

Coburn Mineral Sand Project

Gunson Resources Limited

**Report and recommendations
of the Environmental Protection Authority**

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Environmental Impact Assessment Process Timelines

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29/08/05	Public Comment Period Closed	8
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Summary and recommendations

Gunson Resources Limited proposes to develop the Coburn Mineral Sand Project, 84 kilometres (km) south-east of Denham in the Shire of Shark Bay. This proposal involves the excavation and processing of a major low-grade heavy mineral sand deposit over 12 years. The concentrate would be trucked 250 km south to Geraldton for direct export.

This report provides the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for the Environment on the environmental factors relevant to the proposal.

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

The EPA is also required to have regard for the principles set out in section 4A of the *Environmental Protection Act 1986*.

Relevant environmental factors and principles

The EPA decided that the following environmental factors relevant to the proposal required detailed evaluation in the report:

- (a) Groundwater;
- (b) Flora and Vegetation;
- (c) Fauna;
- (d) Rehabilitation, and
- (e) World Heritage and Conservation Values.

There were a number of other factors which were relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

The following principles were considered by the EPA in relation to the proposal:

- (a) the precautionary principle;
- (b) the principle of intergenerational equity; and
- (c) the principle of the conservation of biological diversity and ecological integrity.

Conclusion

The EPA has considered the proposal by Gunson Resources Limited to develop the Coburn Mineral Sand Project, 84 kilometres (km) south-east of Denham in the Shire of Shark Bay. This proposal involves the excavation and processing of a major low-

grade heavy mineral sand deposit over 12 years. The concentrate would be trucked 250 km south to Geraldton for direct export.

The EPA has noted that there would be a number of environmental concerns associated with any significant mining activity proposed in this area. The proposal is located adjacent to the south-eastern border of the Shark Bay World Heritage Property in a floristically diverse transition zone between two botanical districts. The northern end of the proposed project area is approximately 20 km south of the Hamelin Pool Marine Nature Reserve.

Since referral of the original proposal, Gunson has removed Pit 10, the largest and northernmost pit, from the proposal. The removal of Pit 10 has reduced the life of the proposed mine from 20 to 12 years, and reduced the mine footprint from 5,745 ha to 3,695 ha. Gunson recognised that there was a degree of uncertainty regarding a number of potential impacts associated with the development of Pit 10, which would remain until operational data become available to validate and refine predictive models. Gunson have stated that Pit 10 would not be developed until it can be demonstrated that adverse environmental impacts can be avoided. The EPA supports Gunson's removal of Pit 10 from the proposal for these reasons. This assessment therefore considers only Pits 1-9.

The EPA has evaluated the potential for the proposed mine to affect groundwater in the project area and surrounding region by both mounding and drawdown of groundwater. Mounding is expected on a local scale, whereas drawdown is expected both locally and regionally. The EPA has recommended that mounding be managed through implementation of a specific Groundwater Mounding Management Plan. This Plan includes development of 'threshold' and 'limit' criteria for both groundwater levels and vegetation health. Management responses would be defined for implementation in the event that the 'threshold' criteria are not met. If at any time the 'limit' criteria are exceeded, the proponent would be required to cease all mining that is contributing to the 'limit' criteria being exceeded. The EPA considers that drawdown can be managed by the Department of Environment in accordance with the *Rights in Water and Irrigation Act 1914*, which would set conditions in relation to groundwater abstraction and making good the supply to any other users adversely affected by Gunson's abstraction.

With regard to flora and vegetation, Gunson's surveys have shown that the clearing of 3,695 ha is not expected to result in the loss of any vegetation communities or flora species. While the vegetation surveys undertaken are comprehensive, given the large area proposed for mining the EPA has recommended a condition requiring that Gunson conduct searches for Declared Rare Flora (DRF) and Priority Flora prior to the development of each pit. In the event that DRF are identified in the project area, the EPA has recommended a condition requiring the development of a Declared Rare Flora Management Plan which proposes management strategies be developed for the protection of DRF identified, on advice from the Department of Conservation and Land Management.

Similarly, the EPA has concluded that the clearing associated with this proposal can be managed to meet the EPA's objectives for fauna. The EPA has recommended the development of a Fauna Management Plan, which includes provisions in the event that Threatened Fauna are identified in the project area. The Fauna Management Plan

includes requirements for the baseline surveys of Malleefowl (*Leipoa ocellata*), listed as Vulnerable under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and Threatened under the *Western Australian Wildlife Conservation Act 1950*, and monitoring of populations both inside and outside the project area.

With regard to rehabilitation, the EPA has noted the limited experience of rehabilitation in this region. The majority of vegetation in the project area is relatively slow growing, which along with windy conditions, high evaporation, and sporadic rainfall, present a number of challenges to successful rehabilitation. The EPA has accepted that re-establishment of the ecosystem existing prior to mining is highly unlikely in this environment. It is acknowledged that, at best, rehabilitation can return some ecological function, generally with reduced species diversity and ecosystem complexity. In order to maximise the likelihood of successful rehabilitation, the EPA has recommended a number of conditions. These include the requirement to develop a Progressive Rehabilitation Programme which comprises a Soil Management Plan, Revegetation Management Plan and Weed Management Plan. These plans are based on the establishment of performance and completion criteria, developed in conjunction with the appropriate Government agencies, with defined mitigation strategies in the event that criteria are not achieved.

The EPA has also recommended that, in order to integrate the rehabilitation process with mining operations, Gunson be required to maintain an open area for the drying of clay or slimes not exceeding 40 ha at any one time, and rehabilitate not less than 80% of the total mined area during each year of mining. In order to ensure that mining does not result in an unacceptable environmental outcome, the EPA recommends that a number of pre-determined criteria should be met following five years of rehabilitation. If Gunson are unable to demonstrate achievement of these criteria by the end of seven years, the EPA recommends that prior to further mining, Gunson be required to review the Progressive Rehabilitation Programme to the requirements of the Minister for the Environment on the advice of the EPA, and demonstrate that the criteria can be met should mining continue.

The EPA has considered the potential for impacts on World Heritage and Conservation values due to the proximity of the site to the Shark Bay World Heritage Property (SBWHP). While the original proposal presented a number of risks to the SBWHP, Gunson have demonstrated that these risks are significantly reduced by removal of Pit 10 from the proposal. With the conditions the EPA has recommended, it is expected that impacts would be confined to the project area. While noting the low likelihood of dust impacts on the SBWHP, the EPA has recommended that Gunson be required to prepare a Dust Management Plan, which includes monitoring of deposited dust levels at the boundary of the project area and at Hamelin Pool for the initial three years of the project.

The Commonwealth Minister for the Commonwealth Department of Environment and Heritage determined the proposal to be a Controlled Action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on the basis of potential significant effects on World Heritage, Listed Migratory Species and Listed Threatened species and Communities. Under the terms of the bilateral agreement between Western Australia and the Australian Government under section 45 of the EPBC Act, the EPA examined the effects on these matters in Section 3.1, 3.3, 3.5 of

this Bulletin and has recommended that conditions 6.1, 11.1, 8.1, 8.2 should ensure that effects on these matters are environmentally acceptable.

The EPA has concluded that the proposal is capable of being managed to meet the EPA's objectives provided that there is satisfactory implementation by the proponent of their commitments and the recommended conditions set out in Appendix 4 and summarised in Section 4.

Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister notes that the proposal being assessed is for Gunson Resources Limited to develop the Coburn Mineral Sand Project approximately 84 kilometres south-east of Denham in the Shire of Shark Bay. This involves the excavation and processing of a major low-grade heavy mineral sand deposit. The concentrate would be trucked 250 km south to Geraldton for direct export.
2. That the Minister considers the report on the relevant environmental factors and principles as set out in Section 3;
3. That the Minister notes that the EPA has concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4, and summarised in Section 4, including the proponent's commitments.
4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report.

Conditions

Having considered the proponent's commitments and information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by Gunson Resources Limited to develop the Coburn Mineral Sand project is approved for implementation. These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

- (a) that the proponent shall fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 4; and
- (b) Groundwater Mounding Management Plan;
- (c) Flora and Vegetation Management Plan including a Declared Rare Flora Management Plan;
- (d) Fauna Management Plan including a Threatened Fauna Management Plan;
- (e) Progressive Rehabilitation Programme including a Soil Management Plan, a Revegetation Management Plan, and a Weed Management Plan;
- (f) Bush Fire Management Plan;
- (g) Dust Management Plan; and
- (h) a Mine Closure Plan.

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1. Introduction and background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment on the environmental factors and principles relevant to the proposal by Gunson Resources Limited to develop a mineral sand mine for the excavation and processing of a low-grade heavy mineral sand deposit in the Shark Bay district of Western Australia.

The proposal was referred to the EPA on 17 September 2003, and on 13 October 2003 the level of assessment was set as Public Environmental Review (PER) under Section 38 of the *Environmental Protection Act 1986*. The PER document was made available for a public review period of 8 weeks commencing on 4 July 2005 and ending on 29 August 2005.

The EPA's decision to assess the proposal at the level of PER was based on five main factors, namely groundwater, flora and vegetation, fauna, rehabilitation and World Heritage and Conservation values. The project was assessed bilaterally with the Department of Environment and Heritage due to the Commonwealth controlling provisions in relation to World Heritage, listed threatened species and communities, and listed migratory species (Assessment 2003/1221).

Further details of the proposal are presented in Section 2 of this report. Section 3 discusses the environmental factors and principles relevant to the proposal. The Conditions and Commitments to which the proposal should be subject, if the Minister determines that it may be implemented, are set out in Section 4. Section 5 provides Other Advice by the EPA, Section 6 presents the EPA's Conclusions and Section 7, the EPA's Recommendations.

Appendix 6 contains a summary of submissions and the proponent's response to submissions and is included as a matter of information only and does not form part of the EPA's report and recommendations. Issues arising from this process, and which have been taken into account by the EPA, appear in the report itself.

2. The proposal

Gunson Resources Limited (Gunson) proposes to develop a mineral sand mine for the excavation and processing of a portion of the low-grade heavy mineral sand deposit, the Amy Zone, into a heavy mineral concentrate (HMC) in the Shark Bay district of Western Australia. The Amy Zone is approximately 35 km long, up to 3 km wide and 5-40 m thick. The regional location of the proposal is shown in Figure 1, and the proposed mine layout is shown in Figure 2.



Figure 1: Regional location

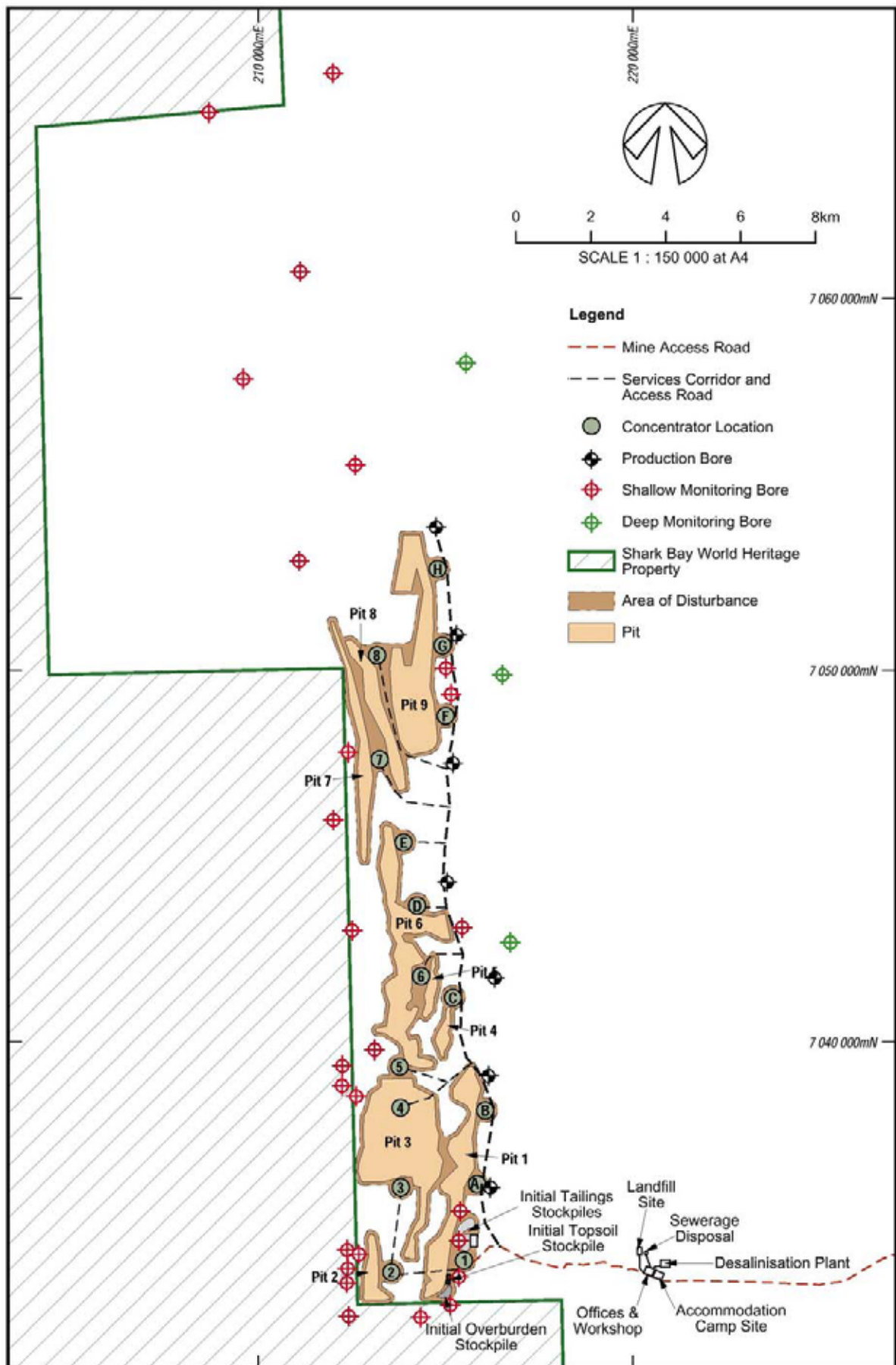


Figure 2. Proposed layout of the Amy Zone Operation. The proposal area is defined as all areas where disturbance will occur through the mining of Pits 1-9, placement of infrastructure, borrow pits, haul roads, access road and other facilities, plus a 50 metre buffer.

The proposed project comprises the construction, operation, rehabilitation and closure of:

- nine open pit mines which would be backfilled with tailings;
- two processing plants (concentrators);
- haul road and access corridors;
- an accommodation camp;
- office buildings, workshops and support facilities;
- a borefield; and
- supporting infrastructure such as a power plant, reverse osmosis desalination plant, power lines and pipelines.

Mining would be carried out using a conventional dry strip mining method. Mining infrastructure would progressively be relocated as mining proceeds at one to two kilometres per year. The estimated total footprint of disturbance is 3,695 ha.

Two 2,300 tonnes per hour (tph) bucket-wheel excavators would be used for mining the ore and overburden in Years 1 and 2. The mined material would 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 would be used to transport the slurry to the concentrator, and return the tailings to the mine void. This mining system would be duplicated from Year 3 of the mine life, with additional mining equipment and a second concentrator equipment.

Initially, the processing plant throughput would be 2,200 tph. This would increase with the addition of a second concentrator to 4,400 tph from Year 3. The concentrators would be built around banks of spirals that remove silica and other lighter specific gravity minerals, allowing valuable heavy minerals to become concentrated. The process of pumping the ore and water over spirals would be repeated until the final concentrate is more than 90% HMC.

Approximately 140,000 tonnes of HMC per annum would be trucked to Geraldton initially, increasing to 280,000 tonnes per annum from Year 3 of the mine life. The HMC would be trucked as two separate product streams:

- Wet High Intensity Magnetic Separator magnetics HMC, 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.

Sand tailings and clay fines (slimes) from the on-site concentrator(s) would be returned to the mined-out area(s) as the mining operation moves forward. Water recovered from the tailings would be recycled to the slurry unit or when necessary stored in a lined dam at the concentrator. Rehabilitation would be conducted progressively, with vegetation removed from areas ahead of the pit and placed on prepared tailings areas behind the pit in a continuous removal/replacement cycle.

The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in Section 2 of the PER document (URS 2005a).

Table 1: Summary of key proposal characteristics

Element	Description
Project Life	Approximately 12 Years
Number of Pits	Nine pits
Rate of Mining	Approximately 2,300 tph for the first two years, increasing to 4,600 tph in Year 3 (~15 million tpa for Years 1 and 2, and 30 million tpa for Years 3 to 12).
Mining Method	Bucket-wheel excavators and in-pit screening modules
Estimated Footprint of Disturbance	Approximately 3,695 ha
Rate of Processing	Approximately 2,200 tph for the first two years increasing to 4,400 tph in Year 3 (~140,000 tpa of HMC from Year 1 increasing to 280,000 tpa from Year 3).
Estimated Volume of Tailings	2,180 tph for each 2,200 tph concentrator.
Volume of Process Water	Up to 18 GL/annum at full production
Estimated Total Volume of Refined Product	Ilmenite – 1,400 kt HiTi – 380 kt Zircon – 660 kt

Note: tph – tonnes per hour, tpa – tonnes per annum, GL/annum - giganlitres per annum, kt – kilotonnes.

Since release of the PER document (URS 2005a), Gunson has removed Pit 10 from the proposal (Appendix 6). Modelling undertaken during the assessment of the project indicated that there was potential for impacts on vegetation in the Nilemah Embayment due to groundwater mounding, and the potential for dust impacts on stromatolites in Hamelin Pool Marine Nature Reserve. These concerns were associated primarily with the development of Pit 10, the northernmost of the proposed mining areas. It was recognised that some degree of uncertainty would remain until operational data became available to validate and refine the predictive models.

Gunson have therefore committed to staging development of the mine. Pit 10 would not be developed unless it can be demonstrated that adverse impacts can be avoided by appropriate management action. This assessment therefore considers only Pits 1-9. Gunson is aware that should it wish to develop Pit 10 at some time in the future, it would need to seek further environmental approval to do so.

The removal of Pit 10 from the Proposal has substantially altered some of the key characteristics of the proposal. These are:

- Reduction of the project footprint and clearing required. Removing Pit 10 and associated infrastructure from the proposal has reduced the project footprint from 5,745 ha to 3,695 ha.
- Reduced impact on ten locally and/or regionally significant plant communities. Removing Pit 10 and associated infrastructure from the proposal means that the area that would be cleared within plant communities E1, E2, E3, E4, E6, M1, S1, S2, S4 and S8 has been reduced (URS 2005a, b).
- Removal of impact on *Acacia drepanophylla*. The PER predicted that three populations of the Priority 3 species, *Acacia drepanophylla*, would be disturbed through the development of Pit 10 and associated infrastructure. This will no longer occur.
- Removal of potential dust deposition impact on stromatolites. The potential for dust deposition on the Hamelin Pool stromatolites due to project implementation was already considered low. However, no impact is expected with mining operations ceasing at the completion of Pit 9, which is located some 20 km to the south of Hamelin Pool.

- Reduction in the potential groundwater drawdown impacts of the project. The removal of Pit 10 decreases the project duration from 20 to 12 years and significantly reduces the proximity to the Nilemah Embayment and Hamelin Pool. It also removes the requirement for pit dewatering because the ore in Pits 1-9 occurs well above groundwater level. Consequently removal of Pit 10:
 - reduces the potential drawdown impacts on the Birdrong Sandstone and Kopke Sandstone aquifers due to water supply abstractions; and
 - removes any potential impacts on Nilemah Embayment from pit dewatering.
- Reduction in potential groundwater mounding impacts of the project. The removal of Pit 10 significantly reduces the proximity of the operations to the Nilemah Embayment and Hamelin Pool. The removal of Pit 10 consequently removes the potential for impacts on Nilemah Embayment from groundwater mounding due to sand tails operations in that pit.
- The length of the flow path from mounded groundwater zones to the Nilemah Embayment has increased from approximately 4 km to 18 km. This has increased the travel time for mounded water by an order of magnitude, therefore no impact on Nilemah Embayment is expected as a result of groundwater mounding.

(Appendix 6).

The potential impacts of the proposal and their proposed management are summarised in Appendix 3.

3. Relevant environmental factors and principles

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and the conditions and procedures, if any, to which the proposal should be subject. In addition, the EPA may make recommendations as it sees fit.

The identification process for the relevant factors selected for detailed evaluation in this report is summarised in Appendix 3. The reader is referred to Appendix 3 for the evaluation of factors not discussed below. A number of these factors, such as sustainability, Aboriginal heritage and mine closure are relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

It is the EPA's opinion that the following environmental factors relevant to the proposal require detailed evaluation in this report:

- (a) Groundwater;
- (b) Flora and vegetation;
- (c) Fauna;
- (d) Rehabilitation, and
- (e) World Heritage and Conservation values.

The above relevant factors were identified from the EPA's consideration and review of all environmental factors generated from the PER document and the submissions received, in conjunction with the proposal characteristics. Submissions that relate only to Pit 10 are not discussed, due to the removal of Pit 10 from the proposal.

Details on the relevant environmental factors and their assessment are contained in Sections 3.1 - 3.5. The description of each factor shows why it is relevant to the proposal and how it would be affected by the proposal. The assessment of each factor is where the EPA decides whether or not a proposal meets the environmental objective set for that factor.

The following principles were considered by the EPA in relation to the proposal:

- (a) the precautionary principle;
- (b) the principle of intergenerational equity; and
- (c) the principle of the conservation of biological diversity and ecological integrity.

3.1 Groundwater

Description

The proposed mine has the potential to affect groundwater in the project area and surrounding region by both mounding and drawdown of the groundwater. Mounding is expected on a local scale, whereas drawdown effects would be expected both locally and regionally.

Submissions

One of the key issues raised in submissions was the potential for groundwater mounding to impact Nilemah Embayment.

A number of submissions raised concerns regarding groundwater drawdown and impacts on other groundwater users in the area as a result of the proposal. The impact on production bores was cited as a major concern, with the potential to affect the viability of pastoral and other pursuits that use water. A number of submitters raised the implications of Gunson's proposed water use, and the process to make good for any loss of amenity.

Concerns were also raised regarding drawdown impacts on the Hamelin Pool Marine Nature Reserve.

Assessment

The area considered for assessment of this factor is groundwater in the project area, as shown in Figure 2, and surrounding region.

The EPA's environmental objectives for this factor is to maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

The assessment of groundwater is split into 2 components:

- mounding; and
- drawdown.

3.1.1 Mounding

Description

Mounding of the groundwater is predicted as a result of the disposal of sand and slimes in slurry form. Water abstracted from the Birdrong and Kopke aquifers would be used to form a slurry to concentrate the heavy minerals and deliver the sand tailings back to the open pit for deposition by hydraulic stackers. Gunson intends to recover mine water from sand in the open void directly behind the mine face during the process and immediately before hydraulic stacking. The stacked sand would contain excess water that would drain quickly to the relatively impermeable basement.

The effectiveness of the drains on the pit floor would largely determine the amount of mine water recovered, and to a lesser extent the amount lost to mounding. It is the development of mounds that allow relatively high rates of water recovery, except where the rate of stacker advance is too fast for the necessary hydraulic gradients to develop. Under these conditions, additional water recovery strategies would be required (URS 2005a), such as abstraction of groundwater via recovery bores.

The PER document (URS 2005a) states that residual water mounds would be environmentally significant where there is the potential for mounding to result in groundwater levels less than approximately 5 m from the surface. Most of the natural vegetation roots are located within the uppermost 1 to 2 m, but several mallee species have deeper root systems. Several areas of thin superficial sand cover have been identified at the southern end of the Amy Zone. The vegetation in these areas may be particularly susceptible to rising groundwater levels.

The area of vegetation predicted by Gunson to be at risk due to mounding is estimated at 2015 ha, as shown in Figure 7.2 of the PER document (URS 2005a). It is however noted that not all of this area is susceptible to mounding (as only low lying areas are expected to be at risk), and that some of this vegetation occurs within the proposed Pit outlines. It is estimated that approximately one third of the vegetation predicted to be at risk from mounding is within the Shark Bay World Heritage Property.

Assessment

The EPA considers that mounding of groundwater requires management to prevent the loss of vegetation.

In order to manage groundwater mounding, Gunson has proposed the following mitigation strategies:

- mapping of the vegetation and typical depths of root penetration;
- installation of multipiezometers to characterise thickness of the superficial formations and depths to the groundwater;
- monitoring of actual groundwater mounding;
- where appropriate, maintenance of active drains in the pit(s) adjacent to areas at risk in order to intercept and abstract tailings water locally contributing to the mounding; and
- where appropriate, review of the mining plans to increase the duration of mining and reduce the height of residual mounding.

Monitoring bores would be located between the mine and sensitive areas to provide early warning of the need for remedial action.

Gunson has stated that groundwater mounding is unlikely to significantly impact on vegetation as mounding is unlikely to affect plant root zones. However, in some areas seepage may enter the root zone, and there may be localised loss of plant condition

and plant deaths (URS 2005a). It is the view of the EPA that it is unacceptable for Gunson's operations to cause the death of any vegetation outside the project area.

The EPA recommended condition 6 requires Gunson to develop a specific Groundwater Mounding Management Plan. This Plan is based on the development of 'threshold' and 'limit' criteria for both groundwater levels and vegetation health. Management responses would be defined for implementation in the event that the 'threshold' criteria are not met. If at any time the 'limit' criteria are exceeded, the proponent would be required to cease all mining that is contributing to the 'limit' criteria being exceeded. In order to recommence mining, the proponent would be required to review the groundwater criteria to suitably protect vegetation in future, and/or have in place a program to return groundwater levels to below the 'threshold' criteria.

The EPA also recommends that, due to the proximity of the proposal area to the Shark Bay World Heritage Property, condition 6-8 require the proponent to maintain a 100 metre buffer zone along the boundary of the Shark Bay World Heritage Property (SBWHP) in which no mining activity occurs and no roads are established. This would minimise the likelihood of visible dust in the SBWHP, and allow monitoring and management of potential groundwater mounding prior to reaching the SBWHP. The EPA considers this buffer to be a suitable location for the installation of groundwater monitoring bores for the characterisation of groundwater mounding and to allow the early detection of the potential for impacts on the SBWHP.

The EPA notes that the potential for groundwater mounding to impact Nilemah Embayment was identified in the PER (URS 2005a). However, the removal of Pit 10 from the proposal has increased the length of the flow path from the mounded groundwater zones to the Nilemah Embayment from approximately 4 km to 18 km. Residence times for the water disposed with sand tailings would increase by at least an order of magnitude (to at least hundreds of years) and no mounding of groundwater would be expected in proximity to the Nilemah Embayment (Appendix 6). The EPA therefore considers that there is not a significant potential for impacts on Nilemah Embayment as a result of this proposal. It is however noted that the EPA supported the removal of Pit 10 from the current proposal, in part, due to the degree of uncertainty regarding the predictive modelling of mounding. The EPA therefore recommends to the proponent that appropriate operational data be collected during the mining of Pits 1-9 to allow for a high level of certainty in predictions of the potential impact on Nilemah Embayment should the proposal to mine Pit 10 be considered at a later date. This is also addressed in Other Advice.

3.1.2 Drawdown

Description

Drawdown of groundwater is expected as a result of water abstraction to provide water for the mining operation. Water would be required primarily to transport the ore from the pit, for mineral concentrating, domestic use and dust suppression. The process water requirement is estimated at 5.9 GL per annum for the first two years. Three bores would be required, each supplying approximately 100 litres per second. A fourth bore would be maintained to provide a back-up water supply if required. When full production is reached after Year 2, the volume of process water required would increase. It is expected that up to 10.4 GL per annum would be required under an optimal tailings drainage configuration, but up to 18 GL per annum would be required if non-optimal conditions occur. It is proposed that this water be abstracted from the regional confined aquifer system.

Groundwater levels in the confined aquifers of this region are not well defined, partially due to inadequate logging and aquifer definition of the private bores in the district, as well as the variable physical condition of these bores. The main aquifers beneath the project area include, from bottom to top, the Kopke Sandstone, Birdrong Sandstone, and Windalia Sand Member. The magnitude of drawdown impacts are expected to be greatest in bores intersecting the Birdrong and Kopke Sandstones. The Birdrong Sandstone is the most commonly used aquifer in the Carnarvon Basin. The Kopke Sandstone is likely the second most important groundwater source in the middle and southern parts of the Gascoyne Platform sub-basin. Where the formation is not too deep, it is utilised as a lower salinity water source in preference to the Birdrong Sandstone.

Gunson has conducted a series of discrete hydrological investigations on the groundwater systems beneath the project area. This has involved drilling programs on both the superficial formations and confined aquifers, as described in the PER document (URS 2005a). A census was also undertaken on 58 bores within a 50 km range of the project area, in order to define the scope of potential impacts on other groundwater users. This comprised the collection of historical data on existing bore locations, construction, groundwater levels and groundwater quality, as detailed in the PER document (URS 2005a).

Modelling has shown that withdrawal of up to 18 GL per annum would lead to overall localised drops in water pressure within the Birdrong and Kopke Sandstone aquifers, and may be expressed through drops in water levels where the regional aquifers are unconfined or semi confined. The maximum predicted drawdown impacts from Birdrong Sandstone and Kopke Sandstone groundwater supply abstractions range from 0.7 to 5.6 m in existing bores on the Hamelin Station (Appendix 6). Gunson predicts that these drawdown impacts do not threaten groundwater supply capabilities in the region. In sub-artesian bores, reductions in supply capability are predominantly expected to be made up by lowering of installed pump units. However in some instances there may be a need to install alternative pump units to replicate previous supplies.

Hydrogeological assessments and predictive simulations (shown in Appendix D of the PER (URS 2005a)) indicate that there would be no drawdown impacts from Birdrong Sandstone and Kopke Sandstone groundwater abstraction on Hamelin Pool Marine Nature Reserve. This is primarily due to the interpreted low vertical transmissivities of the Toolonga Calcilutite and Alinga Formation aquitards that overly the regional confined aquifers (Figure 29 Appendix D, URS 2005a). These assessments are reinforced by the understanding that historical abstractions in the region have not resulted in any known impacts on the Hamelin Pool Marine Nature Reserve (URS 2005a).

Assessment

The EPA notes that a large volume of water is required for the proposed mining operation, primarily to provide process water. Up to 18 GL per year of water would be required from Year 3, when the mine is at full operation. This water would largely be abstracted from the Birdrong Sandstone and Kopke Sandstone aquifers of the Carnarvon Basin. It is also noted that understanding of the hydrogeology of the Carnarvon Basin is relatively limited. Recharge to the Birdrong Sandstone and Kopke Sandstone aquifers, and the available groundwater resources, are poorly defined (Wills and Dogramaci 2000) leading to uncertainty regarding sustainable rates of

abstraction. It is estimated that in the Carnarvon Basin, groundwater recharge may be in the order of 0.5% of annual rainfall (Wills and Dogramaci 2000).

The removal of Pit 10 from the proposal would reduce impacts on the aquifers in terms of groundwater drawdown. The borefield would no longer be located as far north as originally proposed. This would confine the deeper parts of the drawdown cone to the southern and central parts of the project area and significantly reduce the predicted drawdown to other users located to the north. The removal of Pit 10 also decreases the project duration from 20 to 12 years. This would also reduce the extent of regional drawdown and hence the impact on other users at greater distances. As a result of this change the predicted impacts on other groundwater user bores has been revised, as provided in Table 6 of the Response to Submissions (Appendix 6).

Gunson have submitted an application to take groundwater to the Department of Water, in accordance with the requirements of the *Rights in Water and Irrigation Act 1914*. The EPA is informed by the Department of Water that the Department is currently reviewing the allocation limit and policy framework for the Carnarvon Artesian Basin. The Department is of the view that the quantity of water requested by Gunson is available, and would issue a Letter of Intent to Gunson. As part of the water licence, the Water and Rivers Commission intends to impose a number of conditions on Gunson. These include recording of the volume of groundwater drawn and measurement of bore static head pressure at monthly intervals. The licence conditions would also require that Gunson be required, to the satisfaction of the Water and Rivers Commission, to make good the supply to other affected groundwater users, should Gunson's draw adversely affect other users. Due to the ability of the Water and Rivers Commission to place these conditions on the proposal, the EPA does not consider it necessary to recommend any Ministerial Conditions relating to this issue.

Summary

Having particular regard to the:

- (a) the detailed strategy proposed by Gunson for the mitigation of groundwater mounding;
- (b) the recommended condition requiring that Gunson ensures no loss of vegetation outside the project area, by development and implementation of a specific Groundwater Mounding Management Plan, and
- (c) the advice of the Department of Water, that it intends to issue a licence to Gunson in accordance with the *Rights in Water and Irrigation Act 1914*, which would set conditions in relation to groundwater abstraction,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

3.2 Flora and Vegetation

Description

The project area is significant as it is a transition zone between the Southwestern and Eremaean Botanical Provinces. It is proposed that 3,695 ha of vegetation would be cleared over the 12 year life of the mine. In addition to clearing, vegetation within and adjacent to the project area could potentially be affected by:

- groundwater mounding due to tailings seepage (discussed in Section 3.1); and
- dust deposition from mining operations (discussed in Section 3.5).

Four flora and vegetation surveys were undertaken by Mattiske Consulting Pty Ltd over a 15 month period (URS 2005a). These occurred in August 2003, April 2004, September 2004 and November 2004. A total of 231 taxa (including subspecies and varieties) from 132 genera and 51 families were recorded during these surveys. A total of 18 plant communities, consisting of seven Eucalyptus Woodlands, ten Shrublands and one Mosaic community, were defined and mapped (URS, 2005a). Seven Priority Flora species have been recorded in the vegetation communities in the project area, comprising two Priority 2 species, four Priority 3 species and one Priority 4 species.

Additional survey work was conducted during August 2005 (Mattiske 2005), to describe and map the vegetation in areas of the Shark Bay World Heritage Property (SBWHP) that could be at risk from water mounding within the root zone, and to obtain an understanding of the extent of the mosaic plant community (Community M1) to the east of the north end (adjacent to Pit 10, now removed from the proposal). The additional survey increased the total area of vegetation mapping for the project to 24,384 ha. The August 2005 survey indicates that many of the plant communities found in the vicinity of the project area also occur in the SBWHP and on the Coburn and Hamelin pastoral leases to the east of the project area.

Submissions

A need for pre-mined vegetation surveys during the life of the mine was highlighted as being critical in order to minimise the loss of regionally significant biodiversity values.

Concerns were raised over the impact to Priority Flora species caused by mining operations. In particular, species such as *Eremophila occidentis*, known to have low germination rates. It was suggested that research would be required into propagation, seed banking methodology, germination ecology, and restoration ecology of these and other Priority Flora species.

Concerns also related to the impact of dust deposition and groundwater mounding on flora and vegetation.

Assessment

The area considered for assessment of this factor is groundwater in the project area, as shown in Figure 2, and surrounding region.

The EPA's environmental objective for this factor is to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

There is no loss of any vegetation communities or flora species expected as a result of this project (Appendix 6).

With regard to regionally significant vegetation, Mattiske (2005) has indicated that within the total survey area, 14 plant communities may be considered to be regionally significant. The EPA notes that nine of these plant communities also occur in the SBWHP or adjacent pastoral areas and therefore the severity of the impact to these communities is reduced. Of the five remaining regionally significant communities, the proponent has advised that none would be cleared during development of the proposal and associated infrastructure. The S5 plant community is locally significant as it is restricted to deep valleys, which are a locally and regionally unusual landform and S10 plant community is endemic to the Shark Bay region. To ensure that

communities S5 and S10 are not disturbed by mining operations, the EPA has recommended condition 7-7.

Seven Priority Flora species have been recorded in the project area, all of which have been shown by Gunson to occur outside the project area (Appendix 6). While the vegetation surveys undertaken are comprehensive, given the large area proposed for mining the EPA has recommended condition 7-1 to require searches for Declared Rare Flora (DRF) and Priority Flora to be conducted prior to the development of each pit and associated infrastructure. In addition, the EPA recommends condition 7-4 to require that a specific Declared Rare Flora Management Plan be developed should any DRF be found in the project area. The Plan shall include detailed information with regards to the habitat within which the DRF were found and the proposed management strategy for the protection of DRF species. The EPA notes the specific commitment relating to the management of Priority Flora made by Gunson:

Commitment Action 1 - Finalise the draft Priority Flora Management Plan with consideration of comments received during the public review period of the Public Environmental Review document and in consultation with relevant stakeholders.

Commitment Action 2 - Implement the Priority Flora Management Plan (Appendix 4).

Gunson acknowledges that research on rehabilitation techniques may be necessary to ensure the return of several of the Priority Flora species that are less frequently recorded in the survey area, and may be disturbed by mining (e.g. *Scholtzia sp.* Folly Hill; *Eremophila occidentalis* (ms), etc.). Gunson have stated an intention to commence a research programme to address this. The research programme is also likely to include seed banking methodology, germination ecology, restoration technology for taxa where seeding or propagation of cuttings fails, and restoration ecology for reinstatement of species. The EPA encourages this research into propagation and germination techniques for Priority Flora species.

The EPA notes that there is the potential for vegetation to be impacted as a result of groundwater mounding (discussed in Section 3.1), and also as a result of dust deposition on vegetation (discussed in Section 3.5). The EPA has recommended condition 6-1 to ensure that monitoring occurs in areas where vegetation is at potential risk from water mounding, and that mitigation strategies be implemented in the event monitoring indicates that mounding may impact sensitive vegetation areas. The EPA has also recommended condition 11-1 to ensure that vegetation is monitored for the effect of dust deposition, and appropriate mitigation measures are implemented.

Summary

Having particular regard to the:

- (a) proponent's flora and vegetation surveys, which indicate that the project would not be expected to result in the loss of any vegetation communities or flora species;
- (b) recommended condition requiring a Flora and Vegetation Management Plan to ensure the conservation of significant flora communities and flora species. The condition requires Gunson to conduct searches for DRF and Priority Flora prior to the development of each pit, and develop a Declared Rare Flora Management Plan in the event that DRF are identified in the project area;
- (c) proponents commitment to research rehabilitation techniques for Priority Flora;

- (d) management of water mounding and dust to prevent impacts to flora and vegetation, and
- (e) implementation of the Flora and Vegetation Management Plan.

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

3.3 Fauna

Description

The most significant impact on fauna as a result of the proposal would come from the clearing of 3,695 ha of fauna habitat over the 12 year life of the mine. The site is a potential habitat of two species listed as Vulnerable under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and Threatened under the Western Australian *Wildlife Conservation Act 1950*, Malleefowl (*Leipoa ocellata*) and Hamelin Skink (*Ctenotus zasticus*). Other potential impacts may result from noise and light disturbing local populations, accidental road kills and drowning in process water ponds or open seepage interception trenches.

Three fauna surveys were undertaken by Ninox Wildlife Consulting (early spring, autumn and late spring) over two years (2003 and 2004), using a variety of capture methods. These surveys identified eight native mammal species, 45 reptile species and 61 bird species within the project area. Eight introduced mammal species were also recorded. An additional targeted survey was undertaken in September 2004 to determine the presence of the Hamelin Skink (*Ctenotus zasticus*), however none were recorded. No mammals classified as Rare were recorded, however three vertebrate species likely to occur in the project area are gazetted under the *Wildlife Conservation Act 1950* and three under the CALM Priority Fauna List. Most of the species recorded have widespread distributions throughout the semi-arid region and are not restricted to individual habitats (URS 2005a).

Submissions

Comments on the adequacy of the baseline surveys were provided in a number of submissions. Queries were raised on the timing of the fauna surveys and the frequency of the surveys. The trapping methods used in the fauna survey were also queried.

Concern was raised regarding the impact of the operation on the project area's population of Malleefowl.

A number of submissions stated the need for the project to have a fence constructed, maintained and policed to exclude feral animals and livestock, and CALM raised the issue of the impact to fauna as a result of light overspill from mining operations.

Assessment

The area considered for assessment of this factor is the project area, as shown in Figure 2, and surrounding region.

The EPA's environmental objective for this factor is to maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

The EPA notes that several fauna surveys were undertaken, however due to the project area having an unpredictable rainfall regime, the diversity of species recorded during surveys may not be reflective of the actual fauna assemblage likely to be present in the area. This is reflected in the lack of amphibian species recorded. The EPA would expect that sampling over multiple seasons and years would result in a greater diversity of species being recorded in this area. Given that the lead-in time for this proposal did not allow for long-term studies, the EPA has recommended condition 8-1 to require the establishment of fauna monitoring plots and conduct additional fauna surveys prior to the mining of each pit, to identify any significant or unknown species. In the event that any Threatened Fauna (protected under the provisions of the *Wildlife Conservation Act 1950*) are identified during additional fauna surveys, the EPA recommends that Gunson be required to develop a Threatened Fauna Management Plan (recommended as environmental condition 8-4) which would include management strategies for the conservation of Threatened Fauna species.

Three vertebrate species that could potentially 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 Python (*Aspidites ramsayi*). The Hamelin Skink is listed as “Vulnerable”, and both the Peregrine Falcon and Woma Python are listed as “Other Specially Protected Fauna”. None of these species have been recorded during fauna surveys undertaken to date, however, the recommended condition 8-1 addresses this in the event that they are recorded through additional fauna surveys or monitoring.

The EPA notes that Gunson has proposed the following mitigation measures to minimise the impact on vertebrate fauna:

- rapid and progressive rehabilitation of cleared areas;
- liaising with CALM and the Department of Agriculture to develop an annual introduced predator baiting programme;
- de-stocking the Coburn pastoral lease for several years upon approval from the Pastoral Board to allow vegetation to recover and then re-stocking it at a rate well below carrying capacity; and
- liaising with CALM and pastoralists to determine the requirement for open watering points.

The EPA has recommended condition 8-1 to require the development of a Fauna Management Plan, incorporating the mitigation measures as above, proposed by Gunson.

Malleefowl were not sighted during fauna surveys, however, fresh footprints were noted and abandoned nest mounds were evident. The EPA notes that Gunson proposes the following mitigation measures to minimise the impacts on Malleefowl by:

- avoiding nests not in the direct mine path;
- diverting the proposed haul road to avoid nests;
- the staging of clearing (to allow for local migration of Malleefowl into adjacent properties);
- reducing the impact of introduced predators and competitors through baiting programmes and destocking of the pastoral property; and
- establishing permanent fauna monitoring sites in order to monitor the rate of return of this species to the rehabilitated areas.

The EPA accepts that Malleefowl nesting sites would be lost during the mining process and some localised impacts may occur where preferred habitat is cleared. As

the Malleefowl is listed as Vulnerable under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*, the EPA has liaised with the Commonwealth Department of Environment and Heritage on this issue. It is not expected that disturbance due to mining would significantly impact upon the regional population of Malleefowl due to their wide distribution and presence in neighbouring pastoral leases (URS 2005a). In addition, vegetation community types in the project area most inhabited by the Malleefowl are also well represented outside the project area. The EPA has recommended condition 8-1 to ensure that Malleefowl populations are appropriately managed.

There is also the potential for fauna movements to be affected due to light disturbing local fauna populations. Gunson intend to install directional lighting and /or light shields to reduce light overspill. Recommended condition 8-1 includes requirements to ensure that the disturbance to fauna from light overspill is minimised. This condition requires that Gunson liaise with CALM regarding the implementation of best practice directional lighting and/or light shields to minimise the potential impact to fauna.

The EPA considers that there is a potential for fauna loss due to open trenches and water ponds, however Gunson proposes to minimise the potential impact by fencing process water ponds and open seepage interception trenches to deter entry by fauna. The EPA notes that the sides of the ponds and trenches would not have steep slopes and therefore smaller species that may still gain entry to these areas should be able to escape. The EPA has recommended condition 8-1 to require the installation of mesh or “self rescue” mats to provide escape mechanisms for animals to exit the water, and to ensure that there are regular inspections conducted of process water ponds and open seepage interception trenches, to release any trapped animals.

With regard to stygofauna, a survey of the northern end of the project area in 2004 did not identify any stygofauna (URS 2005a). The southern end of the project area was not surveyed due to the lack of suitable bores, however the EPA notes that the presence of stygofauna is not considered likely due to the lack of shallow groundwater. The EPA notes the following recommendation from the Stygofauna Survey Report (URS 2005a):

- Both northern and southern bores would need to be sampled on at least two further occasions (i.e. all bores should be sampled on at least three occasions) in order to:
 - a) account for seasonal variation and abundance;
 - b) be spaced temporally to overcome adverse affects from installation, and sampling replication, and
 - c) gender confidence in negative results.

Gunson have made a commitment to conduct a further survey for stygofauna (Commitment Actions 3, 4 and 5).

Summary

Having particular regard to the:

- (a) provision for additional fauna surveys prior to the development of each pit being mined, to identify any significant or unknown species;
- (b) the recommended condition requiring that Gunson develop, on the advice of the EPA and CALM, a Threatened Fauna Plan in the event that any Threatened Fauna are identified in the project area;
- (c) mitigation measures proposed by Gunson to minimise the impact on vertebrate fauna, and

- (d) development and implementation of a Fauna Management Plan.

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

3.4 Rehabilitation

Description

The proposed mine would result in the clearing of approximately 3,695 ha of vegetation (Appendix 6). Gunson has produced a Rehabilitation Plan which outlines Gunson's strategy for returning the disturbed areas created by mining operations to a pastoral land use. This strategy has the following objectives:

- minimise the amount of cleared area at any one point in time through progressive rehabilitation of mined out pits;
- ensure the post-mining surface morphology is visually congruent to the surrounding undisturbed area;
- stabilise disturbed land as soon as reasonably practicable to control dust and wind erosion, and
- revegetate the stabilised land surface to allow the return of native flora and fauna and sustainable use of the area for pastoral purposes.

Following the start-up process of the first six months, as detailed in the Draft Rehabilitation Plan (URS 2005a), mining and rehabilitation would occur progressively. The pit rehabilitation process would proceed as follows:

- overburden would be stripped from above the orebody and placed directly on the mined out pit floor;
- sand tailings would be deposited on top of the overburden directly,
- sand tailings would then be contoured to the final landform shape;
- subsoil stripped from above the orebody would then be placed on top of the tailings;
- topsoil, having been stripped from above the subsoil, would be placed directly onto returned subsoil to recreate the original soil profile in the surface 1 m;
- topsoil would be levelled and seeded with a mixture of native seeds, and
- vegetation would then be spread across the surface to assist in soil stabilisation.

By this process, the top 1 m of the soil profile, composed of 10 cm of topsoil and 90 cm of subsoil, would be returned to the mined areas.

The normal mining operation is expected to maintain an open area of approximately 40 ha. The replacement of subsoil over contoured tailings would be a continuous operational activity, however the clearing of vegetation and the removal and direct replacement of topsoil would occur periodically.

Submissions

Public submissions raised a number of issues in regard to rehabilitation. These included:

- concerns regarding the adequacy and appropriateness of the Draft Rehabilitation Plan,
- concerns that the Draft Rehabilitation Plan did not demonstrate the likelihood of success of rehabilitation within a reasonable timeframe;
- the need for research studies and trials to be undertaken during the life of the project to increase the knowledge of regeneration ecology and improve rehabilitation techniques;

- CALM submitted that there is the potential for weed invasion within and adjacent to the project area, and that there was a lack of detailed long-term (monitoring and management) strategies to manage weed infestation.

Assessment

The area considered for assessment of this factor is the proposed mine area, as shown in Figure 2.

The assessment of rehabilitation is split into two components:

- soil management; and
- revegetation.

3.4.1 Soil Management

Description

The Amy Zone comprises a complex dune system with high local relief and lower relief dunes with rolling terrain. The majority of the soil profiles surveyed by Blandford and Associates (URS 2005a) were found to have a surface layer of highly mobile sand that consists of coarse grained particles with single-grained fabric of depth varying from 1 cm to 15 cm. This indicates that the surface layer is quite unstable and demonstrates a degree of surface instability due to wind erosion. Under this layer, the majority of the soils displayed development of fabric and coherence at some depth below the surface. Upon disturbance of the soil, it was found that materials are likely to revert to a single grain fabric, predisposing them to accelerated wind erosion.

Field observations of the moisture retention capacity of the soil profiles indicate that the moisture retention increases with increasing depth. Soil studies also indicate that some of the material found at depth is dispersive.

Assessment

The EPA's environmental objective for this factor is to maintain the integrity, ecological functions and environmental values of the soil and landform.

In considering this factor, the EPA concurs with the view of Blandford and Associates (URS 2004a) that, as with any mining proposal, it would not be possible to reproduce soil profiles of similar complexity and variability to those of the pre-mining environment. The aim of landform reconstruction is therefore to produce a physical system that incorporates the fundamental requirements for vegetation establishment, habitat restoration and ecosystem development.

Gunson has identified a number of issues that could arise in the rehabilitation process if the soil profile is not returned in an effective manner. These include:

- poor recruitment of native species;
- a soil profile which inhibits root development;
- a soil profile with decreased moisture retention capacity;
- the dispersion of clays in sub-soils, which has the potential to decrease stability;
- a soil profile which inhibits the vertical infiltration of water, and
- accelerated wind erosion.

The EPA accepts that return of the top one metre of the soil profile, by returning 10 cm of topsoil and 90 cm of subsoil, as proposed by Gunson, follows best practice (Gilkes 2005). However, the EPA considers that the management of the deeper soil profile, below one metre depth, would be critical to the successful rehabilitation of

this site. For this reason, the EPA obtained the advice of Professor Bob Gilkes from the School of Earth and Geographical Sciences at the University of Western Australia regarding the Draft Rehabilitation Plan proposed by Gunson (URS 2005a). Professor Gilkes raised a number of concerns in relation to soil management (provided in Appendix 5), which Gunson have subsequently responded to (Appendix 6).

Professor Gilkes stated that the altered soils and landscapes are most likely to be able to support self-sustaining local plant communities if the rehabilitated landform, soils and deep subsoil materials are identical to those of the pre-mining condition. The proposed Draft Rehabilitation Plan recognises this objective, but as for most mine rehabilitation, would not be able to fully achieve this goal. Gunson accept that the deep soil sand tailings would have reduced water and nutrient retention capability. However, Gunson argue that as the vegetation in the area is largely shallow rooted and rainfall dependent, the moisture retention capacity of the deep soils is of little importance to successful rehabilitation (Appendix 6). In order to ensure adequate characterisation of soils both prior to and following mining, the EPA recommends a condition requiring that a Soil Management Plan be prepared on the advice of the Department of Environment and CALM (condition 9-1). This Plan would set performance and completion criteria for the post-mining soil profile and contingency actions in the event that these criteria are not met. Characterisation of post mining soil profiles will be important to inform the revegetation program.

Dispersive clays have been identified at depth in the soil profile at the proposed mine site. These may contaminate surface soils if the two parts of the profile are mixed. Dispersion of a soil results in the structure or aggregation of the soil being destroyed, so that each particle is separate and behaves as a unit. In this setting, clay dispersion could result in soil pores being blocked, restricting the movement of air and water. If surface soil pores are blocked by dispersed clay, the soil may form a surface crust or hardsetting layer which has the potential to inhibit seedling emergence and water infiltration. In order to manage dispersive clays, Gunson intends to classify all soil as to its dispersive nature prior to mining. Any dispersive soils encountered would be returned to the base of the mine pit. The EPA recommends that that Soil Management Plan require a strategy for the characterisation and management of dispersive clays in the soil profile, including amelioration of any impact to the rehabilitated soil profile (condition 9-1).

In considering the moisture retention characteristics of the post-mining soil profile, the EPA notes that the undisturbed soil profile at this site contains up to 40% fine-grained particles (<0.212 mm). It is anticipated that up to two-thirds of these fine-grained particles would be removed from the soil during the mining process, which is likely to reduce the moisture retention capacity of the soil. Blandford and Associates have submitted that this is unlikely to greatly impact on the success of rehabilitation, as this loss of fines would occur at depths beyond 1 m from the soil surface. On the advice of Professor Gilkes, the EPA considers this to be acceptable. The EPA recommends that condition 9-1 require evaluation of standard soil properties in the rehabilitated soil profile, including soil texture, structure and water retention characteristics.

Gunson propose to deposit the clay (or slimes) resulting from the mining process in a pit adjacent to the mining pit wall in order to avoid the need for solar drying dams. It is noted that the slimes would be both saline and sodic, and are likely to be hostile and impenetrable to deep plant roots (Gilkes 2005). Based on mineral sand mining experiences elsewhere, the EPA is of the view that management of the slimes fraction is likely to be one of the key determinants of rehabilitation success. Recognising the practical difficulties of recombining the slimes back into the sand tails, and the

relatively low volume of slimes resulting from the proposed operation, the EPA considers separate disposal of the sand and slime fractions to be acceptable. Based on observations of past experiences, the EPA considers it important that the management of slimes be integrated with the on-going mining process. This is due to the link between the management of slimes and subsequent rehabilitation objectives which are contingent on the rehabilitated soil profile, such as direct return of topsoil and management of water. For this reason, the EPA recommends a condition to limit the open area for drying of clay or slimes to 40 ha at any one time (condition 9-7) and to require that Gunson rehabilitate not less than 80% of the total mined area during each year of mining, following the start-up process of the first 6 months of mining (condition 9-8).

Finally, the EPA notes that disturbance of the soil topsoil and subsoil prior to mining is expected to affect the soil profile and processes by destroying the earthy fabric of the sands and forming material with a single-grained fabric. This would predispose the soil to accelerated wind erosion. For the purpose of ensuring that dust generated by the proposed mining operation does not impact on the SBWHP, the EPA has recommended condition 11. This condition requires the monitoring of dust, which would provide an indicator of the level of wind erosion. The EPA note the mitigation measures proposed in the Gunson Air Quality Assessment (URS 2005a), which include:

- integrating dust control provisions into operations planning e.g. construction, topsoil stripping;
- integrating dust control provisions into work practices;
- monitoring and feedback mechanisms; and
- using observational and quantitative assessments to guide control efforts.

3.4.2 Revegetation

Description

The typical vegetation of this system currently existing at the site comprises of “tree heath”, or heath with scattered trees. A total of 18 plant communities, consisting of seven Eucalyptus Woodlands, ten Shrublands and one Mosaic community were identified. The majority of the vegetation within the project area is relatively slow growing.

Assessment

The area considered for assessment of this factor is the proposed mine area, as shown in Figure 2.

The EPA’s environmental objective for this factor is to return self-sustaining native vegetation after mining which is as close as possible to the pre-mining vegetation in species composition and ecological function.

Successful revegetation is likely to be a slow process, and is heavily reliant on the success of the land-forming process and a range of other environmental factors. The success of a rehabilitation programme is generally judged on the return of appropriate vegetation density and species richness. The EPA notes however that rehabilitated sites generally do not return to biodiversity values found in undisturbed ecosystems. As stated by Gunson, recreation of pre-existing ecosystem function following significant disturbance is an objective that has rarely been achieved in practice (Appendix 6). At best, rehabilitation can return some ecological function, usually with a reduced diversity of species and ecosystem complexity.

The majority of vegetation within the project area is relatively slow growing. Some species appear capable of colonising disturbed areas, while other species slowly gain dominance over time. It is therefore likely that the rehabilitation sites may experience vegetation successions proceeding at different rates. Evidence collected from disturbed areas in the region of the proposed mine site suggest that it may take an extended period for some sites to attain a community of similar structure and composition as the undisturbed community. Gunson has submitted that this finding has significantly influenced the closure criteria for the project area.

In considering this factor, the EPA notes that the expected site conditions of high summer wind speed and temperature, high evaporation, and unpredictable rainfall, present a number of challenges to successful rehabilitation. The slow growing vegetation of this region cannot be relied upon for the rapid surface stabilisation that is required. In addition, little research has been conducted on the vegetation in the area to determine which species are most able to rapidly colonise the disturbed soil.

Gunson has proposed that while a seed bank is present in the topsoil, further seeding would improve the success and rate of revegetation. Seed would be collected from species in the areas to be disturbed prior to mining and infrastructure development. Particular attention would be paid to seed collection from Priority Species in order to retain their populations within the local area.

Rehabilitation areas would initially be seeded with species known to be successful colonisers. Seeds of species that prefer more established ecosystems (late successional species) would be introduced into the rehabilitation areas once an initial vegetation cover has been established. Key considerations in the selection of species for possible use in revegetation would be:

- all species should be native to the area to help maintain the local character of rehabilitated areas;
- the species mix should include as many annual species as possible, as these would usually germinate within the first winter and quickly provide protection from wind erosion, and
- plants should be adapted to the new habitat that is likely to prevail over the long term. This includes local species known to be tolerant of salinity, or known to naturally grow in sand dunes, in addition to native annuals.

Gunson has proposed a number of rehabilitation methods that would be trialled in the early years of mining in order to make the rehabilitation process more efficient (URS 2005a). Corrective measures would be considered should rehabilitation performance not achieve nominated completion criteria, or be trending away from the nominated criteria. These include measures such as windbreaks, biodegradable matting, seed treatment and dominant species control. The requirement for any of these measures to be implemented as part of a corrective process would be identified by the monitoring and reporting programme.

With regard to weeds, Gunson suggest that weeds may have a positive effect by reducing soil erosion as a result of wind in the initial stages of rehabilitation. However, weeds may also out-compete native species, affecting the growth and recruitment of native species, and decreasing the success of rehabilitation. A monitoring programme is therefore required in order to determine whether weed species are a positive or negative attribute to rehabilitation, and if negative, the methods required to decrease their effect. CALM have identified that the mining area could act as an ongoing source of weeds, and potentially invade the adjacent World Heritage Property. Increased weed management may be required in the SBWHP and conservation estate adjacent to the proposed mining area. The EPA recommends that,

as part of the Progressive Rehabilitation Programme, condition 9-1 require a Weed Management Plan.

The EPA recommends condition 9-6 require that Gunson subject all mining equipment and vehicles entering the site to appropriate hygiene measures to prevent the introduction of soil borne plant diseases. While the EPA notes that dieback (*Phytophthora cinnamomi*) has not been observed in this area, the EPA considers that this precaution is necessary given the high environmental values of this area. The EPA also recommends condition 10 require a Bush Fire Management Plan.

Gunson has proposed a number of completion criteria as part of their Rehabilitation Plan (Appendix F, URS 2005a). The aim of the criteria are to set well defined and achievable targets for the return of the disturbed areas to their prior landuse. Criteria have been established for years 0, 1, 2, 5, 15 and 30. These criteria reflect existing knowledge of the local environment and its ability to recover from disturbance, and also reflect the technology currently available to achieve these goals. The EPA acknowledges that there is a lack of knowledge on rehabilitation in this region given similar disturbances, and that the research and development programmes implemented by Gunson would advance techniques that should improve the rehabilitation rate and outcome.

Notwithstanding this, and to ensure that mining does not continue if it is resulting in an unacceptable environmental outcome, the EPA recommends that Gunson be required to demonstrate that areas mined meet the five year criteria (condition 9-3). If Gunson are unable to demonstrate achievement of these criteria by the end of seven years, the EPA recommends that prior to further mining, Gunson be required to review the Rehabilitation Plan to the requirements of the Minister for the Environment on the advice of the Environmental Protection Authority, and demonstrate that the criteria can be met should mining continue (condition 9-4)

Summary

Having particular regard to the:

- (a) independent advice regarding rehabilitation provided to the EPA by Professor Bob Gilkes;
- (b) EPA's recommended conditions requiring a Soil Management Plan, Revegetation Management Plan, and Weed Management Plan, which set performance and completion criteria for rehabilitation;
- (c) EPA's recommended condition requiring that Gunson maintain an open area for the drying of clay or slimes not exceeding 40 ha at any one time, and rehabilitate not less than 80% of the total mined area during each year of mining; and
- (d) EPA's recommend condition requiring that Gunson demonstrate achievement of the 5 year completion criteria, prior to further mining

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor provided that the recommended conditions are made legally enforceable.

3.5 World Heritage and Conservation Values

Description

The project area is located adjacent to the southeast boundary of the Shark Bay World Heritage Property (SBWHP). The SBWHP covers a total area of 2.2 million ha, including the marine reserves and terrestrial areas. The area was placed on the World Heritage list in 1991 as it satisfies all four natural criteria for listing. These are:

1. outstanding examples representing the major stages of the Earth's evolutionary history;
2. outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment;
3. unique, rare or superlative natural phenomena, formations or features of exceptional natural beauty, and
4. the most important and significant habitats where threatened species of plants or animals of outstanding universal value from the point of view of science and conservation still survive.

The Zuytdorp Nature Reserve, also known as Cooloomia Nature Reserve, is located to the south of the project area. This Class C reserve has an area of 58,850 ha and includes representative sections of the Zuytdorp Cliffs, coastal vegetation and inland heath vegetation of the Victoria Sand Plain district.

The Hamelin Pool Marine Nature Reserve (Marine Reserve No. 6) is located approximately 20 km north of the Amy Zone orebody. This reserve was gazetted to protect the environment of Hamelin Pool, particularly the stromatolites, coquina and ooid shoals, and deposits of unconsolidated and lithified beach ridges of *Fragum erugatum* shells. The most significant feature of Hamelin Pool is the diversity and abundance of stromatolites. These are living fossils identical to fossils dated at 3.5 billion to 3.9 billion years before present, and are of international scientific importance (URS 2005a).

Potential impacts to the World Heritage Property as a result of this proposal are due to dust deposition impacts on the stromatolites at Hamelin Pool, and on vegetation. While the original proposal presented some risk to the SBWHP in relation to water mounding, with the removal of Pit 10 from the proposal this has been significantly reduced (Appendix 6). The EPA has recommended condition 6 to ensure that the potential for groundwater mounding is managed to prevent unacceptable impacts.

Submissions

Key issues raised in relation to this factor were the:

- potential impact of dust on algal mats and stromatolites;
- monitoring of potential impacts on the SBWHP, and
- potential for loss of aspects of the natural heritage of Shark Bay for which it was listed as World Heritage Property.

Assessment

The area considered for assessment of this factor is the Shark Bay World Heritage Property (SBWHP), as shown in Figure 2.

The EPA's environmental objective for this factor is to protect the environmental values of areas identified as having significant environmental attributes.

Gunson have considered the potential impacts of the proposed mine against the criteria for listing of the Shark Bay area as a World Heritage Property (URS 2005a).

This evaluation concluded that the risks to the SBWHP are due to the potential for dust deposition impacts on the stromatolites at Hamelin Pool and on vegetation within the SBWHP, and the potential for vegetation loss due to mounding of groundwater beneath the SBWHP.

Considering firstly dust, the EPA notes that an Air Quality Assessment was carried out as part of the PER (URS 2005a). This considered atmospheric emissions as a result of the proposal at the nearest sensitive receptors, including Hamelin Pool. It is noted that this assessment included Pit 10 as part of the proposal. The emissions inventory showed that the greatest contributor to both PM₁₀ (particulates less than 10 microns in diameter) and TSP (total suspended particulates, generally less than 50 microns in diameter) emissions would be wind erosion of exposed areas, followed by wheel generated dust. It was predicted that peak deposited dust levels at Hamelin Pool would be 1.2 g/m²/month. Gunson noted that this is well below the New South Wales EPA criteria of 4 g/m²/month, however it was also noted that this criterion is defined for the protection of human amenity.

In considering dust in this region, the EPA notes that it is anecdotally reported that dust occurs in the region naturally as a result of the persistent strong winds. Additionally, the stromatolites near the tourist viewing area have been exposed to high levels of dust episodically from vehicles travelling the gravel road prior to its relatively recent sealing (URS 2005a). The effect of dust on these communities is not known.

There is also the potential for soil particulate movement from the project area to the SBWHP with risk of smothering vegetation. Modelling indicates that predicted concentrations would be well below guideline levels at these receptors, and that maximum off-site dust concentrations would be to be to the east of the project area, indicating minimal risk to vegetation within the SBWHP. Nonetheless, there is residual risk that some airborne particulates from mining operations may carry to vegetation in the SBWHP under some meteorological conditions.

The EPA's objective with regard to dust is ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards. The EPA notes Gunson's statement that dust management would be an integral component of site environmental performance. Gunson would undertake a range of preventative measures to minimise fugitive dust sources as part of its daily operations, and provide ongoing monitoring of deposited dust levels (URS 2005a).

The removal of Pit 10 from the proposal has significantly reduced the EPA's level of concern regarding the potential for dust impacts. However, as noted by the proponent, the effect of dust settlement on algal mats and stromatolites located around Hamelin Pool cannot be confirmed until baseline data on dust levels in the Hamelin Pool area and data from dust monitoring have been collected and used to verify the atmospheric model. The EPA broadly supports the Dust Management Plan proposed by Gunson (URS 2005a), and notes that Gunson have stated that work would cease at the site should dust levels become unacceptable. The EPA recommends condition 11 require a Dust Management Plan which includes monitoring of deposited dust levels at the boundary of the project area and Hamelin Pool for the initial three years of the project and the prevention of visible dust in the SBWHP.

With regard to the potential for vegetation loss due to mounding of groundwater beneath the SBWHP, the EPA notes that an area of vegetation in the SBWHP is identified as being in areas of potential risk (shown in Figure 7.2, URS 2005a). It is

however expected that due to the expected depth of the groundwater when it reaches the SBWHP, and the relatively shallow root zone expected for the vegetation in this region, the likelihood of an impact is low. In order to manage the potential for mounding to impact on vegetation, both inside and beyond the SBWHP, the EPA has recommended condition 6.

Summary

Having particular regard to the:

- (a) EPA's recommended condition to manage dust, and requiring monitoring of deposited dust levels at the boundary of the project area and at Hamelin pool, with mitigation measures as necessary;
- (b) statement in Gunson's Environmental Management Plan that work at the site would cease should dust levels become unacceptable; and
- (c) EPA's recommended condition to manage groundwater mounding both inside and beyond the project area,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor provided that the recommended conditions are made legally enforceable.

3.6 Relevant environmental principles

In preparing this report and recommendations, the EPA has had regard for the object and principles contained in s4A of the *Environmental Protection Act (1986)*. Appendix 3 contains a summary of the EPA's consideration of the principles.

4. Conditions and Commitments

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

In developing recommended conditions for each project, the EPA's preferred course of action is to have the proponent provide an array of commitments to ameliorate the impacts of the proposal on the environment. The commitments are considered by the EPA as part of its assessment of the proposal and, following discussion with the proponent, the EPA may seek additional commitments.

The EPA recognises that not all of the commitments are written in a form which makes them readily enforceable, but they do provide a clear statement of the action to be taken as part of the proponent's responsibility for, and commitment to, continuous improvement in environmental performance. The commitments, modified if necessary to ensure enforceability, then form part of the conditions to which the proposal should be subject, if it is to be implemented.

4.1 Proponent's commitments

The proponent's commitments as set in the PER and subsequently modified, as shown in Appendix 4, should be made enforceable. These include:

Priority Flora Management

Stygofauna
Solid and Liquid Waste Management
Hydrocarbon Management
Radiation Management
Aboriginal Heritage Management
Funding for scientific research

4.2 Recommended conditions

Having considered the proponent's commitments and the information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by Gunson Resources Limited to develop the Coburn Mineral Sand Project approximately 84 kilometres south-east of Denham in the Shire of Shark Bay, is approved for implementation.

These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

- (a) that the proponent shall fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 4;
- (a) Groundwater Mounding Management Plan;
- (b) Flora and Vegetation Management Plan including a Declared Rare Flora Management Plan;
- (c) Fauna Management Plan including a Threatened Fauna Management Plan;
- (d) Progressive Rehabilitation Programme including a Soil Management Plan, a Revegetation Management Plan, and a Weed Management Plan;
- (e) Bush Fire Management Plan;
- (f) Dust Management Plan; and
- (g) a Mine Closure Plan.

It should be noted that other regulatory mechanisms relevant to the proposal are:

- Water licensing approvals process pursuant to the *Rights in Water and Irrigation Act 1914*.

5. Other Advice

Since referral of the original proposal, Gunson has removed Pit 10, the largest and northernmost pit, from the proposal. Gunson recognised that there was a degree of uncertainty regarding a number of potential impacts associated with the development of Pit 10, which would remain until operational data become available to validate and refine predictive models, in particular regarding the potential for mounding and the impacts outside the proposal area on native vegetation. In addition, the EPA has noted the limited experience of rehabilitation in this region. The majority of vegetation in the project area is relatively slow growing, which along with windy conditions, high evaporation, and sporadic rainfall, present a number of challenges to successful rehabilitation.

The recommended conditions are designed to ensure that the proponent can manage the potential impacts and undertake adaptive management to rehabilitate the mine site.

While the EPA has judged that this proposal does not represent a significant risk to the Shark Bay World Heritage Property, the proponent must recognise that mining adjacent to the SBWHP will represent a significant challenge and that it will be judged on its performance for this current proposal should Pit 10 be referred to the EPA at a later date.

The EPA notes that under the *Mining Act 1978*, the Department of Industry and Resources (DOIR) has the capacity to impose a Rehabilitation Performance Bond on Gunson. For this reason, the EPA does not recommend a bond under the *Environmental Protection Act 1986*. The EPA would support DOIR imposing a bond exceeding the minimum of \$5000 per hectare minimum, given the high environmental values of this area. The EPA recommends a bond in the order of \$10 000 per hectare.

6. Conclusions

The EPA has considered the proposal by Gunson Resources Limited to develop the Coburn Mineral Sand Project, 84 kilometres (km) south-east of Denham in the Shire of Shark Bay. This proposal involves the excavation and processing of a major low-grade heavy mineral sand deposit over 12 years. The concentrate would be trucked 250 km south to Geraldton for direct export.

The EPA has noted that there would be a number of environmental concerns associated with any significant mining activity proposed in this area. The proposal is located adjacent to the south-eastern border of the Shark Bay World Heritage Property in a floristically diverse transition zone between two botanical districts. The northern end of the proposed project area is approximately 20 km south of the Hamelin Pool Marine Nature Reserve.

Since referral of the original proposal, Gunson has removed Pit 10, the largest and northernmost pit, from the proposal. The removal of Pit 10 has reduced the life of the proposed mine from 20 to 12 years, and reduced the mine footprint from 5,745 ha to 3,695 ha. Gunson recognised that there was a degree of uncertainty regarding a number of potential impacts associated with the development of Pit 10, which would remain until operational data become available to validate and refine predictive models. Gunson have stated that Pit 10 would not be developed until it can be demonstrated that adverse environmental impacts can be avoided. The EPA supports Gunson's removal of Pit 10 from the proposal for these reasons. This assessment therefore considers only Pits 1-9.

The EPA has evaluated the potential for the proposed mine to affect groundwater in the project area and surrounding region by both mounding and drawdown of groundwater. Mounding is expected on a local scale, whereas drawdown is expected both locally and regionally. The EPA has recommended that mounding be managed through implementation of a specific Groundwater Mounding Management Plan. This Plan includes development of 'threshold' and 'limit' criteria for both groundwater levels and vegetation health. Management responses would be defined for implementation in the event that the 'threshold' criteria are not met. If at any time the 'limit' criteria are exceeded, the proponent would be required to cease all mining that is contributing to the 'limit' criteria being exceeded. The EPA considers that drawdown can be managed by the Department of Environment in accordance with the *Rights in Water and Irrigation Act 1914*, which would set conditions in relation to groundwater abstraction and making good the supply to any other users adversely affected by Gunson's abstraction.

With regard to flora and vegetation, Gunson's surveys have shown that the clearing of 3,695 ha is not expected to result in the loss of any vegetation communities or flora species. While the vegetation surveys undertaken are comprehensive, given the large area proposed for mining the EPA has recommended a condition requiring that Gunson conduct searches for Declared Rare Flora (DRF) and Priority Flora prior to the development of each pit. In the event that DRF are identified in the project area, the EPA has recommended a condition requiring the development of a Declared Rare Flora Management Plan which proposes management strategies be developed for the protection of DRF identified, on advice from the Department of Conservation and Land Management.

Similarly, the EPA has concluded that the clearing associated with this proposal can be managed to meet the EPA's objectives for fauna. The EPA has recommended the development of a Fauna Management Plan, which includes provisions in the event that Threatened Fauna are identified in the project area. The Fauna Management Plan includes requirements for the baseline surveys of Malleefowl (*Leipoa ocellata*), listed as Vulnerable under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and Threatened under the *Western Australian Wildlife Conservation Act 1950*, and monitoring of populations and breeding numbers both inside and outside the project area.

With regard to rehabilitation, the EPA has noted the limited experience of rehabilitation in this region. The majority of vegetation in the project area is relatively slow growing, which along with windy conditions, high evaporation, and sporadic rainfall, present a number of challenges to successful rehabilitation. The EPA has accepted that re-establishment of the ecosystem existing prior to mining is highly unlikely in this environment. It is acknowledged that, at best, rehabilitation can return some ecological function, generally with reduced species diversity and ecosystem complexity. In order to maximise the likelihood of successful rehabilitation, the EPA has recommended a number of conditions. These include a Progressive Rehabilitation Programme which comprises a Soil Management Plan, Revegetation Management Plan and Weed Management Plan. These plans are based on the establishment of performance and completion criteria, developed in conjunction with the appropriate Government agencies, with defined mitigation strategies in the event that criteria are not achieved.

The EPA has also recommended that, in order to integrate the rehabilitation process with mining operations, Gunson be required to maintain an open area for the drying of clay or slimes not exceeding 40 ha at any one time, and rehabilitate not less than 80% of the total mined area during each year of mining. In order to ensure that mining does not result in an unacceptable environmental outcome, the EPA recommends that a number of pre-determined criteria should be met following five years of rehabilitation. If Gunson are unable to demonstrate achievement of these criteria, the EPA recommends that prior to further mining, Gunson be required to review the Progressive Rehabilitation Programme to the requirements of the Minister for the Environment on the advice of the EPA, and demonstrate that the criteria can be met should mining continue.

The EPA has considered the potential for impacts on World Heritage and Conservation values due to the proximity of the site to the Shark Bay World Heritage Property (SBWHP). While the original proposal presented a number of risks to the SBWHP, Gunson have demonstrated that these risks are significantly reduced by removal of Pit 10 from the proposal. With the conditions the EPA has recommended, it is expected that impacts would be confined to the project area. While noting the low likelihood of dust impacts on the SBWHP, the EPA has recommended that

Gunson be required to prepare a Dust Management Plan, which includes monitoring of deposited dust levels at the boundary of the project area and at Hamelin Pool.

The Commonwealth Minister for the Commonwealth Department of Environment and Heritage determined the proposal to be a Controlled Action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on the basis of potential significant effects on World Heritage, Listed Migratory Species and Listed Threatened species and Communities. Under the terms of the bilateral agreement between Western Australia and the Australian Government under section 45 of the EPBC Act, the EPA examined the effects on these matters in Section 3.1, 3.3, 3.5 of this Bulletin and has recommended that conditions 6.1, 11.1, 8.1, 8.2 should ensure that effects on these matters are environmentally acceptable.

The EPA has concluded that the proposal is capable of being managed to meet the EPA's objectives provided that there is satisfactory implementation by the proponent of their commitments and the recommended conditions set out in Appendix 4 and summarised in Section 4.

7. Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister notes that the proposal being assessed is for Gunson Resources Limited to develop the Coburn Mineral Sand Project approximately 84 kilometres south-east of Denham in the Shire of Shark Bay. This involves the excavation and processing of a major low-grade heavy mineral sand deposit. The concentrate would be trucked 250 km south to Geraldton for direct export.
2. That the Minister considers the report on the relevant environmental factors and principles as set out in Section 3;
3. That the Minister notes that the EPA has concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4, and summarised in Section 4, including the proponent's commitments.
4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report.

Appendix 1

List of submitters

Organisations:

Conservation Council of Western Australia
Department of Agriculture
Department of Conservation and Land Management
Department of Indigenous Affairs
Marron Pastoral Company
Main Roads Western Australia
Radiological Council
Shark Bay Land Conservation District Committee
Shark Bay World Heritage Property Scientific Advisory Committee
Shark Bay World Heritage Property Community Consultative Committee
Shire of Shark Bay
Wildflower Society of Western Australia (Inc.)
Western Australian Museum

Individuals:

Lucy Commander
Kingsley Dixon
Steve Giles
Dr Graham Thompson
Brian and Mary Wake

Appendix 2

References

DEP (1996a) *Landfill Waste Classification and Waste Definition*. Department of Environmental Protection, Government of Western Australia, September 1996.

EPA (1993) *Draft Western Australian Water Quality Guidelines for Fresh and Marine Waters*. Environmental Protection Authority Bulletin 711, October 1993.

Mattiske Consulting Pty Ltd (2005) *Flora and Vegetation in the Proposed Coburn Mineral Sand Mine, Coburn, Hamelin and Meadow Stations, Shark Bay*. Prepared for URS Australia Pty Ltd on behalf of Gunson Resources Ltd. October 2005.

URS (2005a) *Coburn Mineral Sand Project, Public Environmental Review*. Report prepared for Gunson Resources Limited (July 2005).

Wills, R and Dogramaci, S. (2000) *Hydrogeology Report No. 170, Carnarvon Basin, Hydrogeology and Hydrochemistry of the confined Groundwater Systems, WA*. Water & Rivers Commission, Perth, 2000.

Appendix 3

Summary of identification of relevant environmental factors and principles

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
BIOPHYSICAL			
Sustainability	<ul style="list-style-type: none"> Implementation strategies for sustainable development have been included in the Project design, such as research programs associated with the mining operations, and progressive rehabilitation of disturbed areas. 	<ul style="list-style-type: none"> Pit 10 should be excluded from the current proposal as the environmental risks are too high Need to address sustainability criteria in the rehabilitation programme by supporting a multi-disciplinary, integrated ecological restoration and development program Proposal may negate the benefits of the Camarvon Artesian Basin Sustainability Initiative 	Pit 10 has been removed from the proposal being assessed. The PER document has addressed the four sustainability principles (URS 2005a, section 7.1).
Land systems and landforms	<ul style="list-style-type: none"> Mining operations will modify landforms within the project area and disturb the soil profile. 	<ul style="list-style-type: none"> The statement “the landform will retain congruency with the original landform” was questioned. It was asked whether the dunes would be reformed with the associated swales. 	Not considered to be a relevant factor. Gunson have stated an intention to return the area affected by mining to a landform similar to that pre-mining.
Soils	<ul style="list-style-type: none"> The mechanical disturbance of the soils during mining activities will result in the destruction of fabric. The consequence of this is that the soil will be less favourable for plant growth and more prone to erosion. 	<ul style="list-style-type: none"> Reconstituted post mined mineral sands are complex and suffer from concretion 	Considered to be a relevant factor. Addressed in Section 3.4 ‘Rehabilitation’.
Surface water	<ul style="list-style-type: none"> Surface water drainage will be affected by the modification of the landscape. However, as there are no known sensitive surface water features within the project area, the impacts on drainage are localised and readily manageable. 	No comments received	Not considered to be a relevant factor. The project area is internally draining and has no surface water features due to low rainfall, high evaporative conditions, and high infiltration rates.

Groundwater	<ul style="list-style-type: none"> There will be drawdown impacts on about 60 private bores. Apart from the Spinifex Bore (on Hamelin Station), none of the existing artesian bores are likely to stop flowing. The impacts of groundwater drawdown will be identified quickly and managed, as Gunson will maintain regular contact with the private bore owners in the region to find out whether they have observed drawdown in their bores. Mine water is expected to mound beneath the active stacker areas due to tailings seepage. Areas of vegetation in the SBWHP at risk from mounding have been identified 	<ul style="list-style-type: none"> Concerns about groundwater drawdown and impacts on other groundwater users in the area Impact on production bores, implications for pastoralists 	Considered to be a relevant factor. Addressed in Section 3.1 'Groundwater'.
Flora and Vegetation	<ul style="list-style-type: none"> Approximately 3,695ha of vegetation will be cleared. Groundwater mounding from tailings seepage could potentially affect vegetation to the north, west and east of the project area. Flora and vegetation may also be impacted by dust deposition, generated from mining. 	<ul style="list-style-type: none"> Queries regarding the timing and frequency of surveys Impact on Priority Flora species Vegetation surveys were conducted at less than opportune times. 14 of the 18 vegetation communities described by Mattiske Consulting are regionally significant 	Considered to be a relevant factor. Addressed in Section 3.1 'Groundwater' and Section 3.2 'Flora and vegetation'.
Vertebrate fauna	<ul style="list-style-type: none"> Loss of habitat due to vegetation clearing. Clearing of Malleefowl nesting sites and the forced relocation of individual animals. Fauna may become trapped in process water ponds or open seepage interception trenches. 	<ul style="list-style-type: none"> Queries regarding the timing and frequency of surveys. Trapping methods used in the fauna survey. Impacts on the Malleefowl population Fauna becoming trapped in process water ponds or open seepage interception trenches. Fauna impacts from light overspill from mining operations. 	Considered to be a relevant factor. Addressed in Section 3.3 'Fauna'.

Subterranean fauna	<ul style="list-style-type: none"> No stygofauna have been recorded in the project area. Gunson commits to undertake further sampling of bores within the project area. 	<ul style="list-style-type: none"> Area is a known habitat for subterranean fauna, and the saturated lower part of the palaeodrainage is a potential source of subterranean fauna. 	Considered to be a relevant factor. Addressed in Section 3.3 'Fauna'.
Local and regional biodiversity	<ul style="list-style-type: none"> It is anticipated that there will be reduced local biodiversity values as a result of the project due to the clearing of 3,695ha of vegetation. However, it is expected that there will be no loss of regional biodiversity values or species Due to the mobile nature of the fauna and their expected high regional distribution, the regional impacts on fauna diversity are expected to be minimal. 	<ul style="list-style-type: none"> De-stocking is expected to have a minimal effect on reducing herbivory to aid regional biodiversity. Biodiversity values were not fully addressed at the genetic, ecosystem, and ecological function value levels Potential for weed invasion within and adjacent to the project area 	Considered to be a relevant factor. Addressed in Section 3.2 under 'Flora and vegetation' and Section 3.3 under 'Fauna'.
Mine closure	<ul style="list-style-type: none"> The mine life is projected to be 12 years. Appropriate planning and adequate provisioning for closure is required to ensure decommissioning and closure process occurs efficiently with regards to all aspects of sustainability. 	<ul style="list-style-type: none"> The closure process for the mine was queried, including decommissioning, completion criteria and rehabilitation monitoring. 	Considered to be a relevant factor. Addressed in Section 3.4 under 'Rehabilitation'.
Rehabilitation	<ul style="list-style-type: none"> Progressive rehabilitation will be carried out as the mining operation moves North. Rehabilitation techniques will be improved as more advanced information becomes available A rehabilitation benchmarking study has been conducted to investigate rehabilitation works in semi-arid environments 	<ul style="list-style-type: none"> Objective for final rehabilitation should be to recreate the functional ecosystems existing prior to disturbance. Proponent has not demonstrated the likelihood of success of rehabilitation within a reasonable timeframe. Concerns regarding the adequacy of the draft rehabilitation plan, including the proposed seeding methodology and the list of species to be considered for use in rehabilitation works. Detailed research studies should be undertaken during the life of the project to increase the knowledge of regeneration ecology and improve rehabilitation techniques. 	Considered to be a relevant factor. addressed in Section 3.4 'Rehabilitation'

POLLUTION

<p>Atmospheric emissions (Dust)</p>	<ul style="list-style-type: none"> The main emission with potential for off-site effects is particulate, primarily dust from large open sources associated with mining activities. Carbon dioxide, carbon monoxide, oxides of nitrogen and sulphur dioxide emissions will be minimal. Atmospheric modelling has indicated that there is a low potential for dust to affect the vegetation in the SBWHP, as the winds are predominantly from the south and windborne dust is predicted to be away from the SBWHP. The modelling has also shown that there is the potential for dust deposition at Hamelin Pool when mining commences on the northern end of the project area. Up to 1g/m²/month could be deposited at the southern end of Hamelin Pool. 	<ul style="list-style-type: none"> The potential impact of dust on algal mats and stromatolites was raised. The potential impacts on vegetation due to dust deposition was also raised 	<p>Considered to be a relevant factor. Addressed in Section 3.5 'World Heritage and Conservation Values'</p>
<p>Greenhouse emissions</p>	<ul style="list-style-type: none"> The largest contributor to the net greenhouse emissions from the Project is for power generation To minimise the amount of greenhouse gas emissions from the Project, Gunson intends to utilise high efficiency (38-40%) variable load generator units using natural gas as the energy source for the Project. 	<p>No comments received.</p>	<p>Not considered to be a relevant factor.</p>

Noise	<ul style="list-style-type: none"> The results of the noise assessment predicted that the LA10 noise levels received at the Coburn and Hamelin homesteads would be 10 dB(A) and 11 dB(A), respectively. These levels are below the assigned LA10 noise level of 35 dB(A) for the night-time period under the Environmental Protection (Noise) Regulations 1997. 	No comments received.	Managed by the <i>Environmental Protection (Noise Regulations) 1997</i> .
Vibration	<ul style="list-style-type: none"> Vibration from the Project will be generated by the movement of vehicles within the mining area and on transport routes. This impact however, is considered to be minimal as no blasting or drilling will be required to remove the mineral sand from the pits. 	No comments received.	Not considered to be a relevant factor .
Solid and liquid wastes	<ul style="list-style-type: none"> There is a range of potential impacts if the wastes are not managed properly, including the contamination of land, surface water and groundwater, ecological habitats and an increase in pests and weeds. 	Proposed waste disposal is not in line with WA's strategic directions for waste; a Zero Waste Plan should be developed.	<ul style="list-style-type: none"> Managed under Part V of the <i>Environmental Protection Act 1986</i>. Solid and Liquid Waste Management Plan
Groundwater quality	Project area groundwater is saline ranging from 7,750mg/L to 34,000mg/L. The water to be used for mine processing is 8,900mg/L when it is first extracted from the deep aquifer.	No comments received	Not considered to be a relevant factor. Seepage from mine tailings will result in groundwater mounding but will not increase the salinity of the groundwater.

SOCIAL SURROUNDINGS			
Public health and safety	<ul style="list-style-type: none"> There are no major off-site risks that are associated with the mine site, with the exception of transport. 	Concerns regarding public health and safety including the need for a management plan for the spillage of concentrate during transportation and the increase in traffic on the pastoral lease and the highway.	<p>Not considered to be a relevant factor.</p> <ul style="list-style-type: none"> Objectives of the Radiation Management Plan to meet requirements of the Radiological Council; Further consultation and approvals from the State Mining Engineer and the Radiological Council on return of waste material to mine void is required
Site access and transport	<ul style="list-style-type: none"> The concentrate will be transported to Geraldton utilising B-Double (capacity of 80 tonnes). The expected tonnage is 400 tonnes per day for years 2006 and 2007, which equates to five return trips per day. After 2008, the tonnage will increase to 800 tonnes per day and ten return trips a day. 	Concern regarding increased traffic	<p>Not considered to be a relevant factor.</p> <p>There will be monthly inspections of road conditions and reports will be collected on road conditions from the transport personnel and other project personnel using the roads. The access road will be graded annually or on an as-needs basis to ensure that the road condition is safe for use.</p>
Visual amenity	<ul style="list-style-type: none"> The northern section of the project area may be visible from topographic high points and as the Project will be a 24-hour operation, there will be night-glow from the site. 	No comments received	<p>Not considered to be a relevant factor.</p> <p>Pit 10 has been removed from the proposal being assessed.</p>
Aboriginal heritage	<ul style="list-style-type: none"> One archaeological site was located near the proposed mine access road, but this road has been diverted so as to avoid any disturbance to the site. 	<ul style="list-style-type: none"> Adequacy of the Aboriginal archaeological survey 	<ul style="list-style-type: none"> Gunson has committed to implementation of an Aboriginal Heritage Management Plan (Commitment Actions 12 and 13). Liaise with DIA
European heritage	<ul style="list-style-type: none"> Impacts to Hamelin Pool Marine Nature Reserve and the Shark Bay World Heritage Property 	Information on European heritage in the PER did not include any reference to UNESCO World Heritage listings.	<p>Pit 10 has been removed from the proposal being assessed and therefore reduces the potential impacts to Hamelin Pool . Impacts to the SBWHP are addressed in Section 3.5 'World Heritage and Conservation Values' .</p>

Adjacent land uses	<ul style="list-style-type: none"> There will be drawdown impacts on about 60 private bores The Project is located adjacent to the SBWHP, which includes the Zuytdorp Nature Reserve. Indirect impacts to the SBWHP may occur due to wildfire, weed infestation and modification of local hydrology. 	Concern regarding water drawdown and implications for local economy Impacts on Hamelin Pool and Nilemah Embayment were largely unquantified.	<p>Considered to be a relevant factor. Addressed in Section 3.1 ‘Groundwater’</p> <p>Considered to be a relevant factor. Addressed in Section 3.5 ‘World Heritage and Conservation Values’</p>
EPBC ISSUES			
World Heritage values	<ul style="list-style-type: none"> The Amy Zone orebody is located adjacent to the southeastern boundary of the SBWHP. Impacts to the values of the SBWHP include the potential for vegetation to be impacted by groundwater mounding and dust deposition and the potential for dust deposition on the stromatolites at Hamelin Pool. 	<ul style="list-style-type: none"> Impacts on Hamelin Pool and the Nilemah Embayment were largely unquantified Potential for decrease in the heritage values of Shark Bay 	<p>Considered to be a relevant factor. Addressed in Section 3.5 ‘World Heritage and Conservation Values’</p>
Threatened species and communities	<ul style="list-style-type: none"> The DEH database identified 6 threatened species possibly occurring within 1km of the general SBWHP. 	<ul style="list-style-type: none"> Queries regarding the timing and frequency of flora and fauna surveys. Impacts on the Malleefowl population 	<p>Considered to be a relevant factor. Addressed in Section 3.3 ‘Fauna’.</p>
Migratory species	<ul style="list-style-type: none"> The DEH database identified 2 migratory species possibly occurring within 1km of the general SBWHP. 	No comments received	Not considered to be a relevant factor.

PRINCIPLES		
Principle	Relevant Yes/No	If yes, Consideration
<p>1. The precautionary principle <i>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</i> <i>In application of this precautionary principle, decisions should be guided by –</i> <i>(a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and</i> <i>(b) an assessment of the risk-weighted consequences of various options.</i></p>	Yes	The EPA is satisfied that sufficient information is available to enable a decision to be made that the EPA's principles and objectives are unlikely to be compromised by the implementation of the proposal, subject to a number of conditions and commitments.
<p>2. The principle of intergenerational equity <i>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</i></p>	Yes	While noting the limited experience of rehabilitation in this region, the proposal is not considered to represent an unacceptable impact on the health, diversity and productivity of the environment for future generations.
<p>3. The principle of the conservation of biological diversity and ecological integrity <i>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</i></p>	Yes	While noting that there will be an initial loss in biological diversity within the region, the proposal is not considered to represent an unacceptable impact on the conservation of biological diversity and ecological integrity.
<p>4. Principles relating to improved valuation, pricing and incentive mechanisms <i>(d) Environmental factors should be included in the valuation of assets and services.</i> <i>(e) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.</i> <i>(f) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.</i> <i>(g) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximize benefits and/or minimize costs to develop their own solution and responses to environmental problems.</i></p>	No	
<p>5. The principle of waste minimisation <i>All reasonable and practicable measures should be taken to minimize the generation of waste and its discharge into the environment.</i></p>	No	The EPA notes that Gunson intend to implement a waste hierarchy. This includes using natural gas rather than diesel, maximising water recycling, and recycling of structural waste through a scrap metal merchant.

Appendix 4

Recommended Environmental Conditions and Proponent's Consolidated Commitments

RECOMMENDED CONDITIONS AND PROCEDURES

**STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED
(PURSUANT TO THE PROVISIONS OF THE
ENVIRONMENTAL PROTECTION ACT 1986)**

COBURN MINERAL SAND PROJECT, 84 KILOMETRES SOUTH-EAST OF
DENHAM, SHIRE OF SHARK BAY

Proposal: The development of the Coburn Mineral Sand Project, 84 kilometres south-east of Denham in the Shire of Shark Bay. This involves the excavation and processing of a major low-grade heavy mineral sand deposit, as documented in schedule 1 of this statement.

Proponent: Gunson Resources Limited

Proponent Address: Level 2, 33 Richardson Street, WEST PERTH WA 6005

Assessment Number: 1491

Report of the Environmental Protection Authority: Bulletin 1211

The proposal referred to above may be implemented by the proponent subject to the following conditions and procedures:

1 Implementation

1-1 The proponent shall implement the proposal as documented in schedule 1 of this statement subject to the conditions and procedures of this statement.

2 Proponent Commitments

2-1 The proponent shall implement the environmental management commitments documented in schedule 2 of this statement.

3 Proponent Nomination and Contact Details

3-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal until such time as the

Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.

- 3-2 If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent and provide a letter with a copy of this statement endorsed by the proposed replacement proponent that the proposal will be carried out in accordance with this statement. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.
- 3-3 The nominated proponent shall notify the Department of Environment of any change of contact name and address within 60 days of such change.

4 Commencement and Time Limit of Approval

- 4-1 The proponent shall substantially commence the proposal within five years of the date of this statement or the approval granted in this statement shall lapse and be void.

Note: The Minister for the Environment will determine any dispute as to whether the proposal has been substantially commenced.

- 4-2 The proponent shall make application for any extension of approval for the substantial commencement of the proposal beyond five years from the date of this statement to the Minister for the Environment, prior to the expiration of the five-year period referred to in condition 4-1.

The application shall demonstrate that:

1. the environmental factors of the proposal have not changed significantly;
2. new, significant, environmental issues have not arisen; and
3. all relevant government authorities have been consulted.

Note: The Minister for the Environment may consider the grant of an extension of the time limit of approval not exceeding five years for the substantial commencement of the proposal.

5 Compliance Audit and Performance Review

- 5-1 The proponent shall prepare an audit program and submit compliance reports to the Department of Environment which address:
1. the status of implementation of the proposal as defined in schedule 1 of this statement;
 2. evidence of compliance with the conditions and commitments; and

3. the performance of the environmental management plans and programs.

Note: Under sections 48(1) and 47(2) of the *Environmental Protection Act 1986*, the Chief Executive Officer of the Department of Environment is empowered to monitor the compliance of the proponent with the statement and should directly receive the compliance documentation, including environmental management plans, related to the conditions, procedures and commitments contained in this statement.

5-2 The proponent shall submit a performance review report every five years after the start of operations, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority, which addresses:

1. the major environmental issues associated with implementing the project; the environmental objectives for those issues; the methodologies used to achieve these; and the key indicators of environmental performance measured against those objectives;
2. the level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology where practicable;
3. significant improvements gained in environmental management, including the use of external peer reviews;
4. stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed; and
5. the proposed environmental objectives over the next five years, including improvements in technology and management processes.

5-3 The proponent may submit a report prepared by an independent auditor to the Chief Executive Office of the Department of Environment on each condition/commitment of this statement which requires the preparation of a management plan, programme, strategy or system, stating whether the requirements of each condition/commitment have been fulfilled within the timeframe stated within each condition/commitment.

6 Groundwater

6-1 Prior to commencement of ground-disturbing activities, the proponent shall prepare a Groundwater Mounding Management Plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The objectives of this plan are to:

- identify groundwater level 'threshold' and 'limit' criteria which protect vegetation adjacent to the proposal area.

- monitor groundwater levels within and adjacent to the proposal area.
- identify the management response(s) in the event that ‘threshold’ and ‘limit’ criteria for groundwater levels are not being met.
- establish the baseline health condition of vegetation potentially impacted by groundwater mounding prior to any mining or associated activities undertaken as part of this proposal as indicated by an agreed methodology for assessing the health of vegetation and selected deep-rooted indicator species at appropriate reference and monitoring sites.
- monitor and assess any changes in the health of vegetation and selected indicator species which occur subsequent to the commencement of mining and associated activities.
- identify ‘threshold’ and ‘limit’ criteria for health of vegetation and selected deep-rooted indicator species.
- identify the management response(s) in the event that ‘threshold’ and ‘limit’ criteria for monitoring of vegetation health and selected indicator species are not being met.

This Plan shall include:

1. groundwater level ‘threshold’ criteria for management response(s) and ‘limit’ criteria not to be exceeded outside the project area;
2. a monitoring programme which enables characterisation of the dimensions and magnitude of groundwater mounding in the mining area and adjacent to the proposal, including monitoring of bores between the mining area and the Shark Bay World Heritage Property;
3. the predicted rate of rise of groundwater levels associated with groundwater mounding in order to determine the time frame for management responses which the proponent implements where ‘limit’ criteria are exceeded;
4. the timing and frequency of groundwater level monitoring;
5. the location of appropriate potential impact sites and reference sites in native vegetation adjacent to the proposal;
6. protocols and procedures for monitoring (methodology to include photography and airborne spectral imaging) and quantitatively assessing the health of vegetation and the health of selected indicator species at potential impact sites and reference sites in native vegetation (e.g. cover, density) adjacent to the proposal area;
7. the timing and frequency of monitoring the health of vegetation and selected indicator species;
8. calculations of statistical power of the monitoring procedures referred to in item 6 above to demonstrate that the procedures are appropriate for determining the health of vegetation and selected indicator species;

9. the development of 'threshold' criteria for the health of vegetation and the health of selected indicator where the proponent implements management response(s);
 10. reporting of measured groundwater mounding compared with predictions; and
 11. strategies to maximise water use efficiency and recycling.
- 6-2 The proponent shall implement the Groundwater Mounding Management Plan, required by condition 6-1.
- 6-3 The proponent shall make the Groundwater Mounding Management Plan required by condition 6-1 publicly available.
- 6-4 The proponent shall review and revise annually the Groundwater Mounding Management Plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Water and Rivers Commission.
- 6-5 In the event that the 'threshold' for groundwater levels and/or health monitoring of vegetation and selected indicator species specified in condition 6-1 is/are exceeded following commencement of mining, but do not exceed 'limit' levels specified in condition 6-1, the proponent shall within the time period determined in accordance with condition 6-1 (3) above:
1. implement the management measures specified in condition 6-1; and
 2. report the exceedence and the management measures implemented to the Department of Environment,
but may continue mining.
- 6-6 In the event that the 'limit' criteria identified in condition 6-1 for groundwater levels are exceeded during mining, the proponent shall immediately cease all mining which is contributing to the 'limit' criteria specified in condition 6-1 being exceeded.
- 6-7 In the event that the proponent ceases mining, as referred to in condition 6-6 above, the proponent shall not recommence mining until either:
1. the Minister is satisfied on advice of the Environmental Protection Authority that a program is in place to return groundwater levels to a level below the 'threshold' for groundwater levels; and
 2. the proponent has received written advice from the Minister for the Environment that mining may re-commence.
- 6-8 In the event that the 'limit' criteria identified in condition 6-1 for health of vegetation and selected indicator species are exceeded during mining, the proponent shall immediately cease all mining which is contributing to the 'limit' criteria specified in condition 6-1 being exceeded.
- 6-9 In the event that the proponent ceases mining, as referred to in condition 6-8 above, the proponent shall not recommence mining until either:

1. the Minister is satisfied on advice of the Environmental Protection Authority that the groundwater criteria in condition 6-1 have been reviewed to suitably protect vegetation in future; and
 2. the proponent has received written advice from the Minister for the Environment that mining may re-commence.
- 6-10 The proponent shall maintain a 100-metre buffer between the project area and the boundary of the Shark Bay World Heritage Property in which no mining activity occurs and no roads are established.

7 Flora and Vegetation

- 7-1 Prior to commencement of ground-disturbing activities, the proponent shall prepare a Flora and Vegetation Management Plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The objective of this Plan is to ensure the conservation of significant flora species and vegetation communities which occur in the vicinity of, and within the project area as shown in Figure 1 of schedule 1.

This Plan shall include:

1. searches for Declared Rare Flora and Priority Flora in the area to be disturbed prior to the development of each pit and associated infrastructure, including haul roads;
 2. the management, monitoring and reporting of impacts on Declared Rare Flora and Priority Flora species within the project area, and
 3. any targeted surveys which are required prior to ground-disturbing activities to provide further information on the conservation status of each of the Declared Rare Flora species found, and
 4. reporting procedures and schedule.
- 7-2 The proponent shall implement the Flora and Vegetation Management Plan required by condition 7-1.
- 7-3 The proponent shall make the Flora and Vegetation Management Plan required by condition 7-1 publicly available.
- 7-4 In the event that Declared Rare Flora and/or species listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999*, are identified in the project area, the proponent shall prepare a Declared Rare Flora Management Plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Department of Conservation and Land Management.

This plan shall include:

1. the recorded location of Declared Rare Flora species;

2. a description of the habitat in which the Declared Rare Flora was found, and the extent of the contiguous area of the same habitat in the local area;
3. offsite surveys to determine the extent of rare flora species;
4. the degree of impact of the proposed works on the Declared Rare Flora or its identified contiguous habitat;
5. a management strategy for the protection of Declared Rare Flora species, in the event that approval to impact the declared rare or priority flora has not been provided pursuant to the *Wildlife Conservation Act 1950* , including:
 - a) identification of a protected buffer area around the Declared Rare Flora;
 - b) delineation of the location of the Declared Rare Flora buffer area to prevent accidental damage to the protected area;
 - c) consideration of relocating Declared Rare Flora species;
 - d) education of workers as to the protection of the Declared Rare Flora location;
 - e) specific management measures for topsoil stripping within areas of the contiguous Declared Rare Flora habitat, and
 - f) specific management measures for site rehabilitation and topsoil replacement within areas previously included as contiguous Declared Rare Flora habitat.
6. post-activity monitoring plan for Declared Rare Flora and regeneration of vegetation within areas previously included as contiguous Declared Rare Flora habitat, including for Declared Rare Flora plants.

7-5 The proponent shall implement the Declared Rare Flora Management Plan required by condition 7-4.

7-6 The proponent shall make the Declared Rare Flora Management Plan required by condition 7-4 publicly available.

7-7 The proponent shall not disturb vegetation communities S5 and S10, and shall leave an undisturbed buffer of at least 50 metre width around the vegetation communities.

8 Fauna

8-1 Prior to commencement of ground-disturbing activities, the proponent shall prepare a Fauna Management Plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

This Plan shall include:

1. establishment of permanent fauna monitoring sites;
2. additional fauna surveys ahead of mining to identify any significant or unknown species;
3. a baseline survey of the distribution and abundance of the Malleefowl (*Leipoa ocellata*) at, and in the immediate vicinity of, the site;

4. monitoring of Malleefowl populations both inside and outside the project area for comparison, and to show where populations may be declining, stable or increasing;
5. predator baiting, particularly to control populations of cats and foxes, throughout the project area and appropriate buffers, developed in consultation with the Department of Agriculture and the Department of Conservation and Land Management;
6. investigate and implement best practice directional lighting and/or light shields to reduce impacts of light overspill on fauna;
7. feral animal control strategies, where native fauna is made more vulnerable due to activities associated with mining;
8. fencing around water dams and open seepage interception trenches to prevent encroachment by large and medium sized animals;
9. escape mechanisms such as mesh or 'self-rescue mats' to allow animals to exit water ponds and open seepage interception trenches;
10. regular inspection of process water ponds or open seepage interception trenches for trapped animals; and
11. reporting procedures and schedule.

8-2 The proponent shall implement the Fauna Management Plan, required by condition 8-1.

8-3 The proponent shall make the Fauna Management Plan required by condition 8-1 publicly available.

8-4 In the event that Threatened Fauna, other than Malleefowl, and including those listed as "threatened" under the *Environment Protection and Biodiversity Conservation Act 1999*, are identified in the project area, the proponent shall prepare a Threatened Fauna Management Plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Department of Conservation and Land Management.

This Plan shall include:

1. the recorded location of Threatened Fauna species;
2. a description of the habitat in which the Threatened Fauna is found;
3. the degree of impact of the proposed works on Threatened Fauna or its identified habitat;
4. a management strategy for the protection of Threatened Fauna species, including relocation, or other action recommended by the Department of Conservation and Land Management; and
5. post-activity monitoring plan for Threatened Fauna species.

8-5 The proponent shall implement the Threatened Fauna Management Plan required by condition 8-4.

8-6 The proponent shall make the Threatened Fauna Management Plan required by condition 8-4 publicly available.

9 Progressive Rehabilitation Programme

9-1 Prior to commencement of ground-disturbing activities, the proponent shall prepare a Progressive Rehabilitation Programme for areas of native vegetation disturbed by activities related to the mining operation, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Department of Conservation and Land Management.

This Programme shall include:

1. framework to ensure that the site is left in an environmentally acceptable condition;
2. examination of available rehabilitation technologies and methods for mineral sand operations in Western Australia, where possible;
3. rehabilitation of all disturbed areas;
4. progressive development and refinement of completion criteria;
5. a rehabilitation schedule, including timing;
6. revegetation requirements;
7. management measures;
8. monitoring and maintenance of rehabilitated areas;
9. annual review; and
10. remedial actions.

The Programme shall relate to all areas of native vegetation disturbed during the mining operation, and shall consist of the following Management Plans:

(1) a Soil Management Plan which includes:

1. baseline evaluation of standard soil properties both, prior to and following mining, including chemical (pH, sodicity, electrical conductivity, organic carbon, cation exchange capacity, exchangeable cations, available nutrients (N, P, K) phosphorus retention capacity), physical (texture, structure, stability, water retention characteristics, clay mineralogy) and biological properties (root abundance, biological activity);
2. operational handling of soils during mining and rehabilitation;
3. a strategy for the characterisation and management of dispersive clays in the soil profile, including amelioration of any impact on the rehabilitated soil profile;
4. methods for minimising soil erosion following mining;
5. record-keeping of soil profile reconstruction information;
6. performance criteria, including completion criteria, for the soil profile reconstruction;
7. contingency actions to be carried out in the event that performance criteria are not being met;
8. a review mechanism which modifies work procedures based on the results of monitored outcomes.

Note: The preparation of this Plan shall include advice from the Department of Industry and Resources, the Department of Agriculture and the Commissioner of Soil and Land Conservation.

(2) a Revegetation Management Plan which includes:

1. delineation of areas of vegetation proposed to be disturbed by the mining activity;
2. a baseline vegetation study identifying the appropriate techniques for regeneration or revegetation of the vegetation types affected by clearing;
3. development of performance criteria, including completion criteria, for revegetation;
4. methods for revegetation of disturbed areas;
5. a monitoring program to determine revegetation success;
6. a recalcitrant species program; and
7. contingency actions to be carried out in the event that performance criteria are not being met.

(3) a Weed Management Plan, the objectives of which are:

- to control or eradicate both noxious and environmental weeds;
- to maintain the abundance, species diversity and productivity of vegetation communities in undisturbed areas by controlling the diversity and density of weed species, and
- to prevent the introduction and spreading of new weed species within the project area.

This Plan shall include:

1. baselines studies to provide information to the Department of Conservation and Land Management and the Department of Agriculture regarding the extent and nature of weed species within and adjacent to the project area;
2. monitoring of existing weeds and management so as not to affect areas adjacent to the project area;
3. development of weed monitoring sites in the Shark Bay World Heritage Property, as determined in consultation with the Department of Conservation and Land Management;
4. performance criteria for weed management;
5. reporting procedures and schedule.

9-2 The proponent shall implement the Progressive Rehabilitation Programme required by condition 9-1 until such time as the Minister for the Environment determines, on advice of the Environmental Protection Authority, that the proponent's rehabilitation responsibilities have been fulfilled.

9-3 The proponent shall undertake all reasonable and practicable measures to meet the criteria below within five years of rehabilitation:

1. the rehabilitation area shows no signs of major surface instability, with over 60% of the surface soil having developed a crust;
2. zone infiltration, zone stability and zone nutrients indexes rates are comparable to those found in reference sites;

3. projected foliage cover values of local provenance native species exceed 20% of reference sites;
 4. average species diversity exceeds 20% of analogue sites (excluding weeds);
- 9-4 In the event that the criteria referred to in condition 9-3 are not achieved within seven years following the commencement of commissioning, prior to further mining, the proponent shall review the Progressive Rehabilitation Programme to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and shall demonstrate that the criteria can be met if mining continues.
- 9-5 The proponent shall position pits (for extraction of calcrete to be used for the construction of roads) to avoid areas of high biodiversity value, and shall initiate rehabilitation of these pits within four weeks following cessation of their use.
- 9-6 The proponent shall subject all mining equipment and vehicles entering the site to appropriate hygiene measures to prevent the introduction of soil-borne plant diseases in consultation with the Department of Conservation and Land Management.
- 9-7 The proponent shall maintain an open area for drying of clay or slimes not exceeding 40 hectares at any one time.
- 9-8 Beyond the start-up process of the first six months of mining, the proponent shall initiate rehabilitation on not less than 80% of the total area mined during each year of mining.
- 9-9 Beyond the start-up process of the first six months of mining, the proponent shall return topsoil to mined out areas within three months of its excavation.
- 9-10 The proponent shall implement the Progressive Rehabilitation Programme required by condition 9-1 until such time as the Minister for the Environment determines, on advice of the Environmental Protection Authority, that the proponent's rehabilitation responsibilities have been fulfilled.

10 Bush Fire Management

- 10-1 Prior to commencement of ground-disturbing activity, the proponent shall prepare a Bush Fire Management Plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

This Plan shall include:

1. bush fire prevention measures;
2. bush fire detection and reporting procedures;
3. fire brigade and the proponent's fire suppression equipment and preparedness measures; and
4. training of personnel for fighting fires.

- 10-2 The proponent shall implement the Bush Fire Management Plan, required by condition 10-1.
- 10-3 The proponent shall make the Bush Fire Management Plan, required by condition 10-1 publicly available.

Note: In the preparation of advice to the Minister, the Environmental Protection Authority expects that the advice of the following agencies will be obtained:

- Department of Conservation and Land Management; and
- Fire and Emergency Services Authority.

11 Dust

- 11-1 Prior to ground-disturbing activity, the proponent shall prepare a Dust Management Plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

This Plan shall include:

1. baseline and ongoing monitoring;
2. prevention of visible dust in the Shark Bay World Heritage Property;
3. details of management and/or mitigation measures to minimise dust;
4. monitoring of the effects of dust and saline water used for dust suppression on vegetation;
5. preventative measures to minimise fugitive dust sources as part of daily operations;
6. monitoring of deposited dust levels at the boundary of the project area and at Hamelin Pool for the initial three years of the project to provide baseline data;
7. provision for continuous improvements in dust management; and
8. monitoring and reporting.-

- 11-2 Prior to ground-disturbing activity, the proponent shall implement the Dust Management Plan required by condition 11-1.
- 11-3 The proponent shall make the Dust Management Plan required by condition 11-1 publicly available.

12 Mine Closure

- 12-1 Prior to ground disturbing activities, the proponent shall prepare a Preliminary Closure Plan, which provides the framework to ensure that the site is left in an environmentally acceptable condition, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The Preliminary Closure Plan shall be prepared to be consistent with the Australian and New Zealand Minerals and Energy Council / Minerals Council of Australia (ANZMEC/MCA) *Strategic Framework for Mine Closure* and shall address:

1. outcomes of stakeholder consultation;
2. conceptual plans for the removal or, if appropriate, retention of plant and infrastructure;
3. long-term management of ground and surface water systems affected by mining operations;
4. management of noxious materials to avoid the creation of contaminated areas (including acid-generating materials);
5. reporting procedures and schedule, and
6. a contingency plan for the care and maintenance phase.

Note: In the preparation of advice to the Minister for the Environment, the Environmental Protection Authority expects that the advice of the following agencies will be obtained:

- Department of Conservation and Land Management;
- Department of Industry and Resources; and
- Water and Rivers Commission.

12-2 The proponent shall make the Preliminary Closure Plan required by condition 12-1 publicly available.

12-3 At least three years prior to the anticipated date of closure, or at a time agreed with the Environmental Protection Authority, the proponent shall prepare a Final Closure Plan which is consistent with the ANZMEC/MCA *Strategic Framework for Mine Closure* and is designed to ensure that the site is left in an environmentally acceptable condition, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The Final Closure Plan shall address:

1. removal or, if appropriate, retention of plant and infrastructure in consultation with relevant stakeholders;
2. the final form of land forms and voids;
3. A reconciliation of volumes of areas to be mined, the volumes of areas remaining to be filled with tailings and the final landform determined in 2. above to demonstrate that there is sufficient material remaining either to be mined or through management of the tailings to achieve the desired landform.
4. long-term management of ground and surface water systems affected by mining;
5. rehabilitation and revegetation of all disturbed areas to a standard suitable for the agreed new land use(s) and which aim to restore the original vegetation communities in accordance with agreed performance criteria; and

6. identification of contaminated areas, including provision of evidence of notification and proposed management measures to relevant statutory authorities.

Note: In the preparation of advice to the Minister for the Environment, the Environmental Protection Authority expects that the advice of the following agencies will be obtained:

- Department of Conservation and Land Management;
- Department of Industry and Resources;
- Water and Rivers Commission; and

- 12-4 The proponent shall implement the Final Closure Plan required by condition 11-3 until such time as the Minister for the Environment determines, on advice of the Environmental Protection Authority, that the proponent's closure responsibilities have been fulfilled.
- 12-5 The proponent shall make the Final Closure Plan required by condition 11-3 publicly available.

Procedures

- 1 Where a condition states "to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority", the Environmental Protection Authority will provide that advice to the Department of Environment for the preparation of written notice to the proponent.
- 2 The Environmental Protection Authority may seek advice from other agencies or organisations, as required, in order to provide its advice to the Department of Environment.
- 3 Where a condition lists advisory bodies, it is expected that the proponent will obtain the advice of those listed as part of its compliance reporting to the Department of Environment.

Notes

- 1 The Minister for the Environment will determine any dispute between the proponent and the Environmental Protection Authority or the Department of Environment over the fulfilment of the requirements of the conditions.
- 2 The proponent is required to apply for a Works Approval and Licence for this project under the provisions of Part V of the *Environmental Protection Act 1986*.
- 3 Within this statement, to "have in place" means to "prepare, document, implement and maintain for the duration of the proposal".
- 4 The project area is defined as all areas where disturbance will occur through the mining of Pits 1 to 9, placement of infrastructure, borrow pits, haul roads, access road and other facilities, plus a 50 metre buffer.

Schedule 1

The Proposal (Assessment No. 1491)

The proposal is to develop the Coburn Mineral Sand Project, 84 kilometres south-east of Denham in the Shire of Shark Bay. This involves the excavation and processing of a major low-grade heavy mineral sand deposit which will be trucked 250 kilometres south to Geraldton for direct export.

Table 1 – Key Proposal Characteristics

Element	Description
Project Life	Approximately 12 Years
Number of Pits	Nine pits
Rate of Mining	Approximately 2,300 tph for the first two years, increasing to 4,600 tph in Year 3 (~15 million tpa for Years 1 and 2, and 30 million tpa for Years 3 to 12).
Mining Method	Bucket-wheel excavators and in-pit screening modules
Estimated Footprint of Disturbance	Approximately 3,695 ha
Rate of Processing	Approximately 2,200 tph for the first two years increasing to 4,400 tph in Year 3 (~140,000 tpa of Heavy Mineral Concentrate from Year 1 increasing to 280,000 tpa from Year 3).
Estimated Volume of Tailings	2,180 tph for each 2,200 tph concentrator.
Volume of Process Water	Up to 18 GL/annum at full production
Estimated Total Volume of Refined Product	Ilmenite – 1,400 kt HiTi – 380 kt Zircon – 660 kt

Note: tph – tonnes per hour, tpa – tonnes per annum, GL/annum - gigalitres per annum, kt – kilotonnes.

Figures (attached)

Figure 1 – Regional location

Figure 2 – Proposed layout of Amy Zone Operation. Note: The “proposal area” is defined as all areas where disturbance will occur through the mining of Pits 1 to 9, placement of infrastructure, borrow pits, haul roads, access road and other facilities, plus a 50 metre buffer.



Figure 1: Regional location

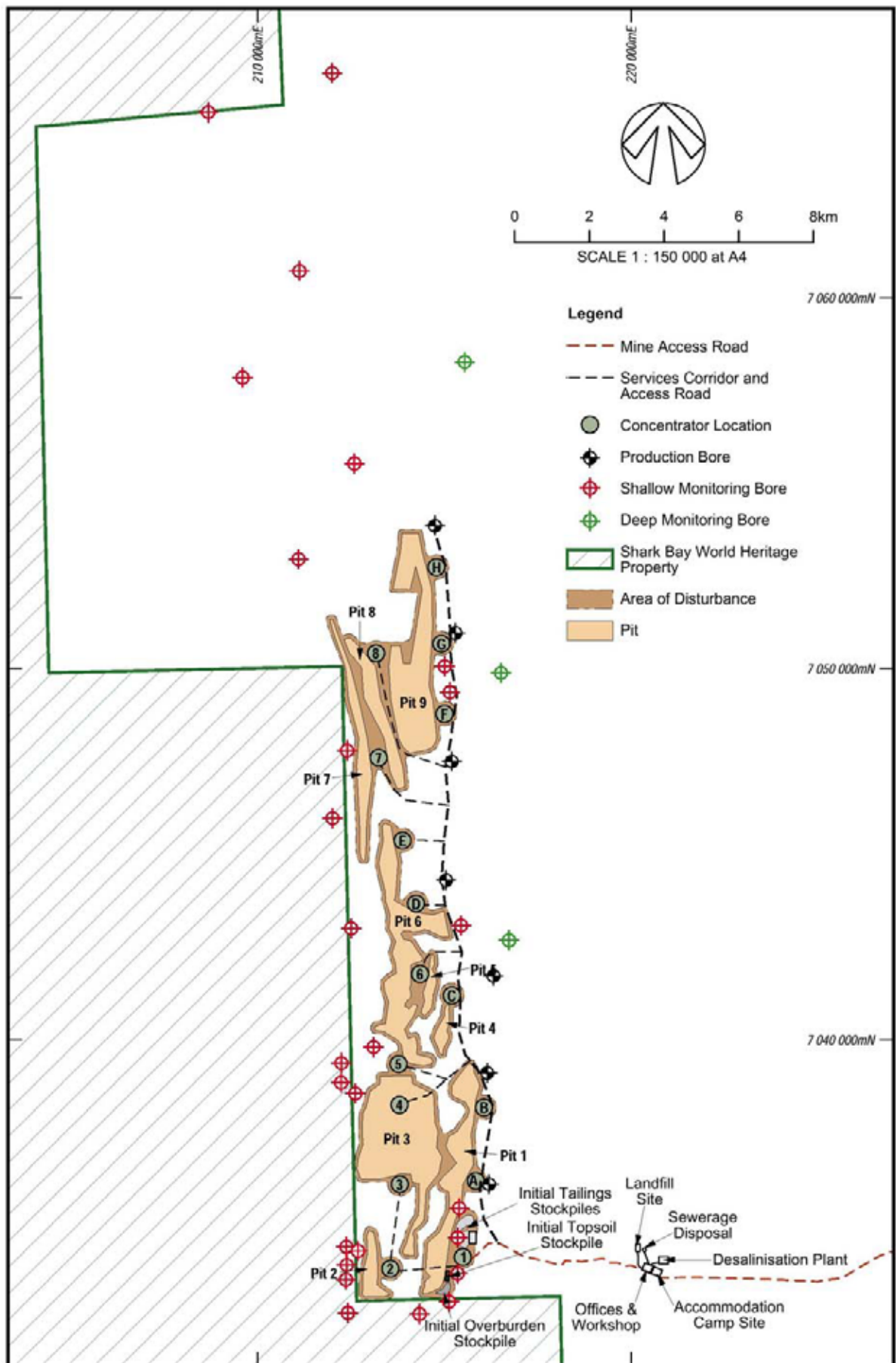


Figure 2. Proposed layout of the Amy Zone Operation. The proposal area is defined as all areas where disturbance will occur through the mining of Pits 1-9, placement of infrastructure, borrow pits, haul roads, access road and other facilities, plus a 50 metre buffer.

Proponent's Environmental Management Commitments

December 2005

**COBURN MINERAL SAND PROJECT,
84 KILOMETRES SOUTH-EAST OF DENHAM,
SHIRE OF SHARK BAY**

(Assessment No. 1491)

Gunson Resources Limited

Proponent’s Environmental Management Commitments – November 2005

COBURN MINERAL SAND MINE (Assessment No. 1491)

Note: The term “commitment” as used in this schedule includes the entire row of the table and its six separate parts as follows:

- a commitment topic;
- the objective of the commitment;
- the ‘action’ to be undertaken by the proponent;
- the timing requirements of the commitment; and
- the body/agency to provide technical advice to the Department of Environment.

Topic	Objective	Actions	Timing	Advice
Priority Flora Management	Maintain the abundance, diversity and productivity of priority flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge	<ol style="list-style-type: none"> 1. Finalise the draft Priority Flora Management Plan with consideration of comments received during the public review period of the Public Environmental Review document and in consultation with relevant stakeholders. 2. Implement the Priority Flora Management Plan. 	<p>Finalise prior to construction phase of the project.</p> <p>Implement during construction and operational phases of the project.</p>	CALM

Stygofauna	<p>Maintain the abundance, diversity, geographical distribution and productivity of stygofauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge</p>	<ol style="list-style-type: none"> 3. Conduct a stygofauna survey in the southern portion of the Project Area using existing bores. 4. Conduct re-sampling of the bores located in the northern portion of the project area. 5. If stygofauna are found in these areas, then sampling outside the project area will be conducted to demonstrate that these species occur outside the Project Area. 	<p>Survey of southern portion prior to construction phase of the project</p> <p>Re-sampling of bores in the northern portion of the Project Area before commencement of mining at Pit 9.</p>	CALM
Solid and Liquid Waste Management	<p>To minimise, re-use or recycle wastes where practicable and to ensure that that any wastes requiring disposal are disposed of in an environmentally acceptable and approved manner.</p>	<ol style="list-style-type: none"> 6. Finalise the draft Solid and Liquid Waste Management Plan with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. 7. Implement the Solid and Liquid Waste Management Plan. 	<p>Finalise prior to construction phase of the project.</p> <p>Implement during construction and operational phases of the project.</p>	DoE, DoIR
Hydrocarbon Management	<p>Ensure that hydrocarbons are handled, utilised, stored and disposed of in an environmentally acceptable and approved manner.</p>	<ol style="list-style-type: none"> 8. Finalise the draft Hydrocarbon Management Plan with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. 9. Implement the Hydrocarbon Management Plan. 	<p>Finalise prior to construction phase of the project.</p> <p>Implement during construction and operational phases of the project.</p>	DoE, DoIR

Radiation Management	To ensure all radiological impacts are in accordance with the ALARA Principle and comply with currently accepted standards and codes of practice.	10. Finalise the draft Radiation Management Plan with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. 11. Implement the Radiation Management Plan.	Finalise prior to construction phase of the project. Implement during construction and operational phases of the project.	Radiological Council of WA, DoIR
Aboriginal Heritage Management	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	12. Finalise the draft Aboriginal Heritage Management Plan with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. 13. Implement the Aboriginal Heritage Management Plan during the construction and operational phases of the Project.	Finalise prior to construction phase of the project. Implement during construction and operational phases of the project.	DIA
Research		14. Contribute funds and supporting scientific research into the ecology of the Shark Bay World Heritage Property.	Prior to commencement of construction	CALM

Abbreviations

CALM Department of Conservation and Land Management
DIA Department of Indigenous Affairs
DoIR Department of Industry and Resources
DoE Department of Environment

Appendix 5

**Technical Review of Soil Related Aspects
of the Proposal by Professor Bob Gilkes**

Specific Terms of Reference

- (1) Assess the adequacy of the soil sampling program carried out by the proponent in terms of characterising the nature of the soils at the project site, including depth distribution of plant roots, characterisation of soil profiles, clay content, nature and distribution of dispersive materials, moisture holding capacity of the soils, erosion potential and occurrence of acid sulphate soils.
- (2) Comment on the capacity of altered soils and landscapes to support self-sustaining local plant communities.
- (3) Assess the adequacy of the proponent's proposed revegetation methods, mining methods, soil handling methods (including handling of topsoil) and landform reconstruction methods in terms of meeting acceptable soil reconstruction standards that would allow the project to meet the EPA's broad objectives for rehabilitation.
- (4) Comment on the likelihood of the proponent being able to achieve a system that has the following five key fundamental requirements needed for vegetation establishment, habitat restoration and ecosystem development (as outlined by D.C Blandford & Associates in the Soils and Landforms Report; Appendix C, Pg10, of the PER Document):-
 - (i) providing an upper profile with sufficient thickness to provide an adequate rooting depth for vegetation,
 - (ii) providing a profile that comprises materials able to retain moisture,
 - (iii) providing an upper profile that has high infiltration rates,
 - (iv) providing an upper profile that comprises materials that have a low erodibility rating,
 - (v) providing a slope length/slope angle/materials combination that enhances long-term stability,whereby the upper profile is defined as the top 1 metre of soil.
- (5) Provide comment on any other matters which the reviewer believes are relevant to rehabilitation at the site.

Technical review of soil-related aspects of the proposed mining and rehabilitation plan for Gunson Resources Coburn Mineral Sands Project.

Reviewer: Prof. R J Gilkes, University of Western Australia

(35 years' experience in soil-related mine-site rehabilitation research including mineral sands mines in WA, Queensland and Victoria)

Reference 1: Adequacy of the soil sampling program

Soil evaluation is described in the PER and particularly in Appendix C. The landforms, profile morphology and textural properties of soils are reviewed in some depth. There are several particle size analyses of soil materials, but in all other respects the intrinsic properties

of soils are not adequately evaluated. There are pH values for single samples from five soil profiles and limited chemical analyses for three subsoil samples (from approx. 1m depth). The Rehabilitation Plan (page 4-1 Paragraph 2) states that “the physical and chemical characteristics of the undisturbed soils are known”, this is not a valid statement as there is little or no information on many soil properties and on variations in properties within the proposed mine site.

Any “baseline” evaluation of soil properties to determine pre-mining conditions and for use as an indicator of rehabilitation success should include the standard chemical, physical and biological measurement observations for the entire solum. These include:

Chemical	Physical	Biological
pH	Texture	Root abundance
EC	Structure, stability, structural strength, erosion potential	Biological activity
OC	Pans (natural and induced)	
CEC	Water retention characteristics	
Exchangeable cations	Clay mineralogy	
Available nutrients (N, P, K)		
P-retention capacity		
Calcium carbonate % (total and reactive)		
Sulphide where appropriate		

I suggest that the standard published Australian Soil Analysis procedures be followed for this characterisation.

Most of these properties are sensitive to the disturbance associated with mining and rehabilitation. Together they provide a quantitative definition of the soil’s resources and capacity to support biota. Many soil surveys for land development routinely collect these and additional data for the solum and the same requirement should operate for the Coburn site. The “quick and easy” LFA procedure that is discussed in the PER is useful but is not a substitute for a thorough definition of soil resources.

Reference 2: Capacity to support a self sustaining local plant community.

This objective is most likely to be achieved if the rehabilitated landform, soils and deep subsoil materials are identical to the pre-mining condition. The proposed rehabilitation plan recognises this objective, but as for most mine rehabilitation, will not be able to fully achieve this goal. In particular:

- Deep soil (>1m) is sand tailings and will have relatively little fine material compared to the original soil. A possible consequence of this change is reduced water and nutrient retention.
- Traffic pans due to machinery may restrict root penetration and require ripping.
- Sodic and structurally unstable soils may develop due to the use of high sodium/calcium ratio water for dust control. (The water is saline with sodium chloride being the dominant salt.)

These matters should be evaluated prior and during the initial mining phase and appropriate management and monitoring strategies evolved. The present small trial mining area and the benchmark studies (Appendix E) do not represent a situation that exactly corresponds to the proposed mine site materials and rehabilitation practice. These concerns should be fully evaluated prior to mining and where possible addressed by appropriate rehabilitation measures so as to increase the likelihood that self-sustaining local plant communities can be returned to the site.

Reference 3: Will the proposed methods of soil reconstruction meet EPA’s rehabilitation objectives?

The proposed procedure follows best practice in the construction of a similar landform, the return of a thick (90+cm) subsoil layer and a topsoil (10cm) layer that has not been affected by prolonged or wet storage. However, the overburden materials will be buried and replaced by sand tailings so that the constructed regolith sequence will be very different from the pre-mining condition. Thus an important difference is that washed sand tailings will be the deeper (>1m) subsoil, such materials are inferior to the loamy sand or sandy loam that comprises the natural deeper subsoil. The company could consider inclusion of some of the slimes (clay) into the sand tailings, but must avoid thick (>ca 10cm) layers of slimes within the sand tailings.

Similarly, disposal of most of the slimes in localised bodies beneath sandy materials will result in a regolith stratigraphy that differs greatly from original conditions. The slimes will be both saline and sodic so are likely to be hostile and impenetrable to deep roots.

These differences from the original regolith profile that includes a loamy sand subsurface material and various thicknesses of calcrete may impact on the establishment and growth of some deep rooted species, and this needs to be thoroughly evaluated by trials during the early stages of mine development. At present there is little or no information on the abundance/function of deep roots under the native vegetation, but elsewhere within regolith under similar rainfall there are deep roots that provide water and nutrients to plants. The reconstructed soils will be able to support vegetation although development of an equilibrium condition will be very slow in this environment and might differ from existing vegetation.

Reference 4: Will the proposed rehabilitation practice meet Blandford’s five fundamental requirements for the top 1 metre of soil?

- (i) Rooting depth: the “reconstruction” of the soil profile to 1 metre depth will allow easy root and shoot exploration of this material, providing that:

- a. Traffic has not produced a dense pan that requires ripping;
 - b. The use of saline, sodium-rich water for dust control does not result in dispersion of clay and surface sealing.
- (ii) Moisture retention: the 1 metre depth of soil will consist of loamy sand and/or sandy loam. The total water retention and available water retention characteristics are unlikely to be substantially affected by proper handling, although this should be evaluated by laboratory measurements. Materials should not be excavated or deposited while wet and physical work on the materials should be minimised. Note that the presence of a traffic pan may prevent plants from accessing this water.
 - (iii) Water infiltration: because the soil materials are very sandy, it is unlikely that infiltration of rainwater will be substantially affected by handling. However, if the development of sodicity due to use of saline water causes surface crusting, this will restrict infiltration and cause uneven wetting and runoff. If handling of topsoil causes an accumulation of sand (i.e. little or no silt and clay) in the top few cm of the profile, it is likely that water repellency will develop. These possibilities should be evaluated at an early stage and are readily ameliorated.
 - (iv) Will erodibility be affected? Erosion by wind and water will increase if handling of the topsoil causes it to lose cohesion due to disturbance and a reduction in clay and organic matter content. Erosion by water may increase if the topsoil becomes dispersive due to the use of saline water for dust abatement. These phenomena can be readily investigated under laboratory conditions.
 - (v) Slope length/angle/materials combinations to resist erosion. Wind erosion is likely to provide a much greater risk than water erosion provided items (iii) are satisfactory. Erodibility is reduced where the soil is cohesive (item iv) and traffic/animal disturbance is avoided. The placement of plant residue on the soil surface and use of matting/wind breaks may be necessary where soil surface strength is weak and particles are easily detached. Landform design should limit exposure to dominant wind directions. Where very sandy topsoils are readily eroded slimes may be incorporated to provide cohesion but this practice is best avoided as sodic slimes may adversely affect several physical and chemical properties of the topsoil.

Reference 5: Other matters:

- (i) The slimes generated by this mining operation are likely to be sodic, highly dispersive and possibly thixotropic. They may be extremely difficult to de-water and require large areas for disposal. The PER does not adequately evaluate this problem. Section 5.2.5 of the Rehabilitation Plan considers that slimes (clay) will be equivalent to 3% (or 4%, page 6-10 PER) of the ore (volume%?). In practice sodic slimes may comprise a much greater volume of material (eg. 30% by volume) due to their thixotropic nature. Indeed several mineral sands mining operations in WA and elsewhere have been adversely affected or even failed because of an inadequate appreciation of the impact of sodic slimes on mineral separation and slime disposal. There is an urgent need to thoroughly evaluate this potential problem.
- (ii) The PER mentions the use of fertilisers without specifying the types of amounts of fertiliser to be used. In general for rehabilitation back to bush vegetation it is best

to avoid the use of fertilisers as they encourage invasion by weeds which is already a problem in the region (radish, dock, etc).

Concluding Remarks

- In my opinion the characterisation of soils presented in the PER and its attachments is inadequate. It does not identify the key properties of the soils or their diversity and thus does not provide a clear basis for measuring rehabilitation success. LFA is not a substitute for soil analysis and is incapable of identifying many soil properties/problems.
- The construction of soil profiles by returning 10cm of topsoil and 90cm of subsoil follows best practice and will facilitate native plant establishment and growth. The deeper subsoil will consist of sand tailings and thus will be inferior to the original deep subsoil which is loamy sand or sandy loam. The impact of this practice may be minor as most root activity occurs in the top metre of soil but this matter needs urgent evaluation once mining commences.
- The soil materials can be damaged by traffic and the introduction of sodium in the salty water used for dust control. Appropriate management of these issues should be adopted.
- The Benchmarking Study is informative but does not include any situation that exactly coincides with the proposed rehabilitation situation and objectives. Several of the benchmark sites and soils are very different from those at the Coburn site. Some sites/soils are similar and these observations encourage the view that a successful rehabilitation procedure can be developed.
- There is some confusion in the documentation concerning acid sulphate soils. The possible concern relates to the occurrence of potential acid sulphate soils (PAS) not actual acid sulphate soils (AAS). Simply put, the occurrence of sulphide (usually pyrite) in ore below the water table requires a management plan to limit oxidation and acidification. Where ore is not below the water table oxidation will not be a problem, but mine planning must include consideration of the occurrence of sulphides.

Appendix 6

Summary of Submissions and Proponent's Response to Submissions

PROPONENT'S RESPONSE TO SUBMISSIONS

Public Environmental Review
Coburn Mineral Sand Project

Prepared for


Gunson Resources Ltd

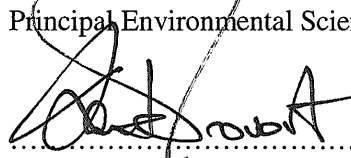
Level 2, 33 Richardson Street
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4 October 2005

42905540/DK:517-F7335.0

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Reference: 42905540/DK:517-F7335.0
Status: Final

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Executive Summary

Gunson Resources Limited (Gunson) proposes to develop the Coburn Mineral Sand Project (the Project) in the Shark Bay district of Western Australia, approximately 250 kilometres (km) north of Geraldton and 84 km southeast of Denham. The Project will comprise the excavation and processing of a major low-grade heavy mineral sand deposit known as the Amy Zone.

The proposal is being assessed as a Public Environmental Review (PER) under Part IV of the Western Australian *Environmental Protection Act 1986*. In addition, the proposal is considered to be a “controlled action” under the *Environment Protection and Biodiversity Conservation Act 1999*. The controlling provisions are world heritage, listed threatened species and communities, and listed migratory species.

The PER is a public document and was subject to an eight-week public review period. During this time, government agencies, private organisations, community groups and the public were invited to make submissions to the Environmental Protection Authority. A total of 18 submissions were received on the PER. Seven submissions on the PER were received from local and State government agencies, six submissions were received from community and industry groups, and five submissions were received from members of the public.

The key issues and concerns raised in the submissions are as follows:

- A number of the submissions stated that the environmental impacts on Hamelin Pool and the Nilemah Embayment were largely unquantified. There was concern that the Project could result in a decrease in the heritage values of Shark Bay.
- Comments on the adequacy of the baseline surveys were provided in a number of submissions. Queries were raised on the timing of the flora and fauna surveys and the frequency of the surveys. The trapping methods used in the fauna survey was also queried. Some comments were made on the adequacy of the Aboriginal archaeological survey.
- Concerns were raised on the adequacy of the draft rehabilitation plan, including the proposed seeding methodology and the list of species to be considered for use in rehabilitation works. A number of submissions recommended that detailed research studies be undertaken during the life of the Project to increase the knowledge of regeneration ecology and improve rehabilitation techniques.
- Some submissions queried the closure process for the mine, including decommissioning, completion criteria and rehabilitation monitoring.
- Concerns were raised about groundwater drawdown and impacts on other groundwater users in the area as a result of the Project.
- The potential impact of dust on algal mats and stromatolites at Hamelin Pool was raised.
- Some submissions raised concerns regarding public health and safety, including the need for a management plan for the spillage of concentrate during transportation and the increase in traffic on the pastoral lease and on the North West Coastal Highway.

Executive Summary

- A number of submissions suggested that Pit 10 should be excluded from the current proposal as the environmental risks are too high.
- A number of submissions suggested that environmental offsets be implemented by the Proponent to compensate for the loss of conservation values as a result of the Project.

This document provides the Proponent's response to the issues raised in the public and government submissions. In addition, it presents Gunson's response to a technical peer review of the Draft Rehabilitation Plan by Professor Bob Gilkes of the University of Western Australia.

1.1 Background

Gunson Resources Limited (Gunson) proposes to develop the Coburn Mineral Sand Project (the Project) in the Shark Bay district of Western Australia, approximately 250 kilometres (km) north of Geraldton and 84 km southeast of Denham. The Project will comprise the excavation and processing of a major low-grade heavy mineral sand deposit known as the Amy Zone.

The proposal is being assessed as a Public Environmental Review (PER) under Part IV of the Western Australian *Environmental Protection Act* 1986. In addition, the proposal is considered to be a “controlled action” under the *Environment Protection and Biodiversity Conservation Act* 1999. The controlling provisions are world heritage, listed threatened species and communities, and listed migratory species.

The PER is a public document and was subject to an eight-week public review period from 4 July to 29 August 2005. During this time, government agencies, private organisations, community groups and the public were invited to make submissions to the Environmental Protection Authority (EPA). The deadline for the submissions was 29 August 2005, though one late submission was accepted. A total of 18 submissions was received on the PER. Seven submissions on the PER were received from local and State government agencies, six submissions were received from community and industry groups, and five submissions were received from members of the public.

1.2 Purpose of this Document

The purpose of this document is to provide the Proponent’s response to the key environmental and social issues raised in submissions made on the Coburn Mineral Sand Project PER.

Eighteen submissions on the PER were received, as follows:

- Submission 1: Private Submission
- Submission 2: Private Submission
- Submission 3: Western Australian Museum (WAM)
- Submission 4: Private Submission
- Submission 5: Private Submission
- Submission 6: Private Submission
- Submission 7: Shark Bay Land Conservation District Committee (LCDC)
- Submission 8: Department of Indigenous Affairs (DIA)
- Submission 9: Shire of Shark Bay
- Submission 10: Shark Bay World Heritage Property Scientific Advisory Committee (SBWHP SAC)
- Submission 11: Shark Bay World Heritage Property Community Consultative Committee (SBWHP CCC)

- Submission 12: Department of Conservation and Land Management (CALM)
- Submission 13: Private Submission
- Submission 14: Main Roads Western Australia (Main Roads)
- Submission 15: Conservation Council
- Submission 16: Radiological Council
- Submission 17: Wildflower Society of Western Australia Inc (Wildflower Society)
- Submission 18: Department of Agriculture (DoA)

Information about the identity of the private submission authors was removed by the Department of Environment (DoE) before the submissions were provided to Gunson and URS. Therefore, these submissions are referred to in this document according to the submission number listed above.

The Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002 state that the Proponent is required to prepare a summary of the pertinent issues raised in public and government agency submissions. A summary of submissions was prepared by URS on behalf of Gunson and submitted to the DoE for review. The DoE approved the Summary of Submissions on 23 September 2005.

1.3 Structure of this Document

This Summary of Submissions document has been structured according to the environmental and social elements listed in Table 6.1 of the PER. The elements addressed in the submissions are listed in Table 1.

Table 1
Environmental and Social Elements Addressed in PER Submissions

Topic	Element of Environment
Integration	Sustainability
	Conservation Estate and Values
	Biodiversity
Biophysical Environment	Flora and Vegetation
	Vertebrate Fauna
	Subterranean Fauna
	Land
	Water

Table 1 (continued)

Topic	Element of Environment
Pollution Management	Air Emissions
	Noise
	Water
	Waste
	Light
Social Surroundings	Public Health and Safety
	Surrounding Land Use
	Culture and Heritage

The document comprises text and two attachments. The format of the report is presented as follows:

- Section 1 Outlines the number and source of submissions that were received.
- Section 2 Presents a revised Project Description and impact assessment as a result of major changes to the Proposal.
- Sections 3-6 Provides responses to pertinent issues relating to Integration, the Biophysical Environment, Pollution Management and Social Surroundings. Each submission is presented (in summary form) in bold and italics. The response is provided immediately below in normal text. The source of the submissions is identified to enable authors of the submissions to identify responses to their comments and questions. Submissions from members of the public have been identified by a numerical value, as the identity of the authors was removed by the DoE before the submissions were provided to URS.
- Section 7 Provides responses to issues relating to other aspects of the Proposal that were identified in the submissions.
- Section 8 Provides an updated list of environmental management commitments which were revised as a result of the submissions and the amended project description.
- Sections 9-10 Lists the references cited in this report and the limitations of this report.
- Attachment A Provides Gunson’s response to a technical peer review of the Draft Rehabilitation Plan by Professor Gilkes of the University of Western Australia.
- Attachment B Provides the details of the experience of the vertebrate fauna study team.

2.1 Changes to the Project Description

Modelling studies undertaken during the environmental assessment of the proposed Project, indicated that there was potential for impacts on vegetation in the Nilemah Embayment from groundwater mounding, and potential for minor dust impacts on stromatolites in Hamelin Pool Marine Nature Reserve associated with the development of the northernmost of the proposed mining areas – Pit 10.

As described in the PER, the studies conducted to date indicate that the potential environmental impacts associated with the development of Pit 10 can be managed effectively. However, it was recognised that some degree of uncertainty would remain until operational data became available to validate and refine the predictive models. Consequently, Gunson committed to staging development of the mine such that Pit 10 would not be developed until it could be demonstrated that adverse impacts could be avoided by appropriate management action.

Following discussions with the EPA and DoE regarding how best to administer this commitment, Gunson has decided to remove Pit 10 from the proposal currently being assessed under the PER. Gunson is therefore now seeking approval to develop Pits 1-9 only. Gunson accepts that should it wish to develop Pit 10 at some time in the future, it will need to seek further environmental approval to do so and undergo further public scrutiny of the proposal at that time. The removal of Pit 10 from the Proposal currently under consideration by the EPA has substantially altered some of the key characteristics of the proposal. The revised characteristics are listed in Table 2. A revised indicative site layout is provided as Figure 1.

**Table 2
Key Characteristics of the Coburn Mineral Sand Project**

Characteristic	Proposed Project
Project Life	12 Years
Number of Pits	Nine pits
Rate of Mining	2,300 tph for the first two years, increasing to 4,600 tph in Year 3 (~15 million tpa for Years 1 and 2, and 30 million tpa for Years 3 to 12).
Mining Method	Bucket-wheel excavators and in-pit screening modules
Estimated Footprint of Disturbance	3,695 ha
Rate of Processing	2,200 tph for the first two years increasing to 4,400 tph in Year 3 (~140,000 tpa of HMC from Year 1 increasing to 280,000 tpa from Year 3).
Estimated Volume of Tailings	2,180 tph for each 2,200 tph concentrator.
Volume of Process Water	Up to 18 GL/annum at full production
Estimated Total Volume of Refined Product	Ilmenite – 1,400 kt HiTi – 380 kt Zircon – 660 kt

Note: tph – tonnes per hour, tpa – tonnes per annum,
GL/annum - Giga Litres per annum, kt – kilo tonnes.

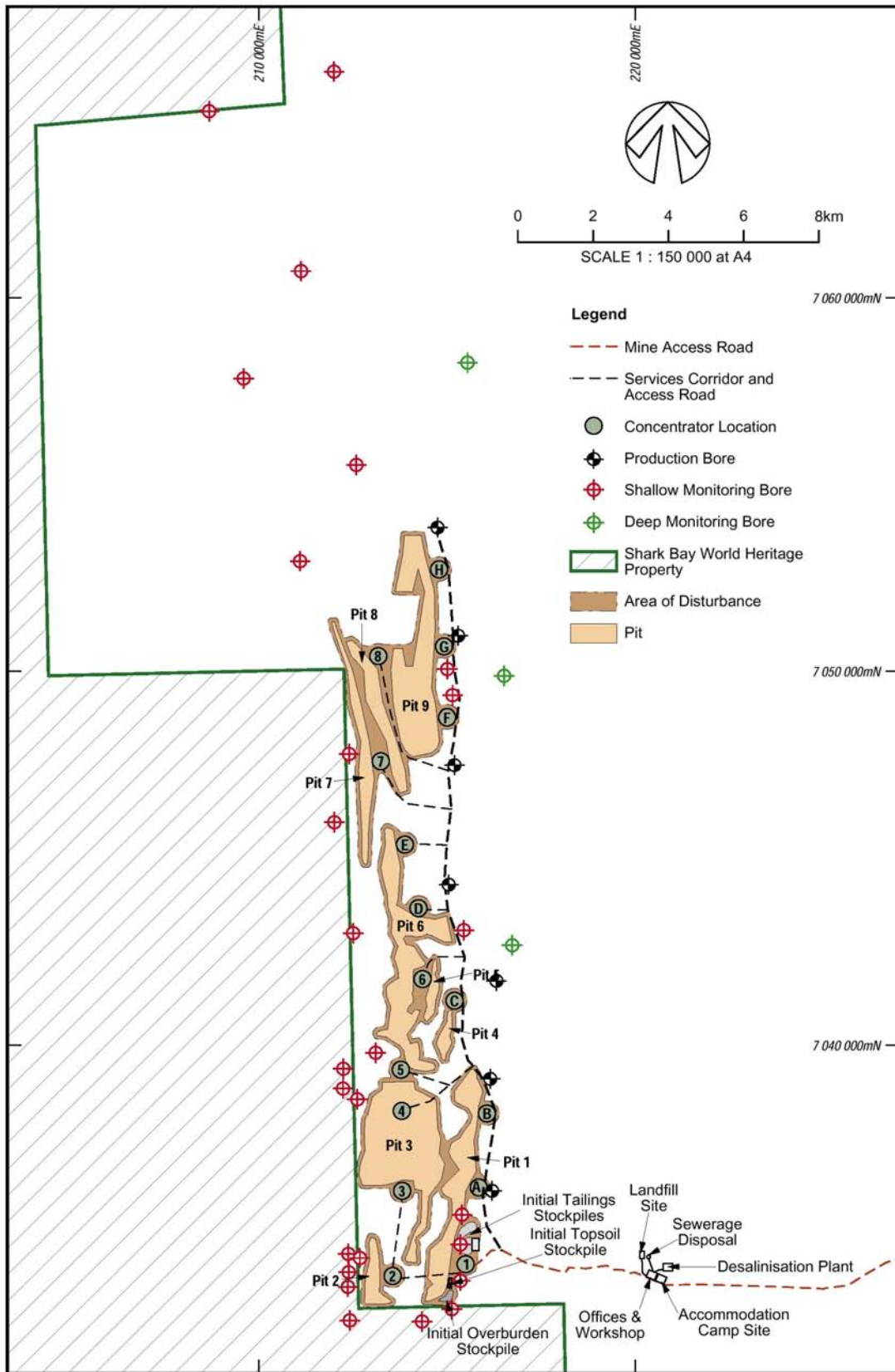


Figure 1: Revised Layout of Amy Zone Operations of the Coburn Mineral Sand Project

The proposed mining and processing methods are unchanged. However, the total volume of ore to be mined is now estimated to be 210 Mm³ and that of the overburden is estimated to be 114 Mm³.

2.2 Revised Prediction of Environmental Impacts

2.2.1 Changes due to Removal of Pit 10

Removing Pit 10 from the proposal means that the number and scale of the environmental impacts predicted in the PER have markedly reduced. The actual changes are listed below:

- **Reduction of the Project footprint and clearing required.** Removing Pit 10 and associated infrastructure from the proposal has reduced the Project footprint from 5,745 ha to 3,695 ha, thus reducing the scale of clearing by over 2,000 ha.
- **Reduced impact on ten locally and/or regionally significant plant communities.** Removing Pit 10 and associated infrastructure from the proposal means that the area that would be cleared within plant communities E1, E2, E3, E4, E6, M1, S1, S2, S4 and S8 has been reduced (see Table 3).

**Table 3
Revised Predicted Area of Disturbance of Vegetation Communities
within the Vegetation Survey Area**

Community	Significance	Area of Community Within Areas Surveyed to August 2005 ¹ (ha)	Predicted Percentage of Area to be Disturbed (%)	
			Previous Proposal (Pits 1-10) ²	Revised Proposal (Pits 1-9) ²
E1	Regional	298.66	67	0
E2	Regional	1,250.92	16	0
E3	Regional / Local	300.73	51	0
E4	Regional / Local	71.85	23	0
E5	-	1,295.25	0	0
E6	Regional / Local	587.59	36	0
E7	Regional	185.28	3	3
M1	Regional / Local	3,490.57	23	0
S1	Regional / Local	5,342.13	45	38
S2	Regional / Local	5,128.77	28	27
S3	Regional / Local	783.78	34	34
S4	Regional / Local	87.18	2	0
S5	Regional / Local	11.43	0	0
S6	Regional	50.00	0	0
S7	Local	3,573.21	1	1
S8	Local	1,295.19	3	0

Table 3 (continued)

Community	Significance	Area of Community Within Areas Surveyed to August 2005 ¹ (ha)	Predicted Percentage of Area to be Disturbed (%)	
			Previous Proposal (Pits 1-10) ²	Revised Proposal (Pits 1-9) ²
S9	Local	627.61	1	1
S10	Regional / Local	3.89	0	0
Total		24,384.04	-	-

Notes:

1. The survey area has been increased since the PER as a result of an additional survey conducted by Mattiske Consulting Pty Ltd in August 2005. Note that the area of the E1 and S4 communities has decreased since the PER was produced (PER Table 7.3) as the boundaries of these communities were refined during the August 2005 survey.
2. These figures were calculated using the total survey area mapped by Mattiske Consulting Pty Ltd during surveys conducted in August 2003, April, September and November 2004, and August 2005.

- **Removal of impact on *Acacia drepanophylla*.** The PER predicted that three populations of the Priority 3 species, *Acacia drepanophylla*, would be disturbed through the development of Pit 10 and associated infrastructure. This will no longer occur.
- **Removal of potential dust deposition impact on stromatolites.** The potential for dust deposition on the Hamelin Pool stromatolites due to Project implementation was already low. However, no impact is expected with mining operations ceasing at the completion of Pit 9, which is located some 20 km to the south of Hamelin Pool.
- **Reduction in the potential groundwater drawdown impacts of the Project.** The removal of Pit 10 not only decreases the Project duration from 20 to 12 years and significantly reduces the proximity to the Nilemah Embayment and Hamelin Pool, but it also removes all requirements for pit dewatering because the ore in Pits 1-9 occurs well above the water table. Consequently removal of Pit 10:
 - markedly reduces the potential drawdown impacts on the Birdrong Sandstone and Kopke Sandstone aquifers due to water supply abstractions; and
 - removes any potential impacts on Nilemah Embayment from pit dewatering.

The water supply borefield intersecting the Birdrong Sandstone and Kopke Sandstone will not extend as far north as originally proposed and would operate for 12, not 20, years. These aspects will limit the distribution of the deeper drawdown cone to the southern and central Amy Zone and substantially reduce the predicted drawdown impacts on other groundwater users, both locally to the north and in a regional context.

- **Reduction in potential water table mounding impacts of the Project.** The removal of Pit 10 significantly reduces the proximity of the operations to the Nilemah Embayment and Hamelin Pool. The removal of Pit 10 consequently removes the potential for impacts on Nilemah Embayment from water table mounding due to sand tails operations in that pit.

The length of the flow path from mounded water table zones to the Nilemah Embayment has increased from about 4 km to approximately 18 km. As such, residence times for the waters disposed with sand tailings will increase by at least an order of magnitude (to at least hundreds of years) and no mounding of the water table would manifest in proximity to the Nilemah Embayment.

2.2.2 Changes due to Additional Vegetation Survey

At the time that the PER was issued for public review, vegetation surveys for the Project had been conducted over 16,287.46 ha of land within and adjacent to the proposed Project footprint. In August 2005, further survey work was conducted to describe and map the vegetation in areas of the SBWHP that could be at risk from water mounding within the root zone, and to obtain an understanding of the extent of the mosaic plant community (Community M1) to the east of the north end of Pit 10. The report on this survey has been provided to the EPASU under separate cover.

The additional area surveyed covered some 8,092 ha. This additional survey increases the total area of vegetation mapping now available to the Project by almost about 50% to 24,384 ha.

As a result of the additional survey, it is now known that the regionally significant vegetation communities E2, E3 and M1, which occurred primarily in the vicinity of Pit 10, are also present to the east of the Project Area, and that communities S1, S2, and S3 are present within the SBWHP to the west of the Project Area. The total area of vegetation types mapped to date is provided in Table 4, along with the revised indicative area of disturbance proposed in each vegetation community.

**Table 4
Revised Area of Vegetation Communities within the Surveyed Area**

Community	Significance	Area of Community within Initial Survey Area as reported in the PER (ha)	Area of Community Within Areas Surveyed to August 2005 ¹ (ha)	Indicative Area of Disturbance (ha)
E1	Regional	299.28	298.66	0.00
E2	Regional	846.81	1,250.92	6.07
E3	Regional / Local	226.10	300.73	0.18
E4	Regional / Local	71.85	71.85	0.00
E5	-	127.73	1,295.25	0.00
E6	Regional / Local	424.86	587.59	2.58
E7	Regional	185.28	185.28	5.25
M1	Regional / Local	1,577.76	3,490.57	0.00
S1	Regional / Local	4,985.74	5,342.13	2,003.81
S2	Regional / Local	4,389.03	5,128.77	1,363.12

Table 4 (continued)

Community	Significance	Area of Community within Initial Survey Area as reported in the PER (ha)	Area of Community Within Areas Surveyed to August 2005 ¹ (ha)	Indicative Area of Disturbance (ha)
S3	Regional / Local	469.48	783.78	270.36
S4	Regional / Local	94.86	87.18	0.00
S5	Regional / Local	11.43	11.43	0.00
S6	Regional	50.00	50.00	0.00
S7	Local	1,815.49	3,573.21	36.83
S8	Local	433.67	1,295.19	0.00
S9	Local	274.19	627.61	6.86
S10	Regional / Local	3.89	3.89	0.00
Total		16,287.46	24,384.04	3,695.05

Notes:

1. Note that the area of the E1 and S4 communities has decreased since the PER was produced (PER Table 7.3) as the boundaries of these communities were refined during the August 2005 survey.

The August 2005 survey of off-site areas recorded six additional Priority Flora species as follows:

- *Abutilon* sp. Hamelin (P2).
- *Chthonocephalus tomentellus* (P2).
- *Millotia depauperata* (P1).
- *Pityrodia glutinosa* (P3).
- *Scaevola chrysopogon* (P2).
- *Triodia bromoides* (P4).

As a result a total of 15 Priority Flora species have been recorded in the area surveyed to date. Table 5 lists the number of populations of each Priority Flora species within the area to be disturbed against the total number of populations recorded in the survey area. The table shows that populations of all species of Priority Flora have been recorded as occurring outside the Project Area, and as such no species will be lost from the survey area as a result of mining.

**Table 5
Known Populations of Priority Species within the Survey Area**

Species	Priority Listing	No. of Populations Within the Project Footprint	No. of Populations Outside of the Project Footprint	Total No. of Populations within the Survey Area
<i>Abutilon</i> sp. Hamelin	P2	0	2	2
<i>Acacia drepanophylla</i>	P3	0	9	9
<i>Acacia subrigida</i>	P2	1	3	4
<i>Chthonocephalus tomentellus</i>	P2	0	8	8
<i>Eremophila occidentens</i> (ms)	P2	2	6	8
<i>Grevillea rogersoniana</i>	P3	7	7	14
<i>Grevillea stenostachya</i>	P3	0	3	3
<i>Jacksonia dendrospinosa</i>	P4	2	1	3
<i>Macarthuria intricata</i>	P3	3	5	8
<i>Millotia depauperata</i>	P1	0	1	1
<i>Physopsis chrysophylla</i>	P3	3	5	8
<i>Pityrodia glutinosa</i>	P3	1	1	2
<i>Scaevola chrysopogon</i>	P2	0	1	1
<i>Scholtzia</i> sp. Folly Hill	P2	0	1	1
<i>Triodia bromoides</i>	P4	0	4	4

Notes:

1. Section 7.7.2 of the PER stated that five of the eight known populations of *Eremophila occidentens* within the survey area would be cleared or disturbed through the development of pits 4-6 and 9, and associated infrastructure. Following a review of the proposed site layout, it is considered that disturbance of three of these populations could be avoided as they occur on the edges of parts of the proposed Project footprint. Consequently, it is now considered that only two populations of this species are likely to be disturbed through Project implementation.
2. Section 7.7.2 of the PER reported that only one population each of *Jacksonia dendrospinosa* and *Macarthuria intricata* were located within the Project footprint. Subsequently, additional populations were located as a result of the August 2005 survey. The updated data were used to prepare the above table.

2.3 Changes to Environmental Management Commitments

The PER included a number of commitments related to management of impacts from Pit 10. Removal of Pit 10 from the Project means that these commitments are no longer necessary and, as such, they have been removed from the list of environmental management commitments listed in the PER. Other minor changes have been made to the commitments as a result of issues raised in the public and government submissions. The revised commitments are listed in Section 8 of this document.

3.1 Sustainability

Submission 4 stated that there was a need to address sustainability criteria in the rehabilitation programme by supporting a multi-disciplinary, integrated ecological restoration and development programme.

At a high level, the Project has committed to economic, environmental and social sustainability with the establishment of its Sustainability Policy, which is presented as Figure 1.3 of the PER. This document is integral to the Company's business processes, decisions and actions prior to, and during, operations. The Policy will guide the Environmental Management System (EMS) for the site. The Policy guides the Company's decision-making processes by commitment to positive behavioural principles that underpin community engagement (e.g. inclusion, respect and accountability) and environmental performance (e.g. minimising biodiversity impacts and continual improvement).

Some evidence of the Company's implementation of this Policy can be seen in the development of the PER, Draft Rehabilitation Plan (Appendix F of the PER) and the Draft Conceptual Closure Plan (Appendix H of the PER). These documents describe the status of current knowledge on various rehabilitation aspects and outline an initial programme of supporting studies and monitoring. Performance measures are also identified in the Draft Rehabilitation Plan (Appendix F of the PER).

It is envisaged that, during the operational phase of the Project, the Company's Sustainability Policy and EMS, in conjunction with the site's annual environmental reviews, will drive the development of a more comprehensive, multi-disciplinary and integrated rehabilitation study programme. One output of this process will be the review and continual improvement of completion criteria for rehabilitated areas aimed at developing self-sustaining vegetation communities that return ecological function to the disturbed landscape as much as practicable.

The DoA submission stated that the intention of the Carnarvon Artesian Basin Rehabilitation Program was to bring the aquifer back under sustainable yield so that this water could be reallocated under a new management framework. The submission expressed concern that allocation of a large volume of water to the Project could negate the benefits of the Carnarvon Artesian Basin Sustainability Initiative. The submission also expressed concern that funds have been spent for the conservation of the resource and sustainable industry development, and that it was unclear to what extent the Project would compromise these initiatives.

The Carnarvon Basin Rehabilitation Project was also promoted to limit and reduce future wastage and loss of groundwater resources from both artesian and sub-artesian bores. Historically, an estimated 70% of the groundwater resources abstracted from the Windalia Sand Member, Windalia Radiolarite and Birdrong Sandstone has been wasted. The historical rates of abstraction are interpreted to have exceeded the recharge to the Carnarvon Basin and consequently, deplete in part the available groundwater resources. This aspect is understood to be manifest over time in declining heads in, and flows from, artesian bores.

The Carnarvon Basin Rehabilitation Project is a long-term management initiative; the Coburn Project, however, is of comparatively short duration. As such, the proposed abstractions by the Coburn Project would probably delay but not compromise the long-term goals of the Carnarvon Basin Rehabilitation Project. The same level of bore rehabilitation is required whether or not the Coburn Project is developed. Further, the Coburn Project intends to install both local and regional multi-piezometers and implement a comprehensive groundwater monitoring and management programme. These aspects will add substantial value to the Carnarvon Basin Rehabilitation Project by:

- the provision of multi-piezometers in significant stratigraphic successions and in a setting where there are none and the groundwater level data on the impacts of historical abstraction are limited;
- enabling improved information and understanding of the local and regional stratigraphy and hydrogeology in terms of aquifer distributions, characteristics, groundwater levels and groundwater quality;
- measurement of transient groundwater levels, enabling assessment of both drawdown and recovery trends;
- renewed assessments of the recharge to and sustainable yields of the regional aquifer systems;
- refinement of predictions regarding the benefits of the Carnarvon Basin Rehabilitation Project and future rehabilitation initiatives; and
- provision of information and tools that might assist in the framing of future groundwater management strategies for the southern Carnarvon Basin.

Submission 6 stated that the Commonwealth Government definition of ecologically sustainable development had been used by the proponent in Section 7.1 of the PER as justification for the Project, but that it considered that the Project would threaten the economic and social sustainability of their property.

The Commonwealth Government definition of ecologically sustainable development presented in Section 7.1 of the PER was provided as background information to demonstrate the Proponent's awareness of the various definitions and standards for sustainability.

The studies that have been undertaken to date, including the groundwater studies, indicate that the Project would not adversely impact on the economic and social sustainability of surrounding land users. In contrast, there are significant social and economic benefits likely to be realised from the Project. This is recognised by the SBWHP CCC, who stated in its submission that "The majority view by members was to generally support the project, given the local employment opportunities that will become available and the need for diversity of development in the area".

3.2 Conservation Estate and Values

The SBWHP CCC, CALM and Wildflower Society submissions stated that the impacts on the internationally significant Hamelin Pool and Nilemah Embayment were largely unquantified. The CALM submission stated that there were potential impacts of dust on algal mats and stromatolites, and regardless of whether Pit 10 goes ahead, the proponent would need to commit to comprehensive pre-mining biological baseline surveys and data collection.

The Proponent disagrees with the comment about the impacts being largely unquantified. The impacts are quantified, but are estimates based on modelling assumptions. It was recognised by Gunson that the reliability of these estimates could not be determined until the mine became operational. Hence its offer to stage development of Pit 10 until the reliability of these estimates could be determined.

However, the removal of Pit 10 from the proposed Project also removes the risk of dust deposition on algal mats and stromatolites in Hamelin Pool. Consequently, Gunson does not accept that there is a need to commit to comprehensive biological baseline studies of algal mats and stromatolites for the current proposal.

The CALM submission was concerned that the proponent had not adequately considered the opportunity to enhance conservation values in other areas to offset any loss of values that result from the Project.

It is considered that the Project as currently proposed will not result in any loss of recognized conservation or biodiversity values or result in significant adverse environmental impacts. In addition, Gunson has committed to implementing a number of management measures and monitoring programs to ensure that the conservation values of the SBWHP are not compromised as a result of the Project.

The Preliminary EPA Position Statement No. 9 on Environmental Offsets (Version 2) (EPA, 2005) makes it clear that environmental offsets should only be considered as a last resort after all other attempts to mitigate significant adverse impacts have been exhausted. As the Proponent has committed to implementing a number of environmental management measures to mitigate potential impacts (including de-stocking the Coburn lease and controlling predators and feral animals), and the PER has concluded that the project can be developed without any significant adverse impacts, it is considered that environmental offsets are not required for this Project.

The Wildflower Society submission asked about the level of funding the proponent proposes to contribute to scientific research in the SBWHP. The Wildflower Society submission stated that details should be provided on the proposed funding to CALM and DoE for monitoring impacts on the SBWHP. The CALM submission recommended that the proponent outline specific scientific research projects and quantify the amount and availability of funds for scientific research and support.

As stated in Section 3.1 of the PER, the Proponent has committed to contributing funds and supporting scientific research into the ecology of the SBWHP. Presently, the Proponent is not in a position to disclose the exact amount of funding to be provided for this purpose as this is to be negotiated with CALM.

The other scientific research project that Gunson will be funding relates to increasing current knowledge on effective rehabilitation techniques for the Project Area. Gunson has recently requested a research proposal from Dr Kingsley Dixon, the Director of Science at the Kings Park and Botanic Garden (KPBG) aimed at maximising the success of the rehabilitation program for the Project. Gunson is not in a position to disclose the amount of funding for this research programme but can confirm that funds will be made available for research purposes aimed at maximising the success of rehabilitation if the Project proceeds.

Gunson will also implement a number of monitoring programmes to provide warning of the potential for adverse impacts on the SBWHP arising from the project. These monitoring programmes include:

- A comprehensive groundwater monitoring programme that will enable the magnitude and dimensions of the water table mounding beneath the sand-stackers to be characterised. The programme will also monitor areas of potential environmental risk due to water table mounding encroaching on the root zones of vegetation stands.
- Annual vegetation monitoring to be undertaken in locations adjacent to the areas affected by mining to monitor the effect of mining operations on vegetation health. The monitoring programme will involve the monitoring of permanent vegetation plots to assess whether there are any adverse impacts on adjacent vegetation.
- A dust monitoring programme that will be implemented to monitor the success of dust management measures. Monitoring dust levels will be undertaken at predetermined locations throughout the minesite and adjacent areas in the SBWHP. The monitoring methodologies and locations of the control sites will be selected in consultation with the DoE.

The results of the monitoring programmes will be reported in the Annual Environmental Report (AER) which will be submitted to the DoE and the Department of Industry and Resources (DoIR). As Gunson will be implementing the monitoring programme and will be reporting to the regulatory authorities on a regular basis, the company does not propose to provide any funding to CALM or the DoE for these programmes.

The Conservation Council submission stated that the proposed mine would cause the deterioration or even disappearance of some aspects of the natural heritage of Shark Bay for which it was listed as World Heritage.

Gunson disputes this allegation. As discussed in Section 10.2 of the PER, the SBWHP was listed in 1991 on the basis that it met all four of the 'natural' criteria set out by the United Nations Educational, Scientific and Cultural Organisation (UNESCO). These criteria are:

1. Outstanding examples representing the major stages of the earth's evolutionary history.
2. Outstanding examples representing significant ongoing geological processes, biological evolution and human interaction with the natural environment.
3. Containing unique, rare or superlative natural phenomena, formations or features of exceptional natural beauty.

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4. Important and significant habitats where threatened species of animals and plants of outstanding universal value from the point of view of science and conservation, still survive.

The presence of stromatolites at Hamelin Pool meets the first criterion as the age of the stromatolites represents evolutionary history. The PER discussed the potential for impacts on the stromatolites due to water and dust issues. No impact was expected due to any changes in surface drainage systems due to:

- the distance between the Amy Zone and Hamelin Pool;
- the proposed water management system that will be implemented by Gunson to recover and recycle water; and
- the porosity of the soils.

The PER also discussed the potential for the stromatolites to be affected by groundwater mounds and predicted that the evaporative cycle within the Nilemah Embayment salt flats would prevent any superficial brackish mine water reaching Hamelin Pool. A hydraulic barrier of marine clay within the geological profile beneath the embayment is expected to restrict the migration of groundwater northwards.

The potential for increased dust deposition on the stromatolites to occur was discussed in Section 8.1 of the PER. Conservative modelling was undertaken, which indicated predicted concentrations to be well below respective guidelines at Hamelin Pool.

With the removal of Pit 10 from the proposed Project, the risk of any impacts on the stromatolites is considered to be negligible.

There are two main natural aspects of the Shark Bay area that meet Criterion 2. These are:

- the large seagrass beds located within Shark Bay; and
- the location of the property within three climatic zones and two major botanical provinces.

No impact on the seagrass beds is anticipated due to the distance between these and the Project Area. The floristic component of the two major botanical zones within the SBWHP will also be unaffected. The PER identified areas of vegetation that may be susceptible to encroachment of water mounds into the root zones, but it is expected that this can be managed effectively through the proposed system for water recovery from the tailings. Monitoring of vegetation condition will be conducted within these areas.

No impact on the natural features of the Shark Bay area that allowed it to meet Criterion 3 is anticipated as the Project Area is a significant distance from these features. All operations undertaken as a part of the Project will be to the south and east of the SBWHP.

Criterion 4 relates to important and significant habitats where threatened species of animals and plants still survive. The SBWHP provides habitat for five species of threatened mammals, 13 threatened reptile

species, three rare bird species, one eighth of the world's dugong population and significant loggerhead turtle rookeries. No impact on these species is expected.

3.3 Biodiversity

Submission 1 and the CALM Submission indicated that de-stocking would have a minimal effect on reducing herbivory to aid regional biodiversity. Submission 1 stated that the area has never had stock in the proposed operations area, but the CALM Submission stated that anecdotal evidence suggests that areas of Coburn Pastoral Lease are heavily degraded.

The Proponent disputes the claim that de-stocking the Coburn Pastoral Lease will have minimal effect on reducing herbivory, as the lease had previously been used for grazing goats and the de-stocking of the lease for several years will allow vegetation to recover. The implementation of this mitigation measure, combined with the implementation of the introduced predator control programme will minimise any risks to local biodiversity values.

As stated above, it can be independently confirmed that the Coburn Pastoral Lease has previously been used for grazing goats, and this would support CALM's statement that areas of the lease are heavily degraded.

Submission 2 noted that the assessment of biodiversity values was not fully addressed at the genetic, ecosystem, and ecological function value levels, though it acknowledged that assessment at a genetic level would be difficult. Submission 4 stated that the PER did not adequately address issues associated with underestimating the high potential value of the plant biodiversity and that it was likely that species and locally-adapted genotypes would be adversely impacted. This submission recommended that pre-mining vegetation surveys be conducted during the life of the mine to minimise loss of regionally significant (species and genotype) biodiversity values.

Biodiversity values were assessed at the ecosystem level through the implementation of a number of baseline surveys. These surveys included:

- Comprehensive flora and vegetation surveys undertaken by Mattiske Consulting Pty Ltd in August 2003 and April 2004, September 2004 and November 2004. An additional survey was undertaken in August 2005.
- Comprehensive fauna surveys conducted by Ninox Wildlife Consulting Pty Ltd in September 2003, April 2004 and October 2004, plus a targeted survey for the Hamelin Skink.
- A stygofauna survey undertaken by the University of Western Australia in October 2004.

An assessment of biodiversity values at a genetic level was not undertaken because it was not identified as being necessary in the scope of environmental work for the PER agreed to with the EPA. The Proponent agrees with Submission 2 that such an assessment would be extremely difficult.

The value of the plant biodiversity was recognised in the PER in Sections 4.2.7 and 4.2.8, with some vegetation communities being recognised as locally and/or regionally significant. However, the Project

will not result in the loss of any flora species or vegetation communities. In recognition of the plant biodiversity in the Project Area, the Proponent will conduct searches for Rare and Priority Flora prior to the development of each pit and associated infrastructure to ensure that up-to-date information is considered in the detailed design of the pits and other project components during the construction and operation of the Project.

4.1 Flora and Vegetation

4.1.1 Plant Communities

The Wildflower Society submission noted that two of the vegetation surveys were conducted at less than opportune times.

Flora and vegetation surveys were undertaken by Mattiske Consulting Pty Ltd in August 2003 and April 2004, September 2004 and November 2004. Another survey has recently been undertaken by Mattiske Consulting Pty Ltd in August 2005. The EPA Guidance Statement on Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004a) states that the primary survey should be conducted following the season which contributes the most rainfall. In this region, rainfall mainly occurs during winter. It should be noted that the August 2003, September 2004 and August 2005 surveys were undertaken after reasonable winter rainfall and therefore conforms with the requirements of the EPA Guidance Statement No. 51. The surveys therefore adequately capture the perennial species and also the annual species that occur after rainfall.

The April and November 2004 surveys provide additional information to capture any seasonal variations in species composition.

The Wildflower Society submission stated that it is remarkable that 14 of the 18 vegetation communities described by Mattiske Consulting are regionally significant and that this would indicate that the proponent is seeking access to a special area and the commitments they are giving with respect to flora and vegetation are only in line with the community's expectation for managing such an area. There is an alternative argument for modifying the World Heritage boundary and restricting the area to be mined.

Plant communities are classified as regionally significant if:

- 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.

It should be noted that limited systematic flora and vegetation survey work has been completed in the region and the occurrence of these communities within the wider regional area is largely unknown. Hence they are classified as regionally significant on the basis of the limited survey work undertaken to date. However as shown by the results of the recent August 2005 survey, many of the plant communities found in the vicinity of the Project Area also occur in the SBWHP and on the Coburn and Hamelin pastoral leases to the east. Mattiske Consulting Pty Ltd (2005) reported that the regionally significant vegetation communities E2, E3 and M1 were recorded to the east of the Project Area and communities S1, S2, and S3 were recorded within the SBWHP. It is considered highly likely that further survey work will confirm

that most of these communities already occur within the conservation estate and that they are not restricted in distribution to just the Project Area.

The removal of Pit 10 from the Project has resulted in a substantial decrease in the overall footprint of disturbance. As shown in Table 3, vegetation communities E1, E2, E3, E4, E6, M1, S4 and S8 are no longer going to be disturbed by the Project. All of these communities are considered to be regionally significant, except for vegetation community S8. In addition, the scale (percentage) of disturbance to three other regionally significant communities (S1, S2 and S3) has decreased as a result of Pit 10 being excluded from the Project and the inclusion of the additional survey areas from the August 2005 survey.

The Wildflower Society submission referred to Section 2.4.2 of the PER and asked if the area to be cleared to provide 300,000 m³ of calcrete for the haul road was included in the Project footprint, and what was proposed for rehabilitation of the calcrete pits.

Section 2.4 of the PER stated that the calcrete for initial construction would likely be sourced from pits adjacent to the proposed alignment. This area was not included in the area to be cleared as the option had not been finalised. The Proponent has since confirmed that development of calcrete pits adjacent to the proposed haul roads will be necessary, but the location of the pits has not yet been identified. Therefore, a small area of additional clearing will be required for this purpose. Areas of significant vegetation containing Priority Flora will be avoided, and all areas disturbed for this purpose will be rehabilitated once they are no longer required.

4.1.2 Priority Flora

Submission 4 stated that plans were required for the protection, conservation and rehabilitation of the priority species impacted by the mining operation, and that detailed research was required in the following areas in relation to priority flora:

- *seed banking methodology;*
- *germination ecology;*
- *restoration technology for taxa where seeding or propagation of cuttings fails; and*
- *restoration ecology for reinstatement of the species.*

Gunson acknowledges that such research may be necessary for the few priority species that are less frequently recorded in the survey area, and may be disturbed by mining (e.g. *Scholtzia* sp. Folly Hill; *Eremophila occidentalis* (ms), etc.). However, Gunson does not believe that such research is necessary for all Priority Flora found on the Project Area, particularly those that have been frequently recorded off the mine site. To this end, Gunson has requested a research proposal from Dr Kingsley Dixon, the Director of Science of the KPBG. It is anticipated that recommendations for research will include, but not be limited to, topsoil handling, recruitment biology and seed dormancy. The research programme is also likely to include seed banking methodology, germination ecology, restoration technology for taxa where seeding or propagation of cutting fails and restoration ecology for reinstatement of species.

Submission 5 stated that mining poses the greatest threat to Eremophila occidentis (P2), which has very low germination, and is unable to be grown successfully from seed. This submission stated that extensive propagation research must be carried out on this species.

The Project does not pose a threat to *Eremophila occidentis* (ms), as only two populations are likely to be disturbed by Project development (see Table 5).

The PER predicted that five of the eight known populations of *Eremophila occidentis* (ms) within the survey area would be cleared or disturbed through the development of pits 4-6 and 9, and associated infrastructure. However, following a review of the proposed site layout, it is considered that disturbance of three of these populations could be avoided as they occur at or near edges of the proposed Project footprint. Consequently, it is now considered that only two populations of this species are likely to be disturbed through Project implementation.

Gunson acknowledges the advice that this species has very low germination and it is envisaged that the research programme outlined above will include propagation research on this species.

4.2 Vertebrate Fauna

4.2.1 Survey Methodology

The WA Museum submission stated that the vertebrate fauna surveys were well designed and comprehensive, despite limitations of sampling duration. Submission 3 stated that the report provides an indication of the richness of the herpetofauna and mammal fauna from the central west coast of WA.

Considering the relative lack of diversity in fauna habitats, the number of trap-nights provided a very good indication of the richness of the herpetofauna and mammal fauna from the Project Area.

The WA Museum submission and Submission 2 indicated that none of the species recorded from the area had been vouchered. Consequently, their identities hold a level of uncertainty.

Given the degree of experience of all fauna team members, the level of uncertainty of the identification of the species captured and observed is minimal. One reptile specimen that could not be identified to species level was vouchered but its identification has not been confirmed as yet. Vouchered specimens only confirm the identity of that individual, not all of the captured animals that have been field identified as belonging to that species. This comment is never raised for birds which are rarely vouchered.

Submission 3 stated that the richness of the mammal fauna was not fully captured due to the limited sampling time.

The sampling regime complied with EPA Guidance Statement No. 56 for a Level 2 Detailed Survey.

Previous long-term studies by Ninnox Wildlife Consulting Pty Ltd have shown that small mammal populations fluctuate widely in response to seasonal and annual environmental conditions. In one

particular study, additional mammal species were being added to the area inventory after 12 years, indicating that small populations were increasing during that time and becoming more ‘trappable’. The lead-in time for mining and/or development projects rarely correspond to changing climatic and/or environmental conditions making these longer-term changes difficult to document. It was acknowledged in the Vertebrate Fauna Survey Report (Appendix K of the PER) that additional sampling would result in species being added to the area inventory.

Submission 2 stated that the timing of the surveys was inappropriate, and should be done in multiple seasons over multiple years. Submission 1 stated that the lack of summer survey periods when reptiles were most active has resulted in reduced reptile species richness and reduced numbers of common species being recorded. Submission 1 also noted that Ninox found eight species that had not been previously recorded, so summer surveys would likely reveal greater species richness potential.

While sampling over multiple seasons and multiple years would result in a greater diversity of species being recorded from any area, as stated previously, the lead-in time for mining and/or development projects does not lend itself to these long-term studies. Temperatures in both October 2003 and November 2004 were warm to hot and reptile activity was relatively high. However, it was acknowledged in the Vertebrate Fauna Survey Report (Appendix K of the PER) that additional sampling would result in species being added to the area inventory.

It is not known which are the common species in the general area as the most relevant and extensive regional study of the Carnarvon Basin does not show the abundance of individuals captured in any of their study locations. Species that are common in one area are not necessarily common throughout their range. It is acknowledged in the Carnarvon Basin study that while the inventory of reptile species was incomplete, further sampling would not be cost-effective.

Submission 2 stated that appropriate diversity indices were not used, limited data prevented a species list being developed for each habitat, and assemblages were not placed in a regional context. Submission 2 also noted that averaged species accumulation curves for each habitat type would demonstrate the adequacy of the surveys.

The level of information detail requested in this submission is substantially beyond that required by EPA Guidance Statement No. 56 (EPA, 2004b). The regional significance of the fauna is discussed in the PER in reference to the Carnarvon Basin study.

Submission 2 stated that the overall trapping was inadequate (especially using pit-traps, funnel traps and echolocation or mist nets) to determine species richness, assemblage structure, ecosystem values or seasonal and temporal variations.

Gunson does not accept that the trapping work was inadequate. The fauna study consisted of three sampling periods (early spring, autumn and late spring) over two years (2003 and 2004), using a variety of capture methods complying with a Level 2 Detailed Survey as required by EPA Guidance Statement No. 56 (EPA, 2004b).

Submission 2 stated that there was no indication of species-specific searches for Egernia skokesii badia, Aspidites ramsayii, Morelia spilota imbricata, Leipoa ocellata and invertebrates, all of which potentially occur at the site and are unlikely to be detected without specific search strategies. A complete site search should have been undertaken for active Mallee fowl nests.

There was no requirement for species-specific searches as all of the trapping and hand-foraging techniques were used in all habitats within the Project Area.

The Vertebrate Fauna Management Plan developed for the Project includes monitoring and management of Malleefowl within the Project Area. Sampling of invertebrates was not identified in the scope of works defined by the EPA.

In regard to amphibians, Submission 1 stated that many potentially rare local endemic species may have been missed (e.g. those active only after heavy rain) due to the lack of appropriately timed surveys. Submission 2 noted that while the amphibian survey was inadequate, no species in the area is of conservation significance, so further surveys are probably unjustified.

It was acknowledged in the Vertebrate Fauna Survey Report (Appendix K of the PER) that amphibians had not been adequately sampled due to the lack of rain in the general area. However, those species that could occur were discussed in some detail.

Submission 2 also stated that some issues in regards to survey limitations were not addressed, and the report does not comply fully with Guidance Statement No. 56.

The Vertebrate Fauna Survey Report (Appendix K) outlines the limitations of the surveys on page 3 of the document. To further bring this report into line with the suggestions provided in Guidance Statement No. 56, the experience of the survey team has been provided in Attachment B.

Submission 1 noted that a series of pit-trapping and active searches ahead of the clearing (especially during summer) could be implemented to identify the presence of significant or unknown species.

The establishment of permanent fauna monitoring sites, as outlined in the Vertebrate Fauna Management Plan (Appendix O of the PER) will assist in the further identification of any significant or unknown species.

4.2.2 Impacts on Vertebrate Fauna

Submission 1 noted that the operation could negatively impact the project area's population of Malleefowl, and suggested that continued monitoring be carried out in the area to determine the long-term impact on the population (i.e. whether they are able to re-establish).

Gunson disputes that the Project will negatively impact on the regional population of Malleefowl, particularly given that it proposes to de-stock the property and control feral predators. However, some localised impacts may occur where preferred habitat is cleared. As stated in the Vertebrate Fauna Management Plan (Appendix O of the PER), permanent fauna monitoring sites will be established in

order to establish the effect of mining on local Malleefowl populations and determine the rate of return of this species to the rehabilitated areas.

Submission 2 stated that where impacts are unavoidable, there is a lack of documentation on why impacts would not result in unacceptable fauna loss.

None of the fauna recorded in the Project Area are likely to be restricted to the mining site. There is no indication in the results of the survey that any species would be impacted to the extent that it would require a change in conservation status.

4.2.3 Management of Vertebrate Fauna

The SBWHP SAC submission stated that the annual introduced predator baiting programme would be a positive step in the conservation of Malleefowl. However, for the effectiveness of the programme to flow into the SBWHP, baiting must be in conjunction with Project Eden baiting regimes.

Gunson will liaise with CALM and the Department of Agriculture to develop an annual introduced predator baiting programme that will provide the maximum positive effect on native fauna within the SBWHP.

Submission 1 stated that while the culling of feral predators may be a useful temporary measure, feral predation pressures would return to normal once mining ceases.

Gunson does not necessarily accept this statement. Following mining, management of the property depends upon the final land use and may still include feral animal control. Even if this is not the case, feral animal control during the period of mining will enhance local biodiversity values and is a valuable measure.

The SBWHP SAC Submission, SBWHP CCC Submission, Submission 6 and Submission 15 stated a need for the Project to have a fence constructed, maintained and policed to exclude feral animals and livestock. Submission 6 stated that stock would be attracted to the smell of water, and would cause problems if they wander onto the property. However, if a fence is constructed, they would congregate and perish, so watering points would also be necessary.

At the time of the survey, no sheep or cattle were present in the Project Area although feral goats were observed. If Hamelin and Coburn Stations remain as grazing properties, the management of stock is the responsibility of the owners. If the Project Area is fenced to exclude these animals, it is unlikely to have a detrimental effect on them and watering points will not be required. The lack of water availability in the Project Area is probably what keeps stock out of the area at present. Stock will not wander significant distances from watering points already in existence. However, it is not in the best interests of the Proponent to have stock attracted to the mining operations. Therefore, Gunson will liaise with CALM and pastoralists to determine the requirement for open watering points and the potential use of seasonal stock traps to target and remove problem animals.

4.3 Subterranean Fauna

The WAM submission stated that the Tamala Limestone of the area is a known habitat for subterranean fauna, and the saturated lower part of the palaeodrainage is a potential source of subterranean fauna.

As stated in Section 4.1.2.3 of the PER, it is known that stygofauna have been recorded in the Tamala Limestone. However, Tamala Limestone is not known to exist within the Project Area.

The Proponent acknowledges the advice from the WAM that the saturated lower part of the palaeodrainage is a potential source of subterranean fauna. The stygofauna study that was undertaken as part of the PER, involved sampling the “saturated lower part of the palaeodrainage”, through the sampling of monitoring bores SMB1-SMB4 (shallow and deep bores). Therefore, although this section of the palaeodrainage may be a potential source of subterranean fauna, it did not yield any fauna during the October 2004 survey as described in the Stygofauna Survey Report (Appendix L of the PER).

The WAM submission referred to Section 4.1.2.3 of the PER, which stated that no reports of stygofauna in the southern portion of the Carnarvon Basin had been identified. The submission stated that virtually no sampling has been undertaken of subterranean fauna in the southern part of the Carnarvon Basin but that stygofauna had been found there. The submission also stated that the records of the WAM’s subterranean fauna database were not accessed in this appraisal.

The statement in Section 4.1.2.3 of the PER was based on the Stygofauna Survey Report (Appendix L of the PER) which stated “The authors are not aware of any other stygofauna reported from the southern portion of the Carnarvon Basin. Examination of saturated sands at Coral Bay south of Cape Range peninsula within the Carnarvon Basin yielded no stygofauna (B. Knott, unpublished)”.

The Proponent acknowledges the advice provided by the WAM that minimal sampling for subterranean fauna has occurred in the Southern Carnarvon Basin and that stygofauna has been found there.

Prior to the stygofauna survey conducted by UWA, Dr W.F. Humphreys of the WAM was commissioned to identify any subterranean fauna present in samples of groundwater collected from the Project Area, and place the findings in a local and regional context in order to assess potential impacts of the Project on stygofauna. As Dr Humphreys is based at the WAM, it is assumed that he referred to the museum’s subterranean fauna database to provide local and regional context, and that the database was included in the “WA Museum unpublished data” to which his report (dated 2 July 2004) refers.

The WAM submission stated that Appendix L of the PER did not provide information on bore construction or if any of the casings were suitable for stygofauna sampling, so the efficacy of the sampling cannot be ascertained.

The bores that were sampled were selected by field personnel with experience in undertaking stygofauna surveys. As stated in the Executive Summary of the Stygofauna Survey Report (Appendix L of the PER), 13 bores were visited during the survey, but only seven bores were identified as being suitable for sampling. The authors of the stygofauna report are aware of the constraints associated with sampling pre-

existing bores for the presence of stygofauna as these factors are discussed in Section 5.2 of the report (Appendix L of the PER).

The basic bore construction details were provided in Table 1 of the Stygofauna Survey Report (Appendix L of the PER). Further details of the SMB1A-1C and SMB2-4 were provided in Section 3.1 of the Groundwater Impact Assessment (Appendix D of the PER). Details of Hamelin 21 (H 21), WH1, WH2, WH2a are not available, as these bores are historical existing bores with no recorded information.

4.4 Land

4.4.1 Rehabilitation Objectives

Submission 2 stated that the objective for final rehabilitation should be to recreate the functional ecosystems existing prior to disturbance. Submission 2, the Conservation Council submission and the Wildflower Society submission stated that the proponent had not demonstrated the likelihood of success of rehabilitation within a reasonable timeframe. The Wildflower Society stated that, given the potentially lengthy period required to revegetate in this region, early and progressive rehabilitation is required.

Final Rehabilitation

Recreation of pre-existing ecosystem function following significant disturbance to the environment is certainly a worthwhile objective for final rehabilitation, but is one that has rarely been achieved in practice. At best, rehabilitation can return some ecological function but usually with a reduced diversity of species and ecosystem complexity.

The rehabilitation concept for the Project is to return the affected area to pastoral use, with native vegetation on a landform similar to the pre-mining landforms. In order to achieve this aim, several rehabilitation objectives have been established. These objectives are consistent with accepted industry best practice.

The final rehabilitation goal for the Project is based on attaining three key objectives namely; a landform similar to that which existed pre-mining, early stability of the soil surface, and revegetation of the soil with the dominant native species that existed pre-mining. These objectives are set at a strategic level. This approach provides for flexible and adaptable operational management over the life of the Project, rather than fixed, task-based activities. The objectives will be supported by relevant studies such as pre-mining landform and vegetation surveys.

The rehabilitation objectives offer the security of commitment to agreed, strategic outcomes. The success of rehabilitation works in achieving the rehabilitation objectives is to be measured against specified completion criteria, as described in Section 7 of the Draft Rehabilitation Plan (Appendix F of the PER). Strategic commitments and completion criteria will be formalised as environmental commitments in the Notice of Intent (*Mining Act 1978*) and will be legally binding. Any amendment to the Project's

Rehabilitation Plan or Closure Plan will be reported in the site's AER for approval by the regulatory authority, the DoIR.

The adaptive management approach also anticipates that knowledge will increase over the life of the Project. It is intended that the results of research trials, monitoring and audits will be regarded as opportunities for improvement and reported to Gunson's EMS for the development (continual improvement) of revised rehabilitation procedures and completion criteria.

Gunson accepts that it has not unequivocally demonstrated that rehabilitation can be achieved in the Project Area. However, as stated by Professor Gilkes in his review of the soil aspects of the Rehabilitation Plan (refer to Attachment A) the findings of the Benchmarking Study (presented in Appendix E of the PER) "encourage the view that a successful rehabilitation procedure can be developed." Professor Gilkes also believes that Gunson's proposed surface (<1 m) soil replacement strategy will facilitate native plant establishment and regrowth.

Progressive Rehabilitation and Timeframe

Where operationally practical, rehabilitation will be progressive. Progressive rehabilitation earthworks, such as the direct return of tailings, overburden and topsoil, are planned, subsequent to the initial development (stripping and stockpiling) of a work area that is safe and functional. Similarly, rehabilitation will occur progressively, although this activity will be seasonally dependant. Gunson recognises that, primarily due to the climatic circumstances, the Project Area presents challenges for revegetation. In recognition of this, Gunson has proposed a programme of rehabilitation trials aimed at improving rehabilitation success.

It is worth noting that, under the *Mining Act* 1978, there is no statutory requirement for rehabilitation to be completed within a specified time period. The primary aim of site rehabilitation is to complete it successfully and in a 'reasonable' timeframe. However, the term reasonable is very subjective. Creating an indicative timeframe that aims for successful rehabilitation within a period of 10 years, for example, is unrealistic for this area. The Rehabilitation Benchmarking Study (Appendix E, PER) highlighted disturbed sites within the broader Shark Bay region that took up to 40 years to return to soil and vegetation structure comparable with that of adjacent undisturbed sites. Thus, the timeframes that are outlined in the Draft Rehabilitation Plan are considered to be both realistic and achievable.

Submission 4 considered the draft Rehabilitation Plan to be an inappropriate rehabilitation strategy considering the unique biodiversity context of the Project Area and suggested that ongoing vegetation surveys should be conducted to fully describe the complex mosaic of vegetation communities and discuss how rehabilitation planning would address inter-community spatial patterns.

Pre-mining vegetation surveys are part of the intended baseline information studies needed to support the overall rehabilitation programme. The Draft Rehabilitation Plan (Appendix F of the PER) will be amended to reflect this need. It is worth noting that Gunson has committed to annual vegetation surveys in locations adjacent to areas affected by mining in order to monitor vegetation health (Commitment 22 in the PER). It is anticipated that, during operations, results from survey work will inform, and potentially revise, the Vegetation and Flora Management Plan. Gunson has also committed to ensuring that two

regionally significant vegetation communities S5 (Low Open Shrubland) and S10 (Tall Open Shrubland), will not be disturbed by mining (Commitment 21 in the PER).

In regard to rehabilitation works, Submission 4 questioned the proposal to use less than half of species identified in the pre-mine surveys. The submission sought justification for this approach, considering the biodiversity of the region. The submission also noted that there were no criteria provided for the selection of species for revegetation.

As stated in the Draft Rehabilitation Plan that was presented as Appendix F of the PER, a Draft Vegetation and Flora Management Plan was prepared and presented as Appendix O in the PER. Advice from this plan was incorporated into the Draft Rehabilitation Plan.

The Vegetation and Flora Management Plan included advice on issues such as site seed collection, planting schedules and flora species to be used for revegetation. This advice was based on information provided by Mattiske Consulting Pty Ltd in the form of a Preliminary Revegetation Plan. The criteria and justification for species selection were also included in the Draft Rehabilitation Plan (p 5-8) and this information is provided below:

- All species should be native to the area. To help maintain the local character of rehabilitated areas only species found in previous local flora surveys were included in the list of species to be considered for use in revegetation works.
- The species mix should include as many annual species as possible, as these will usually germinate within the first winter and quickly provide protection from wind erosion.
- Plants should be adapted to the new habitat that is likely to prevail in the long-term. For the purposes of species selection, it was assumed that the new habitat would be similar to a dune-field and there may be a potential for some low-lying areas to be slightly saline. Therefore, in addition to native annuals, local species known to be tolerant of salinity, or known to naturally grow in sand dunes were included in the species list.

It should be noted that the list provided in the Draft Rehabilitation Plan was only preliminary and is based on the above criteria. It is considered to provide a good basis for the re-establishment of a diverse vegetation community. However, the success of rehabilitation efforts will require ongoing monitoring of revegetated areas. This monitoring will progressively enhance the integrity (and thus likely long term success) of the revegetation programme.

The Rehabilitation Plan proposes the use of broadcast seeding for revegetation. Submission 4 stated that there is no known broadcast seeding technology for the Coburn ecological zone. In regard to broadcasting technology, Submission 4 identified the need for detailed scientific studies specific to the Coburn ecological zone.

Gunson recognises that, due to the climatic circumstances, the Project Area presents challenges for revegetation. In recognition of this, Gunson has proposed a programme of rehabilitation trials aimed at maximising rehabilitation success.

In addition, Gunson has requested a research proposal from Dr Kingsley Dixon, the Director of Science of the KPBG aimed at developing revegetation techniques for the Project. It is anticipated that recommendations for research will include, but not be limited to, topsoil handling, recruitment biology and seed dormancy. These studies will provide part of the knowledge base for the development of locally-applicable revegetation methods, including broadcast seeding.

The Rehabilitation Plan considers the use of salt-tolerant species. Submission 5 asked whether post mining soil properties would be altered. The submission stated that if this were the case, and salt-tolerant species were used in rehabilitation, this would contradict the objective of using locally native species in the rehabilitation.

The predicted salt content of the sand tailings (21.6 mS/m) is less than the maximum value obtained for the Amy Zone prior to disturbance (25 mS/m) and within the range understood to have a minimal effect on plant growth of below 50 mS/m (Moore, 1998). The predicted salinities are expected to decrease with time due to leaching processes. Consequently, the rehabilitated soil profile is not expected to be more saline than the existing soil profile. However, should there be a need to use salt-tolerant species for rehabilitation, this would not contradict the objective of using “local native species”, because such species already occur within the Project Area.

4.4.2 Rehabilitation Techniques

The Wildflower Society submission asked what was meant by the phrase “the landform will retain congruency with the original landform” that was used in the Rehabilitation Plan, and asked whether the dunes would be reformed with the associated swales.

The rehabilitation concept for the Project is to return affected area to pastoral use, with native vegetation on a landform with similar contours to the pre-mining landforms. These objectives are supported by commitments to relevant studies such as pre-mining landform surveys and landform completion criteria (Draft Rehabilitation Plan, Appendix F of the PER). It is intended that the reconstructed landform will have dunes and swales and will retain visual congruency with the original landform.

The SBWHP SAC submission stated that different rehabilitation methods would be required in the north and south of the Project Area.

The SBWHP SAC submission did not explain why different methods would be required. However, the Proponent has proposed an initial programme of rehabilitation trials aimed at improving rehabilitation success. It is intended that the results of research trials, monitoring and audits will be regarded as opportunities for improvement and reported to Gunson’s EMS for the development and initiation of follow-up trials, revised rehabilitation procedures and completion criteria. This will be a process of continual improvement. It is anticipated that the aforementioned, continual improvement process will recognise and accommodate local ecological differences by undertaking revegetation trials in dissimilar ecological zones. The trials, and resultant revegetation methods, will recognise the variations in vegetation communities between the north (*Eucalyptus* woodlands) and the south (*Acacia* shrublands) of

the Project Area. It should be noted that the much of the northern section of the mine – known as ‘Pit 10’ – has now been deleted from the Proposal.

Submission 5 stated that the Rehabilitation Plan has not been subject to independent review or peer reviewed by specialists in the field of mine rehabilitation.

Gunson disagrees with this submission and confirms that it has sought independent peer advice from a number of specialists in this field including:

- Mr Alan Payne, Environmental Consultant (Rangelands), Department of Agriculture. Mr Payne has extensive experience in assessing the condition of vegetation and soils in most pastoral areas of Western Australia. He also has sound knowledge of the Project Area, having undertaken a field survey of the area as part of the Carnarvon Basin Rangeland Survey. Mr Payne was also a participant in the Benchmarking Study presented in Appendix E of the PER.

Mr Payne conducted a review of the Rehabilitation Plan based on his knowledge of the area to determine whether the proposed rehabilitation techniques were suitable for the particular environmental setting.

- Mr Mark Cannon, Environmental Inspector, DoIR. Mr Cannon was asked to review the Rehabilitation Plan from a regulator’s point of view. The plan was submitted to Mr Cannon to determine whether the proposed approach to rehabilitation would be acceptable to the DoIR.
- Mr Doug Blandford, Principal, D.C. Blandford & Associates. Mr Blandford is an environmental consultant with over 30 years experience in natural resource management. He has extensive experience in soil erosion control and mine site rehabilitation. Mr Blandford was asked to peer review the rehabilitation plan to determine whether the plan captured and addressed the key rehabilitation issues for the Project.

Copies of these peer reviews were presented as Appendix G of the PER.

4.4.3 Research Requirements

Submissions 4 and 5, and submissions by the WAM, SBWHP SAC, Conservation Council and Wildflower Society, identified the need for a comprehensive, integrated scientific (rehabilitation) research programme spanning the life of the mine. The WAM submission, Submission 4 and Submission 5 questioned the process of identification of Priority Taxa and knowledge of their regeneration ecology. The WAM submission and Submission 5 considered that detailed research studies are required in regard to seed banks, germination biology, germination ecology, seed viability, vegetative propagation and revegetation methods. Submission 4 also stated that detailed research studies are required for seed banks, seed dormancy and seed treatments.

These questions have been addressed previously in this section (Section 4.4). Gunson has proposed an initial programme of rehabilitation trials as detailed in the Draft Rehabilitation Plan (Appendix F of the

PER) and , as described earlier has recently requested a research proposal from Dr Kingsley Dixon of the KPBG.

Submission 4 stated that 55 species of those listed in the Revegetation Works schedule have no known method for release of deep, intractable seed dormancy and therefore a research plan is required to address this issue.

The Proponent recognises that, due to the climatic and biodiversity circumstances, the Project Area presents challenges for revegetation. In recognition of this, the Proponent has proposed an initial programme of rehabilitation trials (p6-1, Draft Rehabilitation Plan, Appendix F), aimed at improving rehabilitation success, and has requested a research proposal from Dr Kingsley Dixon of the KPBG to address this issue. It is intended that the results of research trials, and monitoring studies will be reviewed by specialists and stakeholder reference groups, and will be regarded as opportunities for improvement and reported to Gunson's EMS for the development and initiation of follow-up trials, revised rehabilitation procedures and completion criteria.

Submission 5 stated that there was a need for trials for the timing of seed sowing and to review scientific literature regarding seed dormancy and undertake studies regarding germination. This submission also identified the need to undertake vegetative propagation research on species known to have poor germination such as *Eremophila occidens*.

Gunson has held discussions with Dr Kingsley Dixon (Director of Science of the KPBG) regarding a research programme into rehabilitation techniques for the Project. It is anticipated that advice from Dr Dixon will be incorporated into Gunson's Research and Development Programme (p6-1, Draft Rehabilitation Plan, Appendix F). This programme will conduct trials, throughout the course of the mine life, relating to the timing of seed sowing, studies on seed germination and vegetative propagation, with particular focus on species with historically poor germination rates such as *Eremophila occidens* (ms).

The Wildflower Society submission noted the need for trials of soil crusting and chemical stabilisers. Submission 4 stated that a detailed research study is required to assess the nutrient sequestration mechanisms and requirements of the local flora. In addition, this submission inferred that the growth requirements of the local species in a post-mining environment would need to be the subject of detailed studies. Such studies should critically evaluate revegetation methods such as fertiliser addition and mulching.

The Proponent has proposed an initial programme of rehabilitation trials, aimed at maximising rehabilitation success. These trials will address soil crusting and the use of chemical stabilisers, and nutrient requirements of local flora. It is intended that the results of research trials and monitoring, will be regarded as opportunities for improvement and initiation of follow-up trials, revised rehabilitation procedures and completion criteria.

Submission 4 stated that the reconstituted post-mined mineral sands are complex and suffer from concretion. This submission stated that managing plant recruitment and survival under these hostile soil conditions requires detailed glasshouse and comprehensive, long-term field research programmes. The submission also stated that the development of a complete research and development strategy for optimising species recruitment is required.

Gunson is aware of the problems of concretion experienced by other mineral sand mines, but notes that these mines are typically “wet” mines where the ore and much of the overburden occurs below the water table. Because the Amy Zone occurs well above the water table, and will be dry-mined, concretion is not expected to be a problem. However Gunson acknowledges that managing plant recruitment and survival will be a very important component of rehabilitation success.

The CALM submission stated that the proponent should clearly specify any/all proposed scientific research projects and quantify the available funding.

As stated in Section 3.1 of the PER, Gunson has committed to contributing funds and supporting scientific research into the ecology of the SBWHP and research projects aimed at developing effective rehabilitation techniques. Presently, the Proponent is not in a position to disclose the exact amount of funding to be provided for these purposes as this is yet to be negotiated with CALM and other research agencies.

4.4.4 Benchmarking Studies

Several stakeholders questioned the relevance of the Rehabilitation Benchmarking Study. The Wildflower Society submission stated that the study (which was provided as Appendix E of the PER) largely failed to demonstrate that rehabilitation is likely to be successful. The submission questioned the relevance of the case studies with respect to rehabilitation resources, degree of disturbance and timeframes. Submission 4 considered that the PER did not provide comparable ecological benchmarks or set rehabilitation (WA and mineral sands operations) benchmarks for an area with a high level of endemism.

The Benchmarking Study, which was presented as Appendix E of the PER, was not intended to set rehabilitation benchmarks but was undertaken to identify factors that facilitated or constrained rehabilitation. In selecting the case study sites, it was recognised that there would not be any one site that would exactly replicate the environmental conditions and proposed operations of the Project. Therefore, effort was made to select those sites that could provide information on specific issues such as rehabilitation of sand dunes in areas that experience strong winds (Namakwa Sands mineral sands mine), revegetation of compacted areas (tracks within the SBWHP), vegetation succession over time, weed control agents, options for dust control and surface stabilisation (North Stradbroke Island mineral sands mine) and the impact of grazing pressure. Initially, this study was to include review of mineral sand mine rehabilitation in the Southwest and Northern Sandplains regions of WA. However, the EPA indicated that this information would be less relevant as the environmental conditions in these areas were different to those of the Project Area.

The applicability of the sites was explained in Section 2.2.1 of Appendix E of the PER, and is summarised below:

- The Coburn test pit was selected because:
 - it is located within the proposed Project Area;
 - it would provide information on natural revegetation that would occur as a result of direct topsoil return; and
 - it would information on topsoil stability within the Nanga land system, where no soil stabilisation measures were implemented with the exception of respreading cleared vegetation.

- Rehabilitated tracks on the Peron Peninsula were selected to provide:
 - it is located in the Shark Bay area and has similar environmental conditions to the Project Area;
 - information on the rehabilitation of tracks that had been compacted by vehicle movements; and
 - information on the type of revegetation that could occur one to two years after rehabilitation.

- The Denham refuse tip was selected because:
 - it is located in the Shark Bay area in similar environmental conditions to those within the Project Area, particularly in relation to the windy conditions;
 - it could provide information on rehabilitation within the Sandplain land system;
 - the soil profile of the site had undergone severe transformation, with soil excavated to 5 m in depth; and
 - it provide information on early vegetation recolonisation (three years after rehabilitation).

- An area of natural revegetation on Eurardy Station was selected as it could provide information on:
 - natural revegetation within the Nanga land system at a site where all of the original vegetation had been removed in an area that experiences similar wind conditions to the Project Area;
 - the efficacy of weed control agents; and
 - the type of revegetation that could occur after sustained grazing pressure over a period of seven years.

- Rehabilitated fire buffers on the Peron Peninsula were included in the study because:
 - they are located in the Shark Bay area in similar environmental conditions to those within the Project Area and are likely to experience high wind speeds;

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- they can provide information on the impact of grazing pressure; and
 - the type of revegetation that could occur after a period of ten years.
- Gravel pits at the Shark Bay Salt Joint Venture were selected to provide information on:
 - gravel pit rehabilitation in the Shark Bay area; and
 - the type of revegetation that could occur after a period of 11 years.
 - The proposed Shark Bay Airstrip, which was cleared but not developed further, was selected because:
 - it is located in the Shark Bay area in similar environmental conditions to those within the Project Area;
 - revegetation in the Sandplain land system;
 - it could provide information on natural revegetation and vegetation succession where no active rehabilitation has occurred; and
 - it could provide information on the type of revegetation that could occur after a period of 15 years.
 - Rehabilitation sites along the Dampier-Bunbury Natural Gas Pipeline (DBNGP) were included in the study to provide information on:
 - rehabilitation of disturbances on the Nerren and Sandplain land systems, which also occur in the Project Area; and
 - rehabilitation of linear corridors in a semi-arid environment.
 - Sixteen sites on Woodleigh Station were included in the benchmarking study at the request of the EPA. These sites provided information on:
 - revegetation on the Sandplain land system where little or no rehabilitation has been undertaken; and
 - the type of revegetation that could occur after a period of 40 years.
 - An old airstrip located on the Hamelin pastoral lease was selected because it could provide information on:
 - the effectiveness of natural revegetation on the Nerren land system where no active rehabilitation has been conducted; and
 - the type of revegetation that could occur after a period of 63 years.

In addition, two operational mineral sands mines were included as case studies as they had a number of environmental similarities to the Project Area and conducted similar operations to those proposed by Gunson. These sites were the North Stradbroke Island mine, which is located off the south Queensland coast and the Namakwa Sands mine, which is located on the northwest coast of South Africa.

While the Coburn Project Area and the North Stradbroke Island mine have different climates, both sites are located in dunal systems subject to strong winds. The main constraints to successful rehabilitation at the mine are wind erosion, irregularity of rainfall and weed invasion. Consequently, this case provided useful information on the management of these issues as part of the rehabilitation programme.

Despite being on different continents, there are a number of similarities between the Namakwa Sands mine and the Coburn Project. These are as follows:

- Both sites are located in the transition zone between arid/desert conditions and more Mediterranean conditions. They have similar climates, though the Namakwa Sands site has a lower average annual rainfall and a higher occurrence of sea fog than the Coburn site.
- Both sites regularly experience strong winds. The Namakwa Sands site has one of the strongest wind regimes in the world with average wind speeds of 3 - 9.5 m/s and gusts of up to 16 m/s. During summer in the Shark Bay area, southerlies consistently blow over 25 km/hr (approximately 7 m/s) for several days.
- Both sites comprise dunal systems with surface aeolian sands, though the southern portion of the Coburn Project Area has a more hilly terrain than the Namakwa Sands site.
- The mining and processing operations proposed for the Coburn Project are similar to those conducted by Namakwa Sands at the mine site, and will result in similar tailings. However, Namakwa Sands' use of seawater in the primary and secondary concentrators means that the tailings produced at this site are significantly more saline than those expected to be produced by the Coburn Project.

The Benchmarking Study indicates that revegetation of disturbed areas will occur and provides encouragement that a successful rehabilitation procedure can be developed if appropriate research and trials are undertaken. This is not only Gunson's opinion, but is also the opinion of the various specialist advisers and technical peers who have reviewed the Draft Rehabilitation Plan (refer to Appendix G of PER and Attachment A this document).

The Wildflower Society asked whether climate change was taken into account for the hypothesised site rehabilitation over time that was presented in the Rehabilitation Benchmarking Study.

Climate change was not specifically taken into account for the hypothesised site rehabilitation over time that was presented in the Rehabilitation Benchmarking Study (Appendix E of the PER). However, it is anticipated that climate change would not affect the predicted outcomes for the rehabilitation for the nominal time frames of Years 1-5 and Years 5-10.

Climate change may affect the hypothesised site rehabilitation for Year 10 onwards because rainfall plays an important role in successful plant establishment and any changes in the rainfall regime may affect this

process. However, it is unlikely that the long-term hypothesised rehabilitation scenarios would differ significantly from those predicted.

The scientific rigour of the Coburn Test Pit trial was questioned by the Conservation Council submission, Submission 4 and Submission 5. These submissions identified the issues of experimental replication, methods, lack of vegetation sampling and weed colonisation.

The Coburn Test Pit was not designed to be a scientific experiment and therefore experimental replication was not undertaken. Rather the test pit provided an indication of the unaided recovery of a local site following surface disturbance.

As stated in Case Study 3 in Appendix E of the PER, no vegetation sampling was conducted at the Test Pit site because there was an obvious difference in species composition and density between the disturbed and analogue sites. It was observed that the dominant colonising species was wild turnip (*Brassica tournefortii*), but others included native species such as *Acacia ligulata*, *Ptilotus* spp., and *Triodia* spp. Unfortunately, Gunson was directed by regulators to spray the site with herbicide to control the wild turnip, thereby limiting opportunities for further information gathering.

Submission 4 commented that there was no evidence of consultation with WA restoration ecologists or a review of current scientific literature on rehabilitation in the mining industry.

The Draft Rehabilitation Plan (Appendix F of the PER) and the Draft Conceptual Closure Plan (Appendix H of the PER) had the benefit of input from technical experts such as D.C. Blandford & Associates and Mattiske Consulting Pty Ltd. References to current rehabilitation practice in the mining industry are provided in the PER, the Draft Rehabilitation Plan and the Draft Conceptual Closure Plan.

4.4.5 Weed Management in Rehabilitation Areas

Submission 4 questioned the current proposal to control weeds where they are considered to impact adversely on native species rather than to support site-specific weed control research. CALM considered that there was potential for weed invasion within and adjacent to the Project Area and that there was a lack of detailed long-term (monitoring and management) strategies to manage weed infestation. This submission also stated that quantitative completion criteria for weed management in the rehabilitated and adjoining areas should be provided in the Rehabilitation Management Plan.

The management of weeds has been addressed in the Draft Weed Management Plan (Appendix O). The Plan provides for objectives, performance indicators, consultation, monitoring and reporting. Specific studies aimed at the control of weed species are likely to form part of the operational Research and Development programme outlined in the Draft Rehabilitation Plan (Appendix F of the PER). Gunson has committed to a comprehensive program to control any weed species resulting from the construction, operation and de-commissioning (see Section 12.6 of Appendix O of the PER).

The cover of weed species is already an item for the completion criteria for the project at years 5, 15 and 30 (Draft Rehabilitation Plan). Permanent vegetation monitoring sites both within and adjacent to the Project Area will be established and monitoring will include weeds.

4.4.6 Plant Decommissioning

The Wildflower Society submission asked whether the concrete foundations described in Section 2.2.4 of the PER would be removed as the processing plant moved forward during the life of the Project.

A value engineering study completed in August 2005 has concluded that concrete foundations for the processing plants are no longer necessary and therefore will not be constructed.

4.4.7 Rehabilitation Provisioning and Bonds

The Wildflower Society submission stated that a process for provisioning of revegetation funding was needed. The SBWHP CCC and Conservation Council submissions supported the lodgement of a substantial bond to be utilised for rehabilitation or restoration where adverse impacts are detected during the life of the mine or after mine closure.

Funding for rehabilitation will be the subject of Gunson's annual, operational budgeting processes. It will be largely based on advice from the site Environmental Officer, estimates of the area available for rehabilitation/cost per hectare and the resources required for research trials. It is expected that the DoIR will apply a realistic rehabilitation bond to the Project. At a minimum, this bond will recognise the cost to rehabilitate the anticipated operational area from a status described as 'open and unrehabilitated'.

4.4.8 Completion Criteria

Submission 4 noted that the completion criteria indicated that species richness and cover would be managed progressively over a 20 year period, but that there is no science that supports post-rehabilitation enrichment strategies that are cost-effective and achieve sustainable biodiversity values and function. The Wildflower Society submission considered that final completion criteria should be applied across the site, as opposed to having low quality rehabilitation initially and becoming higher in quality toward the end of the life of the mine. Submission 4 stated that the completion criteria did not address the critical need to reinstate the pre-mine plant biodiversity at the commencement of the Project. This is reflected in the proposed targets for the early stages of rehabilitation.

Anecdotal evidence suggests that, in comparison to seed-based methods, post-rehabilitation enrichment methods are potentially complex and inefficient. At this stage, post-enrichment methods are considered to have limited application to improved biodiversity following initial rehabilitation. This is why Gunson is placing emphasis on creating conditions conducive to revegetation early in the rehabilitation process through appropriate landforming and contouring, and through direct return of topsoil.

It is intended that the final completion criteria be applied across the site. Progressive targets for biodiversity (species diversity) have been set, culminating at "an average of 80% of analogue sites" at 30 years (Draft Rehabilitation Plan, Appendix F of the PER). These targets are time dependant, rather than area dependant, and allow time for ecological processes to re-establish prior to assessment.

The Wildflower Society submission asked for the basis of the criteria proposed for foliage cover and species diversity.

Cover and species diversity measures have been used extensively throughout recent decades in order to quantify similarities between rehabilitated (disturbed sites treated by active rehabilitation works) and control sites (undisturbed). No one measure is likely to describe rehabilitation success fully. Consequently, the use of cover and diversity measures should be viewed as the foundation of measures representing rehabilitation success. It is anticipated that over time, further measures – based on the recommendations of experts in their field - will be used in order to best demonstrate rehabilitation success.

At this stage, post-enrichment methods should be considered a potential, but as yet untested, option for increasing species richness. Gunson will undertake research to evaluate the usefulness of this approach.

4.4.9 Monitoring

The Wildflower Society submission noted that the establishment of monitoring plots needed to be quite comprehensive, should include some plots in the SBWHP, and the results should be publicly available.

Permanent vegetation plots have been established during the April 2004 vegetation and flora survey undertaken by Mattiske Consulting Pty Ltd. As stated in the Vegetation and Flora Management Plan (Appendix O of the PER) and captured in Commitment 22 of the PER, Gunson will implement a monitoring programme which will include the permanent monitoring plots. CALM will be consulted with regard to the placement of additional plots within the SBWHP. The programme will provide data that will be used to monitor the adjacent areas for any possible impact from mining. The results of the monitoring will be provided in Gunson's AER which will be submitted to the DoIR and DoE.

4.5 Water

The removal of Pit 10 from the Proposal will markedly reduce impacts on the deep aquifers in terms of drawdowns and reduce the extent of water table mounding from residual mine water released with the sand tails. With the removal of Pit 10, the borefield will no longer be relocated as far north as originally proposed. This will confine the deeper parts of the drawdown cone to the southern and central parts of the Project Area and significantly reduce the predicted drawdowns to other users located to the north. The removal of Pit 10 also decreases the Project duration from 20 to 12 years. This will also reduce the extent of regional drawdowns and hence the impact on other users at greater distances.

Table 31 of the Groundwater Impact Assessment (Appendix D of the PER) has been revised to incorporate the changes to predicted impacts on other groundwater users bores. The revised table is provided in this document as Table 6.

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Table 6
Revised Predicted Drawdown Impacts of 11 GL/annum/yr Abstraction on Private Bores

Name / No.	Predicted Maximum Drawdown after 20 Years (m)	Predicted Time for Recovery to < 0.5 m (years)	Predicted Maximum Drawdown after 12 Years (m)	Predicted Impacts due to Drawdown	Equipped With	Proposed Remediation (if required)
Hamelin Station						
Hamelin Homestead No. 1	6.28	6.0	3.6	Lower pressure for power generation	Artesian Headworks	
Hamelin No. 4	<u>2</u>	<u>4.5</u>	<u>1.5</u>	Deeper pumping water level	Windmill	Lower pump inlet
Hamelin No. 5	<u>5.5</u>	<u>5.5</u>	<u>3.7</u>	Deeper pumping water level	Windmill	Lower pump inlet / Upgrade windmill
Outcamp Bore	<u>2</u>	<u>4.5</u>	<u>1.7</u>	Deeper pumping water level	Windmill	Lower pump inlet
Hamelin No. 8	5.61	6	4.9	Deeper pumping water level	Windmill	Lower pump inlet / Upgrade windmill
Hamelin No 9	3.00	5.50	2.8	Deeper pumping water level	Windmill	Lower pump inlet
Hamelin No. 11	<u>3.8</u>	<u>5.5</u>	<u>2.8</u>	Deeper pumping water level	Windmill	Lower pump inlet
Hamelin No. 13	<u>1.4</u>	<u>4</u>	<u>0.8</u>	None	Windmill	
Hamelin No. 14	<u>2</u>	<u>5</u>	<u>2.0</u>	Deeper pumping water level	Windmill	Lower pump inlet
Hamelin No. 16	1.34	4	0.9	None	Windmill	
Hamelin No. 17 New	<u>4.5</u>	<u>6.5</u>	<u>4.0</u>	Deeper pumping water level	Not Equipped	Lower pump inlet
Hamelin No. 18	<u>2.1</u>	<u>5</u>	<u>2.0</u>	Deeper pumping water level	Windmill	Lower pump inlet
Hamelin No. 20B	1.32	4	1.0	None	Windmill	
Hamelin No. 23	<u>4.2</u>	<u>6</u>	<u>3.4</u>	Deeper pumping water level	Windmill	Lower pump inlet / Upgrade windmill
Hamelin No. 24	<u>1.5</u>	<u>4</u>	<u>0.7</u>	None	Not Equipped	
Hamelin No 26	<u>1.2</u>	<u>3.5</u>	<u>0.8</u>	None	Not Equipped	
Hamelin Spinifex 1	<u>8.9</u>	<u>6</u>	<u>5.6</u>	As for Spinifex 2	Flowing	As for Spinifex 2
Hamelin Spinifex 2	8.86	6	5.6	May stop flowing	Flowing	Provide alternative external source.
Hamelin Kevins Bore	3.26	5.5	2.4	Deeper pumping water level	Windmill	Lower pump inlet
Hamelin Five Mile Bore	<u>4.8</u>	<u>5.5</u>	<u>3.2</u>	Deeper pumping water level	Windmill	Lower pump inlet / Upgrade windmill
Hamelin Ten Mile Bore	3.26	5	2.4	Deeper pumping water level	Windmill	Lower pump inlet
Sweeney Mia Bore 2001	3.68	5	2.3	Lower flow pressure	Nil - Artesian Headworks	

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Table 6 (continued)

Name / No.	Predicted Maximum Drawdown after 20 Years (m)	Predicted Time for Recovery to < 0.5 m (years)	Predicted Maximum Drawdown after 12 Years (m)	Predicted Impacts due to Drawdown	Equipped With	Proposed Remediation (if required)
Coburn Station						
Coburn No. 7	7.72	6	7.6	Deeper pumping water level	Mono Pump 54.8m	Lower pump inlet
Coburn No. 8	3.52	7	3.5	Deeper pumping water level	Mono Pump 60.96m	Lower pump inlet
Coburn No. 9 B	8.16	7	8.1	Deeper pumping water level	Mono Pump 60.96m	Lower pump inlet
Coburn No. 11 B	<u>2.5</u>	<u>5.5</u>	<u>2.5</u>	Deeper pumping water level	Mono Pump 60.96m	Lower pump inlet
Coburn No. 14	5.54	7	5.5	Deeper pumping water level	Mono Pump 60.96m	Lower pump inlet
Overlander Roadhouse (Main Roads Bore)						
Overlander Roadhouse	2.27	5	1.7	Deeper pumping water level	Electric Submersible	Lower pump inlet
Billabong Roadhouse						
Billabong Roadhouse	0.93	3	0.8	None	Electric Submersible	
Hamelin Telegraph Station and Caravan Park						
Hamelin Telegraph Station	5.88	6	3.3	Lower flow pressure	Nil - Artesian Headworks	
Meadow Station						
Meadow No. 1	1.15	3.5	0.9	None	Mono Pump	
Meadow No. 3	0.96	3	0.8	None	Electric Submersible	
Meadow No. 4	<u>0.5</u>	<u>3</u>	<u>0.5</u>	None	Windmill	
Meadow No. 5	<u>0.5</u>	<u>3</u>	<u>0.5</u>	None	Windmill	
Meadow No. 6	<u>0.5</u>	<u>3</u>	<u>0.5</u>	None	Mono Pump	
Meadow No. 7	<u>1.2</u>	<u>3.5</u>	<u>1.0</u>	None	Windmill	
Meadow No. 8 (New)	<u>1.7</u>	<u>4.5</u>	<u>1.5</u>	None	Not Equipped	
Nerren Nerren Station						
Nerren Nerren 1A	1.03	3	0.9	None	Mono Pump	
Nerren Nerren 5A	<u><0.5</u>	<u><3</u>	<u>0.5</u>	None	Mono Pump	
Carbla Station						
Carbla Homestead	<u>3.3</u>	<u>5</u>	<u>1.4</u>	None	Artesian Headworks	
Carbla No. 12	<u>2.5</u>	<u>5</u>	<u>0.0</u>	Deeper pumping water level	Windmill	Lower pump inlet
Carbla No. 13	3.07	5	1.9	Deeper pumping water level	Windmill	Lower pump inlet
Carbla No. 14	1.9	4.5	1.3	None	Windmill	
Carbla No. 16	2.47	4.5	1.6	Deeper pumping water level	Windmill	Lower pump inlet
Carbla No. 17	<u>2.2</u>	<u>4.5</u>	<u>1.2</u>	Deeper pumping water level	Windmill	Lower pump inlet

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Table 6 (continued)

Name / No.	Predicted Maximum Drawdown after 20 Years (m)	Predicted Time for Recovery to < 0.5 m (years)	Predicted Maximum Drawdown after 12 Years (m)	Predicted Impacts due to Drawdown	Equipped With	Proposed Remediation (if required)
Six Mile Well	1.67	4	1.1	None	Leaking Artesian Headworks	
SEC Bore	<u>2.5</u>	<u>4.5</u>	<u>1.0</u>	None	Windmill	Lower pump inlet
Nanga Station						
Nanga Homestead	2.15	4	1.4	Lower flow pressure	Artesian Headworks	
Nilemah Artesian No. 1A	6.32	6	3.5	Lower flow pressure	Nil - Artesian Headworks	
Tamala Station						
Cape Well Bore	<i>None</i>	<i>N/A</i>	<i>0.0</i>	None	Mono Pump	
Beethen Outcamp Well	<i>None</i>	<i>N/A</i>	<i>0.0</i>	None	Mono Pump & Windmill	
Natta Outcamp Bore	<i>None</i>	<i>N/A</i>	<i>0.0</i>	None	Windmill & Electric Submersible	
Woodleigh Station						
Woodleigh No 10C	<u>1.5</u>	<u>3.5</u>	<u>0.0</u>	None	Electric Submersible	
Woodleigh No 11	<u>2.0</u>	<u>4.5</u>	<u>0.5</u>	Deeper pumping water level	Windmill	Lower pump inlet
Woodleigh No 22	<u>1.0</u>	<u>3.5</u>	<u>0.0</u>	None	Electric Submersible	
Woodleigh No 25	<u>1.0</u>	<u>3.5</u>	<u>0.0</u>	None	Electric Submersible	
Toolonga Station						
SB2	<u><0.5</u>	<u><3.0</u>	<u>0.0</u>	None	Not Equipped	

Note: Italicised and underlined data have been interpolated between modelled observation points.

The Conservation Council submission stated that drawdown impacts in the superficial formations was of particular concern. Submission 6 stated that the impact on production bores is an overriding major concern, yet cannot be predicted as the proponent is unsure what the extent of the drawdown would be. The Shark Bay LCDC submission stated that a possible drop in groundwater levels could severely affect the viability of pastoral and other pursuits that use water. The Main Roads submission stated that drawdown of the bores accessed by Main Roads may adversely impact their periodic roadworks activities.

The Conservation Council concerns are about drawdown impacts on the Hamelin Pool Marine Nature Reserve. The hydrogeological assessments and predictive simulations (Appendix D of the PER) concluded there would be no drawdown impacts from Birdrong Sandstone and Kopke Sandstone groundwater abstraction on this reserve, primarily due to the interpreted low vertical transmissivities of the Toolonga Calcilutite and Alinga Formation aquitards that overly the regional confined aquifers. These

assessments are reinforced by the understanding that historical abstractions in the region have not presented any known impacts on the Hamelin Pool Marine Nature Reserve.

The hydrogeological assessments also concluded that the superficial formations aquifer systems, such as that beneath the coastal shell banks, would not be affected by groundwater abstraction. This aquifer system is maintained by local rainfall recharge and is separated from the Birdrong Sandstone and Kopke Sandstone by low transmissivity marine clay beds, the Toolonga Calcilutite and Alinga Formation. The PER includes commitments to initiate further investigation and monitoring programmes to define the vertical gradients between the Kopke Sandstone, Birdrong Sandstone and superficial formations to verify this prediction.

The removal of Pit 10 from the Proposal now means that no dewatering of the superficial formations will occur during mining and consequently there will be no drawdown impacts on the Hamelin Pool Nature Reserve linked to this activity.

Submission 6 and the Shark Bay LCDC submission both highlight the potential impacts of drawdown on the viability of businesses in the region that rely on groundwater. The maximum predicted drawdown impacts from Birdrong Sandstone and Kopke Sandstone groundwater supply abstractions (Table 6) range from 0.7 to 5.6 m in existing bores on the Hamelin Station and are 3.5m in Nilemah Artesian No. 1A (Nanga Station), 3.3 m in the Hamelin Telegraph Station Bore, 1.9 m in Carbla No. 13 (Carbla Station), 1.7 m at the Overlander Roadhouse and 1.6 m in Carbla No. 16. These predicted drawdown impacts do not threaten groundwater supply capabilities in the region. Bores such as Hamelin Homestead No.1, Nilemah Artesian No.1 and Hamelin Telegraph Station will remain artesian and the supply capability of other bores is not expected to be significantly different. In sub-artesian bores, any differences (reductions) in supply capability are predominantly expected to be made-up by lowering of installed pump-units to increase submergence. In selected instances there may be a need to install alternative pump-units to replicate previous supplies.

The importance of the existing groundwater use is acknowledged and reflected in the PER, with 14 groundwater-specific commitments to manage the use of groundwater and drawdown impacts from its abstraction. These commitments by Gunson, including both groundwater investigation and monitoring programmes, are specifically intended to define and manage the drawdown impacts within the regional aquifers. The monitoring programme includes an extensive array of monitoring points within all of the hydrogeological units in the region including both aquifers and aquitards. Further baseline studies are also planned to derive an agreed benchmark of existing groundwater levels, amenities and supply conditions and subsequently practical protocols for managing any adverse drawdown impacts on existing amenities or supplies.

Main Roads' concerns were not raised during the bore census. The department did in fact advise that there were no bores that it used along the local stretch of the North West Coastal Highway. This advice was provided after consultation of construction and maintenance maps with associated infrastructure. The only bore encountered during the census and actively used for road maintenance is Nilemah Artesian No. 1A. Subsequent to the bore census, the Shark Bay Shire has completed a new bore along the Useless Loop Road (within the SBWHP) for maintenance of this road. It is predicted in Appendix D of the PER

that Nilemah Artesian No. 1A would be impacted by an artesian pressure reduction of about 35 kPa. At present, the artesian pressure in this bore is about 400 kPa, thus the predicted drawdown impact is less than 10% of the available artesian pressure. At worst, the predicted drawdown impact would increase the filling time of water tankers by a small margin. Further consultation with Main Roads is planned to take place in the next round of baseline studies.

The Shark Bay LCDC submission noted that a possible drop in water pressure could severely affect the viability of pastoral and other pursuits that use water. Submission 6 stated that any decrease in water pressure is unacceptable, as the implications are not understood. Submission 13 noted that enterprises have been developed based on current aquifer pressures and would be adversely affected by pressure reductions.

The predicted drawdown impacts do not threaten groundwater supply capabilities in the region. Bores such as Hamelin Homestead No.1, Nilemah Artesian No.1A and Hamelin Telegraph Station will remain artesian and the supply capability of other bores is not expected to be significantly different.

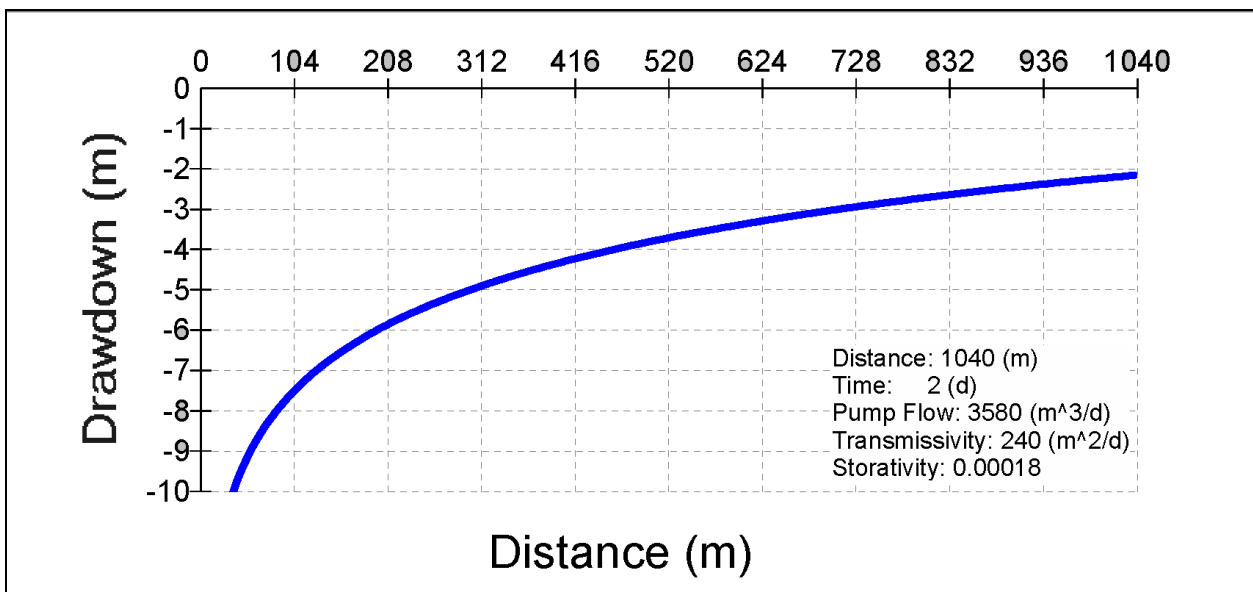
The maximum predicted drawdown impacts from Birdrong Sandstone and Kopke Sandstone groundwater supply abstractions (Table 6) range from 1.1 to 5.6 m in existing artesian bores on the Hamelin, Carbla and Nanga stations and at the Hamelin Telegraph Station and Caravan Park. The maximum predicted drawdowns include 5.6 m in Hamelin Spinifex 2, 3.6 m in Hamelin Homestead No.1, 3.5 m in Nilemah Artesian No. 1A (Nanga Station), 3.3 m in the Hamelin Telegraph Station Bore, 2.3 m in Sweeney Mia Bore 2001, 1.4 m in both the Carbla and Nanga Homestead bores and 1.1 m in the Six Mile Well. Each of these bores, except Spinifex 2, will retain artesian flows, albeit at perhaps slightly lower rates than at present. As discussed in PER Appendix D, Spinifex Bore is expected to cease flowing one to two years after the commencement of mining. Both Spinifex 1 and Spinifex 2 bores have collapsed and cannot be used to house pumps to maintain the supply. Historically, the Spinifex Bore has stopped flowing for extended periods without any nearby abstraction and this cessation of flow has been accepted as a natural condition. Discussions with the Hamelin Station manager during the bore census indicated there is consideration of reticulating water to this site from Hamelin Homestead No. 1 instead of constructing a new bore.

Decreases in pressure at some of the artesian bore sites are discussed in PER Appendix D. It is acknowledged that some artesian bores would be more sensitive than to others and that potential drawdown impacts may vary depending on the nature of the installed infrastructure, amenity and groundwater use(s). Groundwater uses that are sensitive to comparatively small-scale (less than 40 kPa) changes in pressures may be the most sensitive to drawdown impacts from the Coburn Project. Further baseline studies are planned to derive an agreed benchmark of existing groundwater levels, amenities and supply conditions and subsequently practical protocols for managing any adverse drawdown impacts on existing amenities or supplies. Adverse impacts will be determined on the basis of clear unambiguous monitoring data sourced both from the affected supply and local and regional multipiezometers.

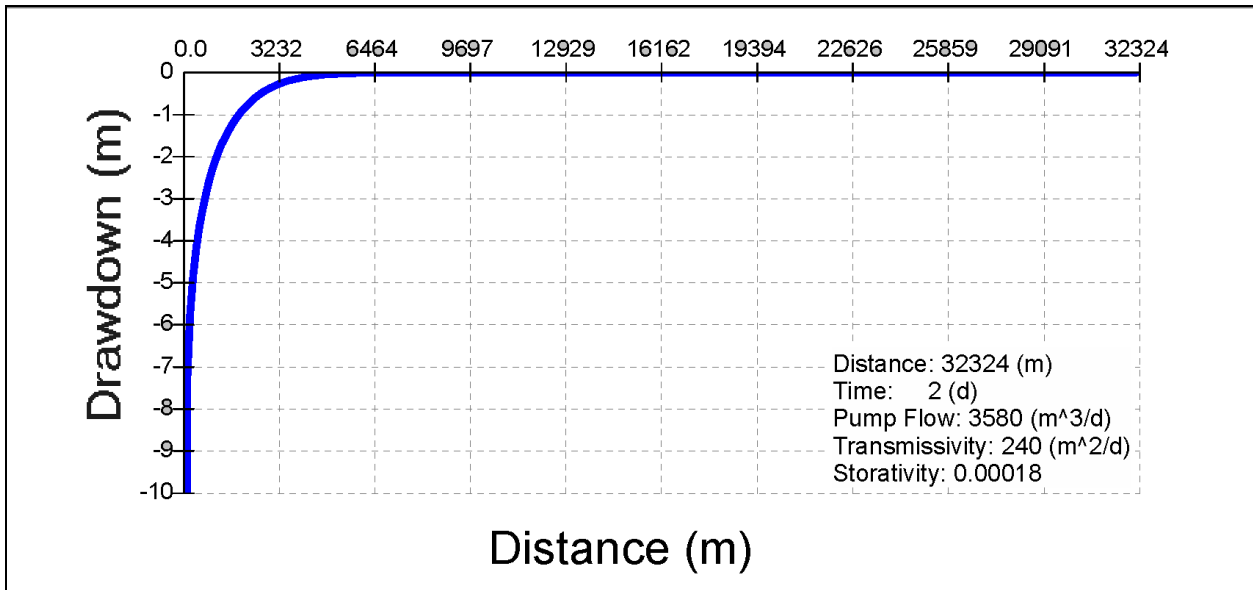
The sensitivity of Hamelin Homestead No.1 to pressure changes is highlighted in PER Appendix D. The implications of a pressure reduction are understood and discussed in Section 6.6 of Appendix D where it is stated that “A decrease in the artesian pressure at the Hamelin Homestead may have a significant

impact on the ability of the existing equipment to generate a local electricity supply.” It is planned that changes in pressure that might lead to remedial measures will be determined during the planned further baseline studies.

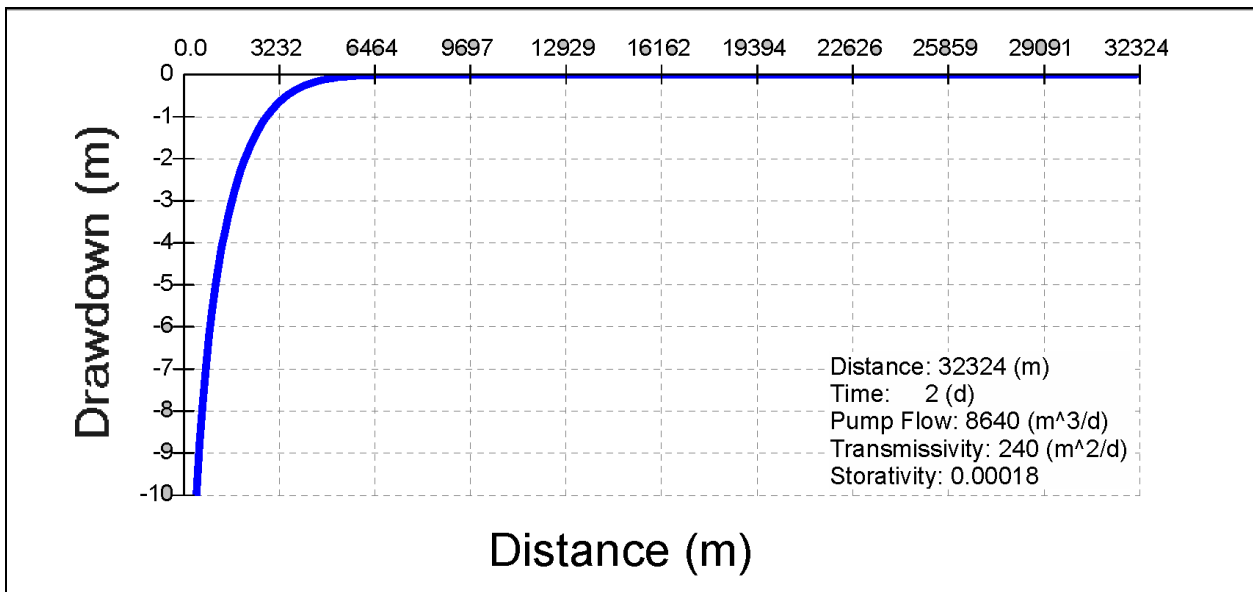
It was indicated in Submission 6 that an immediate 2.1 to 2.8 m (3 to 4 psi) drawdown effect in Hamelin Homestead No.1 during the two-day aquifer test in DTB1. Our interpretations of the aquifer test data show that this outcome is highly improbable. The measured drawdown response in the Birdrong Sandstone in DMB1, 1 km from DTB1, was 2.2 m. The 2.1 to 2.8 m (3 to 4 psi) pressure drop in Hamelin Homestead No. 1 quoted in Submission 6 is not compatible with the measured aquifer test results, given its distance of about 32.3 km from DTB1. Using the hydraulic parameters derived from the aquifer test, it is likely the drawdown effects after two days of pumping may have extended to about 3.5 to 4 km from DTB1. Even if all abstraction is from the Birdrong Sandstone, measurable drawdowns would only have extended about 5 km from DTB1. It would require the application of unrealistic aquifer parameters to propagate drawdown of 2.1 to 2.8 m (3 to 4 psi) to Hamelin Homestead No. 1 during the aquifer test in DTB1. Such parameters might include an aquifer transmissivity ten times higher than that interpreted or recognised for the Birdrong Sandstone, and a storage coefficient some six orders of magnitude lower than interpreted at DMB1. The above statements are demonstrated by Graphs 1 to 6.



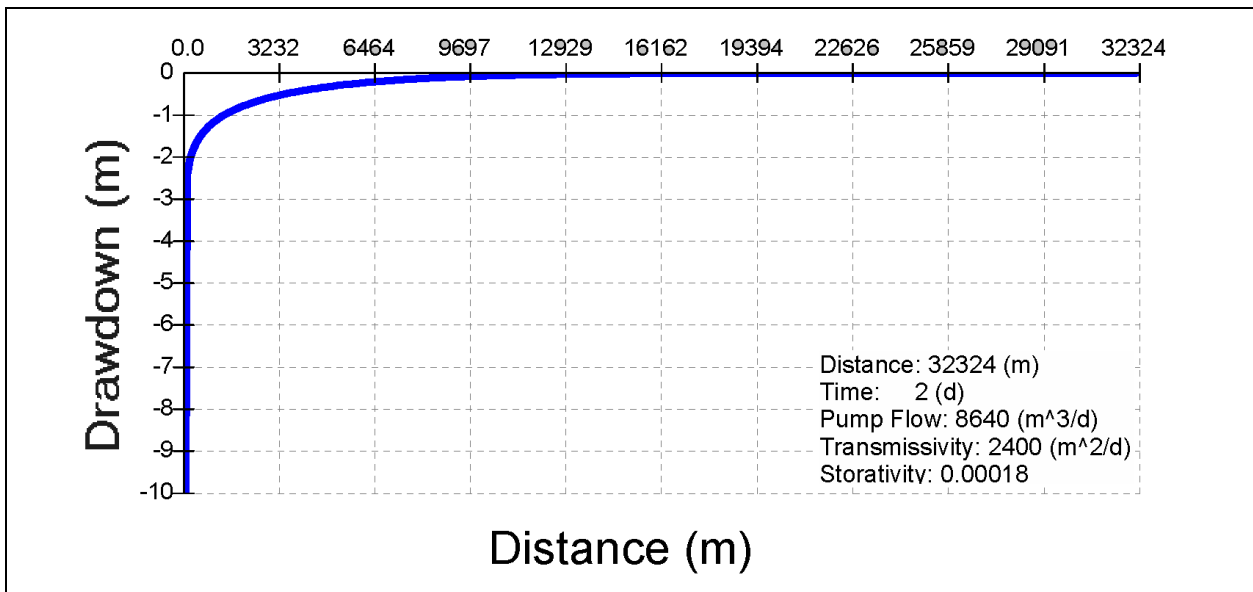
Graph 1: Distance drawdown plot showing the parameters required to achieve the measured drawdown in DMB1.



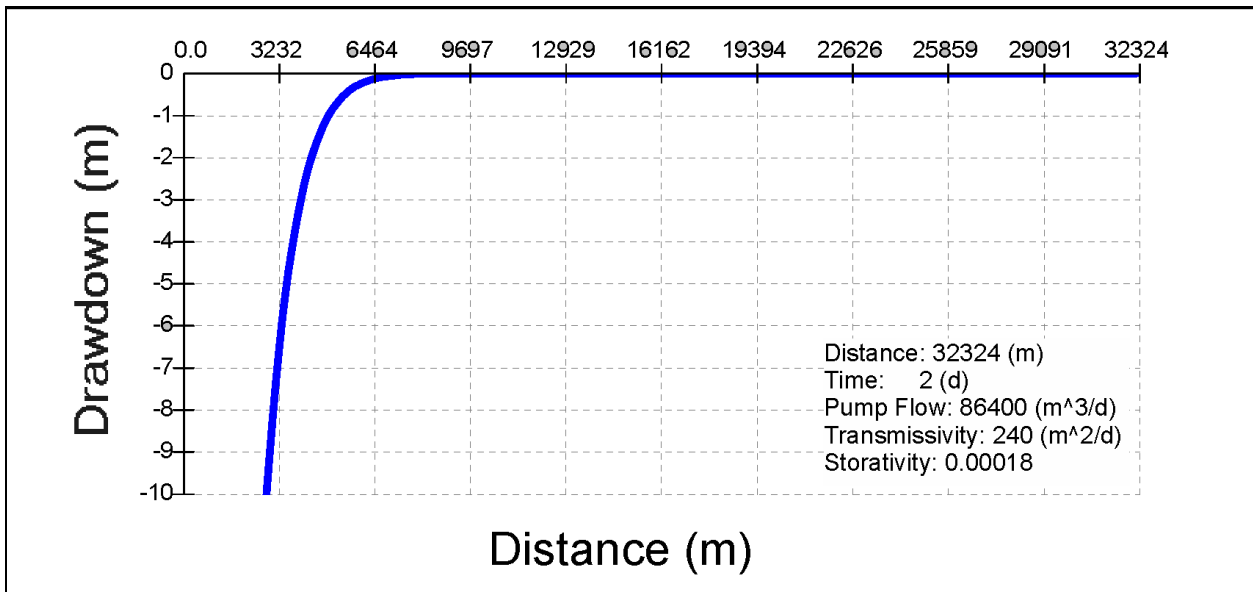
Graph 2: Distance drawdown plot between DTB1 and Hamelin Homestead No.1 using interpreted aquifer parameters.



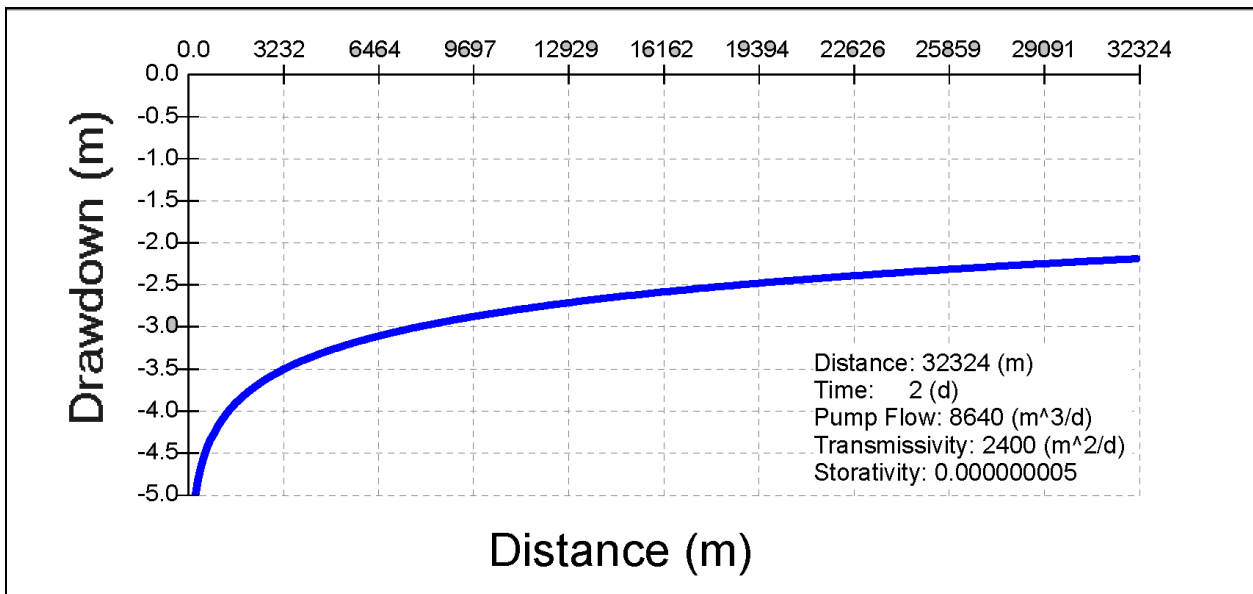
Graph 3: Distance drawdown plot between DTB1 and Hamelin Homestead No. 1 with all abstraction assigned to the Birdrong Sandstone.



Graph 4: Distance drawdown plot between DTB1 and Hamelin Homestead No. 1 with a 10-fold increase in the Birdrong Sandstone transmissivity and all abstraction assigned to the Birdrong Sandstone.



Graph 5: Distance drawdown plot between DTB1 and Hamelin Homestead No. 1 with a 10-fold increase in the abstraction assigned to the Birdrong Sandstone.



Graph 6: Distance drawdown plot between DTB1 and Hamelin Homestead No. 1 with a 10-fold increase in the transmissivity of the Birdrong Sandstone, together with a storage coefficient six orders lower than interpreted and assuming all abstraction was from the Birdrong Formation. All of these conditions are unrealistic in the context of the known regional hydrogeology.

Submission 13 stated that enterprises have also been developed based on current salinity concentrations, yet the time required to rectify any salt intrusion is undefined.

Salt intrusion as described by Submission 13 is out of context with the Coburn Project. Natural variations in salinity are known laterally within the Carnarvon Basin and vertically between the different aquifers. This has been described in detail in Appendix D of the PER. There are no known salt water wedge intrusion issues that relate to the Birdrong Sandstone and Kopke Sandstone aquifers in the Shark Bay district. In addition, it is not likely that the Birdrong Sandstone and Kopke Sandstone aquifers are directly connected to saline or hypersaline sources of the Indian Ocean or Hamelin Pool.

Measured salinity variations at Hamelin 5 and Hamelin 8 are evident in abstracted groundwater during the past 80 years. This is apparent from the results of the bore census conducted by Gunson (see Appendix D of PER). Further changes in salinity are possible, particularly if bores are screened across more than one aquifer zone at locations where significant vertical hydraulic gradients exist. Businesses sensitive to water supply salinity variations should determine the range of local groundwater salinities and target water supply bores in discrete aquifers to minimise the occurrence of salinity changes.

Submission 13 stated that the Groundwater Management Plan may need to incorporate pressure monitoring of the artesian water resources throughout the Basin, and a pre-determined ‘trigger pressure loss’ or ‘benchmark’ below which further water abstraction would cease. The SBWHP CCC submission also stated that a negotiated contingency plan should be established, which would deliver quick and effective action, should an unacceptable drop in pressure be detected.

The Shark Bay LCDC submission noted that the area of monitoring bores should be within an 85 km radius of the corners of the mining lease.

The draft groundwater management plan presented in Appendix D of the PER details a comprehensive programme that includes monitoring of pressures in local artesian bores.

Ceasing process water supply abstraction from the Birdrong Sandstone and Kopke Sandstone at the mine site at any pre-defined 'benchmark' is impractical and unnecessary. Further baseline studies and monitoring, as proposed by Gunson, will enable effective measurement of drawdown distributions and management of any changes to existing supplies and amenities. The further baseline studies will derive an agreed benchmark of existing groundwater levels or pressures, amenities and supply conditions and, provide practical protocols for managing any adverse drawdown impacts on existing amenities or supplies.

As discussed in Appendix D of the PER, Spinifex Bore is expected to cease flowing one to two years after the commencement of mining. Both bores at the site have collapsed and cannot be used to house pumps to maintain the supply. Historically, the Spinifex Bore has stopped flowing for extended periods without any nearby abstraction and this cessation of flow has been accepted as a natural condition. Discussions with the Hamelin Station manager during the bore census indicated that there is consideration of reticulating water to this site from Hamelin Homestead No. 1 instead of constructing a new bore.

The need for regional monitoring bores is discussed in Appendix D of the PER. It is planned to install seven Birdrong Sandstone and Kopke Sandstone multi-piezometers up to 24 km from the Project Area and four Toolonga Calcilutite multi-piezometers at distances of between three and 13 km from the Project Area. The completed census also identified a further five existing bores, between 10 and 52 km from the Project Area, that are infrequently used and could form part of the regional monitoring network. The schedule of available bores is provided in Section 7.1.3 of PER Appendix D. It is understood that this monitoring network will enable accurate assessments of the transient regional drawdowns due to the proposed water supply abstractions, be it by:

- actual drawdown measurements;
- calculation of distance versus drawdown relationships; and/or
- calibration of the developed groundwater flow model to measured drawdowns and subsequent application of the model to simulate regional drawdown distributions.

Based on the developed monitoring programme there is no defined need to have monitoring bores at distances up to 85 km from the Project Area.

The Shire of Shark Bay has recently initiated monitoring of several local bores. The inaugural monitoring results are included in PER Appendix D for Nilemah Artesian No 1A. Additional independent monitoring is also recommended for the Tamala Station bores that draw from the Tamala Limestone. It is the intention of the Proponent to include these monitoring data in the regional groundwater resources database. Monitoring data would also be sought from operators such as the Useless Loop Salt Works, Main Roads and the Water Corporation at Denham. The monitoring results would be collated and

assessed in annual reports issued to the relevant regulatory authorities, in line with Commitment 17 in the PER.

The Shark Bay LCDC submission stated that, contrary to the PER, the artesian water tapped within the Shark Bay area is all taken from the Birdrong Formation.

The Shark Bay LCDC submission also stated that the use of other groundwater sources, such as the Kopke Formation, has not been adequately investigated. Submission 6 noted that the possibility of sourcing the water from aquifers other than the Birdrong and Kopke formations should be further explored.

The Birdrong Sandstone is actually one of several formations that are regional aquifers in the Gascoyne Platform of the Carnarvon Basin and used for water supplies. The individual aquifers are mapped on the basis of different geological, hydraulic and groundwater quality characteristics. A full discussion of the interpreted hydrogeology is given in PER Appendix D, with references to published reports and government documents.

The use of the Kopke Sandstone as a groundwater source is discussed in the PER, particularly in Appendix D. It is stated that the Proponent intends to derive a significant proportion of the groundwater supplies from the Kopke Sandstone. This is demonstrated by the construction of DTB1 that is screened over a 20 m thickness of Birdrong Sandstone and 172 m of Kopke Sandstone. The two sandstone formations are not separated by a definitive confining layer and consequently are interpreted to be hydraulically connected.

Other aquifers in the region include the Windalia Sand Member of the Muderong Shale, the Windalia Radiolarite and at considerable depth, the Tumblagooda Sandstone. The Windalia Sand Member is specifically avoided as a potential groundwater supply source due to the number of existing users that draw from this aquifer. The Windalia Radiolarite would similarly be avoided where it occurs beneath the northern Project Area. The Tumblagooda Sandstone is another regional aquifer, although beneath the Project Area it is below about 1,000 m in depth, making it an uneconomical source.

The only other source of large quantities of water in the region is seawater. However, the use of seawater is not feasible given the world heritage status of the nearest resources, the distances and large pipeline construction/operating costs linked to developing this supply, issues with importation of salt to the Project Area and the potentially adverse impacts on rehabilitation and the local environment.

The DoA submission stated that the department had been unable to determine from the PER whether development of the Meedo Horticultural Precinct (which is located 80 km east of the Wooramel roadhouse) would be compromised.

The Meedo Horticultural District is located about 110 km northeast of the northern Project Area. On the basis of the drawdown assessment conducted for the PER, it is improbable that measurable drawdowns will extend near to the Meedo Horticultural District due to the large distance between the two sites. As such, the Project should have no bearing on the planned Meedo Horticultural District.

The Meedo Horticultural District is located near the Wooramel River on the far side of the Woodleigh Impact Structure as defined by Iasky *et al.* (2001) and Wills and Dogramaci (2000). The latter reference places the Meedo Horticultural District in a similar hydrogeological setting as the Project Area, except for the presence of Windalia Radiolarite instead of the Windalia Sand Member. It is likely that groundwater in this area is derived from rainfall recharge in the east and possibly throughflow from the Tumblagooda Sandstone where juxtaposed with the Windalia Radiolarite, Birdrong Sandstone and Kopke Sandstone by the Kennedy Range Fault. The Woodleigh Impact Structure has the potential to further restrict groundwater interaction between the Project Area and Meedo Horticultural District.

Submission 6 stated that the pastoral community has a major investment in the capping of bores in the Carnarvon Basin, and their plans to utilise that water source is threatened by the proposal:

- ***If groundwater levels or pressures are affected, they would impact on the ability to water and manage stock.***
- ***The pressure of Hamelin No 1 currently generates the Hamelin Pool Station energy supply. This system is very sensitive to pressure, and a small pressure decrease would render it inoperative.***
- ***An aquaculture venture being developed also relies on the pressure and temperature of Hamelin No 1, and would also be threatened by changes.***
- ***The development of tourist accommodation is also underway, and any change to groundwater levels could jeopardise this plan in a number of ways.***

The predicted drawdown impacts do not threaten groundwater supply capabilities on Hamelin Station. Artesian bores Hamelin Homestead No.1 and Sweeney Mia Bore 2001 will remain artesian and the supply capabilities of other bores is not expected to be significantly different.

The maximum predicted drawdown impacts from Birdrong Sandstone and Kopke Sandstone groundwater supply abstractions (Table 6) range from 0.7 to 5.6 m in existing bores on the Hamelin Station, being greatest in Hamelin Spinifex 1 and Hamelin Spinifex 2, and least in Hamelin No. 24. A maximum drawdown of 3.6 m (36 kPa or 5.2 psi pressure reduction) is predicted in Hamelin Homestead No. 1. In sub-artesian bores, any differences (reductions) in supply capability are predominantly expected to be made-up by lowering of installed pump-units to increase submergence. In selected instances there may be a need to install alternative pump-units to replicate previous supplies.

The importance of the existing groundwater use is acknowledged and reflected in the PER, which included 14 groundwater-specific commitments¹ to manage the use of groundwater and drawdown impacts from its abstraction. These commitments by Gunson, including both groundwater investigation and monitoring programmes, are specifically intended to define and manage the drawdown impacts

¹ The number of groundwater-specific commitments has now been reduced due to the removal of Pit 10 from the current Proposal. See Section 8 of this document for details.

within the regional aquifers. The monitoring programme includes an extensive array of monitoring points within all of the hydrogeological units in the region including both aquifers and aquitards.

The ability to water and manage stock would not be adversely affected as Gunson has committed to maintaining such supplies in the PER. Any losses in supply would be determined on the basis of verified monitoring data and agreed benchmarks of groundwater levels and supply demands. The supply would be maintained through an agreed plan of action that will vary depending on the site and groundwater usage pattern.

The sensitivity of the energy and water supply derived from Hamelin Homestead No. 1 has been highlighted in the PER. This bore is not expected to stop flowing, though a pressure reduction equivalent to 3.5 m of head (about 35 kPa or 5 psi) is predicted. Should this pressure loss result in the failure of the energy supply or other existing groundwater use, then Gunson would provide an alternative source of energy and water to replace such losses. Evidently, based on information presented in Submission 6, the power generation system on Hamelin Homestead No. 1 can withstand a pressure drop of 21 to 28 kPa (3 to 4 psi) without the loss of generation capacity. Notwithstanding, the impacts of a maximum 35 kPa reduction in borehead pressure are expected to be minimal.

Further baseline studies are planned to derive an agreed benchmark of existing groundwater levels and pressures, amenities and supply conditions, and subsequently to agree practical protocols for managing any adverse drawdown impacts on existing amenities or supplies. These studies will determine the specific usage, construction and equipment status of individual bores.

Submission 6 asked that the term “make good” be defined and agreed upon by all parties, and a process for resolving disputes should be developed.

Given the above commitments and proposals by Gunson, the term “make good” does not need any further definition. In any event, the concept of making good water supply affected by another project is established in DoE’s groundwater management policies, plans and guidelines (R. Coleman, DoE, pers. comm., 4 October 2005).

The Shark Bay LCDC submission suggested that surrounding water users should be advised of any future test pumping of production bores so that they can assess any reduction in pressure and water levels.

As part of Gunson’s commitments to establishing dialogue with local stakeholders, such notice would be provided to all relevant stakeholders.

The Conservation Council submission stated that groundwater mounding and the eventual discharge of tailings water through shallow aquifers into the Nilemah Embayment and Hamelin Pool are of particular concern (especially for Pit 10).

As indicated in Section 2 of this document, Gunson has removed Pit 10 from the current Proposal. Although the studies conducted to date indicate that the potential environmental impacts associated with the development of this pit can be managed effectively, it was recognised that some degree of uncertainty would remain until operational data became available to validate and refine the predictive models.

Consequently, Gunson has decided to remove Pit 10 from the proposal currently being assessed under the PER and is now seeking approval to develop Pits 1-9 only.

The Shark Bay LCDC, Main Roads, Submission 6 and Submission 13 put forward recommendations for actions by the proponent. These included:

- *explore options for alternative water sources, other than Birdrong and Kopke formations;*
- *explore other options for transporting ore to the concentrator;*
- *agree on a definition of the term “make good”;*
- *develop a process for resolving disputes and formalise as a water licence condition;*
- *allow for groundwater issues to be included in the environmental bond;*
- *monitor groundwater levels and pressures in the region; and*
- *determine a ‘trigger pressure loss’ or ‘benchmark’ below which water abstraction would cease.*

Most of the above items have been previously addressed in the responses to earlier submissions.

There would be no reduction in water consumption by using alternative methods of transporting the ore to the concentrator. There is no water lost through this process and the concentrators require a slurry feed. Gunson has committed to implementing practical operating strategies for maximising water recoveries from the sand tails and to minimise water consumption and environmental impacts.

Further baseline groundwater studies are planned to derive an agreed benchmark of existing groundwater levels and pressures, amenities and supply conditions and subsequently practical protocols for managing any adverse drawdown impacts on existing amenities or supplies.

The process for resolving disputes would be an integral part of the Operating Strategy that typically forms part of the terms, limitations and conditions of the Licence to Take Water. The Operating Strategy would detail the operating rules, monitoring programme and contingency measures associated with the process water supply abstractions. This document would be prepared and approved by the Department of Environment as part of the application for and approval of the Licence to Take Water.

The SBWHP CCC submission recommended that ‘compensatory action’ funding from the proponent be used to continue to cap existing artesian bores in the area so that the quantity of groundwater saved is equivalent to the usage estimated for the mining operation.

Gunson supports the principle of the Carnarvon Basin Rehabilitation Project and associated bore-capping and is prepared to contribute additional benefits in the southern Carnarvon Basin. This contribution may be in the form of assistance in the rehabilitation of bores in the vicinity of the Project Area, that if brought under control would limit future wastage, promote groundwater conservation and potentially lessen drawdown impacts. Further, it needs to be recognised that the Coburn Project intends to install both local and regional multi-piezometers and implement a comprehensive groundwater monitoring and

management programme. These aspects will add substantial value to the Carnarvon Basin Rehabilitation Project. This value adding would be linked to:

- the provision of multi-piezometers in significant stratigraphic successions and a setting where there are none and the groundwater level data on the impacts of historical abstraction are limited;
- improved information and understanding of the local and regional stratigraphy and hydrogeology in terms of aquifer distributions, characteristics, groundwater levels and groundwater quality;
- measurement of transient groundwater levels, enabling assessment of both drawdown and recovery trends;
- renewed assessments of the recharge to and sustainable yields of the regional aquifer systems;
- refinement of predictions regarding the benefits of the Carnarvon Basin Rehabilitation Project and future rehabilitation initiatives; and
- provision of information and tools that might assist in the framing of future groundwater management strategies for the southern Carnarvon Basin.

The proposed contribution to the Carnarvon Basin Rehabilitation Project is not considered a 'compensatory action' and Gunson makes no commitment that the quantity of groundwater saved will be the equivalent to the groundwater used for the mining operation. The Coburn Project is not a contributor to the historical wastage of groundwater resources of the Carnarvon Basin.

The Wildflower Society submission noted that there are several uncapped bores in the Shark Bay area, and stated the proponent should make a commitment to assist with the funding for capping these bores. The DoA submission stated that it was unclear whether the proponent would be looking for ways of contributing to control and manage existing uncontrolled bores in the southern end of the Carnarvon Basin. The department stated that it would like to see as a minimum that Gunson be responsible for rehabilitating all uncontrolled (sub and artesian) bores within and surrounding their impact zone if the Project is approved.

This issue has been addressed in the above response.

The proposed contribution to the Carnarvon Basin Rehabilitation Project may be in the form of assistance in the rehabilitation of bores in the vicinity of the Project Area that, if brought under control, would limit future wastage, promote groundwater conservation and potentially lessen drawdown impacts. The Coburn Project is not a contributor to any historical or future wastage of groundwater resources of the Carnarvon Basin. As such, it is inappropriate that Gunson be asked and considered responsible for the rehabilitation of all uncontrolled artesian and sub-artesian bores within and surrounding the area potentially impacted by drawdown due to proposed future abstractions for process water supplies.

5.1 Air Emissions

Submission 6 stated that dust on vegetation would make plants unpalatable to stock, affecting pastoral productivity.

It is known that dust occurs in the region naturally as a result of persistent strong winds. Dust deposition on vegetation is also likely to occur naturally. The Project is not expected to result in significantly higher levels of dust deposition on vegetation as an extensive dust management programme will be implemented. The proposed dust management measures for the Project include implementing a progressive rehabilitation programme to reduce the risk of dust generation and regular wetting and grading of all unsealed roads. Through the implementation of these management measures and the dust monitoring programme, it is considered that dust will not result in plants becoming unpalatable to stock.

The SBWHP CCC submission raised concern regarding the effect of dust on vegetation and aesthetics in the vicinity of the access tracks on the mine site and along the section of North West Coastal Highway between the mine access road and Geraldton. It stated that it is imperative that the vehicles carting the HMC be covered effectively so that none of the mineral sand overflows or is blown out.

The trucks transporting the Heavy Mineral Concentrate (HMC) to Geraldton will be covered and will not be overloaded. These measures will be implemented not only to minimise dust emissions from the transportation of HMC to Geraldton, but also to minimise loss of valuable product. Water spraying of all unsealed roads, including the main access road and internal haul roads, will be undertaken to minimise dust generated from these roads.

The Main Roads submission recommended that operators be required to have some form of dust suppressant for regular use on the mine access road.

Gunson will be using brackish water for dust suppression on the mine access road. Water spraying of unsealed roads within the Project Area will be undertaken on a regular basis.

5.2 Water

Submission 6 stated that saltwater mounding in grazing areas could kill vegetation or diminish productivity for stock, which would affect pastoral productivity.

It is intended that the mounding of residual process water will not be of sufficient height to impact on overlying vegetation. Monitoring of transient changes in the depth to the water table will be linked to knowledge of the vegetation root zones and groundwater abstraction strategies in areas of apparent vegetation risk. Should any potential impacts become apparent, these would be investigated and used to refine the water management protocols. In these circumstances, the management of identified potential impacts would predominantly be linked to strategies to locally increase the recovery of water from and dewatering of the disposed sand tailings. These strategies would be intended to reduce both mound heights and extents.

5.3 Waste

The Conservation Council submission stated that the proposed waste disposal is not in line with WA's strategic directions for waste and that a Zero Waste Plan should be developed.

The Proponent disagrees with the Conservation Council's statement that the proposed waste disposal for the Project is not in line with WA's strategic directions for waste. According to the report prepared by the DoE and Waste Management Board entitled 'Strategic Direction for Waste Management in Western Australia' (2003), the zero waste concept involves looking at optimising consumption and products so that waste is no longer generated. The waste management hierarchy that is applicable to the Western Australian Zero Waste Model as presented in the DoE and Waste Management Board (2003) report is as follows:

1. Avoid.
2. Minimise.
3. Recycle.
4. Treat.
5. Dispose.

Gunson will implement a waste hierarchy in Project planning by undertaking activities such as:

- To reduce the amount of greenhouse gas emissions, Gunson has **avoided** the use of diesel for power generators and instead will be using high efficiency variable load generator units that use natural gas.
- To **minimise** the amount of waste used and the amount of wastewater from the tailings, water will be recovered and **recycled** from the cyclones and from the tailings water recovery system.
- All waste oils will be collected by the earthmoving 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 for **treatment**.
- Structural waste will be **recycled** through a scrap metal merchant, where possible.
- Any recyclable wastes, such as glass, cans and plastic, within the domestic waste stream will be collected separately and transported off-site to a **recycling** facility.

The Conservation Council submission asked what impacts would result from disposing of the waste water from the desalination plant into the slimes trenches in the pits.

The impacts of disposing reject water from the reverse osmosis plant will be insignificant given the very small quantity requiring disposal compared to the process water throughput. Although the salinity will be

higher than that of the process water, it will be diluted by several orders of magnitude once disposed and mixed with the process water.

5.4 Light

The CALM submission recommended that directional lighting and/or light shields be investigated to further reduce light overspill, which is known to disturb faunal movements and behaviour.

As described in Section 9.3.3 of the PER, Gunson will ensure that the level of lights used will be as low as safety permits. Gunson acknowledges CALM's recommendation and will install directional lighting and/or light shields to further reduce light overspill.

6.1 Public Health and Safety

Radiation

The Main Roads submission raised concern regarding management of a concentrate spill during transport and requested that a management plan for spillage be submitted to the department for review and comment.

A management plan for spillage would only be necessary if transporting radioactive dry separation plant tailings. The transport of HMC from the wet concentrator for export will not meet the classification of 'radioactive' under the Transport Code and is therefore not classified as a Dangerous Good. Therefore, a specific response plan for spillage of HMC is not required. However, this issue will be addressed in the Project's Emergency Response Plan.

The Radiological Council submission commented that:

- *The commitments made in the PER did not reflect the legislative requirement for registration and licensing under the Radiation Safety Act 1975.*

The Proponent is aware that the registration of the mine site and licensing of a Radiation Safety Officer are required under the *Radiation Safety Act 1975*, and confirms that these requirements will be addressed at the time of commencement of mine development.

- *The objectives of the Radiation Management Plan need to meet the requirements of the Radiological Council.*

The objectives presented in the Radiation Management Plan (Appendix I of the PER) were obtained from the agreed scope of work for the environmental impact assessment. However, it is recognised that the Radiation Management Plan will need to comply with requirements of the Radiological Council.

- *Pre-mining radiation monitoring results were unclear in the PER document. Further clarification on actual and predicted levels is required.*

As stated in Section 4.2.4 of the PER, Radiation Advice & Solutions Pty Ltd undertook a Pre-Operational/Baseline Radiation Monitoring Programme in July 2004. The programme included a gamma survey (instrumental readings) and taking soil samples at 35 locations. The gamma readings ranged above and below about 20 nanosieverts per hour (equating to above and below about 30 nanograys per hour). These are very low natural background levels.

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- *Further consultation and approvals from the State Mining Engineer and the Radiological Council on return of waste material to mine void is required.*

Gunson confirms that the Project does not involve the return of dry separation plant tailings to the mine void and therefore approvals from the Radiological Council will not be required. If a dry separation plant was planned, with return of the dry separation plant tailings to the mine site, then it is understood that this would be subject to a separate approvals process, including review of transport regulations for the tailings and (if necessary) licensing of the carrier.

- *Licences are required for the transport of radioactive substances under the Radiation Safety Act 1975, should dry tailings be returned to the mine site.*

This issue has been addressed above.

- *Replace references to the 'Radiation Safety (Transport of Radioactive Substances) Regulations 2001' with 'Radiation Safety (Transport of Radioactive Substances) Regulations 2002'.*

Gunson acknowledges this correction.

Road Transportation

Submission 6 stated concern about the increase in traffic on the pastoral lease. This concern is related to an increase in the risk of accidents due to increase in traffic volume and deterioration in the quality of the roads, and the associated increase of maintenance costs. Submission 6 has suggested that the proponent establish a northern access road as well as the southern access road.

The site access road will traverse the Coburn and Meadow pastoral leases and intersect the North West Coastal Highway approximately 3 km north of the Billabong Roadhouse. This road will be a private road and will not be accessible to the public. Therefore, the increase in traffic on the pastoral lease will not pose a risk to the safety of the general public.

As stated in Section 9.2.3 of the PER, management measures will be implemented to ensure that the condition of the mine access road is maintained. Gunson will undertake monthly inspections of road conditions and collect random reports on road conditions from the transport personnel and other project personnel using the roads. The access road will be graded annually or on an as-needs basis to ensure that the road condition is safe for use.

Gunson will not be constructing the northern access road for this Proposal.

The Main Roads submission raised concern regarding the lack of information in the PER document on frequency and quantity of LNG deliveries from Karratha to the proposed mine site. Main Roads stated that it was not able to determine potential adverse impacts on road access or if any particular requirements were necessary to accommodate the proposed activity.

There will be around one LNG delivery per day to the minesite during the first two years of operations. Around two deliveries per day will be required from Year 3.

Potential impact to road safety at the intersection of the proposed mine access road and North West Coastal Highway was raised in the Main Roads submission. The department requested that a project approval condition be that the intersection is designed in consultation with and to standards and conditions set by Main Roads and the Shire of Shark Bay.

Gunson acknowledges the advice from Main Roads regarding the design of the intersection of the proposed mine access road and the North West Coastal Highway. Gunson will design the intersection in consultation with, and to the standards and conditions set by, Main Roads and the Shire of Shark Bay.

The Main Roads submission and the Shark Bay LCDC submission raised concern for potential impact of drawdown on bores used for road watering and construction. Main Roads indicated that bores in the northern portion of the site were of particular concern and sourcing an alternative water supply may lead to other environmental and social problems.

An alternative supply will not be required. It is predicted that the bore in the northern portion of the site (Nilemah Artesian No. 1A) will experience about 3.5m of drawdown (35 kPa pressure reduction) during the life of the mine. Against a baseline artesian pressure of about 400 kPa, this drawdown impact may result in slightly lower rates of artesian flow at the surface and consequently marginally slower fill times. Drawdowns of this magnitude should not adversely affect the use of the bore.

6.2 Surrounding Land Use

Submissions 6 and 13, and submissions from the Shark Bay LCDC, Shire of Shark Bay, SBWHP CCC and Main Roads raised concern regarding the actual and potential impact of mining activities on water drawdown and consequently on the actual and potential economy of the region and individual businesses. These submissions identified that the use of large quantities of water for mining has potential adverse impacts and economic consequences to the following:

- *pastoral leases and homesteads;*
- *town water supply (Denham and Useless Loop);*
- *aquaculture and irrigated fodder crop operations;*
- *mineral processing at Dampier Salt; and*
- *road maintenance and construction.*

Submission 6 was concerned that pressure in bores in the region would decrease from the commencement of operations. It commented that the decrease in pressure would specifically affect its ability to water and manage stock and the ability to produce an energy supply.

The SBWHP CCC submission has also expressed concern about potential impacts to the Hamelin Pool Pastoral Lease relating to:

- *a decline in levels of artesian water pressure;*

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- *loss of power generation from artesian water;*
 - *an impact on stock grazing due to vegetation reduction;*
 - *change to lifestyle attributed to large numbers of people in the vicinity; and*
 - *the potential for increased dust.*

The Shark Bay LCDC submission stated that not enough research has been done into the impacts of the removal of large quantities of water and lack of investigation into alternative supply. In addition to pastoral stock and homesteads, the Shark Bay LCDC was concerned about impacts to local roadhouses and motels, town water supplies (Denham and Useless Loop), and tourism operations.

The impact of water pressure and supply loss to tourism was identified as a concern in the Shark Bay LCDC submission and in Submission 6. In particular, Submission 6 raised concern about the effect on the development of a tourist accommodation proposal in the area. The proposal would be affected through the loss of ability to produce hydro-generated energy and loss of artificial wetland function. The Shark Bay LCDC submission raised concern about the effect on tourist operations at Nanga, Hamelin Telegraph Station and Monkey Mia.

Concerns regarding potential impacts to aquaculture and fodder crop enterprises were identified in Submission 6 and Submission 13. These enterprises have been developed on current aquifer pressures, temperatures and salinity. The change of these parameters resulting from mining activities could have an adverse affect on the businesses.

The predicted drawdown impacts do not threaten groundwater supply capabilities in the region and will not threaten surrounding land uses and individual businesses. The maximum predicted drawdown impacts from Birdrong Sandstone and Kopke Sandstone groundwater supply abstractions (Table 6) range from 0.7 to 5.6 m in existing bores on the Hamelin Station and are 3.5 m in Nilemah Artesian No. 1A (Nanga Station), 3.3 m in the Hamelin Telegraph Station Bore, 1.9 m in Carbla No.13 (Carbla Station), 1.7 m at the Overlander Roadhouse and 1.6 m in Carbla No. 16. Bores such as Hamelin Homestead No.1, Nilemah Artesian No.1 and Hamelin Telegraph Station will remain artesian and the supply capability of other bores is not expected to be significantly different. In sub-artesian bores, any differences (reductions) in supply capability are predominantly expected to be made-up by lowering of installed pump-units to increase submergence. In selected instances there may be a need to install alternative pump-units to replicate existing supplies.

The sensitivity of the energy and water supply derived from Hamelin Homestead No. 1 has been highlighted in the PER. This bore is not expected to stop flowing, though a pressure reduction equivalent to 3.5 m of head (about 35 kPa or 5 psi) is predicted. Should this pressure loss result in the failure of the energy supply or other existing groundwater use, then Gunson would provide an alternative source of energy and water to replace such losses. Evidently, based on information provided in Submission 6, the power generation system on Hamelin Homestead No. 1 can withstand a pressure drop of 21 to 28 kPa (3 to 4 psi) without the loss of generation capacity. Notwithstanding this, the impacts of a maximum 35 kPa reduction in borehead pressure are expected to be minimal.

The importance of the existing groundwater use is acknowledged and reflected in the PER, which included 14 groundwater-specific commitments to manage the use of groundwater and drawdown impacts from its abstraction. These commitments by Gunson, including both groundwater investigation and monitoring programmes, are specifically intended to define and manage the drawdown impacts within the regional aquifers. The monitoring programme includes an extensive array of monitoring points within all of the hydrogeological units in the region including both aquifers and aquitards. Further baseline studies are also planned to derive an agreed benchmark of existing groundwater characteristics, amenities and supply conditions and subsequently to agree practical protocols for managing any adverse drawdown impacts on existing amenities or supplies.

Gunson made a commitment in the PER to maintain the existing groundwater supplies and uses that are adversely affected by the drawdown impacts of process water abstractions.

Submission 6 also raised concern about loss of pastoral productivity resulting from potential dust on vegetation affecting the palatability of vegetation to stock, loss of vegetation in grazing areas due to salt water mounding and loss of land due to mining.

As discussed in Sections 4.5 and 5.1 of this document, no loss of pastoral productivity due to water mounding or dust deposition on vegetation is expected.

The development of Pit 1 to Pit 9, and associated infrastructure would primarily occur on the Coburn Pastoral Lease, which is owned by the Proponent. A small area of the Hamelin Pastoral Lease will be affected by development of the northern portions of Pit 7 to Pit 9. Any loss of land due to mining would be addressed through a compensation agreement with the owner of this pastoral lease.

The DoA submission asked what the regional cost benefits and regional multipliers are for the project's use of water from the Carnarvon Basin.

The Proponent has not undertaken a regional cost benefit analysis to be able to provide figures on the cost benefits and regional multipliers for the Project's use of water from the Carnarvon Basin. Cost benefit analysis is not a requirement of the Environmental Impact Assessment (EIA) (Part IV Division 1) Administrative Procedures 2002. In fact, the *Environmental Protection Act* 1986 specifically constrains the EPA to addressing only environmental, social and pollution prevention issues, and precludes the assessment of economic costs and benefits.

6.3 Culture and Heritage

The DIA submission requested that a Heritage Management Plan detailing procedures for the discovery of cultural material during the mining work and associated activities be established.

An Aboriginal Heritage Management Plan has been developed for the purpose of protecting Aboriginal heritage in the Project Area and will apply throughout the life of the Project, from exploration, construction and through to the production of mineral sands.

The Aboriginal Heritage Management Plan has been drafted to protect Aboriginal heritage in conjunction with the *Aboriginal Heritage Act 1972* (WA), the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth), the Mining Agreement between Gunson Resources Ltd and the Nanda Native Title Applicants dated 20 September 2004 (Agreement), and the outcomes resulting from regular consultation with the Nanda and Malgana Working Groups as well as other Aboriginal people with an interest in the area.

This Aboriginal Heritage Management Plan provides guidance in relation to:

1. Land access at exploration stage;
2. Land usage at exploration, construction and operations stages; and
3. Site management throughout the life of the Project.

It should be noted that Gunson's Aboriginal Heritage Management Plan includes the use of Aboriginal monitors during the construction process to ensure that any Aboriginal heritage sites found during this phase are managed in accordance with DIA policy and State and Commonwealth legislation.

The SBWHP CCC submission considered that information in the PER on the number of archaeological sites in the Project Area to be incorrect. The committee was also concerned that there was no mention on the importance of water to indigenous people.

There appears to be some confusion about the number of archaeological sites within the Project Area. The confusion about there being more than one site probably relates to the fact that there are a number of archaeological sites registered within 30 km of the Project Area, but these are not within the Project Area itself, except for the one that was recorded in the 2004 heritage survey.

Consultation with the Aboriginal people of the area has consistently reported that there has not been a regular water source in the area of the Project and therefore there is very little chance that any archaeological sites will be found there.

The Conservation Council submission commented that the heritage report used in the PER was "restricted" and indicated concern that the report was not registered with the DIA. The council has requested a more open and thorough and up to date examination of archaeology and heritage of the area.

The baseline report is not registered with the DIA because the Nanda People did not instruct their representatives, Yamatji Land and Sea Council, to register this report with DIA. While Gunson funded this survey, the company did not control whether the report be registered with the DIA.

Since the baseline report of 1999, further surveys (and reports) have been conducted in December 2004 and July 2005.

The submission made by the Conservation Council also stated that information on European heritage in the PER did not include any reference to UNESCO World Heritage listings.

Section 9.5.2 of the PER acknowledges that the SBWHP is a European heritage site that occurs adjacent to the Project Area and Section 10.2 of the PER stated that “The Amy Zone is located adjacent to the southeastern boundary of the SBWHP. The property was listed in 1991 on the basis that it met all four of the ‘natural’ criteria set out by the United Nations Educational, Scientific and Cultural Organisation (UNESCO)”. Further discussion of the UNESCO World Heritage listing is also provided in Section 10.2 of the PER.

7.1 Project Benefits

The Wildflower Society submission stated that there is no positive environmental gain from the Project.

The Proponent disputes the Wildflower Society's claim that there is no positive environmental gain from the Project because there are a number of environmental benefits that would result from the implementation of the Project. The benefits include:

- Contribution of funds and support for scientific research into the ecology of the SBWHP.
- Better understanding of the local and regional environment, including hydrogeology and vegetation.
- Contribution of funds for the Shark Bay Interpretive Centre in Denham, which is a conservation and environmental education centre sponsored by the Federal and Western Australian governments.
- Improvement in fencing between the site and the SBWHP.
- Contribution to the Carnarvon Basin Rehabilitation Project.
- De-stocking the Coburn Pastoral Lease for several years to allow vegetation to recover and then re-stocking it at a rate well below carrying capacity.
- Undertaking introduced predator culling on the property to control populations of dingoes, cats and foxes.

These combined actions assist in mitigating the loss of habitat in the mining area and will result in an environmental gain.

The SBWHP CCC submission stated that the majority view by committee members was to generally support the Project given the local employment opportunities that would become available and the need for diversity of development in the area.

Gunson agrees with this conclusion and confirms that the Project will result in full-time employment for approximately 105 people on an ongoing basis, while a further contribution will be created by the flow-on effects on service industries and other sectors of the economy.

7.2 Pit 10

The CALM and Wildflower Society submissions stated that the proponent has not adequately demonstrated that the potential impacts associated with the development of Pit 10 can be adequately managed.

As discussed in Section 2, Gunson has decided to exclude Pit 10 from the Project.

Submissions by the Wildflower Society, SBWHP SAC, SBWHP CCC, CALM and the Conservation Council stated that Pit 10 should be excluded from the current proposal as the environmental risks are too great. The Conservation Council submission stated that any subsequent proposal for Pit 10 should be the subject of an Environmental Review and Management Programme after it has been demonstrated that there will be no adverse impacts on World Heritage values. The SBWHP CCC submission considered that approval of Pit 10 should be conditional upon the proponent demonstrating that the potential impacts can be managed in an environmentally acceptable manner, i.e. upon completion of the studies outlined in Commitment 1 of the PER.

As stated above, Gunson has decided to exclude Pit 10 from the Project. Gunson acknowledges that further investigations would be required to demonstrate that there would be no adverse impacts on the SBWHP should the company decide to seek approval for mining Pit 10 in the future.

7.3 Proponent Commitments

The Wildflower Society submission stated that many of the proponent's commitments amount to operating within the laws of Western Australia, and commitments should be confined to those which go beyond meeting requirements.

Some of the commitments that are summarised in Section 11 of the PER demonstrate that Gunson is striving to exceed regulatory requirements for the implementation of the Project. For example, Commitment 3 in the PER, which relates to the de-stocking of the Coburn Lease, was developed to provide some environmental benefits for the Project. Commitment 33 in the PER, which states that the Proponent will integrate best practice dust management procedures in consultation with the DoE, also shows that the Gunson is striving to implement management measures that go beyond meeting requirements. Therefore, Gunson disputes the claim made by the Wildflower Society that the commitments in the PER do not go beyond meeting regulatory requirements.

Note: The numbering of commitments presented in Section 8 of this document is different to the number presented in the PER as several commitments are no longer required due to the exclusion of Pit 10 from the proposed Project.

7.4 Environmental Offsets

As offsets, the Wildflower Society submission recommended that the proponent cap the bores in the area and provide funds to CALM and DoE for the monitoring of the impact of the mine on the SBWHP.

Gunson is committed to monitoring of the local and regional groundwater impacts of the mine to comply with the Licence to Take Water. Gunson also supports the principle of the Carnarvon Basin Rehabilitation Project and associated bore-capping, and is prepared to contribute additional benefits in the southern Carnarvon Basin. This contribution may be in the form of assistance in the rehabilitation of

bores in the vicinity of the Project Area that, if brought under control, would limit future wastage, promote groundwater conservation and potentially lessen drawdown impacts.

The Coburn Project is not a contributor to any historical or future wastage of groundwater resources of the Carnarvon Basin. As such, it is inappropriate that Gunson be considered responsible for the rehabilitation of all uncontrolled artesian and sub-artesian bores within and surrounding the area potentially impacted by drawdown due to proposed future abstractions for process water supplies.

As indicated in Section 3.2 of this document, Gunson will implement groundwater, vegetation and dust monitoring programmes to determine whether the Project is having any adverse impacts on the SBWHP. The results of the monitoring programmes will be reported in the AER which will be submitted to the DoE and DoIR. As Gunson will be implementing the monitoring programmes and will be reporting to the regulatory authorities on a regular basis, the company does not propose to provide any funding to CALM or the DoE for these programmes.

The CALM and Wildflower Society submissions stated the proponent should investigate a series of other potential offsets.

All impacts associated with the mining of Pit 1 to Pit 9 are expected to be manageable and not impact on conservation values. According to the Preliminary EPA Position Statement No. 9 on Environmental Offsets (Version 2) (EPA, 2005), “environment offsets should only be considered after all other attempts to mitigate significant adverse impacts have been exhausted”. Therefore, as the Proponent has committed to implementing a number of environmental management measures to mitigate potential impacts, and as it can be demonstrated that the proposal will not result in significant adverse impacts, it is considered that environmental offsets are not required for this Project.

Notwithstanding this, Gunson proposes to implement the following mitigation measures to provide environmental benefits to the region:

- Contribution of funds and support for scientific research into the ecology of the SBWHP.
- Better understanding of the local and regional environment, including hydrogeology and vegetation.
- Contribution of funds for the Shark Bay Interpretive Centre in Denham, which is a conservation and environmental education centre sponsored by the Federal and Western Australian governments.
- Improvement in fencing between the site and the SBWHP.
- Contribution to the Carnarvon Basin Rehabilitation Project.
- De-stocking the Coburn Pastoral Lease for several years to allow vegetation to recover and then re-stocking it at a rate well below carrying capacity.
- Undertaking introduced predator culling on the property to control populations of dingoes, cats and foxes.

Changes have been made to the environmental management commitments as a result of the changes made to the Project Description (through the removal of Pit 10 from the Project) and issues raised in the public submissions. Specifically, the changes are:

- Commitments 1, 15, 16 and 32 have been deleted as these related specifically to Pit 10. Consequently, all commitments have been renumbered.
- Minor changes to the wording of Commitments 10, 11, 13, 14, 15 have been made.

The revised list of commitments is presented as Table 7.

**Table 7
Revised Environmental Management Commitments**

Commitment	Proposed Action	Timing		
		Construction	Operation	Closure
1	The Proponent will develop and implement an Environmental Management System as part of the overall management system for the Project.	✓	✓	
2	The Proponent will de-stock the Coburn pastoral lease for a minimum of several years, and longer if permission is granted by the Pastoral Board, and undertake introduced predator control.	✓	✓	
3	The draft Rehabilitation Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will rehabilitate areas disturbed during the construction and operation of the Project on a progressive basis.	✓	✓	✓
4	The Proponent will implement a soils characterisation programme to identify any potentially dispersive soils and ameliorate any impact to the rehabilitated soil profile.	✓	✓	
5	The Proponent will implement a soils monitoring programme to assess the capabilities of the reconstructed soil profile and compare them with the soil characteristics of the original and analogue profiles.		✓	✓

Table 7 (continued)

Commitment	Proposed Action	Timing		
		Construction	Operation	Closure
6	The draft Groundwater Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. Gunson will implement the Groundwater Management Plan during the construction, operation and decommissioning of the Project.	✓	✓	✓
7	The Proponent will operate the borefield in line with the Project’s groundwater licence Operating Strategy.	✓	✓	
8	The Proponent will remain within the licensed allocation as defined by the Licence to Take Water current at the time.	✓	✓	
9	The Proponent will trial and implement robust, practical and secure tailings water recovery strategies that strongly promote and demonstrate groundwater conservation principles.	✓	✓	
10	The Proponent will implement monitoring programmes, particularly in the initial three years of the project, that enable the magnitudes and dimensions of the water table mounding beneath and in proximity to the sand-stackers and backfilled pit areas to be characterised.	✓	✓	
11	The Proponent will implement investigation and monitoring programmes in known areas of potential environmental risk due to water table mounds encroaching on the root zones of vegetation stands.	✓	✓	
12	If monitoring indicates the mounding will reach the root zones in sensitive vegetated areas, the Proponent will undertake additional mitigation measures as required to minimise long-term impacts.	✓	✓	
13	The Proponent will develop practical operating strategies linked to the sand-stackers that would facilitate the retention in and abstraction of tailing water from localised in-pit drains as required to limit environmental risks to nearby vegetation stands.	✓	✓	

Table 7 (continued)

Commitment	Proposed Action	Timing		
		Construction	Operation	Closure
14	The Proponent will investigate and monitor the vertical hydraulic gradients and hydraulic conductivities within the Alinga Formation and Toolonga Calcilutite to assess potential drawdown impacts propagating from the Birdrong Sandstone and Kopke Sandstone to the unconfined aquifer systems.	✓	✓	
15	The Proponent will establish a multipiezometer network in the Birdrong Sandstone and Kopke Sandstone that provides a robust pre-development baseline and enables an accurate assessment of local and regional drawdown impacts.	✓	✓	
16	The Proponent will develop and implement a communication strategy to broadcast to individual pastoralists the predicted drawdown impacts on their production bores.	✓	✓	
17	The Proponent will maintain supply to existing groundwater users that are adversely impacted by drawdowns resulting from the process water borefield operation.	✓	✓	
18	The Proponent will ensure that vegetation communities S5 and S10 are not disturbed by the Project.	✓	✓	
19	The Proponent will implement annual vegetation surveys in locations adjacent to the areas affected by mining and in the northern section of the Project Area in order to monitor the effect of mining operations on vegetation health.		✓	✓
20	The draft Vegetation and Flora Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Vegetation and Flora Management Plan during the construction and operational phases of the Project.	✓	✓	
21	The draft Fire Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Fire Management Plan during the construction and operational phases of the Project.	✓	✓	

Table 7 (continued)

Commitment	Proposed Action	Timing		
		Construction	Operation	Closure
22	The Proponent will conduct further survey work to determine whether <i>Eucalyptus beardiana</i> and <i>Verticordia dichroma</i> var. <i>syntoma</i> or other Rare or Priority Flora are present within the proposed haul road corridor and accommodation camp area.	✓		
23	Searches for Rare and Priority Flora will be conducted prior to the development of each pit and associated infrastructure to ensure that up-to-date information is considered in the detailed design of the pits and other project components during the construction and operation of the Project.	✓	✓	
24	The draft Priority Flora Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Priority Flora Management Plan during the construction and operational phases of the Project.	✓	✓	
25	The draft Weed Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Weed Management Plan during the construction and operational phases of the Project.	✓	✓	
26	The draft Vertebrate Fauna Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement these Management Plans during the construction and operational phases of the Project.	✓	✓	
27	The Proponent will conduct a stygofauna survey in the southern portion of the Project Area using existing bores. Re-sampling of the bores located in the northern portion of the Project Area will also be conducted. If stygofauna are found to occur in these areas, then sampling outside of the Project Area will be conducted to demonstrate that these species occur outside the Project Area.	✓	✓	

Table 7 (continued)

Commitment	Proposed Action	Timing		
		Construction	Operation	Closure
28	The draft Dust Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Dust Management Plan during the construction and operational phases of the Project.	✓	✓	
29	The Proponent will integrate best practice dust management procedures in consultation with the DoE and regular monitoring and reporting of offsite impacts including vegetation and stromatolites located within the SBWHP.		✓	
30	The draft Solid and Liquid Waste Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Solid and Liquid Waste Management Plan during the construction and operational phases of the Project.	✓	✓	
31	The draft Hydrocarbon Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Hydrocarbon Management Plan during the construction and operational phases of the Project.	✓	✓	
32	The draft Radiation Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Radiation Management Plan during the construction and operational phases of the Project.	✓	✓	
33	The draft Aboriginal Heritage Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Aboriginal Heritage Management Plan during the construction and operational phases of the Project.	✓	✓	

Department of Environment and Waste Management Board (2003) *Strategic Direction for Waste Management in Western Australia*. DoE and Waste Management Board, August 2003.

EPA (2005) *Environmental Offsets. Environmental Protection Authority Preliminary Position Statement No. 9*. Environmental Protection Authority, July 2004.

EPA (2004a) *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia. Environmental Protection Authority Guidance Statement No. 51*. Environmental Protection Authority, June 2004.

EPA (2004b) *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Environmental Protection Authority Guidance Statement No. 56*. Environmental Protection Authority, June 2004.

Mattiske Consulting Pty Ltd (2005) *Flora and Vegetation in the Proposed Coburn Mineral Sand Mine, Coburn, Hamelin and Meadow Stations, Shark Bay*. Report prepared for URS Australia Pty Ltd on behalf of Gunson Resources Limited, September 2005.

Moore, G. (1998) Soil Salinity. In 'Soilguide. A handbook for understanding and managing agricultural soils'. (ed. G. Moore), Agriculture Western Australia Bulletin No. 4343, pp. 146-158.

Wills, R. and Dogramaci, S. (2000) *Hydrogeology Report No. 170, Carnarvon Basin, Hydrogeology and Hydrochemistry of the Confined Groundwater Systems, WA*. Water & Rivers Commission, Perth, 2000.

URS Australia Pty Ltd (URS) has prepared this report for the use of Gunson Resources Limited in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in URS Proposal 03-155.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared in September-October 2005 and is based on the information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Attachment A
Gunson's Response to a Technical Peer Review of Soil
Related Aspects of the Draft Rehabilitation Plan by
Professor Bob Gilkes, UWA

ATTACHMENT A

TECHNICAL REVIEW OF SOIL-RELATED ASPECTS OF THE PROPOSED MINING AND REHABILITATION PLAN COBURN MINERAL SAND PROJECT

1. Introduction

The Environmental Protection Authority (EPA) has requested that a technical review be conducted of the soil-related aspects of the proposed mining and rehabilitation plan for the Coburn Mineral Sand Project. The Project is being assessed as a Public Environmental Review (PER) which was issued by Gunson Resources Limited (Gunson) for public review from 4 July to 29 August 2005.

The purpose of the technical review was defined by the EPA as being “to assess the proponent’s proposed mine planning and rehabilitation to determine whether the EPA’s broad objectives for rehabilitation are capable of being met, having particular regard to the physical nature of the site (soils, landforms and climate) and the characteristics of the native vegetation at the site”.

The EPA’s broad objectives for rehabilitation are:

- To ensure that post-mining landforms are stable and comparable to those which existed pre-mining;
- To maintain the integrity, ecological functions and environmental values of the soil and landform;
- To ensure that rehabilitation achieves an acceptable standard compatible with the intended landuse, and consistent with the appropriate criteria;
- To return self-sustaining native vegetation after mining which is as close as possible to the pre-mining vegetation in species composition and ecological function; and
- To protect the environmental values of areas identified as having significant environmental attributes, in particular the Shark Bay World Heritage Property.

Professor Bob Gilkes from the University of Western Australia was identified by the EPA as an appropriate technical specialist to conduct the review, and was commissioned by Gunson at the EPA’s request. Specific Terms of Reference (ToR) were provided to Prof. Gilkes to guide the technical review. The ToR were as follows:

- (1) Assess the adequacy of the soil sampling program carried out by the proponent in terms of characterising the nature of the soils at the project site, including depth distribution of plant roots, characterisation of soil profiles, clay content, nature and distribution of dispersive materials, moisture holding capacity of the soils, erosion potential and occurrence of acid sulphate soils.
- (2) Comment on the capacity of altered soils and landscapes to support self-sustaining local plant communities.

- (3) Assess the adequacy of the proponent's proposed revegetation methods, mining methods, soil handling methods (including handling of topsoil) and landform reconstruction methods in terms of meeting acceptable soil reconstruction standards that would allow the project to meet the EPA's broad objectives for rehabilitation.
- (4) Comment on the likelihood of the proponent being able to achieve a system that has the following five key fundamental requirements needed for vegetation establishment, habitat restoration and ecosystem development (as outlined by D.C. Blandford & Associates in the Soils and Landforms Report; Appendix C, p. 10, of the PER Document):
 - (i) providing an upper profile with sufficient thickness to provide an adequate rooting depth for vegetation,
 - (ii) providing a profile that comprises materials able to retain moisture,
 - (iii) providing an upper profile that has high infiltration rates,
 - (iv) providing an upper profile that comprises materials that have a low erodibility rating,
 - (v) providing a slope length / slope angle / materials combination that enhances long-term stability,

Whereby the upper profile is defined as the top 1 metre of soil.

- (5) Provide comment on any other matters which the reviewer believes are relevant to rehabilitation at the site.

The ToR also defined that the review would "examine the PER, rehabilitation plan, soil and landform report and any other relevant documents and include discussions with project personnel and with the EPA Service Unit and CALM staff as necessary. A field trip to the project site can be included if appropriate."

A copy of the PER was provided to Professor Gilkes and a site visit conducted with Gunson's Senior Geologist, Paul Leandri. Prof. Gilkes did not discuss the project with Gunson's consultants or Gunson personnel other than Mr Leandri.

Prof. Gilkes submitted his report to the EPASU on 28 August 2005. A copy of the report was provided to URS by Prof. Gilkes on 31 August 2005.

This document provides Gunson's responses to Prof. Gilkes' review. The response is structured according to the five ToR outlined above. Each ToR is reproduced in full, followed by Prof. Gilkes' comment on that ToR copied from his report dated 28 August 2005. Gunson's response to Prof. Gilkes' comment then follows.

2. Reference 1

2.1 EPA Direction

Assess the adequacy of the soil sampling program carried out by the proponent in terms of characterising the nature of the soils at the project site, including depth distribution of plant roots, characterisation of soil profiles, clay content, nature and distribution of dispersive materials, moisture holding capacity of the soils, erosion potential and occurrence of acid sulphate soils.

2.2 Prof. Gilkes' Comments

“Soil evaluation is described in the PER and particularly in Appendix C. The landforms, profile morphology and textural properties of soils are reviewed in some depth. There are several particle size analyses of soil materials, but in all other respects the intrinsic properties of soils are not adequately evaluated. There are pH values for single samples from five soil profiles and limited chemical analyses for three subsoil samples (from approx. 1 m depth). The Rehabilitation Plan (page 4-1 Paragraph 2) states that “the physical and chemical characteristics of the undisturbed soils are known”, this is not a valid statement as there is little or no information on many soil properties and on variations in properties within the proposed mine site.

Any “baseline” evaluation of soil properties to determine pre-mining conditions and for use as an indicator of rehabilitation success should include the standard chemical, physical and biological measurement observations for the entire solum. These include:

Chemical	Physical	Biological
pH	Texture	Root abundance
EC	Structure, stability, structural strength, erosion potential	Biological activity
OC	Pans (natural and induced)	
CEC	Water retention characteristics	
Exchangeable cations	Clay mineralogy	
Available nutrients (N, P, K)		
P-retention capacity		
Calcium carbonate % (total and reactive)		
Sulphide where appropriate		

I suggest that the standard published Australian Soil Analysis procedures be followed for this characterisation.

Most of these properties are sensitive to the disturbance associated with mining and rehabilitation. Together they provide a quantitative definition of the soil's resources and capacity to support biota. Many soil surveys for land development routinely collect these and additional data for the solum and the same requirement should operate for the Coburn site. The "quick and easy" LFA procedure that is discussed in the PER is useful but is not a substitute for a thorough definition of soil resources."

Prof. Gilkes summarised his response to this ToR in his Concluding Remarks as follows:

"In my opinion the characterisation of soils presented in the PER and its attachments is inadequate. It does not identify the key properties of the soils or their diversity and thus does not provide a clear basis for measuring rehabilitation success. LFA (Landscape Function Analysis) is not a substitute for soil analysis and is incapable of identifying many soil properties/problems."

2.3 Gunson's Response

Gunson (and its consultants) agrees that "LFA is not a substitute for soil analysis" and wishes to point out that the Draft Rehabilitation Plan refers to LFA only in relation to its potential usefulness as a monitoring tool for measuring the success of the rehabilitation program. At no point has the PER or the Rehabilitation Plan suggested its use as a substitute for soil analysis.

Gunson also agrees that detailed material characterisation as suggested by Prof. Gilkes, including physical and chemical analyses, will need to be undertaken once mining commences and material is available for landscape reconstruction. This is captured in the PER as Commitments 5 and 6. However, we do not see any value in conducting detailed soil analyses at the feasibility and pre-approval stage of a development. We also do not see how one can use a set of baseline conditions as an indicator of rehabilitation success when that baseline will be totally destroyed and rebuilt by the mining, and overburden and tailings disposal process. Indicators of rehabilitation success are generally developed when the final surface form has been defined and constructed, and the revegetation program has been designed and agreed to by the various parties involved.

It needs to be remembered that the result of mining is an artificial landscape, and a new physical and biological system. This new system has its own set of attributes that must be examined and understood when the system is being designed so that the behaviour and performance of the end product is as predicted and as required. All soils data collected prior to disturbance has limited application to the new system. This is the basis of carrying out extensive soil and vegetation investigations when the final arrangement of overburden, tailings and surface soil materials has been determined.

Therefore, Gunson does not agree that the characterisation of soils presented in the PER is inadequate for the purposes of the PER and design of the Draft Rehabilitation Plan. Given the relative similarity of regolith and solum conditions present throughout the site and their similarity of profile form and type, the nature of the surface form, the physical nature of the upper 1 m of the solum across the site, and the dominance of deep sandy surface soils across the site, it was

considered that a low diversity and complexity of soils existed and therefore a detailed soil survey was not necessary. Instead, the approach adopted was that of defining the soil landscapes of the Project Area. This method of identifying the range of soil types present is considered totally adequate for the terrain, general regolith type, and expected range of principal profile forms experienced at the site. It allows definition of the basic soil types present and indicates those aspects of the soils present that need to be investigated as part of the rehabilitation program.

3. Reference 2

3.1 EPA Direction

Comment on the capacity of altered soils and landscapes to support self-sustaining local plant communities.

3.2 Prof. Gilkes' Comments

“This objective is most likely to be achieved if the rehabilitated landform, soils and deep subsoil materials are identical to the pre-mining condition. The proposed rehabilitation plan recognises this objective, but as for most mine rehabilitation, will not be able to fully achieve this goal. In particular:

- Deep soil (>1 m) is sand tailings and will have relatively little fine material compared to the original soil. A possible consequence of this change is reduced water and nutrient retention.
- Traffic pans due to machinery may restrict root penetration and require ripping.
- Sodic and structurally unstable soils may develop due to the use of high sodium/calcium ratio water for dust control (the water is saline with sodium chloride being the dominant salt).

These matters should be evaluated prior to and during the initial mining phase and appropriate management and monitoring strategies evolved. The present small trial mining area and the benchmark studies (Appendix E) do not represent a situation that exactly corresponds to the proposed mine site materials and rehabilitation practice. These concerns should be fully evaluated prior to mining and where possible addressed by appropriate rehabilitation measures so as to increase the likelihood that self-sustaining local plant communities can be returned to the site.”

Prof. Gilkes summarised his response to this ToR in his Concluding Remarks as follows:

- “The soil materials can be damaged by traffic and the introduction of sodium in the salty water used for dust control. Appropriate management of these issues should be adopted.
- The Benchmarking Study is informative but does not include any situation that exactly coincides with the proposed rehabilitation situation and objectives. Several of the benchmark sites and soils are very different from those at the Coburn site. Some

sites/soils are similar and these observations encourage the view that a successful rehabilitation procedure can be developed.”

3.3 Gunson’s Response

Gunson agrees with much of Prof. Gilkes’ comment and in particular, his three dot points regarding matters requiring management during the initial mining phase. These are all issues that we have recognised and addressed in the Rehabilitation Plan. We accept that the deep soil sand tailings will have reduced water and nutrient retention capability. However, as the vegetation in the area is largely shallow rooted and rainfall dependent, the moisture retention capacity of the deep soils is of little importance to successful rehabilitation. We are aware of the consequences of excessive trafficking and agree that it needs careful management. We are also aware of the potential problems associated with using brackish water for dust control, which is why it is only proposed for use in regularly trafficked areas. It is not intended to irrigate the rehabilitation area with this water.

We also agree with Prof. Gilkes when he makes the statement that a capacity to support self-sustaining local plant communities...”is most likely to be achieved if the rehabilitated landforms, soils, and deep subsoil materials are identical to the pre-mining condition”. However, it needs to be recognised that replication of the entire baseline soil profile, after mining and removal of minerals and slimes, cannot be achieved in practice and would require substantial additional clearing for overburden stockpiles and rehandling of overburden, drying and grinding of the slimes and their subsequent blending with tailings. Whilst this might be physically feasible, it is not economically feasible, nor is it environmentally responsible given the extra clearing, trucking and rehabilitation required. Nor do we believe it is necessary to enable rehabilitation of the disturbed mining area.

Gunson accepts that the trial mining area and the benchmark studies do not exactly correspond to the proposed mine site materials and rehabilitation practice. It was recognised early in the process that a directly comparable site was unlikely to exist, so effort was made to ensure that the range of sites covered the range of issues likely to affect rehabilitation. Gunson agrees with Prof. Gilkes that “some sites/soils are similar and these observations encourage the view that a successful rehabilitation procedure can be developed.”

4. Reference 3

4.1 EPA Direction

Assess the adequacy of the proponent’s proposed revegetation methods, mining methods, soil handling methods (including handling of topsoil) and landform reconstruction methods in terms of meeting acceptable soil reconstruction standards that would allow the project to meet the EPA’s broad objectives for rehabilitation.

4.2 Prof. Gilkes' Comments

“The proposed procedure follows best practice in the construction of a similar landform, the return of a thick (90+ cm) subsoil layer and a topsoil (10 cm) layer that has not been affected by prolonged or wet storage. However, the overburden materials will be buried and replaced by sand tailings so that the constructed regolith sequence will be very different from the pre-mining condition. Thus an important difference is that washed sand tailings will be the deeper (>1 m) subsoil, such materials are inferior to the loamy sand or sandy loam that comprises the natural deeper subsoil. The company could consider inclusion of some of the slimes (clay) into the sand tailings, but must avoid thick (>ca 10 cm) layers of slimes within the sand tailings.

Similarly, disposal of most of the slimes in localised bodies beneath sandy materials will result in a regolith stratigraphy that differs greatly from original conditions. The slimes will be both saline and sodic so are likely to be hostile and impenetrable to deep roots.

These differences from the original regolith profile that includes a loamy sand subsurface material and various thicknesses of calcrete may impact on the establishment and growth of some deep rooted species, and this needs to be thoroughly evaluated by trials during the early stages of mine development. At present there is little or no information on the abundance/function of deep roots under the native vegetation, but elsewhere within regolith under similar rainfall there are deep roots that provide water and nutrients to plants. The reconstructed soils will be able to support vegetation although development of an equilibrium condition will be very slow in this environment and might differ from existing vegetation.”

Prof. Gilkes summarised his response to this ToR in his Concluding Remarks as follows:

- “The construction of soil profiles by returning 10 cm of topsoil and 90 cm of subsoil follows best practice and will facilitate native plant establishment and growth. The deeper subsoil will consist of sand tailings and thus will be inferior to the original deep subsoil which is loamy sand or sandy loam. The impact of this practice may be minor as most root activity occurs in the top metre of soil but this matter needs urgent evaluation once mining commences.”

4.3 Gunson's Response

Gunson agrees with much of Prof. Gilkes' comment. We believe that our topsoil placement strategy will facilitate native plant establishment and regrowth and accept that the sand tailings will be inferior to the original sandy loam, but that this should be a minor concern given that most of the vegetation is shallow rooted based on investigations to date which indicated that the rooting zone was within the top 1 m of the soil profile. However, we acknowledge Prof. Gilkes' concern regarding the lack of information on the abundance/function of deep roots under the native vegetation, and intend to investigate this matter further for selected species prior to finalising design of the Rehabilitation Plan.

Some of Prof. Gilkes' comments require clarification as follows:

- The reference by Prof. Gilkes to include slimes within the sand tailings is a normal response to attempts to elevate soil moisture in the deeper sub-soil. However, this is easier said than done in practice. We are aware of the extreme difficulty experienced by mining companies when attempts have been made to incorporate slimes and sand tailings in an acceptable mix for profile reconstruction. The difficulty lies in intrinsic material differences at defined moisture contents. The slimes would need to be oven dried, ground to separate the particles, mixed with the sand in a suitable mixing apparatus, then re-applied to the area as a uniform soil mixture. Such a practice is economically impracticable and of little benefit to the final rehabilitation outcome.
- Prof. Gilkes comments that the slimes placed below sandy materials will result in a regolith that differs greatly from the original conditions. This is true, but is by design. This is an artificial landscape and an artificial profile. The aim of placing the slimes deep within the profile is to ensure that they do not hinder moisture and root penetration. They will indeed act as an aquiclude at this depth but field evidence indicates that few, if any, plant roots penetrate to the depth of the slimes. If they do, they will encounter a zone of enhanced soil moisture, which can be argued as being a good thing.

5. Reference 4

5.1 EPA Direction

Comment on the likelihood of the proponent being able to achieve a system that has the following five key fundamental requirements needed for vegetation establishment, habitat restoration and ecosystem development (as outlined by D.C Blandford & Associates in the Soils and Landforms Report; Appendix C, Pg10, of the PER Document):

- providing an upper profile with sufficient thickness to provide an adequate rooting depth for vegetation,*
- providing a profile that comprises materials able to retain moisture,*
- providing an upper profile that has high infiltration rates,*
- providing an upper profile that comprises materials that have a low erodibility rating,*
- providing a slope length/slope angle/materials combination that enhances long-term stability,*

whereby the upper profile is defined as the top 1 metre of soil.

5.2 Prof. Gilkes' Comments

- i. Rooting depth: the "reconstruction" of the soil profile to 1 metre depth will allow easy root and shoot exploration of this material, providing that:

- Traffic has not produced a dense pan that requires ripping;
 - The use of saline, sodium-rich water for dust control does not result in dispersion of clay and surface sealing.
- ii. Moisture retention: the 1 metre depth of soil will consist of loamy sand and/or sandy loam. The total water retention and available water retention characteristics are unlikely to be substantially affected by proper handling, although this should be evaluated by laboratory measurements. Materials should not be excavated or deposited while wet and physical work on the materials should be minimised. Note that the presence of a traffic pan may prevent plants from accessing this water.
- iii. Water infiltration: because the soil materials are very sandy, it is unlikely that infiltration of rainwater will be substantially affected by handling. However, if the development of sodicity due to use of saline water causes surface crusting, this will restrict infiltration and cause uneven wetting and runoff. If handling of topsoil causes an accumulation of sand (i.e. little or no silt and clay) in the top few cm of the profile, it is likely that water repellency will develop. These possibilities should be evaluated at an early stage and are readily ameliorated.
- iv. Will erodibility be affected? Erosion by wind and water will increase if handling of the topsoil causes it to lose cohesion due to disturbance and a reduction in clay and organic matter content. Erosion by water may increase if the topsoil becomes dispersive due to the use of saline water for dust abatement. These phenomena can be readily investigated under laboratory conditions.
- v. Slope length/angle/materials combinations to resist erosion. Wind erosion is likely to provide a much greater risk than water erosion provided items (iii) are satisfactory. Erodibility is reduced where the soil is cohesive (item iv) and traffic/animal disturbance is avoided. The placement of plant residue on the soil surface and use of matting/wind breaks may be necessary where soil surface strength is weak and particles are easily detached. Landform design should limit exposure to dominant wind directions. Where very sandy topsoils are readily eroded slimes may be incorporated to provide cohesion but this practice is best avoided as sodic slimes may adversely affect several physical and chemical properties of the topsoil.

5.3 Gunson's Response

Gunson agrees with the above comments but with the following clarifications:

- i Gunson does not intend to use sodium-rich water for dust suppression on the rehabilitation areas, and is aware that compaction from trafficking will need to be minimised and remediated where necessary.
- ii Gunson does not intend to deposit surface soil materials when wet.
- iii Sodidity is unlikely to develop because saline water will not be used for dust control on the rehabilitated areas. Respreding cleared vegetation is the preferred dust control method. Furthermore, given that the topsoils in the area are predominantly cohesionless sands, with very low clay content, the potential for sodicity to develop is very low.
- iv The potential for topsoil to become dispersive is low, not only because it is not intended to control dust on the rehabilitation areas with saline water, but also because application of sodium to the clay aggregates is more likely to cause flocculation than dispersion.
- v Gunson recognises that wind erosion is a greater concern than is water erosion and intends to control it in the first instance by placement of cleared vegetation on the surface. Other options include spraying the soil surface with a bituminous emulsion. It should also be noted that the soils of the area readily form a crust after disturbance and are not prone to wind erosion.

6. Reference 5

6.1 EPA Direction

Provide comment on any other matters which the reviewer believes are relevant to rehabilitation at the site.

6.2 Prof. Gilkes' Comments

“The slimes generated by this mining operation are likely to be sodic, highly dispersive and possibly thixotropic. They may be extremely difficult to de-water and require large areas for disposal. The PER does not adequately evaluate this problem. Section 5.2.5 of the Rehabilitation Plan considers that slimes (clay) will be equivalent to 3% (or 4%, page 6-10 PER) of the ore (volume%?). In practice, sodic slimes may comprise a much greater volume of material (e.g. 30% by volume) due to their thixotropic nature. Indeed several mineral sands mining operations in WA and elsewhere have been adversely affected or even failed because of an inadequate appreciation of the impact of sodic slimes on mineral separation and slime disposal. There is an urgent need to thoroughly evaluate this potential problem.

The PER mentions the use of fertilisers without specifying the types or amounts of fertiliser to be used. In general for rehabilitation back to bush vegetation it is best to avoid the use of fertilisers as they encourage invasion by weeds which is already a problem in the region (radish, dock, etc).”

Prof. Gilkes also made the following comment in his Concluding Remarks:

- “There is some confusion in the documentation concerning acid sulphate soils. The possible concern relates to the occurrence of potential acid sulphate soils (PAS) not actual acid sulphate soils (ASS). Simply put, the occurrence of sulphide (usually pyrite) in ore below the water table requires a management plan to limit oxidation and acidification. Where ore is not below the water table oxidation will not be a problem, but mine planning must include consideration of the occurrence of sulphides.”

6.3 Gunson’s Response

Gunson does not agree with the above comments for the following reasons:

- (1) Regarding the nature of the slimes, there is no evidence at present to indicate that they will be sodic. Prof. Gilkes assumes that the slimes MAY be sodic and bases his comments accordingly. It is important to point out that the use of saline/brackish water in the process system will result in the slimes being saline but the presence of sodium as the salt rather than the ion (Na^+) will result in the suppression of sodicity and potential dispersion with the associated volume expansion referred to. Further, the suppression of sodicity will be a function of the presence of chlorides (NaCl) which will enhance flocculation, the reverse of dispersion. Gunson proposes to further investigate these issues once a representative sample of this mining waste stream is available and landscape reconstruction is in the design/planning phase.

Further, independent flocculation tests under laboratory conditions have indicated that the slimes flocculation process was further enhanced by the use of saline water. While the degree of flocculation may be significant, the large percentage of material (clays) passing $2\ \mu\text{m}$ (88%) will still result in this clay layer acting as an aquiclude at depth. In practical terms, the presence of this ‘clay zone’ will result in differential permeability at depth where the horizontal permeability is greater than the vertical permeability. This will result in sub-surface zones where moisture retention is greater in some areas. The presence of high calcium or high chloride groundwater will continue to suppress sodicity and potential dispersion.

- (2) Regarding the fertiliser issue, Prof. Gilkes may have misunderstood the context in which the use of fertiliser is discussed in the draft Rehabilitation Plan. Section 6 of the draft plan identifies a number of options that will be trialled during the initial stages of rehabilitation in order to determine their effectiveness. These options include the use of fertiliser.

Whilst the potential for weed invasion to occur is acknowledged, it is also important to recognise that there may be some nutrients or minerals missing from the soil and which may be important in ensuring successful rehabilitation. In these circumstances, the targeted use of fertiliser in conjunction with an effective weed control programme could produce a better rehabilitation outcome.

The need for fertilisers, and the type and amount that could be used, will be assessed as part of the rehabilitation programme. This is a standard approach in the mining industry, and one that allows for adaptive management of rehabilitation areas.

- (3) Regarding the occurrence of potentially acid sulphate soils, the fact that all the ore in Pits 1 to 9 inclusive occurs well above the groundwater table, means that acid sulphate soils and their potential for resulting in acid mine drainage, will not be an issue for the Coburn sand mine.

7.0 Conclusion

In summary, Gunson accepts and agrees with many of Prof. Gilkes' comments, many of which are already incorporated into the draft Rehabilitation Plan. Those comments that are not, such as the need to investigate the abundance and function of deep roots into the subsoil will be incorporated into the Plan for investigation once mining commences.

We are pleased that our proposed surface (<1 m) soil replacement strategy is supported by Prof. Gilkes and encouraged that he too believes that it will facilitate native plant establishment and regrowth. We are also pleased that he recognises that some of the observations presented in the Benchmarking Study "encourage the view that a successful rehabilitation procedure can be developed."

Many of Prof. Gilkes' comments are based on the assumption that saline water will be used for dust control on the rehabilitation areas. This will not be the case. Gunson intends to only apply saline water as a dust control measure on roads and heavily trafficked areas of the pit. Respreading cleared vegetation will be the primary dust control measure used on the rehabilitation area. Hence, many of Prof. Gilkes' concerns regarding soil sodicity and dispersion resulting from application of saline water will not eventuate.

However, there are a few areas of disagreement.

Principal among these is the need for a detailed baseline soil survey at this pre-approval stage of development and the value of such information given that the soil profile will be totally destroyed and rebuilt by the mining process. We do, however, agree that detailed soil analysis will be required once mining commences to provide guidance for rebuilding the surface soil profile in the rehabilitation areas.

We also do not accept that the original soil profile can be recreated after mining. As indicated in our response, to do so is just not economically feasible, not (in our opinion) environmentally responsible, nor is it necessary to ensure successful rehabilitation.

Furthermore, we do not share Prof. Gilkes' concerns regarding the potential sodicity of the slimes and difficulty in their management. However, we do appreciate the warning and will further

investigate the issue prior to mining to reconfirm our preliminary estimates of moisture retention and volume of slimes to be handled.

Overall therefore, Gunson is pleased to have commissioned Professor Gilkes' peer review and thanks him for his advice.

Attachment B
Expertise and Experience of the
Vertebrate Fauna Study Team

ATTACHMENT B

EXPERTISE AND EXPERIENCE OF THE VERTEBRATE FAUNA STUDY TEAM

JANET HENRY - a principal of Ninox Wildlife Consulting which was formed in 1981. Ninox provides expertise in vertebrate fauna surveys to a wide range of clients (see list below). Prior to forming Ninox she spent 17 years in the Western Australian Museum mammal department, specialising in identification, taxonomy, cataloguing, data entry, analysis of research data and public liaison. Field work included fauna surveys in the WA Wheatbelt, Eastern Goldfields, Pilbara and Kimberley. Since forming Ninox she has undertaken extensive fauna survey work, particularly in the Goldfields and south-west forests. Long-term studies have involved monitoring of fauna colonisation of rehabilitation.

GOVERNMENT

Dept. of Conservation & Environment	Commonwealth Heritage Commission
Dept. of Conservation & Land Management	Water Corporation of W.A.
Dept. of Environmental Protection	Waterways Commission

EXPLORATION AND MINING

Alcoa of Australia	Hamersley Iron Pty Ltd
Anaconda Nickel Ltd	Iluka Resources Limited
BHP Billiton	Metro Brick
BGC Quarries & Asphalt Pty Ltd	Mines & Resources Australia Pty Ltd
BHP Minerals Pty Ltd	Paddington Gold
Cyprus Gold Australia Corporation	Western Mining Corporation
Dominion Mining Ltd	Westralian Sands
Fox Resources	W.A. Petroleum Pty Ltd
Gunson Resources Ltd	Worsley Alumina Pty Ltd

ENVIRONMENTAL CONSULTANTS

AGC Woodward-Clyde Pty Limited	Ian Pound & Associates
Bowman Bishaw Gorham	McArthur and Associates
Dames & Moore (now URS)	B. O'Brien & Associates Pty Ltd
D.C. Blandford & Associates	PPK Environment & Infrastructure Pty Ltd
John Consulting Services	URS Australia Pty Ltd
LeProvost Environmental Consultants	Welker Environmental Consultancy
Kabay Environmental	Woodman Environmental Consulting Pty Ltd
Lewis Environmental Consultants	

CONSULTING BOTANISTS

M. Blackwell & Associates	Mattiske Consulting Pty Ltd
E. Goble-Garratt & Associates	A. Napier & Associates

CONSULTING ENGINEERS

Croft & Associates	Kinhill Engineers
Helleman & Associates	Maunsell & Partners
Halpern Glick Maunsell	Minenco Pty Ltd (CRA)

OTHER

Enviroscan	Stirling Shire Council
Serpentine-Jarrahdale Council	Thompson & Ong Town Planners

EDWARD CANNELLA - a Director of Biostat Pty Ltd has, since 1991, worked extensively throughout Western Australia as a sub-contractor to Ninox Wildlife Consulting. Tertiary qualifications include: Master in Environmental Science (Murdoch University); Graduate Diploma in Environmental Science (Murdoch University); Bachelor of Science (Major in Zoology – University of Western Australia)

Sub-contract work includes the following areas: Augusta, Boddington, Broad Arrow, Cadjebut, Collie, Coolgardie, Ellendale, Kalgoorlie, Kambalda, Kununurra, Laverton, Leinster, Leonora, Mandurah, Marandoo, Menzies, Mt Monger, Mt Weld, North Dandalup, Paraburdoo, Paynes Find, Perth Metropolitan, Quindanning, Talling Peak, Tom Price, Widgiemooltha and Yandi.

Additional experience with:

- Bamford & Associates
- Matiske Consulting Pty Ltd
- Kinhill Pty Ltd
- Hart Simpson & Associates Pty Ltd
- Bowman Bishaw Gorham Pty Ltd
- Goble-Garratt & Associates
- Worsley Alumina Pty Ltd
- Argyle Diamond Mines Pty Ltd (primary consultant)
- Main Roads Western Australia (primary consultant)
- Normandy Kaltails Pty Ltd (primary consultant)
- CSBP Kwinana (primary consultant)
- Kabay Consulting (primary consultant)

MAUREEN FRANCESCONI - has worked with Ninox Wildlife Consulting since 1990, initially as a widely experienced ornithologist but subsequently as a multi-skilled team member. Sub-contract work includes the following areas: Augusta, Boddington, Busselton, Capel, Collie, Ellendale, Kalgoorlie, Laverton, Mandurah, Quindanning, Talling Peak, Wiluna and Yandi. Tertiary qualifications include: B App Sc (Lib & Info Tech.) Grad Dip (Bus Mgt). Personal ornithological surveys include Dryandra State Forest, Eastern Goldfields, Pilbara, and Kimberley.

Additional experience with:

- MJ & AR Bamford Consulting Ecologists
- Matiske Consulting Pty Ltd
- Biostat Pty Ltd
- CALM
- Bush Business

- ♦ ANZSES (Australian and New Zealand Scientific Expedition Services)
- ♦ A. Sanders
- ♦ Birds Australia (Volunteer)

KEVIN FAIRBAIRN - has worked with Ninox Wildlife Consulting since 1998, initially as a widely experienced ornithologist but subsequently as a multi-skilled team member. Sub-contract work includes the following areas: Augusta, Barrow Island, Boddington, Collie, Ellendale, Kalgoorlie, Kambalda, Leonora, Mandurah and Quindanning. Tertiary qualifications include: B Applied Science – WAIT 1985 (Final year project – bird feeding preferences in Jarrah/Marri/Wandoo woodland). Kevin accompanied Dr J. Ford during two field surveys in the Murchison, Gasgoyne and Goldfields. Personal ornithological surveys include Dryandra State Forest, Eastern Goldfields, Pilbara, and Kimberley.

Additional experience with:

- ♦ Bamford & Associates
- ♦ Biostat Pty Ltd
- ♦ Birds Australia (Volunteer)

STEVE GILES – worked with Ninox on the Coburn Mineral Sand project as an assisting zoologist. Tertiary qualifications include Master of Applied Science (Zoology) James Cook University, Qld; Minor thesis, M.App.Sci (Tropical Vertebrate Ecology) James Cook University, Queensland. Graduate Diploma (zoology) James Cook University, Queensland. Bachelor of Science (botany/zoology); Science Technicians Certificate (Chemistry) S.A Institute of Technology; Bachelor of Science (Earth science, 1st year only) Flinders University, S.A.

Additional experience with:

- ♦ Sinclair Knight Merz Ltd
- ♦ Australian Trust for Conservation Volunteers
- ♦ CRC James Cook University
- ♦ James Cook University
- ♦ Department of CALM (voluntary)