Appendix O
Draft Environmental Management Plan

D R A F T E N V I R O N M E N T A L M A N A G E M E N T P L A N

Coburn Mineral Sand Project

Prepared for

Gunson Resources Limited
Level 2, 33 Richardson Street
WEST PERTH WA 6872

30 June 2005

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1.1 The Environmental Management Plan

The Environmental Management Plan (EMP) for the Coburn Mineral Sand Project provides measures proposed by Gunson Resources Limited (Gunson) to prevent or mitigate potential impacts to the environment and heritage values during construction and operation of the Coburn Mineral Sand Project (the Project).

The EMP is in a draft form and is appended to the Public Environmental Review (PER) produced for the Project. This document provides the basis for the environmental management programme for the Project and should be read in conjunction with the PER for the Project.

The EMP will be finalised with consideration of the government and public submissions made during the PER public review period and the conditions of environmental approval, if the Project is approved.

1.2 Gunson Sustainability Policy and Framework

Gunson's Sustainability Policy (Figure 1.1) outlines the company's policy and guiding principles in relation to sustainability. In summary, Gunson will demonstrate a responsible approach to social, economic and environmental performance that is aligned with the evolving priorities of the community. This includes employees, contractors, Aboriginal peoples, mining community members, suppliers, customers, environmental organisations, governments, the financial community and shareholders.

Gunson will ensure, as far as practicable, that the proposal for the Coburn Project meets or is consistent with principles outlined in National and State sustainability strategies, such as the National Strategy for Ecologically Sustainable Development (1993), Western Australian State Sustainability Strategy (2003) and EPA Position Paper No.6 "Towards Sustainability" (2004).

Gunson is adopting the Guiding Principles of the International Council on Mining & Metals (ICMM) to facilitate development of sustainable outcomes for the Project. The ICMM has developed a framework for sustainable development which comprises of the following principles:

- Implement and maintain ethical business practices and sound systems of corporate governance;
- Integrate sustainable development considerations within the corporate decision-making process;
- Uphold fundamental human rights and respect cultures, customs and values in dealing with employees and others who are affected by our activities;
- Implement risk management strategies based on valid data and sound science;
- Seek continual improvement of our health and safety performance;
- Seek continual improvement of our environmental performance;
- Contribute to conservation of biodiversity and integrated approaches to land use planning;
- Facilitate and encourage responsible product design, use, re-use, recycling and disposal of our products;
- Contribute to the social, economic and institutional development of the communities in which we operate; and
- Implement effective and transparent engagement, communication and independently verified reporting arrangements with our stakeholders.

Site-specific sustainability strategies in regards to the Project include:

- Undertaking research programmes associated with the mining operations on an as-needs basis

to address information gaps as they arise during the life of the Project;

- Providing scientific and technical advice (where required) to assist in the future development of standards and controls;
- Developing and implementing an EMS consistent with ISO14001;
- Progressively rehabilitating the site;
- Improving site rehabilitation techniques as more advanced information becomes available; and
- The use of natural gas for power generation.

1.3 Determination of Environmental Management Requirements

As discussed in Section 1.1, the EMP contains a series of Management Plans (MPs) to manage key impacts for the Project. The MPs were developed based up on the impact identified during the environmental risk assessment process undertaken during the PER. The preliminary environmental risk assessment identified the following key risks, which were ranked as very high or high risks:

- Abstraction of groundwater to meet process water requirements causing groundwater drawdown which may impact on other groundwater users;
- Tailings seepage leading to groundwater mounding which could affect the surrounding vegetation;
- Vegetation clearing resulting in the removal of Priority Flora species, removal of Malleefowl breeding mounds and dust deposition on the vegetation within the SBWHP; and
- Potential difficulties in successfully rehabilitating the site after mining.

In addition to the risk assessment, key considerations in determining management requirements include:

- Environmental Impacts – whether the activity has the potential to have an effect on the environment, either beneficial or adverse;
- Sustainability – an assessment as to whether or not a particular issue or activity is either likely to detract from or enhance fulfilment of sustainability principles;
- Commonwealth Legislation – an assessment of whether the activity/issue is relevant to the *Environment Protection and Biodiversity Conservation Act* 1999, and if so whether the activity conforms to the Act;
- State Legislation – whether the activity or issue under consideration is relevant to applicable Western Australian environmental legislation, and if so, whether the activity conforms to the legislation; and
- Stakeholders – whether bodies and or individuals are likely to be affected by, or influence, a particular environmental or social issue.

The EMP will be revised with consideration of comments received during the PER's public review period, comments made in the Environmental Protection Authority (EPA) report and recommendations, and relevant components of the Ministerial approvals, assuming that the Project is approved.

GUNSON RESOURCES LIMITED

ABN 32 090 603 642

SUSTAINABILITY POLICY

GUIDING PRINCIPLE

The Company firmly believes that its opportunity to continue to contribute to and thrive in Australia must be earned through a demonstrated commitment to sustainable development. Sustainable development is defined as *development that meets the needs of the present without compromising the ability of future generations to meet their needs.*

POLICY

Accordingly, our actions must demonstrate a responsible approach to social, economic and environmental performance that is aligned with the evolving priorities of our communities of interest.

We use the term 'communities of interest' to include all individuals and groups who have, or believe they have, an interest in the management decisions about our operations that may affect them. This includes employees, contractors, Aboriginal peoples, mining community members, suppliers, customers, environmental organisations, governments, the financial community and shareholders.

Our actions must reflect our values that we share with our employees and communities of interest, including honesty, transparency and integrity. They must underscore our ongoing efforts to protect employees, communities, customers and the natural environment.

We will demonstrate leadership and sustainable practice by:

- Involving communities of interest in the design and implementation of our operations;
- Proactively seeking, engaging and supporting dialogue regarding our operations;
- Conducting all facets of our business with excellence, transparency and accountability;
- Contributing to initiatives to promote production, use and recycling of metals and minerals in a safe and environmentally responsible manner;
- Seeking to minimise the impact of our operations on the environment and biodiversity;
- Practicing continuous improvement through the application of new technology, innovation and best practices in our operations for the benefit of future generations; and
- Compliance with laws and regulations in each state in which we operate and apply the standards reflecting our adherence to our guiding principle and our adherence to best international practices.

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Figure 1.1: Gunson's Sustainability Policy

1.4 Structure of EMP and its Components

The Draft EMP has been structured in accordance with the Guidelines for the Preparation of Environmental Management Plans prepared by the Environmental Audit Section of the Department of Environmental Protection (April 2003).

A MP has been developed for each key environmental aspect determined by the outcomes of the environmental risk assessment, and includes management and monitoring requirements for both construction and operation activities. Each MP for the Project includes the following sections:

Current status	Provides a brief statement on the nature of the receiving environment as relevant to the issue to be managed.
Potential impacts	Outlines the potential impacts proposed by the project activities.
Environmental Objectives	States the principle environmental outcomes that are targeted.
Performance Indicators	Lists performance indicators/criteria that are applicable to the potential impact.
Stakeholder Consultation	Lists individuals/groups who have been consulted in the development of the management plan.
Management, Monitoring/ Reporting and Contingency	Describes the management actions applying to different stages of the Project, defines who is responsible for implementing the management actions and describes the response to complaints or trigger criteria and reporting.

Management Plans have been developed for the following:

- Dust;
- Liquid and Solid Wastes;
- Hydrocarbons;
- Radiation;
- Groundwater;
- Vegetation and Flora;
- Weeds;
- Vertebrate Fauna;
- Fire; and
- Aboriginal Heritage.

Gunson proposes to develop the Coburn Mineral Sand Project (the Project) in the Shark Bay district of Western Australia, approximately 250 kilometres north of Geraldton and 84 kilometres southeast of Denham (Figure 2.1). The Project will comprise the excavation and processing of a major low-grade heavy mineral sand deposit known as the Amy Zone. The heavy mineral concentrate (HMC) produced at the site will be trucked to Geraldton.

Figure 2.1: Regional Location Map

The Amy Zone orebody is approximately 35 km long, up to 3 km wide and between 10 and 40 metres (m) thick. The orebody comprises approximately 620 million tonnes of ore hosted in loose, dunal sand with very low clay content. Based on the average grade of 1.1 % Heavy Mineral (HM), over five million tonnes of HMC will be yielded over approximately 20 years. The economic minerals of the Amy Zone include ilmenite, rutile, leucoxene and zircon.

The Project will include:

- ten open-cut mine pits;
- two processing plants (concentrators) that will be relocated as mining progresses northwards;
- a borefield;
- haul roads and access corridors;
- offices, workshops and other supporting infrastructure; and
- an accommodation camp.

The Project Area is located on the Hamelin, Coburn and Meadow pastoral leases (Figure 2.2) immediately east of the Shark Bay World Heritage Property (SBWHP). These leases are used for grazing sheep and goats. The proposed layout of the Project Area is illustrated in Figure 2.3.

Mining of the Amy Zone will be carried out using a conventional dry strip mining method. Mining infrastructure will be progressively relocated as mining proceeds at one to two kilometres per annum. A typical layout of equipment and activities associated with each mine pit is presented in Figure 2.4. Two 2,300 tph bucketwheel excavators will be used for mining the ore and overburden in Years 1 and 2. The mined material will be conveyed to an in-pit screening module for the removal of oversize and roots before the sand is mixed with water and pumped to a concentrator. When necessary, booster pumps will be used to transport the slurry to the concentrator, and return the tailings to the mine void. This mining system will be duplicated from Year 3 of the mine life, with the duplication of the mining and concentrator equipment.

Initially, the plant throughput will be 2,200 tonnes per hour (tph) and then will increase with the addition of a second concentrator to 4,600 tph from Year 3 (~ 15 million tonnes per annum). The concentrators comprise a primary concentration circuit, a secondary concentration circuit and a non-mags upgrade circuit.

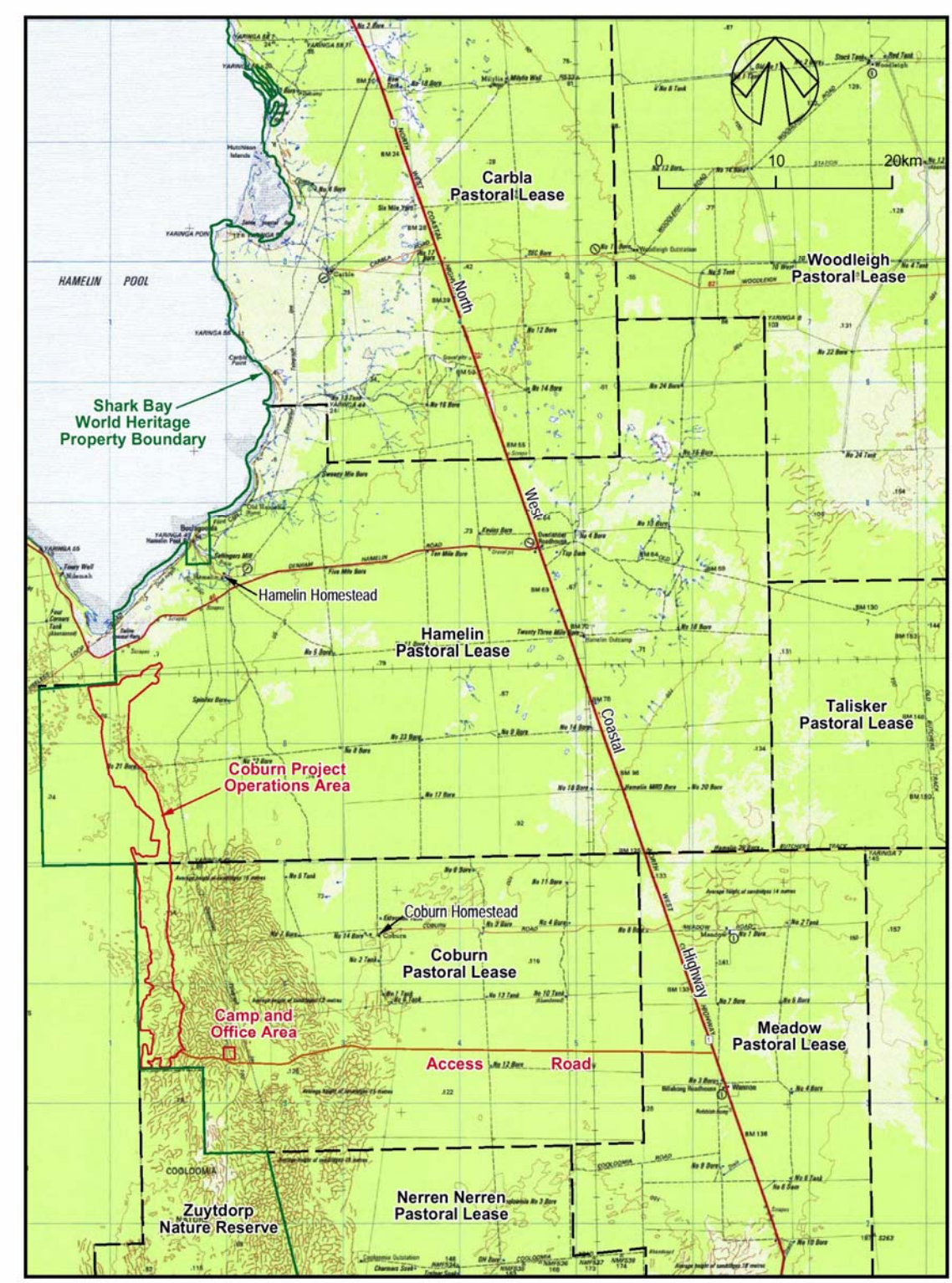

Figure 2.2: Locality Map

The concentrators will be built around banks of spirals that remove silica and other lighter specific gravity minerals, allowing valuable heavy minerals to become concentrated. This process of pumping the ore and water over spirals will be repeated until the final concentrate is more than 90% HMC.

The HMC will be trucked approximately 300 km to Geraldton as two separate product streams, as follows:

- Wet High Intensity Magnetic Separator (WHIMS) Magnetics, which consist primarily of ilmenite with minor amounts of leucoxene and
- Non magnetic HMC, which contains a mixture of weathered (secondary) ilmenite, leucoxene, rutile, zircon and minor levels of waste minerals.

Approximately 140,000 tonnes of HMC per annum (or around 400 tonnes per day) will be trucked to Geraldton, increasing to 280,000 tonnes per annum (or around 800 tonnes per day) from Year 3 of the mine life. Sand tailings and clay fines (slimes) from the on-site concentrator(s) will be returned to the mined-out area(s) as the mining operation moves forward. When necessary, water from the tailings will be recycled through a settling dam located in the tailings area to reduce the fine clay loading in the water.

Rehabilitation of mined areas will be progressive with clearing occurring ahead of the mining operation and recontouring and revegetation occurring behind the mine pit. The mine void will be progressively and continuously backfilled with overburden, sand tailings and slimes. The tailings will be contoured using a bulldozer approximately 100 m behind the active tails area.

Process water will be sourced from groundwater. Total water demand could be up to 18 GL/pa under full production, allowing conservation, reuse or recycling of water. Potable water for the camp and mine office will be processed through a reverse osmosis system to bring the brackish bore water to a potable standard.

During construction, the overall workforce including rostered personnel will total 100. Once mining operations commence the workforce will total 80 personnel including contractors and staff, increasing to 105 once full production is attained.

The mining and concentrating operations will occur 24 hours per day, seven days a week.

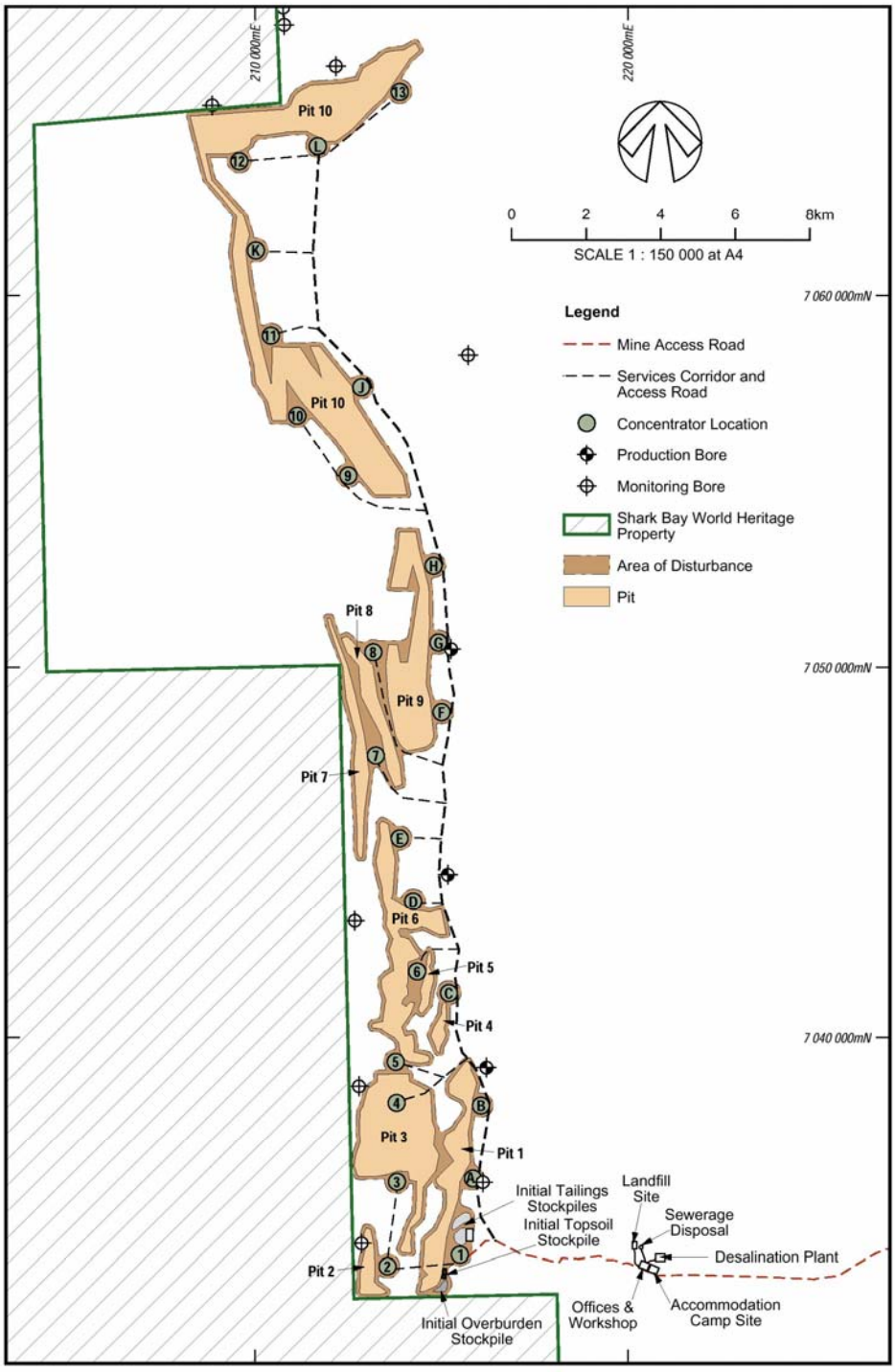

Figure 2.3: Proposed Layout of Amy Zone Operations of the Coburn Mineral Sand Project

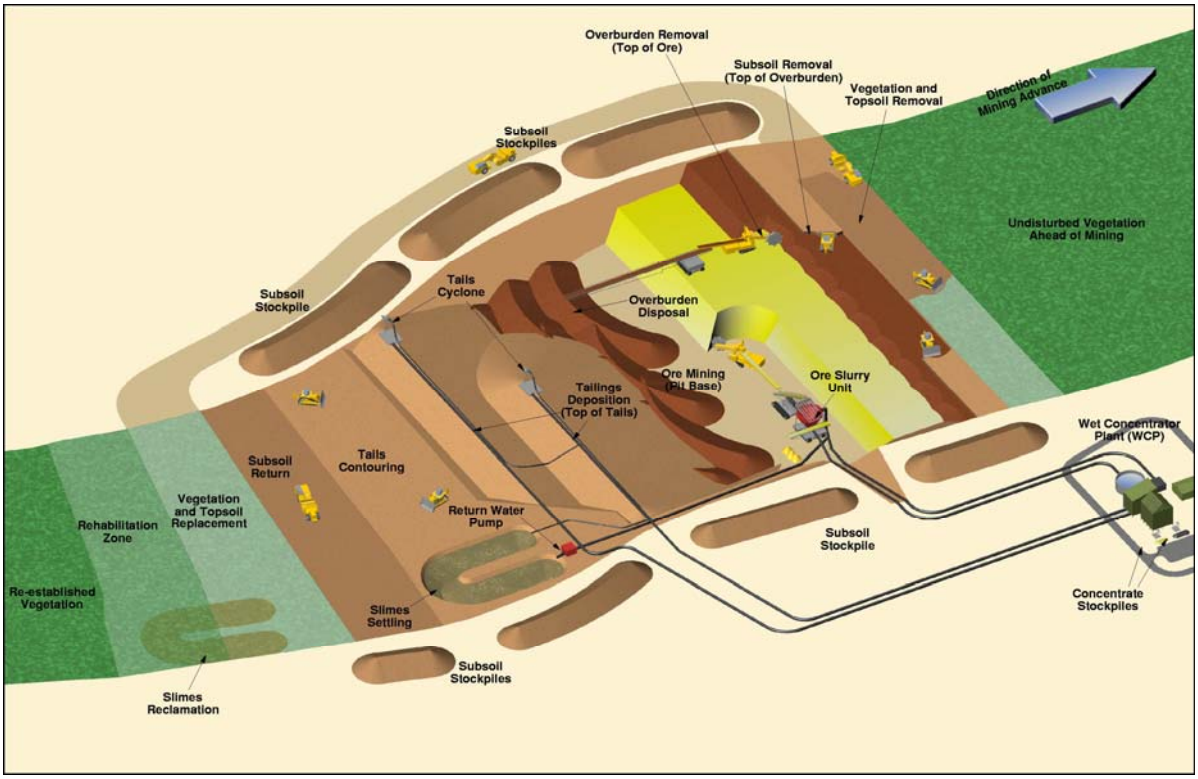

Figure 2.4: Schematic of the Conceptual Pit Layout

3.1 Environmental Setting

The Project Area is located in the southwest extremity of the Carnarvon Basin, Western Australia. The Carnarvon Basin is one of the major sedimentary basins of Western Australia and extends from near Cape Range in the Exmouth area, south to Murchison River and inland to Kennedy Range. The basin is bordered to the east by the Yilgarn Block, Gascoyne Province, Hamersley Basin and Ashburton Trough, south by the Northampton Block, and north by the Canning Basin (Burbidge et al. 2000). It is also influenced by Victoria Plateau and Carnarvon Coastal Plain geologies (DEP 2001). The Carnarvon Basin consists of four distinct geomorphological provinces - Edel, Peron, Yaringa and Gascoyne/Wooramel (CALM 1998). The Peron and Edel provinces are the most prominent, covering most of the Shark Bay area (DEP 2001).

The Edel region, which includes the Project Area, is characterized by 40-60 m high, modern, calcareous dunes that formed above the Tamala Limestone over the last 10,000 years (CALM 1998). These Tamala dunes have a north-south alignment, demonstrating that Pleistocene wind directions are similar to those of today. Most of the southern Shark Bay area occurs in the Victoria Sand Plain District, which has extensive undulating sandy plains with isolated low coastal dunes. The land surface elevation varies from approximately 20 m AHD in the north of the Project Area to approximately 100 m AHD in the south. The dunes are covered with calcareous soils of pale to reddish brown sand over loamy sand, and have deep profiles with a pH near 8.5 (Burbidge et al. 2000).

The Carbla Plateau occurs to the north of the Project Area where the superficial sand cover thins and becomes intermittent between outcrops of duri-crust. Surface drainages become more apparent as the topography becomes increasingly dominated by the duri-crust to the north-east and east. Overall, these trend northwards towards Hamelin Pool.

The Shark Bay region forms part of the Carnarvon Basin. It sits within a transitional climatic region that experiences an overlap of tropical and temperate zones, resulting in hot dry summers and mild winters. The area is classified as a Hot Grassland (summer drought) by Bureau of Meteorology (BOM 2004). The maximum temperature is high most of year, and extreme in summer. Summer can bring thunderstorm activity, significant rainfall, tropical cyclones, extreme wind, low levels of cloud cover, extended sunshine duration and high levels of incident solar radiation (Burbidge et al. 2000).

Rainfall is sporadic, with annual precipitation ranging 200-400 mm (EPA 2001) and the timing and magnitude of rain is highly influenced by cyclonic and thunderstorm activity. Average annual rainfall is about 212 mm at Hamelin Pool, although rainfall at the Project Area is likely to be around 240 mm per annum (Hamelin Pastoral lease owner/manager pers. comm.). The majority of rain falls between May and August. Evaporation is high ranging from 3,000 mm in the east to 2,000 mm in the west. This is largely attributed to the lack of cloud cover, low humidity and medium to strong winds (CALM 1998). Most rainfall typically evaporates or quickly infiltrates.

The region is characterised by high evaporative conditions and high infiltration capacity dunal soils. The catchment area upstream of the Project Area is relatively small and is likely to produce little runoff during storm events. Most rainfall typically ponds in depression areas and evaporates or quickly infiltrates.

There are five significant aquifers in the Gascoyne Platform area, all of which are mostly confined except for local areas in the eastern recharge area overlying the Ajana Ridge (refer to Figures 5, 6 and 42 of Appendix D of the PER). The principal confined aquifers in the Gascoyne Platform sub-basin of the Carnarvon Basin in order of increasing age are:

- Windalia Radiolarite;
- Windalia Sand Member of the Muderong Shale;
- Birdrong Sandstone;
- Kopke Sandstone; and
- Tumblagooda Sandstone.

Further descriptions of the hydrogeology are provided in Appendix D Groundwater Resources Impact Assessment.

Unconfined aquifers in and near the Project Area are limited to a shallow palaeo-drainage and down-gradient areas adjoining Hamelin Pool. Apart from a thin, saturated layer occupying the lower-most part of the superficial sand in the axis of an inferred north to north north-west trending palaeo-drainage, the superficial sand deposits in the Project Area are dry, i.e. above the water table.

The Project Area is located within the transition zone between the South West Botanical Province and the Eremaean Botanical Province (Beard 1990). The northern extent of the Irwin Botanical District (a part of the South West Botanical Province) is described by Beard (1990) as 'tree heath' comprising herbs and grasses, small and large shrubs, and small trees up to 6 m. The southern portion of the Project is a part of the Carnarvon Botanical District (a part of the Eremaean Botanical Province) and is characterised by Acacia shrublands and low woodlands. This boundary represents the transition from the complex and species rich heathlands and woodlands of south-western Australia to the less diverse Acacia shrublands of the Carnarvon Basin and is thought to relate to the increasing quantity and reliability of rainfall to the south-west (Beard 1976).The region is thought to be a major transition zone for the vascular flora of Western Australia, with 229 taxa ending their northern most range within the World Heritage Property (Trudgen & Keighery 1995).

Shark Bay is located near the intersection of three phytogeographic regions: the southern inland, northern coastal and southern coastal site groups (Gibson et al. 2000). As a result, many fauna species present in this region are at the northern, southern or western limits of their distribution. Consequently, the Shark Bay area is of significant zoological importance.

Wide-ranging fauna surveys have been conducted previously throughout the Carnarvon Basin (see Burbidge et al., 2000). Densities of small non-flying mammals were found to be low during field surveys, assisted by the fact that 23 of the original 48 indigenous species are now extinct in the region (McKenzie, Hall & Muir 2000). A total of one monotreme, three macropod, one honey possum, ten dasyurid, four rodent and nine introduced species were recorded (McKenzie, Hall & Muir 2000). Previous studies also recorded a total of 13 wide ranging bat species (McKenzie & Muir 2000) and 279 bird species with relatively stable populations, comparable to the results for the nearby Murchison catchment (Johnstone, Burbidge & Muir 2000). Herpetofauna surveys of the Carnarvon Basin recorded 133 species, with patterns in regional composition related to biogeographical, ecological and local evolutionary processes (McKenzie et al. 2000b).

Further descriptions of the biological environment are summarised in Section 4 of the PER and the following appendices of the PER:

- Appendix C - Soil Types of the Amy Zone;
- Appendix J - Vegetation and Flora Survey Report;
- Appendix K - Vertebrate Fauna Survey Report; and
- Appendix L - Stygofauna Survey Report.

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4.1 Responsibilities for Environmental Management

The Mine Manager is primarily responsible for the implementation of the Coburn Mineral Sand Project EMP. In addition, the EH&S Superintendent and Environmental Coordinator will be responsible for implementation of the plans.

4.2 Stakeholder Consultation

Gunson initiated a stakeholder consultation programme in early 2003 to coincide with the commencement of the environmental assessment process. The aims of the consultation undertaken during this phase of the environmental approvals process were to:

- Identify key stakeholders;
- Provide stakeholders with information on the proposed Project; and
- Identify the key issues and the extent of the potential impacts that need to be assessed in the impact assessment.

During this initial phase of consultation, Gunson identified and consulted with the following stakeholders:

- Department of Environment and Heritage (DEH);
- Department of Environment (DoE) (Perth and Mid-West regions);
- Environmental Protection Authority Services Unit (EPASU);
- Department of Industry and Resources (DoIR);
- Department of Conservation and Land Management (CALM);
- Department of Indigenous Affairs (DIA);
- Department of Agriculture;
- Shark Bay World Heritage Property Scientific Advisory Committee (SAC);
- Shark Bay World Heritage Property Community Consultative Committee (CCC);
- Gascoyne Development Commission (GDC);
- Mid-West Development Commission;
- Midwest Gascoyne District Fire and Emergency Services;
- Shire of Shark Bay;
- City of Geraldton;
- Pastoral Lease Holders;
- Yamatji Land and Sea Council;
- Nanda Aboriginal Working Group; and
- Malgana Aboriginal Working Group.

Consultation was primarily undertaken through presentations and information sessions. A site visit was undertaken by the DEH, DoE and CALM in June 2003. Further site visits were hosted by Gunson in August and September 2004. Project presentations were also provided to local pastoralists following the September site visit. The aim of the site visit was to provide the stakeholders with an appreciation and understanding of the Project in the context of the environmental setting. Information was also distributed by Gunson and URS via pamphlets and update letters to relevant stakeholders.

The issues identified during the consultation programme are listed in Table 5.1 of the PER with the main issues being:

- The potential difficulty in successfully rehabilitating the land after mining;
- Potential impacts to the SBWHP;
- Potential groundwater drawdown effects on conservation values and groundwater users;

- Potential impacts to conservation values due to tailings seepage;
- Impacts on Malleefowl, which is listed as Vulnerable under the EPBC Act, due to the removal of breeding mounds within the Project Area; and
- Impacts to Priority Flora, as nine Priority Flora species have been recorded in the Project Area.

4.3 Monitoring and Reporting Requirements

An ongoing monitoring and reporting programme will be developed in consultation with the DoE and DoIR to measure Gunson's compliance to its commitments. Impacts and issues identified from the monitoring programme will be included in the Annual Environmental Report.

Reports will be submitted to the DoE and DoIR, for review and auditing where applicable. The monitoring and reporting programmes will be the responsibility of the Environmental Coordinator.

4.4 Audit and Review

Whole-site audits will initially be completed every six months. An audit will be led by the Environmental Adviser to determine compliance with the plan. The site Manager and other relevant parties will then be consulted to ensure the final audit report is relevant and appropriate. Once it is complete, copies will be sent to the following persons:

- EH&S Superintendent; and
- Mine Manager.

The EH&S Superintendent is responsible for ensuring that all corrective actions arising from the audit are completed.

4.5 Awareness and Training

The Project Area and surrounds have a range of environmental and heritage values that may be at risk from site activities. It is fundamental to the effective management of these values that Project personnel are aware of the environmental issues, and know their roles and responsibilities with regard to the environmental protection and incident response. The level of environmental awareness required will depend on the individual's function within the Project.

At this stage of the Project, the personnel requirements have not been defined, and thus training and induction requirements have not been established. A Training and Induction Management Plan will be developed by Gunson following Project approval.

4.6 Statutory Requirements

The Project will be subject to regulatory control under a range of Commonwealth and State Acts and regulations. The following Statutory requirements apply to the Project:

- *Aboriginal Heritage Act 1972*;
- *Bush Fire Act 1954*;
- *Conservation and Land Management Act 1984*;
- *Environmental Protection Act 1986*;
- *Explosive and Dangerous Goods Act* 1961-1978;
- *Mining Act 1978*;
- *Mines Safety and Inspection Act 1994*;
- *Rights in Water and Irrigation Act 1914*;
- *Soil and Land Conservation Act 1945*;
- *Waterways Conservation Act 1976*;
- *Water and Rivers Commission Act 1955*; and

- *Wildlife Conservation Act 1950*.

In addition, the following Commonwealth legislation applies to the Project:

- *Australian Heritage Commission Act 1975;* and
- *Environment Protection and Biodiversity Conservation Act 1999.*

Other regulations, standards and guidelines include:

- *Bush Fires Regulations 1954*;
- *Environmental Protection (Controlled Waste) Regulations 2001*;
- *Environmental Protection (Liquid Waste) Regulations 1996*;
- *Environmental Protection (Noise) Regulations 1997*;
- *Mines Safety and Inspection Regulations 1995*;
- EPA Guidance Statement for the Assessment of Environmental Factors. Minimising Greenhouse Gas Emissions. No. 12. Western Australia;
- EPA's Draft Statement No. 14. (Version 3) Road and Rail Transportation Noise Western Australia;
- EPA Guidance Statement for the Assessment of Aboriginal Heritage. No. 41. Western Australia;
- EPA Guidance Statement for the Assessment of Terrestrial Fauna Surveys for Environmental Impact Assessment No. 56. Western Australia;
- National Environment Protection Measure for Ambient Air Quality, National Environmental Protection Council, 1998;
- National Health and Medical Research Council (NHMRC) Ambient Air Quality Goals;
- Guidelines for Acceptance of Solid Waste to Landfill 2002;
- DoE Contaminated Site Management Series, Bioremediation of Hydrocarbon-Contaminated Soils in Western Austalia;
- DoIR Guidelines on the Safe Design and Operating Standards for Tailings Storage;
- DoIR Guidelines on the Development of an Operating Manual for Tailings;
- Australian and New Zealand Minerals and Energy Council (ANZMEC) and Minerals Council of Australia (MCA), Strategic Framework for Mine Closure;
- Commonwealth Environmental Protection Agency Series 'Best Practice Environmental Management in Mining' 1995; and
- AS 2436-1981 – Australian Standards Guide to Noise Control on Construction, Maintenance and Demolition Site.

5.1 Current Status

At present there are no atmospheric emissions at the site. There are also no ambient air quality data available for the region. However, given the rural nature of the area and the lack of either urban population or industry, existing air quality is expected to be good. On occasion suspended and deposited particulate levels may be elevated due to windblown dust, erosion and/or bushfires. Soil and landform studies commissioned by Gunson have confirmed that the surface sands of the Project Area have a proportion of fine sand and a degree of instability due to wind erosion.

Despite the likelihood of existing background levels of particulates being elevated on a seasonal basis, the modelling undertaken for the air quality assessment conducted assumed zero background concentrations to represent an estimate of the atmospheric impacts associated with the proposal only.

To assist with the air quality assessment, an atmospheric dispersion modelling study has been undertaken in order to estimate maximum pollutant concentrations. TAPM, (v.2.0) and AUSPLUME (v.6) were used to model potential air quality impacts arising from the Project in accordance with the EPA guidelines. Further detailed information regarding these models and methodology can be found in the Air Quality Assessment Report (Appendix N).

The study discussed above was undertaken by Gunson in March 2005. Results from the modelling suggest that atmospheric emissions such as NO_X, CO and SO_2, generated from the Project are predicted to represent negligible risk at nearest sensitive receptors. Gunson will monitor the latest developments in pollution control technology and implement where practical as a part of their commitment to continuous improvement to environmental management.

Dust modelling studies have however indicated that there is potential for off-site issues particularly given the strong southerly winds occur during much of the year, therefore this plan focuses on the management of fugitive dust. Fugitive sources of particulate (as PM_{10}) represent the greatest contributor to regional air emissions, although still well below ambient guideline criteria for public health and amenity.

5.1.1 Climate and Meteorology

The Shark Bay district is located within a transitional climatic region that experiences an overlap of tropical and temperate zones, resulting in hot dry summers and mild winters. The area is classified as a Hot Grassland (summer drought) by Bureau of Meteorology, BOM (2003). The area is affected by the winter circulation of the south, and the monsoonal summers of the north.

The maximum temperature is high most of year, and extreme in summer. Summer can bring thunderstorm activity, significant rainfall, tropical cyclones, extreme wind, low levels of cloud cover, extended sunshine duration and high levels of incident solar radiation.

Rainfall is sporadic, with annual precipitation ranging 200-400 mm, and the timing and magnitude of rain is highly influenced by cyclonic and thunderstorm activity. Average annual rainfall is about 212 mm at Hamelin Pool. The majority of rain falls between May and August. Evaporation is high ranging from 3,000 mm in the east to 2,000 mm in the west. This is largely attributed to the lack of cloud cover, low humidity and medium to strong winds.

Table 5.1 provides climate data for the Hamelin Pool weather station, which is located to the north of the Project Area.

Table 5.1 Climatic Data from Hamelin Pool Weather Station

Month	Mean Monthly Rainfall (mm)	Mean Daily Maximum Temperature (deg C)	Mean Daily Minimum Temperature (deg C)	Mean Daily Evaporation (mm)	Mean Monthly Evaporation (mm)	Mean Wind Speed (km/h)	Mean Relative Humidity (%)
Jan	7.6	36.9	20.5	13.4	415.4	18.1	39.5
Feb	13.1	36.7	21.2	13.9	392.7	17.8	42.5
Mar	15.7	34.9	20.1	11.6	359.6	16.5	43.0
Apr	13.7	30.3	17.0	7.1	213.0	14.7	48.0
May	33.1	25.2	13.2	5.2	161.2	13.4	54.0
Jun	47.7	21.5	10.6	3.4	102.0	12.2	63.5
Jul	40.2	20.7	9.2	3.4	105.4	13.3	62.5
Aug	21.5	22.2	9.4	4.7	145.7	14.4	55.0
Sep	8.1	25.4	11.1	6.5	195.0	17.5	46.5
Oct	5.2	28.2	13.0	10.0	310.0	19.2	42.0
Nov	3.7	31.8	15.8	11.0	330.0	19.6	39.0
Dec	2.4	34.8	18.3	12.5	387.5	18.5	39.0
Annual	211.9	-	-	-	3,117.5	-	-
Daily	-	29.1	15.0	8.7	-	16.3	47.5

Source: BOM (2004); BOM station 006025 Hamelin Pool; 20 to 105 years of record.

The area is influenced by southeast trade winds, which generate southerly winds for the majority of the year. During summer, southerlies consistently blow over 25 km/hr for several days. Cyclones generating wind gusts up to 180 km/hr occur periodically over summer and autumn.

Figure 5.1 shows the Coburn (the Gunson Project Area) TAPM data split into seasonal windroses for 2002. The windroses were generated to characterise the existing meteorological conditions and validate the meteorological data files for modelling purposes.

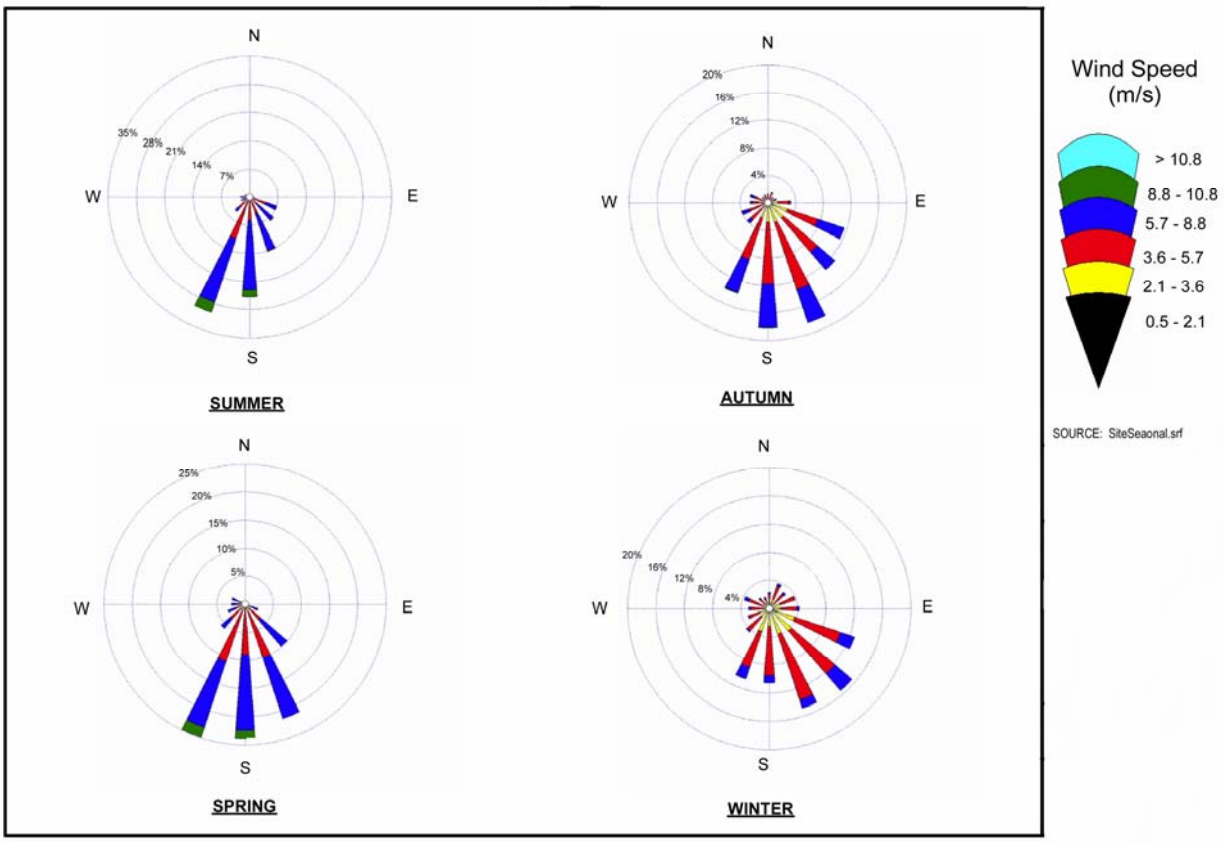

Figure 5.1: Windrose for Coburn 2002 (TAPM Generated)

5.2 Potential Impacts

Potential sensitive receptors from dust deposition include:

- Stromatolites at Hamelin Pool; and
- Vegetation in the SBWHP.

The following types of particulates have been identified as being generated from the Project.

5.2.1 Suspended Particulates

Suspended particulate matter is dust or aerosol that stays suspended in the atmosphere for significant periods. The current nomenclature is to describe fractions of suspended particulate as:

- PM_{10}: all particulate effectively less than 10 microns (μm) in diameter;
- $PM_{2.5}$: all particulate effectively less than 2.5 μm in diameter; and
- TSP: total suspended particulate, generally less than 50 μm in diameter.

Within the range of suspended particulate, the group of particles which are sized 10 µm or less (PM_{10}) have been associated with health effects including increases in mortality, aggravation of existing respiratory and cardiovascular disease, increased hospital admissions and increased asthma incidents. More recent research however, indicates that it may be the $PM_{2.5}$ fraction that has the greatest impact on human health. Particulate that are larger than 10 µm, tend not to be able to penetrate the respiratory tract and do not appear to be significant with respect to potential health effects.

Major natural sources of background particulate levels include bushfires, pollen and wind-blown dust from exposed areas. Anthropogenic sources include stationary and mobile combustion sources, road dust, agriculture, mining, major fires and emissions from industrial processes. Background levels vary widely depending on location, meteorology and proximity of major point or area sources.

TSP and PM_{10} are recognised as the primary pollutants of concern for the Project, in particular, those arising from fugitive sources. As such dust mitigation measures have been recommended to minimise off-site impacts during the life of the Project.

5.2.2 Deposited Particulate Matter

Deposited particulate matter is dust that, because of its aerodynamic diameter and density, rapidly falls from the air. In general terms, deposited particulate has a diameter of greater than about 20 µm. However there is no sharp dividing line between these particles and the smaller particles of suspended matter that fall more slowly out of the air. Because of the size of the particulate matter, most of this material will not enter the body. Hence the effects of deposited particulate are primarily nuisance, and may only affect health via annoyance reactions and the like.

The dust deposition rate is measured as the amount of dust deposited on a horizontal surface as a result of gravitational settling over a specified time period. The units for this parameter are grams per square metre per month (g/m^2/month).

Problems with dust generation are most likely to occur during the transportation of Heavy Mineral Concentrate (HMC) on internal roads and during topsoil and overburden stripping activities. The construction and operation of the Project will also generate dust through clearing and topsoil removal and vehicular movement. The clearing will be staged to minimise the areas of exposed soil at any one time.

Dust fallout and suspended particulates are potentially significant issues for the proposed development, due to possible nuisance effects on neighbouring properties and the potential for non-compliance with the National Environmental Protection Measures (NEPM) goals. The degree of dust generated will also depend on the moisture content of the ground surface.

5.2.3 NEPM Air Quality Criteria

In June 1998, the National Environment Protection Council (NEPC) released a National Environment Protection Measure (NEPM) for Ambient Air Quality, setting out national standards and goals for criteria pollutants. It should be noted however, that these goals are designed for use as regional goals and are not intended to be used as near-source or site boundary criteria.

In 2003, the Ambient Air Quality NEPM was amended to include an Advisory Reporting Standard for $PM_{2.5}$. Ambient air quality criteria applicable to this proposal are given in Table 5.2.

Table 5.2 NEPC Ambient Air Quality Criteria

Pollutant	Maximum Concentration	Time Average
PM_{10}	50 ug/m^3	annual
$PM_{2.5}$	25 ug/m^3	24-hours
(advisory reporting standard)	8 ug/m^3	annual

5.2.4 NHMRC Goals

The NHMRC have published ambient air quality and interim national indoor air quality goals. These are presented in Table 5.3.

5.2.5 NSW Impact Assessment Criteria

Impact assessment criteria apply downwind of a proposed facility. They are set to protect against adverse effects on human health and are therefore, much lower than emission limits set for concentrations in the stack.

A comprehensive approach has been taken by the New South Wales Environment Protection Agency (NSW EPA) with the publication of impact assessment criteria to be applied in the design stages of an activity to ensure that there will be no impact on people's health or amenity. These criteria are set on the basis of the toxicity of a chemical or, if more stringent, the odour threshold of a pollutant. These criteria cover the full range of pollutants associated with the proposed Project and are considered appropriate to this proposal.

NSW EPA impact assessment criteria are given in Table 5.4. In addition to these, the NSW EPA has set a criterion of 4 g/m^2/month for deposited dust to protect amenity.

Table 5.3 Recommended Ambient Air Quality Goals (NHMRC)

Parameter	Ambient Limit		Measurement Criteria
	(ug/m^3)	(ppm)	
Total Suspended Particulate	90	-	Annual average

Table 5.4 NSW EPA Impact Assessment Criteria

Pollutant	Assessment Criteria (µg/m^3)	Time Average
PM_{10}	50	1-hour
	30	Annual
TSP	90	annual
Deposited Dust	4 g/m^2/month	annual

5.3 Stakeholder Consultation

Gunson has undertaken preliminary stakeholder consultation with CALM, DoE and surrounding pastoralists in regards to the management of dust. This process will continue throughout the life of the Project and will address any issues raised by stakeholders. A key concern raised during this process was the impact of dust on vegetation and marine values in Hamelin Pool. The monitoring and reporting programmes will focus on the associated impacts of dust on these biophysical values. Gunson will also develop a complaints register and is target levels for emissions in consultation with the DoE.

5.4 Management

The following management actions have been integrated into the Project or will be implemented to ensure that there will be no adverse effects on the local and regional air quality as a result of the construction and operation of the proposed Project.

These include an emissions inventory, dispersion modelling and dust management procedures.

5.4.1 Emissions Inventory

An emissions inventory was prepared in accordance with the National Pollutant Inventory (NPI) Emission Estimation Technique (EET), Manual for Mineral Sands Mining and Processing (Environment Australia 2001). The inventory comprises a large number of fugitive sources such as removal of overburden by Bucket Wheel Excavator and wind erosion of exposed areas. Emission estimates from these types of sources relies heavily upon calculations using emission factors. Emissions of dust (particulates) were determined for two mining periods for the proposed operations that represent 'worst case' scenarios for off-site impacts to surrounding receptors:

1. *Scenario 1* - During the first period of operation during which it is anticipated to have greatest exposed areas of disturbance as the initial pits, infrastructure and haul roads are constructed; and

2. *Scenario 2* - Towards the end of the mining operations, during which the mining will be at its northernmost extent and closest to Hamelin Pool.

Gunson estimates that approximately 20 million tonnes per annum of overburden and ore will be moved in the first two years, increasing up to 50 million tonnes per annum in subsequent years. Mining activities that have the potential to result in dust emissions include the following:

- topsoil removal and replacement;
- subsoil removal and stockpiling;
- excavation of overburden and ore;
- wheel-generated dust from machinery and vehicle movements on site; and
- dust pick-up (wind erosion) from exposed areas, including the operational pits, areas cleared for the concentrators and offices, access roads, stockpiles and the accommodation camp.

These emissions are typically referred to as 'fugitive' emissions. That is, they arise from open 'area' or 'volume' sources and are often intermittent. The annual emission estimates of TSP and PM_{10} for Scenario 1 and 2 are shown in and Table 5.5 (fugitive sources).

Table 5.5 Emissions Inventory: Fugitive Sources

Fugitive Sources	Scenario 1		Scenario 2	
	Annual Emission TSP	Annual Emission PM_{10}	Annual Emission TSP	Annual Emission PM_{10}
	(kg/yr)	(kg/yr)	(kg/yr)	(kg/yr)
Initial Pit Development	3,100	1,002	3,100	1,002
Wind Erosion Exposed Areas	215,360	107,680	221,235	110,617
Mining in Pit	25,521	11,417	51,042	22,834
Un/loading Stockpile Areas	13,148	5,882	23,172	10,367
Handling, Transfers and Conveying	31,536	12,614	63,072	25,229
Wheel generated dust	127,385	31,591	254,770	63,182
TOTAL (kg/yr)	**416,049**	**170,186**	**616,390**	**233,231**
TOTAL (T/yr)	**416**	**170**	**616**	**233**

(Based on NPI Emission Estimation Technique Manual for Mineral Sands Mining and Processing, Version 1, Environment Australia 2001)

The greatest contributor to PM_{10} emissions on an annual basis is wind erosion of exposed areas (Figure 5.2). This is also true of TSP emissions. The second greatest contributor to dust emissions is wheel generated dust. As this method of emission is assumed to occur over all the access roads, its effect on ground level dust concentrations at any one point is expected to be less substantial. This is due to the total area of the roads and their proximity to the rest of the access road network.

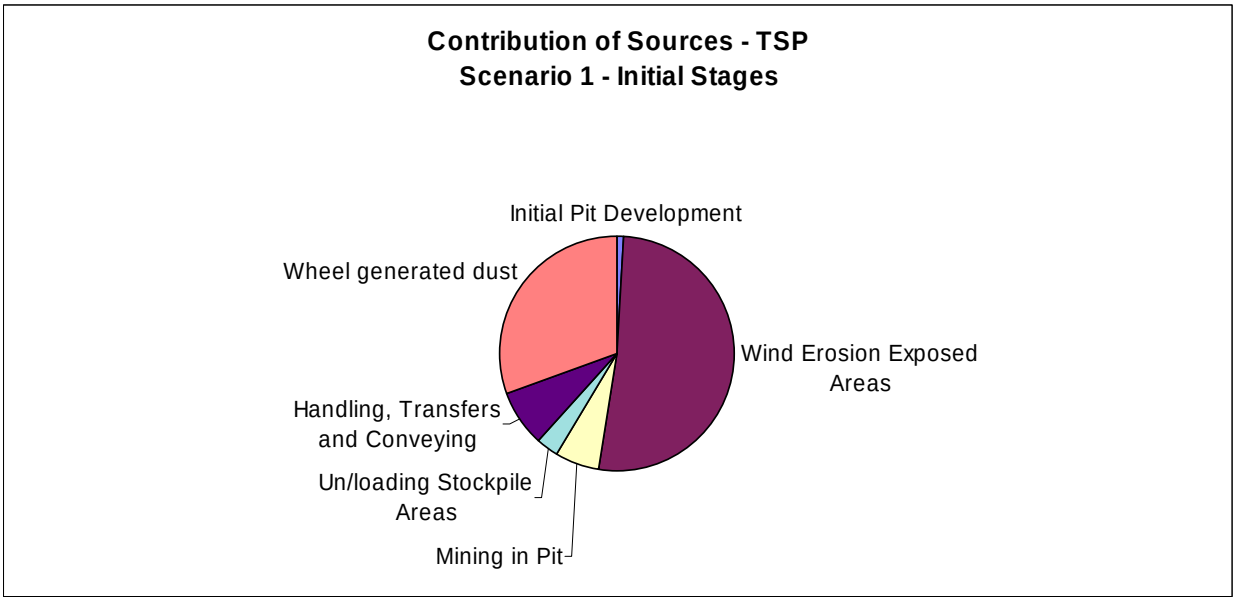

Figure 5.2: Annual PM10 and TSP Emissions by Source (Scenario 1 – Initial Development)

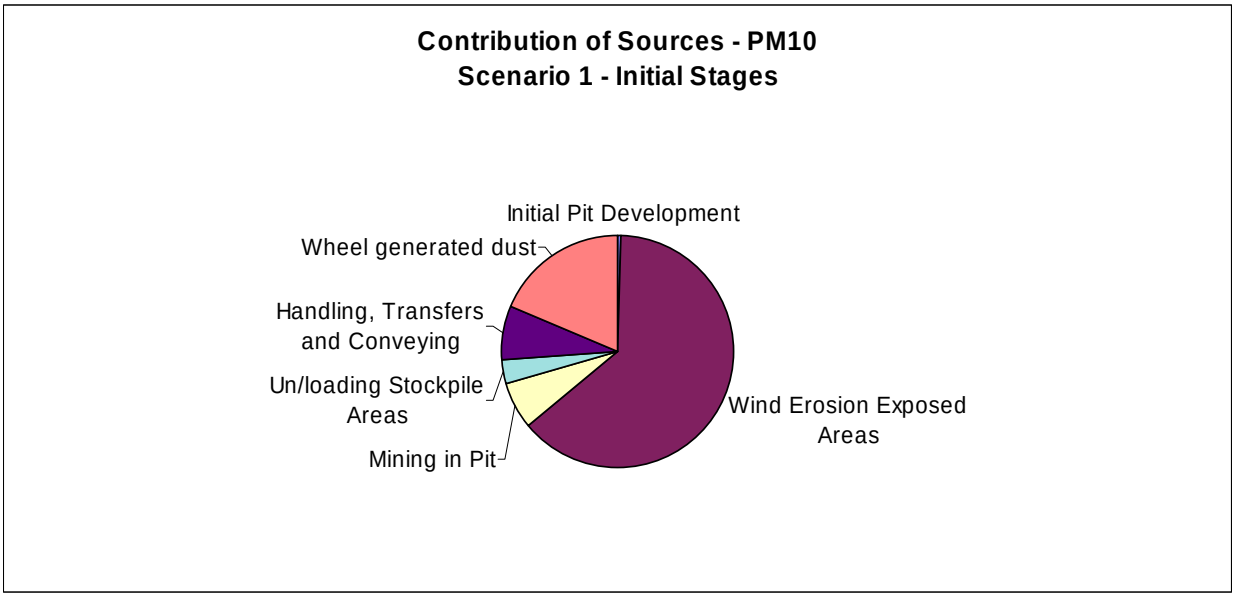

Figure 5.2: Annual PM10 and TSP Emissions by Source (Scenario 1 – Initial Development)

5.4.2 Dispersion Modelling

All particulates were modelled to predict maximum downwind concentrations. The following assumptions were used for modelling:

- The terrain was assumed to remain at sea level (flat) for the entire area of the site;
- Building dimensions were not considered as part of the modelling exercise; and
- The average canopy height of the terrain surrounding the site is approximately 2 m due to the presence of woodlands. A roughness factor of 0.4 m was therefore designated for land use. This roughness height is categorised as 'rolling rural' in AUSPLUME.

All particulate emissions were assigned to either 'area' or 'volume' sources and included in the dispersion modelling as follows:

- Volume sources (such as truck un/loading and stockpiles experiencing wind erosion) were located on the perimeter of the mine pit and assumed to be 3 m high;
- The area sources were all approximated to rectangular shapes and were set at ground level (including access roads). They were located based upon the south western corner of the area and aligned upon north within the grid coordinates and terrain already specified in AUSPLUME; and
- Deposited dust was based on the TSP emissions of Scenario 2 to capture the worst case of deposition into Hamelin Pool. Deposition was modelled as an annual average. This annual average was divided by 12 to convert it to a monthly average for comparison with the guideline value.

Table 5.6 presents a summary of the maximum predicted concentrations at all offsite receptor locations and at the discrete receptors (nearest sensitive receptors) for comparison with the respective guidelines.

Table 5.6 Dispersion Modelling Results

Pollutant	Maximum Predicted Concentration	Guideline	Units, Time Average
TSP			
Off-site	20.27	90	µg/m^3, annual
Coburn Homestead	0.16		
PM_{10} (24- hours)			
Off-site	20	50	µg/m^3, 24-hours
Coburn Homestead	1.8		
PM_{10} (annual)			
Off-site	1.7	30	µg/m^3, annual
Coburn Homestead	0.064		

The modelling results show maximum off-site concentrations are within guideline criteria for all particulate types. Further information on the emission inventory assessment methodology is provided in the Air Quality Assessment Report (Appendix N of the PER).

5.4.3 Dust Management

Dust generation during the vegetation clearing activities will be managed by undertaking the clearing in stages to minimise the areas of exposed soil at any one time. Dust generation during the transportation of material and the operation of the mineral sand mine is unlikely to have a significant impact on nearby land users, as stringent dust control measures will be implemented during the construction and operational phases of the project. These include:

- providing a buffer zone of vegetation between the proposed mining areas to act as windbreaks, reducing wind velocity and dust mobilisation;
- implementing a progressive rehabilitation program to reduce the risk of dust generation;
- ensuring exposed stockpiles are watered or sprayed where required;
- not overloading trucks or conveyors to avoid spillages;
- regular wetting and grading of all unsealed roads;
- commencing rehabilitation as soon as possible after mining;
- not disturbing topsoil until absolutely required;
- using biodegradable or inert chemical polymers/bitumen to stabilise bare soil surfaces;
- scheduling vegetation and soil clearing for the months of April and May;
- undertake a comprehensive monitoring programme;
- where appropriate, growing temporary cover crops to bind the soil and protect soil surface from wind; and
- providing appropriate training for site personnel.

5.5 Monitoring

It is anticipated that through the implementation of the proposed management actions, the likelihood of adverse impacts arising from the Project will be prevented. To confirm this prediction, the following monitoring procedures will be implemented:

- Sampling of control sites to allow comparison with areas that have been unaffected by the operations;
- Installation of dust deposition gauges/bags that will provide basic, long term data;
- Photographic monitoring at established control sites throughout the minesite and adjacent areas (SBWHP and Hamelin Pool);
- Continuous particle monitors for collection of continuous data on short-term events; and
- Size selective samplers designed to sample dust fractions of a particular size.

Results from the monitoring programme will be used to confirm the accuracy of the dispersion models within five years of commencement of the mine.

An assessment of deposited dust levels at nearest sensitive receptors, including the Hamelin Bay stromatolites (north) and vegetation in the SBWHP (west) will be integrated into the monitoring programme.

Other qualitative assessments undertaken during the construction and operation of the Project will include complaints from neighbours and visual assessment of dust emissions to ensure no adverse off-site impacts at key receptors occur.

5.6 Reporting

Reporting will record the method of monitoring, the number and type of complaints (if received), the results of any monitoring undertaken and any changes in control measures. This information will be provided to the DoE and DoIR in Gunson's Annual Environmental Report.

5.7 Contingency

The Mine Manager can order work to cease if it is considered that conditions may cause unacceptable dust levels. The Mine Manager can also order lower speed limits if necessary to prevent unacceptable dust levels. Contingency actions will be initiated when problems are identified during the monitoring programme, or an adverse impact has been determined in consultation with relevant stakeholders.

Once detected, the adverse impact will be reported to the DoE and investigated by an independent suitably qualified professional. Upon determination of the cause, a remediation strategy will be developed and implemented in consultation with the DoE.

5.8 References

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Environment Australia 2001, NPI Emission Estimation Technique Manual for Mineral Sands Mining and Processing. Version 1 April 2001.

National Environment Protection Measure for Ambient Air Quality, NEPC, 1998, www.ephc.gov.au Environmental Protection &

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National Health and Medical Research Council NHMRC Ambient Air Quality Goals. http://www.nhmrc.gov.au/publications National Health and Medical Research Council website. Date Accessed: 29 November 2000.

6.1 Current Status

At present there are no liquid or solid waste issues within the Project Area.

6.2 Potential Impact

During the construction and operation of the mine there will be several potential sources of solid and liquid waste. These include:

- Waste water;
- Hydrocarbons;
- Structural waste;
- Domestic waste;
- Sewage; and
- Waste water from the desalinisation plant.

If these wastes are not managed, then a range of potential impacts are possible. These include the contamination of land, surface water and groundwater, ecological habitats and an increase in weeds.

6.3 Environmental Objectives

The environmental objectives for the Liquid and Solid Waste Management Plan are to:

- Minimise any solid and liquid wastes produced as a result of the mining process;
- Ensure waste is disposed of in an environmentally acceptable manner in accordance with regulatory requirements;
- Integrate a waste hierarchy (i.e. avoid, reuse, reduce, reuse, recycle, treat, dispose) for waste minimisation and establish a 'closed loop' within as many waste streams as possible; and
- Ensure no release of hydrocarbons to the environment, either as a result of storage or handling incidents.

6.4 Performance Indicators

The success of the Liquid and Solid Waste Management Plan will be determined by routine monitoring of groundwater levels and quality, solid waste quantities and compliance to relevant standards, guidelines and local authorities.

The relevant acts and guidelines in regards to the management of liquid and solid waste are:

- *Environmental Protection Act* 1986;
- *Health Act 1911- 1979*
- *Mining Act* 1978;
- *Explosive and Dangerous Goods Act* 1961-1978;
- Environmental Protection (Controlled Waste) Regulations 2001;
- Environmental Protection (Liquid Waste) Regulations 1996;
- Guidelines for Acceptance of Solid Waste to Landfill 2002;
- Guidelines on the Safe Design and Operating Standards for Tailings Storage (DoIR);
- Guidelines on the Development of an Operating Manual for Tailings Storage (DoIR); and
- ANZMEC/MCA Strategic Framework for Mine Closure.

6.5 Stakeholder Consultation

Stakeholder consultation has been undertaken with the DoE and the Shire of Shark Bay. Further information will be contained in the license to be

applied for under Part V of the *Environmental Protection Act* 1986.

6.6 Management

Gunson will work to minimise, reuse and recycle wastes. Solid and liquids wastes will be treated or disposed on-site where possible. Waste material will be managed on-site to prevent groundwater and surface water contamination or risk to public health. Wastes that are transported off-site will be managed in accordance with the *Environmental Protection (Controlled Waste) Regulations, 2001*. On-site operations will comply with all applicable licence conditions. Each type of waste that will be generated at the site and its management is outlined below.

6.6.1 Waste Water

The major source of water loss is to tails replacement. Sand tailings will be produced at a rate of 2,180 tph for each 2,200 tph concentrator. The sand tails are pumped as a slurry at a density of 55% solids by weight from the concentrator to a series of cyclones located in the mined-out pit. The cyclones dewater the sand tails to approximately 65-70% solids to allow water to be recycled. The stacking system is used to generate the contours with final shaping by bulldozers ahead of resurfacing with subsoil and topsoil. When required, a portion of the recovered water is directed to a settling dam and pumped to the in pit screening module for re-use. The settling dam will be located in the mine void between the sand tails and the pit batter.

When the slimes content of the recovered water is too high, the water will be diverted to the slimes settling trench where the slimes will be settled and clear water recovered.

6.6.2 Hydrocarbons

Oils and greases will primarily be used by the earthmoving contractor. All waste oils will be collected by the contractor and recycled to an approved facility. Oily rags and filters for disposal will be recycled or disposed of at an appropriate hydrocarbon disposal facility.

Hydrocarbon products will be stored above ground in bunded facilities and will be constructed and operated in accordance with Australian Standards. A Hydrocarbon Management Plan is provided in Section 7

6.6.3 Structural Waste

Structural waste may be generated from maintenance activities. This waste will be recycled through a scrap metal merchant, where possible.

6.6.4 Domestic Waste

Domestic waste such as general refuse, green waste, paper and putrescibles will be collected and disposed of to an on-site landfill. Where possible, recyclable wastes will be collected separately and transported off site to a recycling facility.

6.6.5 Stormwater

All stormwater from the plant site will be intercepted by a drainage system and channelled into a sediment retention basin and oil separator, stored and allowed to evaporate.

Runoff from sealed areas will also be channelled to retention ponds where it will be allowed to evaporate. Drainage systems will be designed to withstand the extreme effects of storm and flooding activities. They will also be designed and constructed to prevent leakage to groundwater.

6.6.6 Sewage and Grey Water

There will be a small amount of waste generated from Gunson site personnel from the crib rooms and ablutions on the site. There will typically be a total of 105 personnel on the site over a 24 hour period once full production is attained. It is anticipated that each of these personnel will generate 10 – 50 litres of wastewater per day as a result of flushing toilets and washing.

The camp and offices will be designed and installed with suitable processing systems to dispose of domestic liquid waste such as sewage and grey water. The site disposal system will be designed to comply with all relevant standards and discharge requirements specified by the Health Department and the Water Corporation.

6.6.7 Waste Water from Desalination Plant

Some 200 KL/day of potable water will be required to service the workforce. This will be obtained by desalination of brackish groundwater.

The desalination system has not been selected as yet, but it is anticipated that approximately 20 KL/day of saline waste water is to be discharged with the tailings into the mined-out pit.

6.7 Monitoring

Monitoring will be conducted for water quality to ensure that levels do not cause an occupational or environmental hazard. Water samples will be collected from major retention ponds and discharge points for analyses of sediment load, salinity, pH and other relevant parameters on a monthly basis.

Regular inspections of on-site landfill and waste treatment facilities will be undertaken to ensure that liquid and solid waste is adequately disposed of and the appropriate guidelines are being satisfied.

Details of quantities, concentrations and other data obtained during the monitoring program will be the responsibility of the Environmental Coordinator. Information on monitoring and incidences will be reported within the company's database or operations day book.

For significant waste incidents and complaints a more intensive monitoring and management program will be implemented.

6.8 Reporting

All incidents and spills will be recorded and reported to the EH&S Superintendent and documented in Gunson's Annual Environmental Report. All incidents of significant environmental impact will be reported to the DoE.

6.9 Contingency

All site personnel will be given adequate training to take appropriate precautions to minimise the risk of an incidence or spill. In addition, personnel will be trained in emergency response procedures to effectively manage emergency situations.

In the event of a spill, remediation will be conducted as soon as possible. Gunson will maintain documented procedures, accountabilities and a completed register of these sites.

7.1 Current Status

Gunson recognises the potentially harmful effects of hydrocarbons on the environment and human health and safety. The Hydrocarbon Management Plan is designed to provide guidance and to ensure that all storage and use of hydrocarbons are regulated and monitored consistently. It is also designed to allow for rapid recognition of any hydrocarbon spillage or leaks, and to quickly control these losses and minimise their impact.

At present there are no hydrocarbon contamination issues at the site.

7.2 Potential Impact

All mine sites have accidental spillages of hydrocarbons which can cause minor to significant harm to the environment. In the majority of cases, a contaminated site will be the result of an unexpected incident (eg. hose burst on a hydraulic machine).

When released into a natural environment, hydrocarbons can have a range of negative impacts. They can be released in a variety of manners, and in an array of forms.

Hydrocarbons can affect the environment by significantly reducing the quality of the soil and groundwater and negatively impacting the rehabilitation process. They can also significantly affect human health and safety when handled incorrectly, and when stored in a way that increases the risk of fire.

7.3 Environmental Objectives

The environmental objective of the Hydrocarbon Management Plan is to ensure no release of hydrocarbons to the environment, either as a result of storage or handling incidents.

7.4 Performance Indicators

The effectiveness of the Hydrocarbon Management Plan will be determined through the regular monitoring of groundwater quality. These may be simple, regular tasks that allow for effective analysis of an incident. Further performance indicators include recording the quantity of hydrocarbons in storage facilities and determining when any inconsistencies in quantities occur.

The key guidelines in regards to the management of hydrocarbons are the Contaminated Sites Management Series (DoE 2004) and Environmental Protection (Controlled Waste) Regulations 2001

7.5 Stakeholder Consultation

Hydrocarbon management has not been raised as an issue of concern during stakeholder consultation to date. Consultation during Project construction and operations will continue to be conducted with the DoE and DoIR.

7.6 Management

In relation to management of hydrocarbons, there are six main aspects that should be continually monitored and reviewed during construction and operations. These comprise storage of hydrocarbons, transportation, containment, awareness and use, recycling, disposal and spill response.

7.6.1 Storage

All hydrocarbon fuel areas will be appropriately signposted and constructed in accordance with the type of hydrocarbon being stored. Regular inspections will be carried out on all storage facilities to ensure the structures are fit for purpose.

Handling techniques and equipment are to be identified and be appropriate to the type of hydrocarbon, in accordance with the Water Quality Protection Guidelines No.10 Mining and Mineral Processing – Above-ground fuel and chemical

storage (2000) and AS 1692 – Tanks for Flammable and Combustible Liquids (1989).

7.6.2 Transportation

Supply Officers are accountable for ensuring that all carriers and/or contractors used for the transportation of hydrocarbons are selected on their ability to comply with Government regulations.

7.6.3 Containment

Containment facilities will be appropriate to the type of hydrocarbon being stored/used and will, as a minimum, meet the relevant Australian Standards and Government regulatory requirements.

Containment facilities available for hydrocarbon products include:

- Bunding;
- Closed drains;
- Interception pits;
- Transfer pit shielding; and
- Special storage pits incorporating bunding.

A register of containment facilities will be maintained and appropriate testing will be carried out at nominated intervals by a reputable testing authority. Records of all tests will be maintained in the register.

7.6.4 Awareness and Use of Hydrocarbons

The responsible use and handling of hydrocarbon-based products will minimise the potential for spillage loss through wastage. The Environmental Coordinator will examine work procedures, identify areas with the potential to impact on the environment and implement methods of decreasing wastage/spillage.

All contractors and suppliers must be aware of, and follow, the safe handling procedures during the transfer of hydrocarbon-based products. Contractors must be able to demonstrate that they conform to the appropriate written procedures to undertake work and practices for individual tasks.

Accountabilities for loading, unloading and transporting of hydrocarbons and waste oils will be clearly assigned for both internal and external suppliers and transporters. These will be maintained and updated as part of the site's environmental management system.

7.6.5 Recycling

All hydrocarbon products will be used to their full capacity. Once utilised, methods of recycling will be investigated prior to the consideration of other disposal methods.

7.6.6 Disposal of Waste Hydrocarbons and Containers

Disposal of waste hydrocarbons and containers will be conducted as follows:

- Oil and Grease – Waste oil and grease will be collected by contractors and recycled to an approved facility.
- Oily Waste Water – Waste water will be contained on site and either filtered to remove the oil residues and disposed of onsite or removed from site and disposed of by approved contractors.
- Oil Filters and Rags – Oil filters, oily rags and disposable containers will be separated on site, recycled or drained free of oil prior to transport. Once off site, the filters and rags will be disposed of at an appropriate hydrocarbon disposal facility or council landfill sites.

7.6.7 Hydrocarbon Spill Response

If a spill does occur, the following process will be followed:

- Check: for DANGER to yourself and others (hydrocarbon fumes, potential to slip on liquid). If the type or quantity of the spill presents an threat to personnel or the environment, the area will be evacuated and the Mine Manager will be contacted immediately;
- Control: Locate source and plug any leaks, shutdown pumps, etc;
- Contain: Absorb spilt hydrocarbons, build temporary earthen bunds or diversion if necessary, cover drains;
- Cleanup: Restore the area to its pre-spill condition by using absorbent material to soak up residual hydrocarbon. Use a skimmer to collect contained hydrocarbons in a triple oil separator, or retain the spilled hydrocarbon on the surface of a body of water and pump to a suitable storage container. Waste oil or fuel and oily water are to be disposed of by recycling via a recognised collection/recycling agency;
- Report: The incident is to be reported to the supervisor and in the operations 'day book'. (All personnel are responsible for ensuring that immediate action is taken to report any hydrocarbon incident, and to minimise the spread and environmental impact of any hydrocarbon spill, provided it is safe to do so); and
- Replace: Restock materials and replace any damaged or faulty equipment.

In the event of a spill, the bioremediation of the affected area would be undertaken in accordance with the Contaminated Sites Management Series, Bioremediation of Hydrocarbon-Contaminated Soils in Western Australia (DoE 2004).

7.7 Monitoring

An inventory of all receivals and dispatches of all hydrocarbon products from all major hydrocarbon storage facilities will be maintained. The inventory should record the following information:

- Supplier, quantities, types and storage location of hydrocarbon products arriving onsite;
- Quantities and types of hydrocarbons consumed;
- Hydrocarbons lost to the environment by evaporation and spillage; and
- Hydrocarbons leaving the site as secondary waste (ie. trace amount in effluent).

The above information will be recorded and maintained.

All hydrocarbon storage and dispensing facilities will be subject to regular audits, and if required, appropriate corrective action taken.

Vehicles, machinery and the in-pit machinery will be inspected for any actual or potential leaks at the commencement of construction and again at the commencement of operations. The storage and dispensing facilities, vehicles, machinery and the in-pit machinery will also be inspected regularly.

7.8 Reporting

All incidents of hydrocarbon contamination will be reported to supervisors and documented into an operations 'day book'. Incidents will be reported in Gunson's Annual Environmental Report. All incidents of significant environmental impact will be reported to the DoE.

7.9 Contingency

All site personnel using hydrocarbon products will be provided with adequate training to take appropriate precautions to minimise the risk of spillage and misuse. All soil at risk of contamination will be

regularly assessed, and if contaminated, remediation will be conducted as soon as possible. Gunson will maintain documented procedures, accountabilities and a completed register of these sites.

A spillage register or incident tracking system shall be developed, maintained and made available at all times to internal or external auditors.

8.1 Current Status

Radiation is naturally associated with mineral sands owing to the presence of thorium and monazite. Naturally occurring background radiation levels are typically low and would only present a radiological hazard when in concentrated form.

A pre-mining gamma radiation survey of the proposed Project Area was conducted in July 2004. Radiation Advice & Solutions Pty Ltd undertook the Pre-Operational/Baseline Radiation Monitoring Program (refer to Appendix I of the PER) using soil samples and gamma doserate readings from some 35 sites, primarily concentrating in the southern part of Amy Zone, which is to be mined in the earlier years of the Project. Soil samples were then analysed by an external laboratory for uranium and thorium.

The expected heavy minerals content of the ore to be mined from the Project (at 1.1%) is quite low compared with typical Western Australian mineral sand operations, and the heavy mineral suite is in turn, very low in monazite content (0.1-0.2%). As a result, the HMC to be produced in the wet concentrator is much lower in radionuclide content than the typical HMC produced at other WA sites. For example, a thorium grade of less than 140 ppm is expected, compared to the typical level of 300 ppm (Hewson & Upton 1996).

The pre-operational environmental gamma survey showed very low levels (less than two nanosieverts per hour) of above-ground radiation, consistent with local sandy soils containing very low levels of uranium, thorium, and potassium. Even locations which had been identified as containing higher grades of heavy minerals showed gamma radiation doserates that were essentially no more than the cosmic ray component. This was due to the very low monazite content (and hence uranium and thorium content) in the heavy mineral suite. In comparison, these doses are very low considering that background cosmic radiation is approximately 30 nanosieverts per hour in mid-latitude locations.

8.2 Potential Impacts

The potential radiological impacts arising from the Project include:

(i) emission of radionuclides in fugitive dust;

(ii) emission of radon and thoron gas;

(iii) release of dissolved radionuclides to groundwater or to surface waters; and

(iv) direct gamma shine from stockpiles and uncovered ore.

These impacts can result in radiation doses to workers and to members of the public. In the case of the Project, all of these potential impacts are assessed to be negligible, but monitoring of the workers involved in stockpiling, loadout, and transport of the product heavy mineral concentrate to the purchaser's facilities would be advisable, for an initial period, to confirm the lack of hazard and fulfill 'duty of care' and due diligence obligations. The reasons why the radiological impacts of the Project are assessed to be so low are outlined below.

(i) radionuclides in fugitive dust:

This is likely to be insignificant as a dose delivery pathway, for two reasons. Firstly, the as-mined mineral grain size is so large as to almost preclude the possibility of dust suspension in air (although attritioning can in principle produce finer particles); and secondly, the radionuclide content of the mineral grains is substantially below the average for other WA mineral sand deposits.

(ii) emission of radon and thoron:

This is assessed as insignificant as a dose delivery pathway because of the low radionuclide content of the ore. It is also true that diffusion of radon and thoron from heavy mineral grains is minimal because of the tightly bound nature of the crystalline structure.

(iii) release of dissolved radionuclides to surface or ground waters

This is highly unlikely because the material as mined is highly insoluble and is deposited in dunes after concentration in an aqueous environment; and because no chemical processing takes place in the wet concentrator. Thus, the material remains insoluble throughout the process. Even in the case of tailings returned from a dry separation plant, the material would still be insoluble and immobile, and hence not a threat to the groundwater.

(iv) direct gamma irradiation:

Pre-operational baseline surveys undertaken suggest direct gamma irradiation to be insignificant, but may give a small dose to workers stockpiling and loading HMC. At commencement of the operations, these workers will be issued with radiation badges (e.g. Thermoluminescence Dosemeter [TLD] badges) to enable assessment of their doses. It is most unlikely however that even these "most exposed" workers will exceed the annual limit for members of the public (i.e., 1 millisievert), let alone approach the pro rata annual limit for radiation workers, which is 20 millisieverts.

Wet plant tailings are not radioactive nor chemically mobile. Thus, there is no radiation-related constraint on their disposal.

8.3 Environmental Objectives

The objectives of the Plan are to:

- Ensure radiological impacts to the public and environment are kept as low as reasonably achievable and comply with acceptable standards and statutory requirements; and
- Ensure that risk is managed to meet DoIR requirements and EPA criteria in respect of public health and safety.

Legislation and guidelines relevant to the management of radiation include:

- *Mines Safety and Inspection Act 1984*;
- *Radiation Safety Act 1975*;
- Radiation Safety (General) Regulations 1983;
- Radiation Safety (Qualifications) Regulations 1980;
- Radiation Safety (Transport of Radioactive Substances) Regulations 2001;
- EPA Draft Guidance Statement No. 2 (Off-site Individual Fatality Risk);
- Dangerous Goods Regulations 1992;
- Code of Practice on the Management of Radioactive Wastes from the Mining and Milling of Radioactive Ores 1982; and
- Commonwealth Code of Practice in the Mining and Milling of Radioactive Ores 1987 (which are currently being rewritten as the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing, due for release late 2005).

HMC trucked to the purchaser or to port for export will be exempt from the requirement to comply with the regulations as detailed in the Code of Practice for the Safe Transport of Radioactive Materials, issued by ARPANSA in 2001, which mirrors the international requirements issued by the International Atomic Energy Agency (IAEA). This exemption arises from the application of paragraph 107 (a) to (e) of the International Regulations, and of Clause 2.4 of the Australian Code.

Should mineral separation plant tailings be required to be returned to the pit for disposal, the material may need to comply with this Code, depending on the specific activity of the waste. Essentially, the Code requirements are that (a) the vehicles will need to be correctly 'placarded' as carrying radioactive materials, classified as Dangerous Goods Class 7; and (b) the drivers will need to carry "Consignor's Certificates" detailing the activity, Transport Index,

and identity of the material, which will be classified as LSA-1, Low Specific Activity ore concentrate. In addition, basic monitoring of the drivers will be necessary.

8.4 Performance Indicators

Basic dust monitoring and gamma surveys, radiation levels recorded by site personnel and any public complaints will be used as the main indicators of compliance and performance.

8.5 Stakeholder Consultation

Gunson has undertaken extensive consultation with DoE and DoIR in regards to the management of radiation. Key concerns raised during the process include the potential for on-site radiation hazards to exist from tailings being returned to the mine void.

While actual hazard to workers is expected to be minimal, issues such as radiation safety can become contentious and risk perceived to be greater when trust and confidence in management systems is low. Gunson is committed to further stakeholder consultation and addressing employee and community concern throughout the life of the Project. This will provide opportunities for workers and the community to be involved in the management plan so that confidence in safety measures is maintained.

8.6 Management

Following on-site surface radiation surveys and inspection of radionuclide content of the ore, it is confirmed that the potential impacts associated with operations of open pit mining and of the wet concentrator are negligible and will not require radiation control. However, Gunson plans to conduct surveys throughout the operation and decommissioning of the mine to ensure protection of the environment, public and employee health.

The following procedures will be used to manage radiation:

(i) Equipment, facilities, and procedures: These will encompass design features for dust and spillage control, as required. The area will be bunded to prevent dispersion by rainfall runoff. Dust control will comprise filtered, air-conditioned cabins for operators of fixed or mobile loadout plant.

(ii) Instructions and Training: All workers will be given basic radiation protection information and instructions in the form of a Radiation Safety Manual, at initial induction. This briefing will be recorded and the acceptance of the Rad Safety manual will be receipted. Information will include discussion of individual dose calculations and the method by which they will be reported back to the individual. Hygiene requirements, namely washing before meals and no smoking in the workplace, will be emphasised.

(iii) Waste Management System: Tailings from the wet concentrator will not contain regulatable concentrations of radionuclides. Thus there will be no specific radiation controls over the disposal of tailings. Because any monazite in the ore reports to the HMC product, essentially all radionuclides will be exported from the mine site and become the responsibility of the customer, to be disposed of by them unless material is returned to the mine for disposal.

(iv) Rehabilitation: Rehabilitation of the mined-out pit will take place progressively and comprises backfilling, contouring and revegetation.

Control of radioactive contamination in crib rooms and work areas will be provided for by periodic alpha probe surveys to confirm clean conditions. These would sensibly occur during commissioning, with the expectation that data will show that the surveys can then be discontinued. This decision will be based on no readings on visibly dust-free surfaces exceeding 0.4 Bq/cm^2.

There will be a program of dust sampling at the perimeter of the wet plant. This can be most simply done using passive collectors, with ‘controls’ at a distant location. These would be read at intervals of six months.

Groundwater samples will be taken down-gradient of waste disposal areas, proposed to be on a yearly basis, after commencement of any disposal of radioactive materials. This is intended to check for any movement of potential contaminants away from disposal areas. Table 8.1 summarises Gunson's proposed management procedures for the Project.

Table 8.1 Summary of Proposed Management Procedures

Pathway	Personal	Workplace	Environmental
Gamma Dose	Badges, eg, TLDs, issued 3-monthly to workers transporting HMC	Gamma survey by instrument, initially after commissioning, then yearly if reqd.	nil
Airborne Alpha Activity in Dust Concentration	Personal air samplers to workers in selected, during initial commissioning period, representative coverage	Fixed sampler(s), representative coverage	Passive dust collectors at plant boundary and at remote locations
Surface Contamination		Monthly survey of cribroom, workplaces, during commissioning.	
Groundwater			Sampled once at 1 year after disposal of any radioactive materials, downgradient

8.7 Monitoring

Gunson's mining operations will be monitored to ensure protection of the environment, public and employee health. Monitoring will include:

- Basic dust monitoring and gamma surveys twice annually around the HMC stockpiles, and if mineral separation plant waste is to be returned to the minesite, the waste tipping area;
- Basic monitoring of workers involved with the transport of the HMC. If results confirm doses are below acceptable standards, then monitoring may cease:
- Selected personnel will be issued with radiation badges (e.g. "TLD" badges) to enable assessment of their doses. It is most unlikely however that even these "most exposed" workers will exceed the annual limit for members of the public (i.e., 1 millisievert), let alone approach the pro rata annual limit for radiation workers, which is 20 millisieverts. If results confirm the doses are below the limit for members of the public, then with approval of DOIR, the company and *employees*, may decide to cease issue of the TLD badges; and
- Additional radiation monitoring as required, particularly in response to any complaint.

8.8 Reporting

The monitoring methods, results and recommendations will also be included in Gunson's Annual Environmental Report. The monitoring and reporting programmes will be the responsibility of the Environmental Coordinator.

8.9 Contingency Action

Contingency actions will be completed upon receiving stakeholder concerns and requests. Any incident which could involve unexpected radiation exposure will be reported promptly the mine manager.

8.10 References

Hewson G & Upton H 1996, Operational and Regulatory Aspects of the Management of Radioactive Wastes Arising from Mineral Sands Processing. Rad. Prot. In Aust. 14, No. 3, pp 60-67.

8.11 Acknowledgments

A Radiation Management and Monitoring Plan has been drafted by Radiation Advice & Solutions Pty Ltd on behalf of Gunson Resources Limited for the purpose of incorporation into this EMP.

9.1 Current Status

Gunson Resources Limited (Gunson) propose to mine and produce a heavy mineral concentrate from the Amy Zone at the Coburn Mineral Sands Project, located near Shark Bay. The Amy Zone is predominantly formed of re-worked Peron Sandstone situated along a north-south trending palaeo-coastline beneath the western margins of Coburn and Hamelin stations. Gunson propose to use bucket-wheel excavators to extract the ore, and then concentrate the heavy mineral fraction using water-based gravity separation methods. Process water supplies would be abstracted from regional confined aquifers that occur beneath the project area.

The Project is situated within the Gascoyne Platform of the southern Carnarvon Basin. Locally, the shallow stratigraphy is dominated by the Peron Sandstone of the superficial formations, Toolonga Calcilutite, Alinga Formation, Muderong Shale Formation (including the Windalia Sand Member) Birdrong Sandstone and Kopke Sandstone, formally known as the Gascoyne Platform sub-basin that encompasses the Shark Bay Region amongst other regions. Significant groundwater systems occur in the Gascoyne Platform sub-basin, in sediments of Palaeozoic and Mesozoic ages. Several sub-basins are located along the eastern and western margins that are geologically but possibly not hydrogeologically distinct from the Gascoyne Platform. Shallow groundwater is present in localised areas of saturated Peron Sandstone and undifferentiated estuarine deposits around the margins of Hamelin Pool (including the northern part of the project site), within the Tamala Limestone Formation along the Indian Ocean coastline and possibly in small pockets on Nerren-Nerren, Hamelin and Coburn Stations.

The groundwater quality (i.e. salinity) varies with depth and location around the Shark Bay Region. The shallow groundwater in the Tamala Limestone is generally fresh to brackish quality, while in the Hamelin Pool and inland areas, the shallow aquifers contain groundwater that is brackish to hypersaline. The deep aquifers (comprising permeable sandstones of Palaeozoic and Mesozoic age) contain brackish to saline groundwater. Generally, the deep groundwater systems are also vertically stratified with higher salinities at shallower depths and in proximity to the current-day recharge zone along the Ajana Ridge, east of the Gascoyne Platform.

Groundwater is utilised locally for pastoral, domestic and road maintenance purposes. Pastoral groundwater users within the local area include Coburn, Hamelin, Meadow and Carbla Stations with Tamala and Nerren-Nerren Stations at more distant locations, i.e. more than about 50 km from the Project site. Groundwater is used for domestic purposes at each of the above Pastoral Stations as well as the Hamelin Pool Telegraph Station Caravan Park, Nanga Resort, Billabong Roadhouse and the Overlander Roadhouse. Groundwater is also used for road maintenance by the Shark Bay Shire from Nilemah Artesian No. 1A bore located on the old Nanga Station property. The Shire is also planning to install a new bore within the Nanga property, south of the Useless Loop Road near the Nanga-Tamala Station boundary for a similar purpose.

The existing local groundwater users draw groundwater mainly from the deep aquifers including the Windalia Radiolarite, Windalia Sand Member of the Muderong Shale, Birdrong Sandstone, Kopke and Tumblagooda Sandstones. In the project region (i.e. within about 50 km of the project site), groundwater is drawn primarily from the Windalia Sand Member and Birdrong Sandstone to the south-east, east and north-east; and from the Windalia Radiolarite and Birdrong Sandstone to the north-west. Outside the Project region, Tamala Station draws shallow groundwater from the Tamala Limestone using shallow bores and wells. Meadow and Nerren Nerren Stations draw groundwater from the Windalia Sand Member, Birdrong Sandstone and Tumblagooda Sandstone.

The Project plans to draw process water supplies from the Birdrong Sandstone and Kopke Sandstone to minimise the effects of drawdown on the local bores. The issue of excessive drawdown impacts is of concern to the operators of private bores in the region. A general issue includes the availability and

sustainability of drawing large amounts of groundwater from the confined aquifers in the Gascoyne Platform sub-basin.

It is planned to use brackish groundwater derived from the Birdrong and Kopke aquifers to form a sand slurry to concentrate the heavy minerals and deliver the treated sand back to the open pit for deposition by hydraulic stackers. It is intended that Gunson will recover mine water from the barren sand in the open void directly behind the mine face during the process and immediately before hydraulic stacking. The stacked sand will contain excess water that will drain quickly to the relatively impermeable basement, which will normally consist of the Toolonga Calcilutite. The effectiveness of the drains on the pit floor will largely determine the amount of mine water recovered and to a lesser extent the amount lost to mounding beneath the tailings.

No groundwater-dependent flora or fauna are known in the Project Area. No stygofauna were found following a survey conducted on all shallow groundwater bores in and near the Project Area. The nearest groundwater dependent ecosystem is likely to be the estuarine ecology associated with Hamelin Pool and the Nilemah Embayment. Both are groundwater discharge areas. The stromatolites along the shoreline of Hamelin Pool, near the old Hamelin Telegraph Station, are located in groundwater discharge zones about 12 km from the northern Project Area. The groundwater discharge is from a different catchment than the Project Area and Nilemah Embayment. There are no predicted impacts on the Hamelin Pool ecosystem due to occurrence of residual tailings waters in the superficial formations and water table environment.

9.1.1 Confined Aquifers

There are four major confined aquifers beneath the Project Area. The most extensive aquifers in the Carnarvon Basin are the Cretaceous Birdrong Sandstone and Windalia Radiolarite. The Birdrong Sandstone lies between about 100 m and 150 m below sea level at the project site, while the Windalia Radiolarite possibly occurs beneath only the very northernmost part of the site. Groundwater flow within these aquifers is generally towards the west. The other significant confined aquifers are the Cretaceous Windalia Sand Member, Devonian Kopke Sandstone, and Ordovician Tumblagooda Sandstone. The Windalia Sand Member is restricted to the Shark Bay area and is not planned for development as many of the local pastoral bores utilise this aquifer. The Kopke Sandstone and Tumblagooda Sandstone formations are regional scaled aquifers, although the latter is too deep beneath the project site to be economically viable for development.

Groundwater levels of the confined aquifers are not well defined, partially due to inadequate logging and aquifer definition in the private bores in the region as well as the variable condition of these bores. The quality of groundwater in the confined aquifers varies both with depth and spatially. The salinity of the Birdrong and Kopke aquifers in the region range between about 1,500 and 8,000 mg/L total dissolved solids. The Windalia Sand Member ranges in salinity between approximately 5,000 and 9,000 mg/L total dissolved solids.

9.1.2 Unconfined Aquifers

Several shallow unconfined aquifers occur in the region, predominantly in the Peron Sandstone within the northern part of the project site and Tamala Limestone to the west. Local Quaternary to Recent estuarine sediments in the Nilemah Embayment may also contain minor aquifers. Recent investigations suggest that the superficial sand formations in the middle and southern half of the Project Area are dry.

Short-term groundwater yields from the Tertiary sediments in the Project Area are likely to be comparatively low (below 500 kL/day). Water quality of the unconfined aquifers is variable, but is generally saline to hypersaline.

9.2 Potential Impact

A series of hydrogeological investigations have been conducted on the groundwater systems beneath the Project Area in 2005 (see Appendix D of the PER).

A comprehensive census has also been undertaken of private bores in the surrounding region to define the scope of potential impacts on other groundwater users. The key findings of the groundwater impact assessment indicate that the predominant environmental issues and potential risks include:

- Recovery and reuse of process water from the disposed sand and slimes tailings, limiting consumptive groundwater use;
- Mounding of the water table in the superficial formations, due to disposal of sand and slimes tailings in slurry form, to within the root zones of vegetation stands;
- The transport and fate within the superficial formations of residual process waters not recovered from the disposed sand and slimes tailings, given the water table aquifer would discharge in part into salina domain in foreshore areas of the Nilemah Embayment and Hamelin Pool;
- Salinisation of the process water supplies due to recycling and cumulative effects of evaporative losses;
- Drawdown impacts within the superficial formations resulting from pit dewatering in the northern Project Area;
- Drawdown impacts within the confined aquifer systems due to large-scale abstractions from the Birdrong Sandstone and Kopke Sandstone for process water supplies;
- Removal from storage of groundwater in the regional confined aquifer systems due to rates of forecast abstractions exceeding the estimated recharge and throughflow beneath the Project Area;
- Potential for propagation of drawdown impacts from the regional confined aquifer systems into the water table aquifer systems; and
- Temporary deficits in recharge compared to abstraction and consequent removal of groundwater from storage in unconfined zones of the regional aquifer systems.

Each of these known groundwater resources issues has been specifically addressed in order to frame the potential environmental impacts and effects on existing groundwater supply amenities and use. The hydrogeology of the Carnarvon Basin is comparatively poorly defined. Consequently, there is uncertainty in the interpreted hydrogeology. The findings of hydrogeological site investigations and geo-biology research in the vicinity of Hamelin Pool have been applied in order to understand and manage the outlined issues.

9.3 Environmental Objectives

The environmental objectives for the Groundwater Management Plan are as follows:

- Maintain or improve the quality of groundwater to ensure that existing and potential users, including ecosystem maintenance are protected, consistent with the Australian and New Zealand Water Quality Guidelines (ANZECC 2000);
- Maintain the integrity, functions and environmental values of hydrogeology; and
- Ensure that the beneficial uses of groundwater can be maintained.

Relevant legislation and standards for the management of groundwater include:

- *Conservation and Land Management Act* 1984*;*
- *Environmental Protection Act* 1986*;*
- *Rights in Water and Irrigation Act* 1914*;*
- *Rights in Water and Irrigation Regulations* 2000*;*
- *Water and Rivers Commission Act* 1995; and
- National Water Quality Management Strategy Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000).

9.4 Performance Indicators

An effective Groundwater Management Plan will be achieved by:

- Implementation of the monitoring programme detailed in the Groundwater Resource Impact Assessments Report (see Appendix D of the PER) and summarised in Section 9.7 below to provide essential data for ongoing management;
- Maximising water recovery of both mining and water management practices;
- Minimising groundwater abstraction and hence the level of impact on other users; and
- Impact minimisation that will include the following targets:
  - Collection of adequate environmental data to allow informed impact assessments;
  - Minimise residual groundwater mounding to prevent adverse vegetation stress; and
  - Management of drawdown impacts and implementation of equitable remedial actions for those competing groundwater users.

These strategies will be used to develop practical site-specific benchmarks of water use efficiency and impact minimisation. Successful implementation will be determined by review against the regulatory framework and standards outlined above. Key performance indicators will be:

- Successful water recovery techniques that minimise the height and extent residual groundwater mounding;
- Stable vegetation communities in proximal areas to the mine with thin superficial sand thicknesses;
- Minimal impacts on sensitive ecological and hydrogeological systems;
- Groundwater abstraction that remains within the licensed allocation; and
- Successful management of impacts on local users.

9.5 Stakeholder Consultation

Gunson has undertaken extensive stakeholder consultation with DoE and pastoralists surrounding the Project Area in regards to groundwater issues and management. Stakeholder consultation will continue throughout the life of the Project. The main issues identified during the consultation process comprise:

- Potential groundwater drawdown effects on conservation values and groundwater users;
- Potential impacts to conservation values due to tailings seepage; and
- Potential impacts to the SBWHP.

9.6 Management

The following management actions are proposed to minimise the effects of groundwater extraction and use on the existing environment:

- Determination of baseline conditions with regard to water levels and water quality distributions within the area of potential impact;
- Install multipiezometers in the superficial formations and shallow Toolonga Calcilutite to provide data for managing the following key aspects:
  - Shallow water mounding close to the active pits to determine the distribution of residual waters for the optimisation of water recovery;
  - Shallow water table monitoring to provide data for managing areas with potential risk to vegetation root zones. This would include mapping of the vegetation and typical depths of root penetration; and

  - Shallow water table environment in the Nilemah Embayment area.

- Where appropriate, maintain active drains in the pit(s) adjacent to areas at risk in order to intercept and abstract tailings water locally contributing to the mounding. This would include continual review of the mining plans to increase the duration of mining and reduce the residual mounding;

- Install multipiezometers in the confined aquifers and confining layers to measure impacts and determine long term hydraulic responses;

- Measure and monitor process water supply extraction and movements within the mine water circuits to maintain tight control over usage patterns and make-up requirements;

- In addition to the dedicated network above, monitor water levels in selected private bores in the region for drawdown impacts and salinity for quality considerations; and

- Regular assessment and reporting on the impacts of process water supply abstraction, mounding of the water table, pit dewatering and regional resource management issues.

9.7 Monitoring

Groundwater monitoring programmes have been developed to enable assessment and management of the shallow aquifers due to mine dewatering, residual mounding of the water table in the superficial formations and drawdown in the confined aquifers due to process water supply abstraction. The key objectives of the monitoring programmes are shown below in Table 9.1. The monitoring programmes would involve both quantitative and qualitative measurements of the groundwater resources including:

9.7.1 Monitoring Overview

The following actions are provided as an overview of monitoring procedures:

- All pumpages from the deep bores and mine water recovery system will be monitored monthly and provision will be made to install suitable flow meters;

- A local and regional water level monitoring network will be installed comprising multi-piezometers that discretely measure levels in each of the main deep aquifers to determine the impacts of the planned extraction. The locations of these bores have been selected during the groundwater impact assessments (see Appendix D of the PER), to provide a network that is independent of pumping cycles as in an operating bore. Emphasis has been placed on monitoring the artesian bores to the north, given that they may be able to be monitored reliably under static conditions;

- Water levels will be measured in the production and monitoring bores on a monthly basis;

- The salinity of the process water bores will be monitored monthly;

- Annual water monitoring report will be prepared;

- Regular (initially monthly) analyses of the drinking water quality will be undertaken to determine the major and minor chemistry, key indicator physio-chemical parameters, normal suite of indicator organisms and effectiveness of any disinfection system installed; and

- Regular assessments will be made of the monitoring data to refine the model calibration to provide a predictive management tool for impacts on other users.

9.7.2 Monitoring Programme Detail

A monitoring programme appropriate for the assessment of the impact of mining on the shallow groundwater and regional confined aquifer water resources is outlined in Table 9.1.

Table 9.1 Monitoring Programme

Monitoring	Parameters	Monitoring Frequency
BASELINE MEASUREMENTS AND SAMPLING		
Local Superficial Formations Multipiezometers • SMB2 to SMB4. • Additional Multipiezometers SMB5 to SMB12 • Additional Vegetation Monitoring Multipiezometers VMB1 to VMB19 Adjacent to The Active Pits. • Nilemah Embayment Monitoring Multipiezometers NMB1 to NMB13 to the north of the Area	Groundwater Levels Groundwater Quality: pH, EC, TDS. Groundwater Quality: pH, EC, TDS, Total Alkalinity, Total Hardness, Cl, CO_3/HCO_3, SO_4, NO_3, NO_2, Na, K, Ca, Mg, Fe, SiO_2, Al, Mn, As, Cd, Cu, Pb, Se and Zn.	Monthly Quarterly Annually
Regional Piezometers • Existing/Nilemah Artesian No.1A, Coburn No.4, Hamelin MRD Bore, Hamelin 26 (SB1), and Meadow 5(old), and DMB1 • Additional Multipiezometers DMB2 to DMB7 and IMB1 to IMB4	Groundwater Levels or Pressures (artesian bores) Groundwater Quality: pH, EC, TDS (artesian bores)	Monthly.
MONITORING DURING MINING		
Local Superficial Formations Multipiezometers • SMB2 to SMB4. • Additional Multipiezometers SMB5 to SMB12 • Additional Vegetation Monitoring Multipiezometers VMB1 to VMB19 Adjacent to The Active Pits. • Nilemah Embayment Monitoring Multipiezometers NMB1 to NMB13 to the north of the project area	Groundwater Levels Groundwater Quality: pH, EC, TDS. Groundwater Quality: pH, EC, TDS, Total Alkalinity, Total Hardness, Cl, CO_3/HCO_3, SO_4, NO3, NO2, Na, K, Ca, Mg, Fe, SiO_2, Al, Mn, As, Cd, Cu, Pb, Se and Zn.	Monthly Quarterly Annually
Regional Piezometers • Existing/Nilemah Artesian No.1A, Coburn No.4, Hamelin MRD Bore, Hamelin 26 (SB1), and Meadow 5(old), and DMB1 • Additional Multipiezometers DMB2 to DMB7 and IMB1 to IMB4	Groundwater Levels or Pressures (artesian bores) Groundwater Quality: pH, EC, TDS (artesian bores)	Monthly

Table 9.1 (cont.'d)

Monitoring	Parameters	Monitoring Frequency
Sump-pumps	Abstraction Volumes	Weekly
	Pump Operating Hours	Weekly
	Collation of Cumulative Discharge	Monthly
	Groundwater Quality:	Monthly
	pH, EC, TDS	
	Groundwater Quality:	Quarterly
	pH, EC, TDS, Total Alkalinity, Total Hardness, Cl, CO_3/HCO_3, SO_4, NO_3, NO_2, Na, K, Ca, Mg, Fe, SiO_2, Al, Mn, As, Cd, Cu, Pb, Se and Zn.	
Production Bores	Abstraction Volumes	Weekly
	Groundwater Levels	Weekly
	Groundwater Quality:	Monthly
	pH, EC, TDS	
	Groundwater Quality:	Quarterly
	pH, EC, TDS, Total Alkalinity, Total Hardness, Cl, CO_3/HCO_3, SO_4, NO_3, NO_2, Na, K, Ca, Mg, Fe, SiO_2, Al, Mn, As, Cd, Cu, Pb, Se and Zn.	
POST-MINING MONITORING		
Local Superficial Formations Multipiezometers • SMB2 to SMB4. • Additional Long-Term Multipiezometers SMB5 to SMB12 • Additional Vegetation Monitoring Multipiezometers VMB1 to VMB19 Adjacent to The Active Pits. • Nilemah Embayment Monitoring Multipiezometers NMB1 to NMB13 to the north of the project area.	Groundwater Levels	Monthly
	Groundwater Quality: pH, EC, TDS.	Quarterly
	Groundwater Quality: pH, EC, TDS, Total Alkalinity, Total Hardness, Cl, CO_3/HCO_3, SO_4, NO_3, NO_2, Na, K, Ca, Mg, Fe, SiO_2, Al, Mn, As, Cd, Cu, Pb, Se and Zn.	Annually
Regional Piezometers • Existing Nilemah Artesian No.1A, Coburn No.4, Hamelin MRD Bore, Hamelin 26 (SB1), and Meadow 5(old). • Additional Multipiezometers DMB2 to DMB7 and IMB1 to IMB4	Groundwater Levels or Pressures (artesian bores)	Monthly.
	Groundwater Quality: pH, EC, TDS (artesian bores)	Quarterly

Note: 1 The duration of post-mining monitoring is not closely defined. It is linked to, and dependent on the need to manage rehabilitation programme schedules and rates of water table recovery. The minimum duration would be three years.

The monitoring programme stipulated above will be reviewed annually and revised as appropriate to remain compatible with the needs of the operating and receiving environments. Monitoring and reporting programmes will be the responsibility of the Environmental Coordinator.

9.8 Reporting

Reporting will follow existing DoE Guidelines. Results of groundwater monitoring investigations will be included in the Annual Coburn Environmental Report and submitted to the DoE.

Detailed annual Aquifer Reviews will outline the operational and technical aspects of the Project. It is important that the Aquifer Reviews provide definitive assessments and reviews of the following:

- New information on baseline groundwater environments;
- Residual mound characteristics;
- Residual mound distributions;
- Rates of tailings water recovery;
- Findings of risk assessments associated with propagation of the mounds to within vegetation root zones;
- Refinements on the fate of the residual tailings waters;
- Forecasts of consumptive process water uses;
- Lateral drawdown impacts within the confined aquifer systems;
- Impacts of drawdown on other groundwater users; and
- Vertical propagation of drawdown within the Alinga Formation and Toolonga Calcilutite.

These assessments should subsequently be applied to refine the water resources monitoring and management programmes.

9.9 Contingency

Contingency actions will be initiated when problems are identified during Gunson's monitoring programme, or an adverse impact has been determined in consultation with relevant stakeholders. Notwithstanding other reporting or notification requirements, the DoE will be notified within 14 days of Gunson becoming aware of the issue.

Once detected, the adverse impact will be investigated by an independent suitably qualified professional. Upon determination of the cause, a remediation strategy will be developed and implemented in consultation with the DoE.

10.1 Current Status

10.1.1 Vegetation

The Project Area is located within the Irwin Botanical District, as part of the South-western Botanical Province. The vegetation system of the survey area is referred to as the Tamala System. The typical vegetation of this system comprises of "tree heath", or heath with scattered trees (Mattiske Consulting Pty Ltd, 2005). The vegetation communities within the survey area mainly consist of Low Open Woodlands dominated by *Eucalyptus* spp., and Tall Open Shrublands dominated by *Acacia* spp.

Communities are described as 'Threatened Ecological Communities' (TECs) if they have been defined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (English and Blyth 1997) or the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act 1999). None of the plant communities within the Project Area are considered to be TECs.

Vegetation types are considered Regionally Significant when they are limited to specific landform types, are uncommon or restricted plant community types within the regional context, or support populations of Declared Rare Flora (Mattiske 2005). Of the 18 vegetation communities described and mapped within the Project Area, 14 may be considered as Regionally Significant (E1, E2, E3, E4, E6, E7, S1, S2, S3, S4, S5, S6, S10 and M1) due to being limited in the broader geographic region (Table 10.1). Plant community S5 is particularly significant as it is restricted to deep valleys, which are a regionally unusual landform.

Vegetation communities are referred to as Locally Significant where the presence of Priority Flora species has been recorded, where they provide a range extension of particular taxa from previously recorded locations, or where they are very restricted to one or two locations or occur as small isolated communities. Twelve vegetation communities (Table 10.1) may be considered locally significant due to the presence of Priority Flora species.

Communtiy S10 is especially significant as it is dominated by the Priority 3 species *Physopsis chrysophylla* and on the basis of current information appears to be restricted within the survey area. Vegetation community S5 is also very restricted in the local sense. Vegetation communities E4 and S4 may be considered Locally Significant as they support *Grevillea acaciodies*, the presence of which in the Project Area represents a range extension for this species. Three vegetation communities on the eastern section of the survey area and the access road (S7, S8 and S9) may also be considered Locally Significant due to the presence of calcrete in the soils (Mattiske 2005). In conclusion, Mattiske (2005) identified four communities (S5, S8, S9, and S10) as being of particular significance, as priority species constitute a dominant element of the species composition.

10.1.2 Flora

A total of 231 taxa (including subspecies and varieties) from 132 genera and 51 families were recorded. Fourteen introduced (weed) species were recorded. None of these introduced species recorded are listed as Declared Plants, as defined by the Department of Agriculture (2004). The weed species are discussed in more detail in the Weed Management Plan, Section 12.

No plant taxa gazetted as Declared Rare Flora under the *Wildlife Conservation Act* (1950) were recorded within the Project Area. No plant taxa listed as Threatened pursuant to Schedule 1 of the EPBC Act (1999) were recorded in the Project Area.

Nine Priority Flora species (CALM 2005) have been recorded in the vegetation communities in the Project Area. These species are discussed in more detail in Section 11.

Table 10.1 Significance of Plant Communities

Community	Contain Priority Flora	Priority Flora Dominant	Restricted to Calcareous Soils	Species with Range Extension	Locally Significant	Regionally Significant
E1						X
E2						X
E3	X				X	X
E4				X	X	X
E5						
E6	X				X	X
E7						X
S1	X				X	X
S2	X				X	X
S3	X				X	X
S4				X	X	X
S5	X	X			X	X
S6						X
S7	X		X		X	
S8	X	X	X		X	
S9	X	X	X		X	
S10	X	X			X	X
M1						X
Total	**10**	**4**	**3**	**2**	**12**	**14**

10.2 Potential Impacts

Potential impacts on the local flora and vegetation may include:

- Loss of vegetation due to clearing operations;
- Introduction of weed species to the local environment;
- Loss of vegetation due to the creation of excessive dust;
- Loss of vegetation due to change in groundwater levels through dewatering;
- Loss of vegetation due to groundwater mounding;
- Fire caused by human activities; and
- Potential leakage or spillage of environmentally hazardous materials or hydrocarbons.

Approximately 5,745 ha of vegetation will be cleared over a 20 year period to accommodate the proposed mineral sand mine. This area comprises less than 25% of the total vegetation within the Project Area (Table 10.2).

Vegetation and topsoil (upper 10cm) will be collected from up to 150m ahead of the mine face and dispersed onto areas prepared for rehabilitation. This procedure will occur on a regular basis throughout the year.

Table 10.2 Predicted Area of Disturbance

Vegetation Community	Area of Community (ha) within Survey Area	Predicted Area of Disturbance	
		Area (ha)	%
E1	299.29	200.35	66.94
E2	846.81	199.14	23.52
E3	226.11	152.63	67.50
E4	71.85	16.81	23.40
E5	127.73	0.00	0.00
E6	424.86	211.53	49.79
E7	185.28	5.25	2.83
M1	1577.76	799.38	50.67
S1	4985.74	2381.10	47.76
S2	4389.03	1426.65	32.50
S3	469.48	270.36	57.59
S4	94.86	1.44	1.52
S5	11.43	0.00	0.00
S6	50.00	0.00	0.00
S7	1815.49	36.83	2.03
S8	433.67	36.94	8.52
S9	274.19	6.86	2.50
S10	3.89	0.00	0.00
Total	**16287.46**	**5745.26**	**24.28**

10.3 Environmental Objectives

The environmental objectives of the Vegetation and Flora Management Plan are:

- Minimise the impacts on the abundance, species diversity, geographic distribution and productivity of plant communities.
- Protect Declared Rare Flora, consistent with the provisions of the *Wildlife Conservation Act* 1950.
- Protect flora listed under the Schedules of the EPBC Act.
- Preserve flora of other conservation or scientific significance (e.g. undescribed taxa, range extensions, outliers).

10.4 Performance Indicators

The effectiveness of the Vegetation and Flora Management Plan will be determined through a range of regular monitoring practices both within the Project Area and at analogue sites. The performance indicators for vegetation and flora management will be developed in accordance with the Strategic Framework for Mine Closure, (ANZMEC/MCA 2000) and the Commonwealth Environmental Protection Agency Series 'Best Practice Environmental Management in Mining' (1995). This framework provides a set of objectives and principles designed to facilitate for mine closure across Australia. The performance indicators will also be consistent with the objectives outlined in the *Soil and Land Conservation Act* 1945.

The plan will be reviewed against the following performance indicators:

- Soil surface assessment, areas affected by erosion (size, type and severity);
- Zone Infiltration, Stability and Nutrients indexes;
- Stability of final landform; and
- Revegetation density and floristics.

These criteria will be assessed against the predetermined analogue sites outside the Project Area.

10.5 Stakeholder Consultation

Gunson will liaise with CALM, Department of Agriculture and the surrounding land users in relation to the Vegetation and Flora Management Plan. Gunson will also continue to consult with relevant stakeholders and Departments throughout the life of the Project.

The concerns expressed by stakeholders to date were:

- Comprehensive survey work is required; and
- Determine potential for impact on native flora.

Mattiske Consulting Pty Ltd has been consulted in the development of the Vegetation and Flora Management Plan. Mattiske Consulting Pty Ltd was responsible for conducting five surveys in the Project Area in order to accurately document the existing flora and vegetation communities. Mattiske Consulting Pty Ltd was also responsible for suggesting mitigation measures in order to minimise the impact of mining on the vegetation, and providing rehabilitation recommendations to assist in the rapid return of native species to the disturbed areas.

10.6 Management

Gunson has outlined a range of measures designed to minimise the impact of mining operations on the botanical values in the area and increase the process of rehabilitation. These measures are consistent with those suggested by Mattiske Consulting Pty Ltd (2005) and include:

- Limit clearing to that which is necessary for operations, particularly adjacent to the SBWHP. Vegetation to be removed will be mapped and clearly defined prior to any clearing activities;
- Topsoil containing natural seed stores and essential microbial species are directly returned to rehabilitation areas where possible to ensure viability;
- Vegetation cleared from the leading edge of mining will directly returned to rehabilitation areas where possible to ensure viability of seed bank, to increase protection for soil and seedlings against wind erosion and to provide fauna habitat;
- Prior to clearing as much seed as possible from vegetation within the disturbance footprint, including Priority Flora, will be collected for later rehabilitation;
- The Coburn Station will be de-stocked of sheep and goats for a period of several years, or longer if permission from the Pastoral Board can be obtained. After this period, stock will be returned to the property. Returned stock levels will be well below the carrying capacity recommended by the Department of Agriculture. Decreased grazing pressure is expected to increase vegetation condition over the entire property;
- Rehabilitation to occur progressively as the mining operations move northwards; and
- Dunal topographic systems be rehabilitated following earthworks.

The mining operations are expected to impact on native flora. However, a range of measures will be applied in order to mitigate this impact.

10.7 Monitoring

Gunson will implement a monitoring programme to assess the effectiveness of the Vegetation and Flora Management Plan. The monitoring plots will provide data that will be used to assess the progress and success of rehabilitation and to monitor the adjacent country for any possible impact from mining, particularly from tailings seepage on flora and vegetation communities. These permanent vegetation plots will be established in association with fauna monitoring sites, and will also be designed in consultation with CALM in order to adequately address any botanical issues that may arise during the environmental assessment process and to prepare guidelines for future monitoring. The effective management of vegetation and flora in the region is particularly important due to the local and regional significance of 14 of the 18 vegetation communities (Mattiske Consulting Pty Ltd 2005).

10.8 Reporting

Monitoring results will be reported in Gunson's Annual Environmental Report. The plan will be updated on a regular basis to integrate new management strategies or changes in technologies.

10.9 Contingency

Vegetation and flora outside the mining disturbance area will be monitored using permanent vegetation plots to identify affects of mining operations on vegetation health. A range of measures are outlined in the Rehabilitation Plan that are designed to continually improve rehabilitation methods. A successful rehabilitation programme will provide communities that retain biodiversity values similar to those found in the adjacent undisturbed environments.

10.10 References

CALM 2005. Declared Rare and Priority Flora List. Publicly available list prepared by the Department of Conservation and Land Management, Western Australia.

Department of Agriculture 2004. Declared Plants List. Publicly available list prepared by the Department of Agriculture, Western Australia.

DEP 2000. Bush Forever. Volume 2 – Directory of Bush Forever Sites. Department of Environmental Protection, Western Australia.

Mattiske Consulting Pty Ltd 2005. Flora and Vegetation in the Proposed Coburn Mineral Sand Mine Coburn and Hamelin Stations – Shark Bay. Unpublished report for URS Australia Pty Ltd by Mattiske Consulting Pty Ltd, Kalamunda, WA.

11.1 Current Status

The Project Area is located within the Irwin Botanical District, as part of the South-western Botanical Province. The vegetation system of the survey area is referred to as the Tamala System. The typical vegetation of this system comprises of "tree heath", or heath with scattered trees. The vegetation communities within the survey area mainly consist of Low Open Woodlands dominated by *Eucalyptus* spp., and Tall Open Shrublands dominated by *Acacia* spp.

A total of 231 taxa (including subspecies and varieties) from 132 genera and 51 families were recorded during surveys by Mattiske Consulting Pty Ltd (2005). No plant taxa gazetted as Declared Rare Flora under the *Wildlife Conservation Act* (1950) were recorded within the Project Area. No plant taxa listed as Threatened pursuant to Schedule 1 of the EPBC Act (1999) were recorded in the Project Area.

Nine Priority Flora species (CALM 2005) have been recorded in the vegetation communities in the Project Area (Table 11-1, Figure 11.1). In addition, eight species have been recorded outside their previously recorded ranges. These are *Acacia galeata*, *Austrostipa macalpinei*, *Daveisia divaricata* subsp. *?lanulosa* (ms), *Dicrastylis soliparma*, *Grevillea acacioides*, *Grevillea stenostachya* (P3), *Trachymene coerulea* subsp. l*eucopetala* and the introduced species *Avellinia michelii*, as documented by Western Australian Herbarium records (CALM 2005).

Table 11.1 Priority Flora Species Recorded within the Project Area

Botanical Name	Priority Listing	Description	General Location	Project Area Plant Communities
Acacia drepanophylla	3	Tree, 2.5–4(–5) m high	Shark Bay region	E3, S7, S8 and S9
Acacia subrigida	2	Erect shrub, 1–3 m high	Shark Bay region and SW WA	S1, S2, S3 and S5
Eremophila occidens	2	Shrub, to 1.5 m high	Shark Bay and Exmouth regions	S1, S2 and S3
Grevillea rogersoniana	3	Erect, many-stemmed, shrub or tree, 1–4m high	Shark Bay region	S1, S2 and S3
Grevillea stenostachya	3	Dense, pungent shrub	Coburn Project Area and 70km east of the Project Area	E6 and S7
Jacksonia dendrospinosa	4	Small tree	Geraldton Sand Plains	S2
Macarthuria intricata	3	Small, intricately branched shrub	Endemic to the Shark Bay area	S2 and S10
Physopsis chrysophylla	3	Erect shrub, 1–5 m high	Shark Bay and Kalbarri regions	S1, S2, S3 and S10
Scholtzia sp. Folly Hill	2	Late successional species	Geraldton Sand Plains and Shark Bay	S2

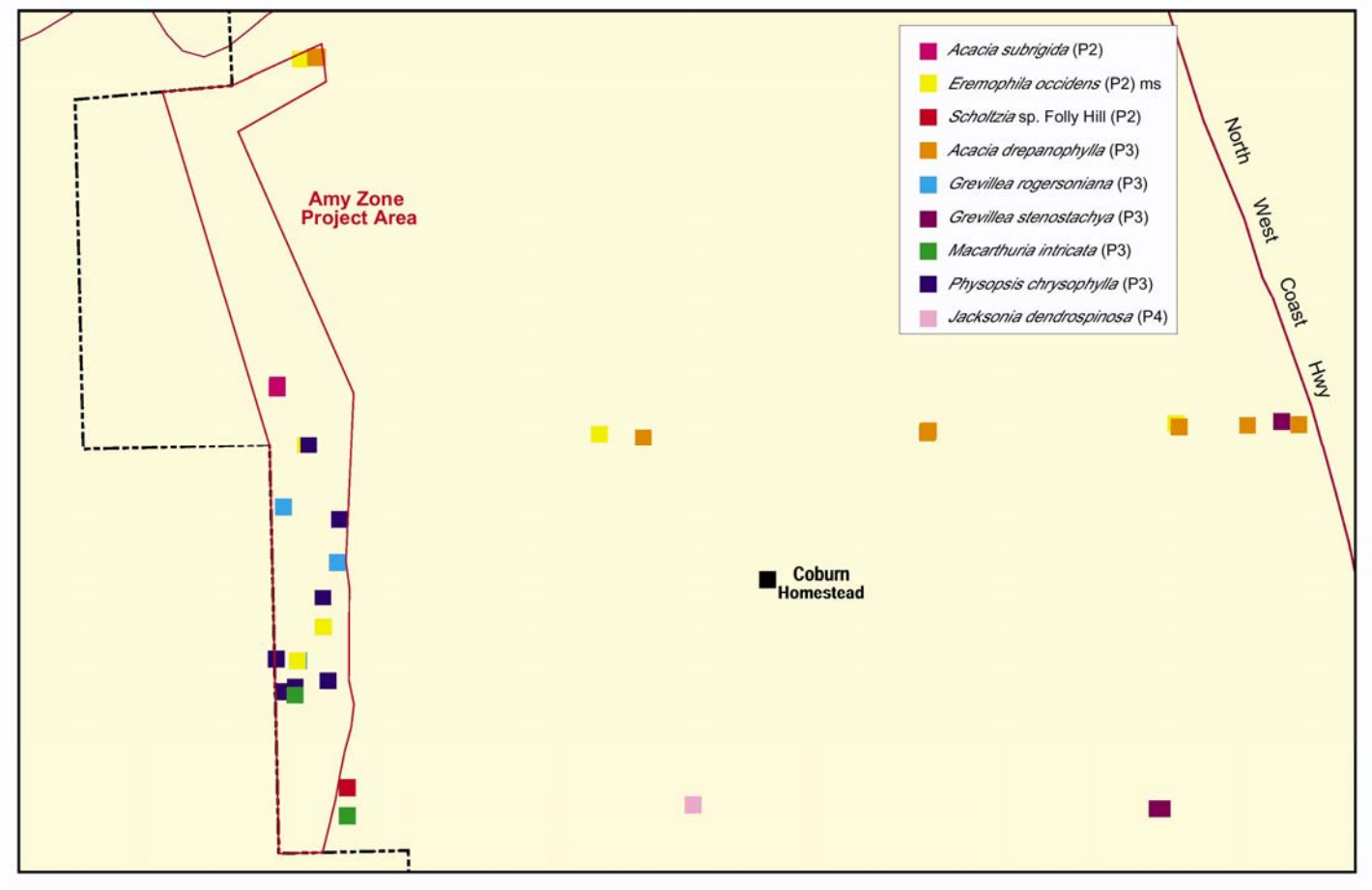

Figure 11.1: Priority Flora Locations in Proximity to the Project Area

11.2 Potential Impacts

Potential impacts on the local Priority Flora populations may include:

- Loss of Priority Flora populations due to clearing operations;
- Loss of Priority Flora populations due to change in groundwater levels through dewatering;
- Loss of Priority Flora populations due to groundwater mounding; and
- Loss of Priority Flora populations due to wildlife, leakage or spillage of environmentally hazardous materials or hydrocarbons.

11.3 Environmental Objectives

The environmental objectives of the Priority Flora Management Plan are:

- Minimise the impacts on the abundance, species diversity, geographic distribution and productivity of Priority Flora populations.
- Protect Declared Rare Flora, consistent with the provisions of the *Wildlife Conservation Act* 1950.
- Protect flora listed under the Schedules of the EPBC Act.
- Preserve flora of other conservation or scientific significance (e.g. undescribed taxa, range extensions, outliers).

11.4 Performance Indicators

The effectiveness of the Priority Flora Management Plan will be determined through a range of regular monitoring practices both within the Project Area and at analogue sites. The plan will be reviewed against the following performance indicators:

- Soil surface assessment, areas affected by erosion (size, type and severity);
- Zone Infiltration, Stability and Nutrients indexes;
- Stability of final landform; and
- Revegetation density and floristics.

These criteria will be assessed against the predetermined analogue sites outside the Project Area.

11.5 Stakeholder Consultation

Gunson will liaise with CALM, Department of Agriculture and the surrounding land users in relation to the Priority Flora Management Plan. Gunson will also continue to consult with relevant stakeholders and Departments throughout the life of the Project.

The concerns expressed by stakeholders to date were:

- Comprehensive survey work is required; and
- Determine potential for impact on native flora.

Mattiske Consulting Pty Ltd has been consulted in the development of the Priority Flora Management Plan. Mattiske Consulting Pty Ltd was responsible for conducting five surveys in the Project Area in order to accurately document the existing priority flora populations. Mattiske Consulting Pty Ltd was also responsible for suggesting mitigation measures in order to minimise the impact of mining on the vegetation, and providing rehabilitation recommendations to assist in the rapid return of native species to the disturbed areas.

11.6 Management

Gunson has outlined a range of measures designed to minimise the impact of mining operations on the botanical values in the area. These measures are consistent with those suggested by Mattiske Consulting Pty Ltd (2005) and include:

- Vegetation communities S5 and S10 will not be affected by mining operations.

- Limit clearing to that which is necessary for operations, particularly adjacent to the SBWHP. Vegetation to be removed will be mapped and clearly defined prior to any clearing activities;
- Topsoil containing natural seed stores and essential microbial species are directly returned to rehabilitation areas where possible to ensure viability;
- Vegetation cleared from the leading edge of mining will directly returned to rehabilitation areas where possible to ensure viability of seed bank, to increase protection for soil and seedlings against wind erosion and to provide fauna habitat;
- Prior to clearing as much seed as possible from vegetation within the disturbance footprint, including Priority Flora, will be collected for later rehabilitation;
- The Coburn Station will be destocked for a period of several years, or longer if Pastoral Board approval can be obtained. After this period, stock will be returned to the property. Returned stock levels will be well below the carrying capacity recommended by the Department of Agriculture. Decreased grazing pressure is expected to increase vegetation condition over the entire property;
- Rehabilitation to occur progressively as the mining operations move northwards; and
- Dunal topographic systems be rehabilitated following earthworks.

Further survey work will be conducted to determine the presence of *Eucalyptus beardiana* and *Verticordia dichroma* var. *syntoma* (P3) within the Project Area.

11.7 Monitoring

Gunson will implement a monitoring programme to assess the effectiveness of the Priority Flora Management Plan. The monitoring plots will provide data that will be used to assess the progress and success of rehabilitation and to monitor the adjacent country for any possible impact from mining, particularly from tailings seepage on Priority Flora populations. These permanent vegetation plots will be established in association with fauna monitoring sites, and will also be designed in consultation with CALM in order to adequately address any botanical issues that may arise during the environmental assessment process and to prepare guidelines for future monitoring. The effective management of Priority Flora in the region is particularly important due to the local and regional significance of 14 of the 18 vegetation communities (Mattiske Consulting Pty Ltd 2005).

11.8 Reporting

Monitoring results will be reported in Gunson's Annual Environmental Report. The plan will be updated on a regular basis to integrate new management strategies or changes in technologies.

11.9 Contingency

Vegetation and flora outside the mining disturbance area will be monitored using permanent vegetation plots to identify affects of mining operations on vegetation health. Emphasis will be placed on maintaining Priority Flora populations within the region, and preserving particularly significant vegetation communities. A range of measures are outlined in the Rehabilitation Plan that are designed to continually improve rehabilitation methods. A successful rehabilitation programme will provide communities that retain biodiversity values similar to those found in the adjacent undisturbed environments.

11.10 References

CALM 2005. Declared Rare and Priority Flora List. Publicly available list prepared by the Department of Conservation and Land Management, Western Australia.

Department of Agriculture 2004. Declared Plants List. Publicly available list prepared by the Department of Agriculture, Western Australia.

DEP 2000. Bush Forever. Volume 2 – Directory of Bush Forever Sites. Department of Environmental Protection, Western Australia.

Mattiske Consulting Pty Ltd 2005. Flora and Vegetation in the Proposed Coburn Mineral Sands Mine Coburn and Hamelin Stations – Shark Bay. Unpublished report for URS Australia Pty Ltd by Mattiske Consulting Pty Ltd, Kalamunda, WA.

12.1 Current Status

The National Weed Strategy defines a weed as "a plant which has, or has the potential to have, a detrimental effect on economic, social, or conservation values" (ARMCANZ, ANZECC and Forestry Ministers, 1997).

Mattiske Consulting Pty Ltd (2005) recorded seventeen introduced species in the Project Area (Table 12.1), of which most are currently restricted to small, often disturbed sites. The report suggests that the high level of soil disturbance associated with the proposed mining activity poses a risk of increased weed invasion. In a test pit developed by Gunson in 2004, *Brassica tournefortii*, *Rostaria pumila* and *Sonchus oleraceus* were recorded. The latter two species were found only in the trial pit. *Brassica tournefortii* was widespread across the Project Area and SBWHP where it had already invaded relatively undisturbed environments but has become very abundant with additional disturbance. This species has become a problem in *Acacia* shrublands of the Zuytdorp Nature Reserve where it replaces the native species Parietaria debilis, particularly when under grazing pressure (Keighery et al. 2000). Similar but more localized problems also occur in the SBWHP. The increased number of introduced species after disturbance, as shown in the test pit, poses an issue for revegetation and could also threaten further weed invade into the adjacent SBWHP.

Table 12.1 Weed Species Located within the Project Area

Botanical Name	Common Name	Description	Site Locations
Aira caryophyllea	Silvery Hairgrass	Annual, grass-like or herb, 0.07–0.4 m high. Fl. green, purple, Oct–Nov.	E3, E4, E6, E7 and S7
Asphodelus fistulosus	Onion Weed	Annual or biennial herb, 0.2-0.4m high, Fl. white, Jun–Oct	E2, E3, S2 and S8
Avellinia michelii	N/A	Small slender annual, grass-like or herb, 0.05–0.3 m high. Fl. green, Aug–Oct	E4
Brassica tournefortii	Wild, Prickly or Mediterranean Turnip	Annual, herb, 0.1–0.6 m high. Fl. yellow, cream, white, Jun–Nov.	All site locations (E1, E2, E3, E4, E5, E6, E7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, M1 and PIT)
Bromus japonicus var. vestitus	N/A	Annual, grass-like or herb, to 0.5 m high. Fl. green, Aug–Oct.	S9
Calandrinia ciliata	N/A	Succulent, prostrate to decumbent annual, herb, stems to 0.25 m long. Fl. purple, Sep–Nov.	E3, E6, S1, S2 and S7
Cuscuta epithymum	Lesser Dodder	Parasitic, twining annual, herb or climber. Fl. white, Aug–Dec.	E2

Table 12.1 (cont.'d)

Botanical Name	Common Name	Description	Site Locations
Hypochaeris glabra	Smooth Catsear	Rosetted annual or perennial, herb, 0.08–0.5 m high, leaves smooth; flower heads up to 1.5 cm across. Fl. yellow, Jan–Dec	S1 and S5
Lamarckia aurea	Goldentop	Tufted annual, grass-like or herb, 0.2 m high, Fl. yellow, green, purple, Aug–Nov	S2 and S8
Pentaschistis airoides	False Hairgrass	Delicate tufted annual, grass-like or herb, 0.05–0.16 m high. Fl. green, red, purple, Sep–Dec	E2, S2, S4 and S5
Raphanus raphanistrum	Wild Radish	Erect annual, herb, 0.15–1 m high, Fl. yellow, white, pink, Apr–Nov.	E1, E2, E3, E4, E5, E6, S1, S2, S3, S7 and M1.
Rostraria pumila	N/A	Tufted annual, grass-like or herb, 0.05–0.2 m high. Fl. green, Jul–Oct	E2, E3, S4 and PIT
Schismus barbatus	Kelch Grass	Tufted ascending annual, grass-like or herb, 0.05–0.25 m high. Fl. green, purple, Aug–Nov	S8
Sisymbrium erysimoides	Smooth Mustard	Erect annual, herb, 0.1–0.8 m high. Fl. yellow, Apr–Oct	E3
Sonchus oleraceus	Common Sowthistle	Erect annual, herb, 0.1–1.5 m high. Fl. yellow, Jan–Dec	PIT
Urospermum picroides	False Hawkbit	Erect annual or biennial, herb, to 1.2 m high. Fl. yellow, Aug–Dec	E3

CALM has identified and implemented management plans for the following six weed species in the adjacent Shark Bay area:

- *Tribulus terrestris* (Caltrop);
- *Emex australis* (Double Gee);
- *Mesembryanthemum crystallinum* (Ice Plant);
- *Citrullus colocynthis* (Pig Melon);
- *Brassica tournefortii* (Prickly Turnip); and
- *Rumex vesicarius* (Ruby Dock).

Only one species (*Brassica tournefortii*) occurs in the Project Area. Monitoring will occur in the Project Area and by CALM in the SBWHP to increase understanding and ascertain weed colonisation rates.

Rehabilitation trials undertaken for the Rehabilitation Benchmarking Study suggested that *Brassica tournefortii* is likely to be a dominant colonising weed species. The study indicated that *Brassica tournefortii* was located in most Case Study sites, both disturbed and undisturbed. The abundance seemed to decrease as time since disturbance increased, suggesting that as sites become more stable, native species dominate and this weed species becomes scarce (see Appendix E of the PER).

12.2 Potential Impacts

Gunson recognises that the proposed project has the potential to impact on the existing environment. Impacts related to weeds may include:

- An increase in abundance of weeds within the Project Area;
- Introduction of new weed species to the Project Area;
- An increase in weed abundance in areas adjacent to the Project Area; and
- Introduction of new weed species to regions adjacent to the Project Area.

Traffic entering the minesite has the ability to introduce weed species to the area, and the disturbance caused by the mining operations can allow the rapid colonisation of weeds. These actions can significantly affect the rehabilitation process. Due to rapid growth and high reproductive rates, weeds have the ability to out-compete native species, thus decreasing the success of the rehabilitation programme. The introduction of weeds may also affect the growth and recruitment of native species in areas adjacent to the Project Area.

Weeds may have a positive affect by reducing wind induced soil erosion in the initial stages of rehabilitation. Therefore, a monitoring programme is required to determine whether weed species are a positive or negative attribute to the rehabilitation process, and if negative, what methods are required to be implemented in order to decrease their effect. The rapid identification of weeds will facilitate more successful eradication programmes and provide information that will lead to the prevention of future occurrences.

12.3 Environmental Objectives

The environmental objectives of the Weed Management Plan are to:

- Maintain the abundance, species diversity, geographical distribution and productivity of vegetation communities in undisturbed areas by controlling the diversity and density of weed species;
- Conduct baseline studies to provide more information to CALM, and the Department of Agriculture on the extent and locations of weed species within and adjacent to the Project area;
- Prevent the introduction and spreading of new weed species within the Project area;
- Monitor and manage existing weeds so not to affect undisturbed areas; and

- Prohibit introduction and proliferation of new weed species.

12.4 Performance Indicators

Performance Indicators will be used to measure the success of the Weed Management Plan. The following criteria will be used to assess the success against the environmental objectives:

- Abundance of introduced weed species; and
- Presence and abundance of newly introduced weed species.

12.5 Stakeholder Consultation

As a part of the stakeholder consultation process Gunson has liaised with CALM, Department of Agriculture and surrounding land users in relation to the Weed Management Plan. Gunson will also continue to consult with relevant stakeholders and departments throughout the life of the project.

12.6 Management

Gunson will implement a comprehensive programme to control any weed species due to construction, operation and decommissioning of the mine.

Gunson has outlined a range of measures designed to minimise the negative impact of weed species on the rehabilitation process and the surrounding environment. These measures are consistent with those suggested by Mattiske Consulting Pty Ltd (2005) and include:

- The installation of a plant and equipment wash down area for vehicles and equipment entering and leaving the site. The final location of the washdown area is to be finalised in consultation with the Department of Agriculture. Washdown will occur in concrete bunded areas and waste water will be collected in sedimentation ponds and treated before disposal.
- Monitoring weed abundance and diversity using permanent vegetation plots both in the rehabilitation and surrounding areas. This will allow for the possible early detection and eradication of new species and to determine the rate of colonisation;
- Undertake routine visual inspection trips;
- Topsoil containing natural seed stores and essential microbial species is respread over tailings as soon as possible after being removed to encourage the growth of native seedlings;
- Assessing the potential risk and impact of each weed species to determine invasiveness and management priorities for action;
- Employee training and awareness programs to educate personnel on ecology, impacts and management of weeds;
- Emphasis on prevention (quarantine) rather than cure; and
- Research possible biological, physical and chemical control methods for weed species.

12.7 Monitoring

Weeds located in rehabilitated areas will be monitored through the rehabilitation monitoring programme, whilst weeds located outside these areas will be monitored through the Vegetation and Flora monitoring programme. The monitoring of permanent vegetation plots will measure the affect of weed species on the rehabilitation process. These plots will provide data that can then be used to assess the progress and success of rehabilitation. These permanent vegetation plots will be designed in consultation with CALM in order to adequately address any botanical issues that may arise during the environmental assessment process and to prepare guidelines for future monitoring. The monitoring and control of weed species is particularly important due to the local and regional significance of 14 of the 18 vegetation communities, and the current low floristics

and density of weed species within the Project Area (Mattiske Consulting Pty Ltd 2005).

12.8 Reporting

Results of the monitoring programme will be reported in Gunson's Annual Environmental Report. The plan will be updated on a regular basis to integrate new management strategies or changes in technologies and chemicals.

12.9 Contingency

Weed infestations identified during monitoring and rehabilitation site visits will be assessed and controlled as soon as practical by chemical methods. Techniques for weed management will be reviewed in light of new data as a part of Gunson's commitment to continuous improvement. This includes reassessing truck washdown procedures, types of herbicide and method of treatment (physical or chemical). Further action will include the timing of monitoring, spraying and reassessing quarantine procedures.

12.10 References

ARMCANZ, ANZECC and Forestry Ministers 1997, The National Weeds Strategy: A Strategic Approach to Weed Problems of National Significance. Agricultural and Resource Management Council of Australia and New Zealand, Australian and New Zealand Environmental and Conservation Council, Forestry Ministers.

Department of Agriculture 2004, Declared Plants List. Publicly available list prepared by the Department of Agriculture, Western Australia.

DEP 2000, Bush Forever. Volume 2 – Directory of Bush Forever Sites. Department of Environmental Protection, Western Australia.

Keighery GJ, Gibson N, Lyons MN & Burbidge AH 2000, Flora and vegetation of the southern Carnarvon Basin, Western Australia. In 'Biodiversity of the southern Carnarvon Basin' Supplement No. 61. Eds - Burbidge AH, Harvey MS and McKenzie NL. Western Australian Museum.

Mattiske Consulting Pty Ltd 2005, Flora and Vegetation in the Proposed Coburn Mineral Sands Mine Coburn and Hamelin Stations – Shark Bay. Unpublished report for URS Australia Pty Ltd by Mattiske Consulting Pty Ltd, Kalamunda, WA.

13.1 Current Status

Fauna surveys by Ninox Wildlife Consulting (Ninox) identified a total of eight native mammal species, 61 bird species and 45 reptile species within the Project Area. Most of the vertebrate species found in the surveys have a widespread distribution throughout the semi-arid region and are not restricted to individual habitats. One species known to occur within the Project Area (Malleefowl) is listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and classified as 'Vulnerable'. Malleefowl management is discussed in more detail in Section 13.7.

Some vertebrates that are classified as rare, threatened or vulnerable were not found during the Project Area surveys. This is not unusual, as by definition, the presence of these animals would be difficult to confirm because of their scarcity (Ninox 2005), and is a reality when dealing with short-term studies (Cowan & How 2004).

Three vertebrate species likely to occur in the Project Area are gazetted under the *Wildlife Conservation Act* (1950). These are the Hamelin Skink (*Ctenotus zasticus*), Peregrine Falcon (*Falco peregrinus*), and the Woma (*Aspidites ramsayi*). The Hamelin Skink is listed as "Vulnerable", and both the Peregrine Falcon and Woma are listed as "Other Specially Protected Fauna".

A further three vertebrate species likely to occur in the Project Area are gazetted under the CALM Priority Fauna List. These are the reptiles *Lerista maculosa* (Priority 1) and *Lerista humphriesi* (Priority 2), and the Australian Bustard (*Otis australis*: Priority 4). However, the taxonomic status of *Lerista maculosa* appears to be in doubt and it is likely that it will be synonymised with *Lerista uniduo* (K. Aplin, pers. comm.).

No mammals classified as Rare were recorded during the surveys of the Project Area. Whilst many species historically occured in the area, they now only occur on Bernier and Dorre Islands, or other islands off the mid-west coast of Western Australia. The Brush-tailed Bettong (*Bettongia penicillata*) and Bilby (*Macrotis lagotis*) have been reintroduced onto the Peron Peninsula but are unlikely to occur outside the electric fence that protects the peninsula from exotic predators (C. Sims, pers. comm.). None of these extant mammals have been recorded naturally on the mainland and are therefore extremely unlikely to be present in the Project Area.

Six introduced mammals were recorded during the surveys. The herbivores were rabbits (*Oryctolagus cuniculus*), goats (*Capra hircus*) and a camel (*Camelus dromedarius*). The three carnivores recorded were feral dogs (*Canis f. familiaris*), red foxes (*Vulpes vulpes*) and feral cats (*Felis catus*).

13.2 Potential Impacts

The potential impact of the proposed mine development on the local vertebrate fauna will be:

- Removal or degradation of habitat for mining and infrastructure;
- Removal of habitat for access roads;
- Loss of Malleefowl mounds;
- Fauna behavioural changes due to noise and transport;
- Loss of habitat due to accidental wildfire;
- Disturbance to fauna through lighting and road kills; and
- Loss of fauna due to drowning in process water ponds or becoming trapped in the seepage interception trenches adjacent to the tailings disposal areas.

Removal of fauna habitat is expected to result in the localised loss or disturbance of some vertebrate and invertebrate populations. While many of the birds, larger mammals and reptiles will be able to relocate and avoid the impact of exploration, mining and construction of infrastructure, many of the smaller vertebrates will be unavoidably killed by large machinery, or by exposure to predators. However, no loss of regional biodiversity values or species is

expected to occur because most vertebrate fauna found in the Project Area are widespread in distribution, and measures to be employed by Gunson are likely to mitigate the effects of mining operations.

13.3 Environmental Objectives

The objectives of the Vertebrate Fauna Environmental Management Plan are to:

- Maintain the abundance, species diversity and geographical distribution of fauna;
- Protect species listed under the EPBC Act;
- Protect Specially Protected (Threatened) and Priority Fauna and their habitats, consistent with the provisions of the *Wildlife Conservation Act* 1950;
- Protect rare and endangered species listed under the *Wildlife Conservation Act* 1950;
- Monitor and protect where possible species listed under the CALM Priority Fauna List; and,
- Protect other fauna species of particular conservation significance (eg. undescribed taxa, range extensions, outliers).

Threatened fauna are protected by CALM under the provisions of the *Wildlife Conservation Act* 1950. Threatened and migratory fauna are also protected under the provisions of the EPBC Act. Migratory birds are listed under the Japan-Australia (JAMBA) and China-Australia (CAMBA) Migratory Bird Agreements.

13.4 Performance Indicators

The effectiveness of the Vertebrate Fauna Management Plan will be determined through a range of regular monitoring practices both within the Project Area and at analogue sites. The performance indicators for vertebrate fauna management will be developed in accordance with the Strategic Framework for Mine Closure (ANZMEC/MCA 2000) and the Commonwealth Environmental Protection Agency Series 'Best Practice Environmental Management in Mining' (1995). This framework provides a set of objectives and principles designed to facilitate for mine closure across Australia.

The Vertebrate Fauna Management Plan will be assessed against the predetermined analogue sites outside the Project Area. However, it is important to note that the return of fauna to the Project Area is reliant upon the success of the site rehabilitation. The fauna are likely to return if the rehabilitated ecosystem is able to provide the required amount of food and protection from predators. However, regardless of the success of the rehabilitation, it is unlikely that the current fauna diversity will be re-established completely.

13.5 Stakeholder Consultation

The stakeholders that have been consulted during the planning process, and who will continue to be consulted over the life of the mine, include the following:

- Department of the Environment and Heritage (DEH);
- DoE;
- CALM;
- DoIR;
- Shark Bay Shire Council; and,
- Traditional Owners.

Previous discussions with stakeholders have highlighted the following concerns and recommendations:

- Fauna study to be done to determine species/community representation;
- Comparison with World Heritage Property;

- Minimise introduced pest species. Currently there is fox baiting at Coburn station; and
- Potential for isolation of fauna from alteration to landforms.

13.6 Management

Gunson has outlined a range of measures that will be conducted within the Project Area. The aims of these management actions are to minimise the impact on vertebrate fauna and increase rehabilitation success.

These measures include:

- Avoidance of unnecessary clearing of vegetation beyond that strictly required. Where possible, equipment will be placed on flattened shrubbery rather than clearing and root stock will be preserved in the ground by shallow scraping during essential temporary clearing;
- Direct return of cleared vegetation and vegetative material to the rehabilitation areas as they create extremely good microhabitat for a large range of fauna, particularly reptiles. Rapid and progressive rehabilitation of cleared areas such as laydown sites, access tracks and grid lines will occur where these are no longer required;
- Rehabilitation will be structured to encourage the return of fauna by providing micro-relief and dense vegetation cover. Rehabilitation will occur progressively as the mining area moves north in order to decrease the amount of disturbance time and area. A Rehabilitation Plan is provided as Appendix F of the PER;
- The entire Coburn Station will undergo annual exotic predator baiting programmes in conjunction with the Department of Agriculture. This will assist fauna populations both within and outside the Project Area;
- Destocking of Coburn Station for several years. The removal of exotic grazing species will increase vegetation density over the station, providing an increase in food resources and predator protection for many native fauna species;
- Firearms, trail bikes and pets will be excluded from the Project Area;
- Adequate rubbish disposal procedures will be applied, especially for food refuse, in order to discourage scavenging by crows, foxes and feral cats. Large numbers of these animals can have an adverse impact on other fauna;
- Fencing will be erected around the water dams and open seepage interception trenches to stop encroachment by large/medium sized animals;
- Mesh or “self rescue mats” will be placed at the edge of water dams and trenches to allow any small vertebrate fauna to exit the water. In addition, regular inspections of these areas will be conducted and any trapped animals will be released;
- Ensuring that all site personnel are adequately briefed and made aware of the environmental constraints imposed on the projects and themselves;
- Reporting of breaches of sound environmental practice, so that problems can be anticipated or rectified at an early stage; and
- Consideration of preparing a brief handout on sound environmental practices which will be given to all site personnel during site induction.

These management measures are in accordance with those suggested by Ninox Wildlife Consulting (2005). Specific systems-focussed management measures that will be conducted on site by Gunson employees will be referred to in an Environmental Management System.

13.7 Malleefowl Conservation

Malleefowl were once common and widespread in the semi-arid zone of Australia, mainly in the mallee

and *Acacia* scrublands, and especially in the north and east of the mulga-eucalypt line. The regional and national populations have been restricted by factors such as habitat clearing, increased fire frequency, competition with introduced herbivores including stock and exotic animals, and increased predation by feral animals such as foxes, cats and dogs. Along with protection under the EPBC Act, Malleefowl are also protected under the provisions of the State *Environmental Protection Act* 1986 and the *Wildlife Conservation Act* 1950.

During surveys undertaken by Ninox in 2003 and 2004, Malleefowl were not sighted, but their distinctive footprints and nesting mounds were recorded. Nineteen nesting sites were observed within the Project Area, although the discovery of more nests with increased fauna surveys is likely. The distribution of identified nesting mounds showed that most nests occurred in the middle to southern portion of the Project Area. Their condition ranged from very old, degraded mounds to relatively fresh, but no currently used nests were located. Given their extremely variable home range size and their timid nature, the actual Malleefowl population within the Project Area cannot currently be elucidated.

The Fauna Management Plan has been developed to minimise the impact of mining and associated infrastructure on Malleefowl and ultimately designed to enable the eventual return of the Malleefowl to the rehabilitated site. However, direct impacts on the Malleefowl population within the Project Area are expected. These impacts include:

- Removal of 10 existing nesting sites; and
- Removal of habitat for mining and infrastructure.

Impacts that are anticipated to occur less frequently comprise:

- Potential loss of habitat due to fire caused by human activities;
- Disturbance through lighting and road kills; and
- Behavioural changes due to disturbance created by noise and transport.

The mining activities and removal of Malleefowl habitat is expected to result in the localised loss or migration of this species. However, review of aerial photography covering the eastern part of the SBWHP and Coburn and Hamelin pastoral leases has illustrated that the vegetation community types in the Project Area most inhabited by the Malleefowl are also well represented outside the Project Area. The presence of similar vegetation types indicates that there will be adequate habitat for the preservation of the Malleefowl outside the Project Area. The mining disturbance is not expected to significantly impact upon the regional Malleefowl population due to their wide distribution and presence in neighbouring pastoral leases (Benshemesh 2000).

Futhermore, the mitigation measures outlined in Section 13.6 are expected to allow for an overall increase in Malleefowl populations throughout the Coburn and Hamelin Stations, predominantly through a reduction in introduced predators and an improvement in vegetation condition through the reduction in introduced herbivores.

Successful rehabilitation of the disturbed areas will result in the return of vegetation communities similar to known Malleefowl habitat. The mounds are most prevalent within the central to southern areas of the Project Area and the S2 vegetation type (Tall Open Shrubland of *Calothamnos formosus* subsp. *formosus*, *Hakea stenophylla* subsp. *notialis* and *Acacia ligulata* with occasional emergent *Eucalyptus selechiana*, *Eucalyptus mennensis* subsp. v*espertine* with *Banksia ashbyi* over *Lamarchea hakefolia* var. *brevifolia* and *Beckea* sp. Nanga (pn) over *Triodia danthonoides* [Mattiske, 2005]). Successful revegetation should eventually result in the return of Malleefowl to the Project Area. However, it is anticipated that the Malleefowl are unlikely to return to the rehabilitated areas for at least five years after rehabilitation due to the specific habitat type required by the species. As the vegetation on the rehabilitated land establishes and matures, it is anticipated that the

habitat will be more conducive for Malleefowl to return to the site.

Additional mitigation measures that are specifically related to Malleefowl conservation have also been proposed by Gunson. These include:

- Mounds that are not in the direct mine path, or near a mine access road, will not be disturbed. There are a number of Malleefowl mounds along the proposed haul road. When constructing the road, the alignment will be diverted to avoid disturbing these mounds. Signage will be erected to indicate the known location of Malleefowl mounds; and
- Clearing for the Project will only occur in areas strictly required for mining operations and provision of firebreaks. Fragmentation of habitat by access corridors will be minimised where practical. Clearing will be undertaken with the focus on maintaining corridors to link vegetation patches and will be conducted in stages to allow for local migration of Malleefowl into adjacent properties.

Protection of the species will be aided by the provision and transfer of knowledge on the species and the threats to its survival. Gunson proposes to manage this in the following way:

- All site personnel will be educated on management information pertinent to the conservation of Malleefowl in and around the Project Area prior to commencement of work on site. This will include educating personnel on Malleefowl characteristics and importance of reporting of sightings to on-site managers;
- Create a monitoring programme consistent with EPA Guidance Statements and in conjunction with advice and approval from CALM;
- Monitoring of Malleefowl populations and breeding numbers both inside and outside the Project Area for comparison and to show where populations may be declining, stable or increasing;
- Providing long-term ecological data on Malleefowl in the vicinity of the Project Area over a period of approximately 20 years, through the provision of permanent fauna monitoring plots;
- Monitoring of feral animal populations to provide information on the effectiveness of control strategies in benefiting Malleefowl populations; and
- Reporting sightings to the Malleefowl Preservation Group to ensure that the presence of Malleefowl is known and recorded so that the data can be used to monitor the regional population.

These management measures are in accordance with those suggested by Ninox Wildlife Consulting (2004) and Benshemesh (2000), and will be implemented for the life of the mine and for the duration of mine decommissioning and closure following completion of operations. The results of the Malleefowl monitoring surveys will be reported in the Annual Environmental Report.

13.8 Monitoring

The implemented rehabilitation process will be monitored by the initiation of a permanent fauna sampling procedure. This will provide data that can then be used to assess the progress and success of rehabilitation and to monitor the adjacent country for any possible impact from mining on fauna populations. These permanent fauna sites should be established in association with flora and vegetation monitoring plots, and should also be designed in consultation with CALM in order to adequately address any vertebrate fauna issues that may arise during the environmental assessment process and to prepare guidelines for future monitoring. This may include further baseline sampling to more fully document the vertebrate fauna of the area and to clarify their habitat use.

13.9 Reporting

Results of the monitoring programme will be reported in Gunson's Annual Environmental Report. The Plan will be updated on a regular basis to integrate new management strategies or changes in technology.

13.10 Contingency

Contingency actions will be initiated when problems are identified during Gunson's monitoring process, or a stakeholder becomes concerned with an aspect of the mining process, or a factor that is exacerbated by the mining process becomes apparent.

13.11 References

ANZMEC/MCA 2000, Strategic Framework for Mine Closure, Commonwealth of Australia. Australian and New Zealand Minerals and Energy Council & Minerals Council of Australia.

Benshmesh J 2000, National Recovery Plan for Malleefowl. Environment Australia. ISBN 0759010072.

Malleefowl Preservation Group, 2005. http://www.malleefowl.com.au (Date accessed: 14 February 2005)

Cowan MA & How RA 2004, Comparison of ground vertebrate assemblages in arid Western Australia in different seasons and decades. Records of the Western Australian Museum, Supplement No. 22:2.

Mattiske Consulting Pty Ltd 2005, Flora and Vegetation in the Proposed Coburn Mineral Sands Mine Coburn and Hamelin Stations – Shark Bay. Unpublished report for URS Australia Pty Ltd by Mattiske Consulting Pty Ltd, Kalamunda, WA.

Ninox 2005, Vertebrate Fauna Survey of the Coburn Mineral Sand Project. Unpublished report for URS Australia Pty Ltd by Ninox Wildlife Consulting, Albany, WA.

Storr GM 1990, Birds of the Shark Bay area, Western Australia. In: PF Berry, SD Bradshaw, & BR Wilson (eds), Research in Shark Bay. Report of the Franco-Australe Bicentenary Expedition Committee. Western Australian Museum.

14.1 Current Status

Fire has long been part of the Australian environment and has played an important role in shaping the flora and fauna (Smith 1995). Fire occurs in most vegetation types and is a major factor affecting plant diversity, with impacts on both the "expression" and the "distribution" of diversity (Gill 1999). This diversity is achieved through removing adult plants and recycling nutrients.

Fires are started from two possible causes 1) Natural events such as lightning strikes and storms and, 2) human-induced or anthropogenic events which include sparks from welding or grinding activities or from onsite accommodation areas and the transport and storage of diesel fuels.

The purpose of the Fire Management Plan is to facilitate effective fire management practices from the above possible causes. The plan aims to manage site operations in a way that prevents fires and protects life, property and the natural and cultural values of the area.

The Project Area is located adjacent to the southeast edge of the Shark Bay World Heritage Property (SHWHP) which covers 2.2 million ha, including the marine reserves and terrestrial areas. Approximately 5km north of the Project Area is Hamelin Pool Marine Nature Reserve. Zuytdorp Nature Reserve (Cooloomia Nature Reserve) is located south of the Project Area and is a Class C reserve with an area of 58,850 ha. To the east of the site is Coburn, Meadow and Hamelin pastoral leases, which are currently being used as grazing land for sheep and goats. The Fire Management Plan aims to be consistent with these surrounding land uses in respect to fire management.

14.2 Potential Impact

The impact of the proposed mine development on fire management may include:

- Increased possibility of fire in the region;
- Loss of life;
- Damage to infrastructure and stock; and
- Increased susceptibility of sand blowouts or invasion by weeds following a fire disturbance.

14.3 Environmental Objectives

The environmental objectives of the Fire Management Plan are to:

- Prevent the occurrence of fires in the Project Area;
- Protect people, property and conservation values from fires within the Project site and the surrounding area;
- Prevent fires that contribute to a reduction in biodiversity in the region; and
- Provide fire prevention and suppression with minimum environmental damage.

14.4 Performance Indicators

The effectiveness of the Fire Management Plan will be determined through regular monitoring of the occurrence of fire within and adjacent to the Project Area. Further performance indicators include recording the frequency, intensity and cause of fires.

14.5 Stakeholder Consultation

Gunson has consulted the following stakeholders in relation to the Fire Management Plan:

- CALM Denham office;
- Shark Bay Shire Council;
- Fire and Emergency Services Authority of Western Australia (FESA) Midwest Gascoyne District;
- SBWHP Community Consultative Committee;
- Yamatji Land Council; and

- Surrounding pastoral land holders.

Gunson is confident that concerns raised by stakeholders regarding the management of fire can be managed in a safe and effective manner.

Gunson will continue to consult with all fire management agencies throughout the life of its Project.

14.6 Management

The plan aims to be consistent with the Midwest Gascoyne District – Wildfire Response Plan (FESA 2003) and the Fire Management Policy outlined in the Shark Bay Terrestrial Reserves Management Plan 2000 – 2009 (CALM 2000). Fire management strategies used in the adjacent SBWHP include: (1) fire exclusion to protect conservation values, (2) buffer burns to protect conservation areas and communities, and (3) habitat burns to achieve a mosaic of vegetation successional stages and a variety of faunal habitats (CALM 2000). Mutual arrangements will be established between other hazard management agencies on a neighbourly basis which will include Local Government Response Plans and other Standard Operational Procedures.

Due to the low population densities adjacent to the Project Area, management strategies will be centred on residential operational staff, surrounding landholders and associated infrastructure.

Gunson will employ the following management strategies for fire management:

- Prepare a detailed emergency response plan;
- Implement strategies to allow efficient coordination of fire fighting authorities;
- Install co-ordinated fire detection warning systems and suppression response protocols; and
- Comply with relevant regulations, policies and guidelines with the DoE and EPA for use of fire retardants.
- Fire Prevention and Protection
  - Implement and maintain firebreaks and fire access to aid firefighting and reduce the likelihood of a fire spreading;
  - Select fire suppression methods that have a low impact on the landscape;
  - Design accommodation and plant site areas in a manner to reduce the risk of fire;
  - Supply sufficient fire fighting equipment (fire extinguishers, protective gear) to machinery and accommodation areas and provide a effective placement plan for employees to locate necessary equipment in the event of an emergency;
  - Clearly mark and maintain evacuation doors, points and routes;
  - Identify potential sources of ignition i.e. natural gas supply to modular power units;
  - Manage stock piles of cleared vegetation; and
  - All machinery that is likely to cause a fire during operation will comply with Part VII of the Bush Fires Regulations 1954.
- Training
  - Site construction workers shall be trained in fire and safety procedures;
  - Undertake training and education programs for employees on fire management, prevention and equipment. eg Emergency and Evacuation procedures and First Aid; and
  - Integrate fire safe work practices such as the issuing of Hot Work Permits for open flame activities.
- Storage
  - Comply with all relevant regulations, under the *Mines Safety and Inspection*

Regulations 1995 for fuel transport and storage areas;

- Oxygen and fuel gas cylinders shall not be stored together, with a minimum of 3 meters between cylinders; and
- Flammable materials (solid, liquid or gases) shall not be stored within 5 meters of any occupied building, suitably secured and correctly signposted "Danger Highly Flammable".

- Responsibility
  - Delegate responsibility to Site, Project or OSH/ES&H managers to ensure strategies are carried out. These individuals will be responsible for evacuation of buildings and effected areas to a pre-arranged emergency meeting point;
  - Delegates will be responsible for weekly testing of alarm systems, escape routes and fire extinguishers;
  - Managers will be responsible for maintaining excellent housekeeping standards of storage areas and operational activities;
  - Managers will also be responsible for liaisons with local authorities such as CALM Denham office; Shark Bay Shire Council; Midwest Gascoyne District Emergency Management Committee and FESA; and
  - All fire fighting activities will be performed in accordance with the *Bush Fire Act 1954.*

Gunson will integrate the "Comprehensive Approach" to emergency management. This provides for a comprehensive and systematic way of managing hazards. The approach separates the management aspects into four elements of:

- Prevention;
- Preparedness;
- Response; and
- Recovery.

14.7 Monitoring

A monthly review of the procedures and equipment will be undertaken to assess effectiveness and identify deficiencies of the Fire Management Plan.

14.8 Reporting

All fire incidents, problems or concerns raised by employees will be reported to the Mine Manager. A systematic approach to dealing with employee concerns will be formulated. All incidents will be reported and documented.

The Fire Management Plan will be reviewed annually as a part of Gunson's commitment to continuous improvement and environmental management for its mining activities.

14.9 Contingency

In the event of a fire, it should be reported immediately to the Mine Manager or equivalent who will raise the alarm. Employees should assemble at pre-determined assemble points until instructed otherwise.

14.10 References

CALM 2000, Shark Bay Terrestrial Reserves Management Plan 2000 – 2009. Department of Conservation and Land Management for the National Parks and Nature Conservation Authority Perth, Western Australia.

Gill AM 1996, Biodiversity and bushfires: An Australia –wide perspective on plant-species changes after a fire event. In: Australia's Biodiversity – Responses to Fire, Plants, birds and invertebrates. Prepared by A.M. Gill, J.C.Z Woinarski and A. York.

Biodiversity Technical Paper, No. 1. Department of Environment and Herotage, Commonwealth of Australia, pp. 9-53.

Smith A 1995, http://sres.anu.edu.au/associated/fire/ecol/ascontent.htm. Date Accessed: 16 February 2005.

15.1 Current Status

A preliminary anthropological and archaeological survey was conducted in July 1999 with a survey team nominated by the Nanda and Malgana native title working groups. Baseline Research conducted this survey pursuant to an exploration heritage agreement between Gunson and Yamatji Land and Sea Council as representative body for the Malgana and Nanda Native Title Claimants. No registered Aboriginal sites were located within the survey area, and no new archaeological or ethnographical sites were located during the survey. This survey concluded that the proposed exploration work program could proceed.

In early December 2004, an anthropological and archaeological mining work program survey was conducted over mining lease applications 09/111 and 09/112 and the access road with representatives nominated by the Nanda working group. This area represents the first four years of the Project. This survey was conducted by Eureka Archaeological Research and Consulting. No registered Aboriginal sites were located within the survey area, and no new archaeological or ethnographical sites were located. One archaeological site was located near the access track, but this track has been diverted so as to avoid any disturbance. This survey concluded that the mining work program could otherwise proceed.

Final anthropological and archaeological mining work program surveys, from years 4 to 10 of the Project within the Nanda native title claim are proposed to take place in May 2005. Years 10 to 15 of the project will also be surveyed but only on the basis of giving Gunson an indication of whether there are likely to be any heritage issues in the first instance, and will undergo full mining work program surveys when the Project has moved north to ensure that Aboriginal people are not bound by an out-of-date survey.

All surveys will include representatives nominated by the Nanda working group (and Malgana working group where necessary) along with other Aboriginal people with an interest in the Gunson Project Area.

15.2 Potential Impacts

Mining activities that may have an impact on Aboriginal Heritage include the removal of vegetation and topsoil for mining and associated infrastructure. These activities have the potential to disturb ethnographic and archaeological sites within the Project Area.

15.3 Environmental Objectives

The environmental objectives for the Project are:

- Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act* 1972 (WA) and EPA Guidance Statement (No.41), Assessment of Aboriginal Heritage (EPA, 2001); and
- Ensure that changes to the biological and physical environment resulting from the project do not adversely affect the cultural associations with the area.

15.4 Performance Indicators

Aboriginal Heritage Sites are protected under the provisions of the *Aboriginal Heritage Act* 1972. Aboriginal Heritage surveys were carried out in accordance with EPA Guidance Statement (No. 41), Assessment of Aboriginal Heritage.

15.5 Stakeholder Consultation

Gunson Resources has undertaken extensive consultation with the Nanda and Malgana People, and their representatives the Yamatji Land and Sea Council since 1999. Gunson's Project has been a standing item on the agenda at the Nanda working group meeting since February 2004. Gunson regularly meets with the Malgana working group and will increase its attendance as the projects approaches their native title claim area.

Other Aboriginal people with an interest in the Project Area have been, and continue to be consulted,

both verbally and in writing, as they have become known to Gunson since early 2004.

Gunson will continue to consult with all Aboriginal stakeholders throughout the life of the Project.

15.6 Management

The Project will not result in any off-site impacts on cultural heritage sites. Personnel for both construction and operation will be provided with cultural awareness training regarding protection of heritage sites.

Given that no ethnographic or archaeological sites have been located within the Project Area to date, it has been unnecessary to implement any management of known sites. However, should heritage sites be located during the final series of surveys, or during construction or operations of the Project, these will be managed pursuant to the Aboriginal Heritage Protocol annexed to the Mining Agreement between Gunson and the Nanda Native Title Applicants dated 20 September 2004, the *Aboriginal Heritage Act 1972* (WA), *Aboriginal and the Torres Strait Islander Heritage Protection Act 1984* (Cth).

There is a possibility that unknown Aboriginal heritage sites may be found at any time, including being uncovered during excavation of the Gunson site. If it is suspected that an Aboriginal site has been discovered, the following course of action is to be followed:

1) Work is immediately stopped in the area of the suspected Aboriginal heritage site, the area is to be cordoned off to an area of 5 metres and an archaeologist notified;

2) If the archaeologist assesses the find to be Aboriginal heritage site, they will prepare a report with recommendations and provide to Gunson;

3) Gunson will liaise with the Department of Indigenous Affairs in relation to whether a Section 18 Application of *Aboriginal Heritage Act* 1972 (WA) is required, if this course of action is deemed necessary; and

4) Gunson staff and/or contractors will be advised when the above process has been completed and work can continue in the vicinity of the area.

There is a possibility that sub-surface Aboriginal heritage sites, including skeletal remains, may be uncovered during excavation, or other environmental disturbance, to the Gunson site. If it is suspected that skeletal remains have been discovered, which are of a highly sensitive nature, the following procedure is to be strictly complied with:

1) Work is immediately stopped in the area of the suspected skeletal remains, the area is to be cordoned off to an area of 5 metres and the police, the Department of Indigenous Affairs and an archaeologist is notified. Work in the surrounding areas is to proceed with extreme caution;

2) The Police/Coroner will confirm if remains are of human origin and whether or not they relate to a crime, of whether they relate to a traditional Aboriginal burial;

3) If area of the skeletal remains is considered to be fundamental to Gunson's activities continuing, as determined by Gunson, then archaeologist applies for an emergency Section 16 of *Aboriginal Heritage Act* 1972 (WA) Application to remove the remains so that Gunson's activities can continue. Gunson will seek advice as to whether a Section 18 of *Aboriginal Heritage Act* 1972 (WA) Application is required.

4) If origin of remains cannot be established on site, then Coroner will order the remains to be removed from site for testing in Perth (can take anywhere between two days and two weeks). Gunson will assist Police/Coroner in removal of remains to ensure that potential cultural information is not obscured or destroyed. Skeletal remains are to be treated as though they are of Aboriginal origin, until established otherwise.

5) If remains are found to constitute evidence of a crime, then the matter will remain within Police/Coroner jurisdiction and Gunson will work with them as directed.

6) If remains are found likely to be a traditional Aboriginal burial, then Gunson will manage in conjunction with the Department of Indigenous Affairs and the local Aboriginal people.

7) Gunson will ensure that Federal Minister for Aboriginal Affairs is notified that Aboriginal remains have been found pursuant to section 20(1) *Aboriginal and Torres Strait Islander Heritage Protection Act* 1984 (Cth).

8) If archaeologist assesses the remains to be relatively recent, then Department of Indigenous Affairs Registrar is unlikely to order a carbon date, or other testing. However, if remains are assessed as antiquity, then Registrar is likely to apply a further testing ruling. Local Aboriginal consultation may result in further testing prior to re-burial.

15.7 Monitoring

To ensure that the initial construction works do not disturb any possible sub-surface Aboriginal heritage sites, two Aboriginal monitors, as nominated by the relevant Aboriginal native title claimant working group, will monitor the initial construction works to ensure that any Aboriginal skeletal remains or other artefacts that may be identified are managed in accordance with the Gunson procedures.

15.8 Reporting

Once the Aboriginal heritage survey has been conducted, an Aboriginal heritage survey report will be provided that either 'clears' the area for the proposed activity to proceed, or it confirms the presence of Aboriginal Sites, if any, that may exist within the area surveyed. These results will then be documented and effectively relayed in order for Gunson to effectively manage the site in accordance with the recommendations of the heritage report.

15.9 Contingency

Gunson will ensure that any archaeological sites in the general vicinity of the Gunson site are adequately marked and protected from disturbance or interference. This commitment extends into the construction and operational phases of the Gunson project.

15.10 Acknowledgements

Information contained within this EMP has been derived from an Aboriginal Heritage Management Plan drafted by Kellie Hill Consulting on behalf of Gunson Resources Limited.