural relationships.
technical reference group - TRG	group comprising representatives from government agencies and environmental consultancies and other specialists to provide policy, statutory and technical advice on a project.
test pit	a small-scale pit excavated to provide information about the metallurgical, hydrogeological and engineering characteristics of the ore and overburden.
threatened species	any species classified as vulnerable, endangered, critically endangered or extinct in the wild by the Department of Sustainability and Environment, Victoria.
topographic	of, or pertaining to, topography; descriptive of a place.
topsoil	upper layer of soil, usually containing more organic material and nutrients than the subsoil beneath it.
traffic management plan	a document outlining procedures and management measures to minimise the impacts of a project on the public road network and other road users.
TSP	total suspended (airborne) particulate.
vertosols	cracking clay soils that display significant shrinking and swelling during wetting and drying cycles.
watertable	the surface of the groundwater, below which soil and rock are saturated.
wet concentrator plant (WCP)	plant item that performs the preliminary separation of minerals from the mined ore. Produces a heavy mineral concentrate stream for further treatment.
wet gravity processing	slurry-based ore treatment reliant on the specific gravity of the particles.
Wet High Intensity Magnetic Separator (WHIMS)	the equipment/procedure of separating the magnetic and non-magnetic components of the HMC.
wetlands	a low-lying area regularly inundated or permanently covered by shallow water.

Wimmera Mallee pipeline	water distribution pipeline from the Murray River to west and southwest Victoria.
work authority	an authority granted under section 42 of the MRSD Act that allows the start of mining.
work plan	a plan lodged under section 40 of the MRSD Act that defines the location and scope of mining works. It includes a rehabilitation plan and an occupational health and safety plan.
works approval	a plan approved under the Environment Protection Act for the management and mitigation of discharges to the environment.