Nickel/Cobalt ore mining and processing operations, Murrin Murrin, 60km east of Leonora

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Anaconda Nickel NL

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 816
May 1996

THE PURPOSE OF THIS REPORT

This report contains the Environmental Protection Authority's environmental assessment and recommendations to the Minister for the Environment on the environmental acceptability of the proposal.

Immediately following the release of the report there is a 14-day period when anyone may appeal to the Minister against the Environmental Protection Authority's report.

After the appeal period, and determination of any appeals, the Minister consults with the other relevant ministers and agencies and then issues his decision about whether the proposal may or may not proceed. The Minister also announces the legally binding environmental conditions which might apply to any approval.

APPEALS

If you disagree with any of the contents of the assessment report or recommendations you may appeal in writing to the Minister for the Environment outlining the environmental reasons for your concern and enclosing the appeal fee of $10.

It is important that you clearly indicate the part of the report you disagree with and the reasons for your concern so that the grounds of your appeal can be properly considered by the Minister for the Environment.

ADDRESS

Hon Minister for the Environment
12th Floor, Dumas House
2 Havelock Street
WEST PERTH WA 6005

CLOSING DATE

Your appeal (with the $10 fee) must reach the Minister's office no later than 5.00 pm on 17 May 1996.

Environmental Impact Assessment Process Timelines

Date	Timeline commences from receipt of full details of proposal from proponent for public review	Time (weeks)
12/2/96	Proponent document released for public comment	
11/3/96	Public comment period closed	4
15/3/96	Issues raised during public comment period summarised by EPA and forwarded to the Proponent	1
29/3/96	Proponent response to the issues raised received	2
3/5/96	EPA reported to the Minister for the Environment	5

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Contents

Figures

Contents (cont'd)

Page

Tables

Appendices

Summary and recommendations

This report and recommendations provides the Environmental Protection Authority's advice to the Minister for the Environment on the environmental factors relevant to the proposal by Anaconda Nickel NL (the proponent) to develop the Murrin Murrin Nickel - Cobalt Project.

The proposed nickel/cobalt ore mining and processing operation is located near the former gold mining centre of Murrin Murrin, approximately 60km east of Leonora, in Western Australia. The project involves the establishment of open cut mine pits, a processing plant and associated infrastructure. The project will produce refined products of nickel and cobalt as well as an ammonium sulphate by-product.

A number of environmental topics generated by the proposal were considered by the Environmental Protection Authority (EPA). From these, the EPA has identified the major environmental issues requiring detailed evaluation as:

- impact on locally and regionally significant vegetation associations, Declared Rare and Priority flora;
- impact on Threatened and Priority fauna species and animal habitats;
- impact on surface water systems;
- impact on the water table due to the extraction of groundwater;
- solid and liquid waste disposal (tailings dam and evaporation pond);
- protection of groundwater quality (salinity) from lakes forming in the mined out pits;
- gaseous emissions (including greenhouse gases and odours);
- noise;
- import and handling of sulphur at the Esperance Port;
- on-going environmental management; and
- the rehabilitation and decommissioning of the project.

The EPA considers that the major environmental issues identified during the assessment could be adequately managed through the proposal design and the proponent's environmental management commitments, in conjunction with approvals required from other agencies such as Department of Minerals and Energy, Water and Rivers Commission and the Department of Environmental Protection.

However, the EPA has concluded that the presence of the Declared Rare Flora, *Hemigenia exilis*, requires the preparation and implementation of a plan to manage this species within the project area to minimise any uncertainty regarding its long term survival. It is the EPA's view that the conservation and management plan should be part of a much wider management approach to ensure protection of this species beyond the mining tenements and pastoral leases occupied or leased by the proponent. The Department of Conservation and Land Management and not the proponent would have primary responsibility for ensuring protection initiatives are implemented beyond the boundaries of the project area.

The EPA also considers that the proponent should use all reasonable and practicable measures to minimise the discharge of wastes including gaseous emissions. In addition, a rehabilitation and decommissioning strategy should be developed as early in the project life as possible, so that rehabilitation can be best integrated with project planning.

Following evaluation of the environmental issues, the EPA has concluded that the proposal can be managed to meet the EPA's objectives subject to the proponent's commitments, and the conditions and procedures recommended in this assessment report.

Recommendation No.	Summary of recommendations
1	That the proposal can be managed to meet the EPA's objectives, subject to the successful implementation of the proponent's commitments and the EPA's recommended conditions and procedures.
2	That prior to construction, the proponent be required to prepare a plan for the conservation and management of *Hemigenia exilis* within the project area.
3	That the proponent include consideration of greenhouse gas emissions in the Environmental Management Programme (EMP) to be prepared under Commitment 1, and in the Environmental Management System (EMS) to be prepared under Commitment 2.
4	That the proponent be required to prepare and implement a plan which describes the process for decommissioning and rehabilitation of the lease and which manages ground and surface water systems affected by the tailings disposal area and evaporation pond area, including development of a 'walk away' solution.
5	That, if the Minister provides environmental clearance that the proposal may be implemented, that clearance be subject to the Conditions set out in Section 6 of this report.

1. Introduction and background

1.1 Purpose of this report

This report and recommendations provides the Environmental Protection Authority's advice and recommendations to the Minister for the Environment on the environmental factors applicable to the proposal to develop a nickel/cobalt ore mining and processing operation near the former gold mining centre of Murrin Murrin, approximately 60km east of Leonora.

1.2 Background

Anaconda Nickel NL (Anaconda) is the nominated proponent for the project. Anaconda proposes to develop a nickel/cobalt project comprising open-cut pits and a processing plant using a high pressure acid leach process to extract the metals from the ore. The metals would then be refined using a combination of solvent extraction, precipitation and electrowinning techniques.

Anaconda (Dames and Moore, 1996a) indicate that the objective of the Project is to produce:

- refined products of nickel and cobalt as:
  - nickel metal briquettes;
  - refined cobalt sulphate crystals or cobalt metal;
  - mixed nickel cobalt sulphide powder; and
- an ammonium sulphate prill by-product.

In December 1995, the proponent referred the project to the Environmental Protection Authority which set the level of assessment at Consultative Environmental Review. Figure 1 is a location map for the project.

1.3 Structure of this report

This report is divided into 7 sections.

Section 1 introduces the report by stating its purpose, describing the historical background to the proposal and its assessment, and outlining the structure of the report.

Section 2 summarises the proposal. The proposal is described in more detail in the proponent's Consultative Environmental Review (Dames and Moore, 1996a)

Section 3 explains the method of assessment and provides a summary of the topics raised through the setting of guidelines and in public submissions. From these topics and others raised throughout the assessment process, those considered to be issues that require further evaluation by the Environmental Protection Authority are identified. A table summarising this process is provided (Table 2).

Section 4 sets out the evaluation of the environmental issues associated with the proposal. Each issue is dealt with in its own subsection, which initially states the objectives of the assessment for that issue. The relevant Environmental Protection Authority policy is stated and any technical information is provided. Comments from key agencies/interest groups are summarised, and the proponent response is presented. The subsection on each issue is concluded with the Environmental Protection Authority's evaluation in terms of achieving the stated objectives.

Section 5 summarises the conclusions and recommendations and includes a table summarising the evaluation of the environmental issues (Table 5). Section 6 describes the recommended environmental conditions. References cited in this report are provided in Section 7.

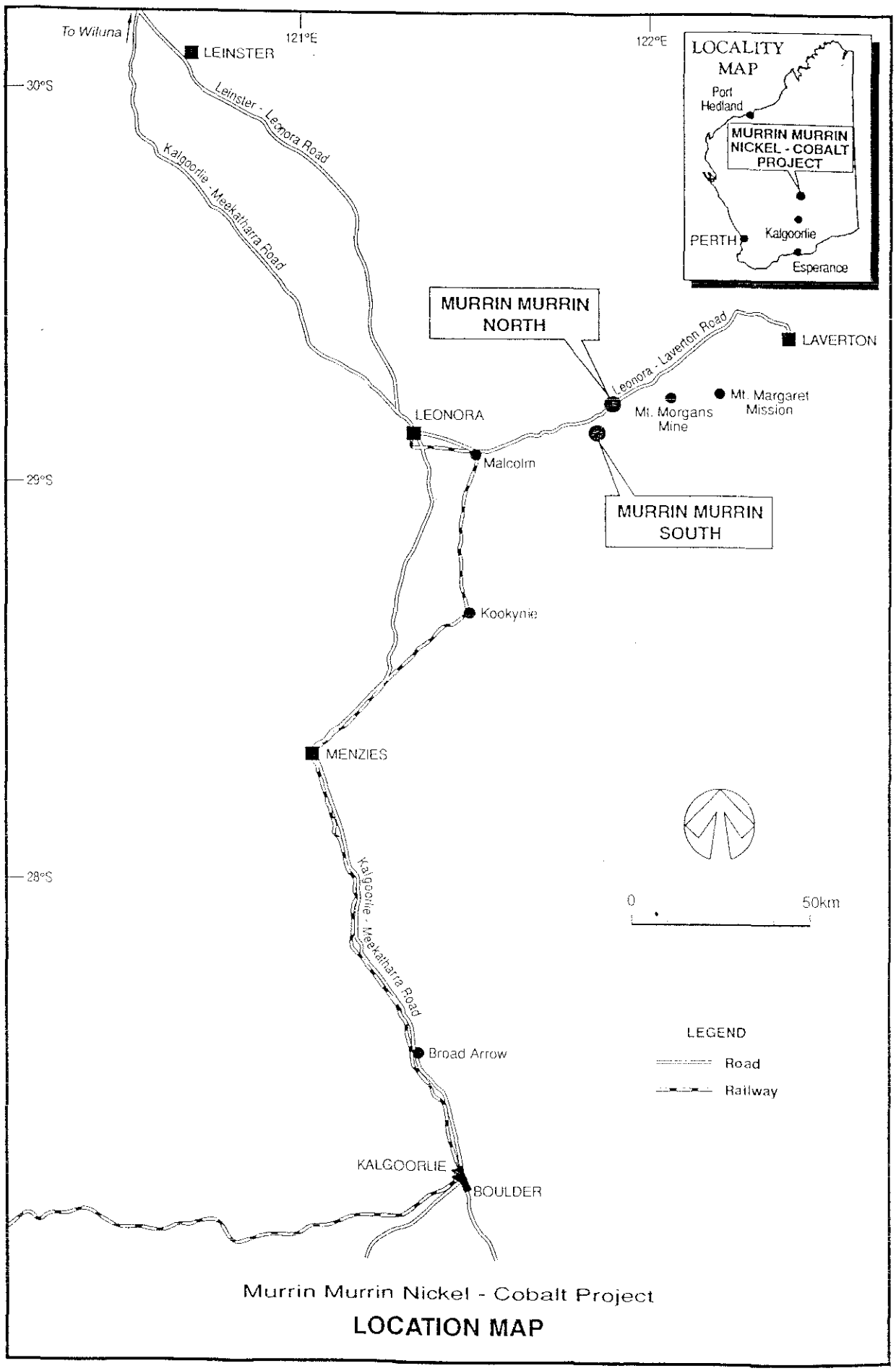


Figure 1. Location plan (Source: Dames and Moore, 1996a)

2. Summary description of the proposal

Anaconda (Dames and Moore, 1996a) indicate that the major components of the Murrin Murrin Nickel-Cobalt Project comprise:

- open-cut nickel-cobalt ore mining operations;
- open-cut calcrete mining operations;
- a processing plant comprising:
  - ore preparation facilities;
  - a high pressure acid leaching process circuit;
  - a counter current decantation washing circuit;
  - a slurry neutralisation circuit;
  - a solution neutralisation circuit;
  - a mixed sulphide precipitation circuit; and
  - a nickel and cobalt refinery;
- water supply borefields; and
- solid and liquid waste disposal facilities (including an evaporation pond, a tailings dam and overburden stockpiles).

These mining and processing operation would be supported by:

- a double contact sulphuric acid plant, with heat recovery for steam generation;
- a power generation and distribution system;
- industrial gas plant;
- on-site fuel and chemical storage facilities;
- product and raw materials handling systems;
- administration, plant support and plant control facilities;
- workforce accommodation;
- airstrip; and
- dedicated mine haul roads.

A detailed project description is provided in Section 3.0 of Anaconda's Consultative Environmental Review (Dames and Moore, 1996a). Key project characteristics provided in the CER, including raw materials inputs and process outputs (and atmospheric emission characteristics) are indicated in Table 1 and are detailed in Appendix 5 of this report. The project layout is indicated in Figure 2.

Table 1. Summary of project characteristics

Inputs	
Nickel cobalt ore	4Mtpa
Calcrete	900,000tpa
Sulphur	490,000tpa
Water	30,000m^3pd
Natural gas	20,000Gjpd
Outputs	
Nickel metal briquettes	27,000tpa
Cobalt sulphate crystals*	8,200tpa
Cobalt metal*	1,550tpa
Mixed nickel cobalt sulphide powder	29,000tpa
Ammonium sulphate crystals	60,000tpa
Tailings	3,750,000tpa
Carbon dioxide	0.6Mtpa
Final market requirements will determine whether cobalt sulphate or cobalt metal will be produced (Dames and Moore, 1996a).	

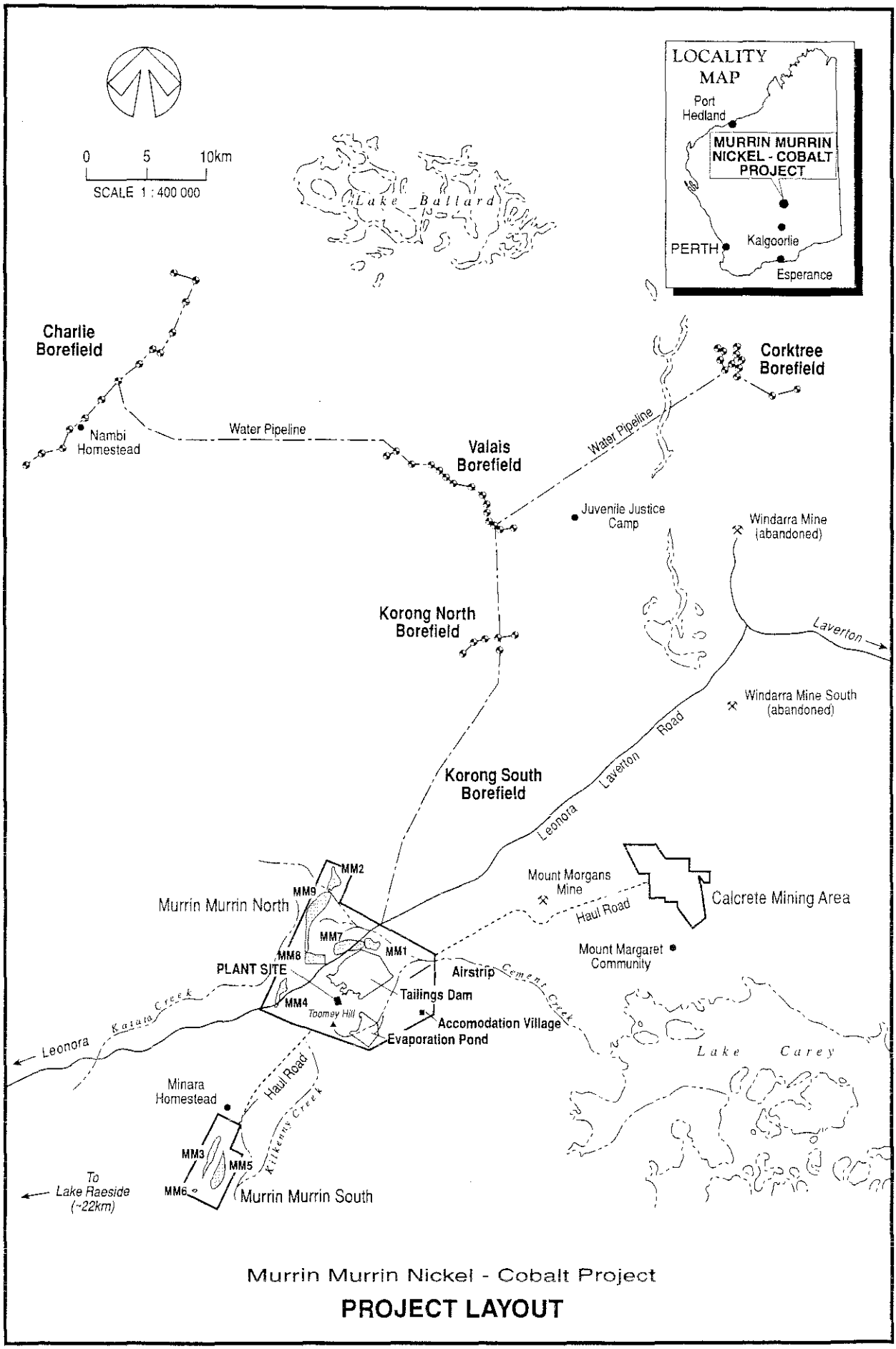


Figure 2. Identification of environmental issues.

3. Identification of environmental issues

3.1 Method of assessment

The purpose of the environmental impact assessment is to determine the environmental factors relevant to a proposal and to formulate conditions and procedures to which the proposal should be subject, should it proceed.

A set of administrative procedures has been identified (refer to flow chart in Appendix 1) in order to implement this method of assessment.

The first step in the method is to identify the environmental topics to be considered. A list of topics (or possible issues) was identified by the DEP, on behalf of the EPA, through the preparation of guidelines.

These topics are then considered by the proponent in the Consultative Environmental Review both in terms of identifying potential impacts as well as making project modifications or devising environmental management strategies.

The CER was then reviewed to ensure that each topic had been discussed in sufficient detail prior to its release for public and government agency comment. The proponent's CER was available for public review for four weeks between 12 February 1996 and 11 March 1996, during which fifteen submissions were received.

Following completion of the public review period, the responses received were summarised for the Department of Environmental Protection. This process can raise additional environmental topics to be considered by the proponent.

Anaconda was invited to respond to matters raised in the summary of submissions. Appendix 2 contains the summary of the submissions and the proponent's response to those submissions. The list of submitters is included in Appendix 3.

Eighteen environmental topics varying in significance have been identified. The EPA considers all the topics and identifies those that do not require further evaluation. Often these topics can be addressed through the processes of other agencies or are no longer relevant to the proposal. The remaining topics are considered to be issues of environmental significance that require further evaluation by the EPA.

For each environmental issue, the environmental impacts of the proposal, and the proponent's environmental management commitments, were evaluated in the context of the EPA's assessment objective and relevant policy and technical information. The complete list of the proponent's consolidated environmental management commitments is included in Appendix 4 of this report. If the commitments achieve the assessment objectives, there is no need for the EPA to make recommendations to the Minister for the Environment on that issue, otherwise the EPA may recommend conditions and procedures necessary to achieve the EPA's objectives. Where the proposal has unacceptable environmental impacts, the EPA can advise the Minister for the Environment. The Minister for the Environment determines whether the proposal should proceed and under what conditions.

Limitation

This evaluation has been undertaken using information currently available. The information has been provided by the proponent in the CER and supplementary documentation, by DEP officers utilising their own expertise and reference material, by utilising expertise and information from other State government agencies, information provided by members of the public and contributions from EPA members.

The EPA recognises that further studies and research may affect the conclusions. Accordingly, the EPA considers that if the proposal has not substantially commenced within five years of the date of this report, then such approval should lapse. After that time, further consideration of the proposal should occur only following a new referral to the EPA.

3.2 Public and agency submissions

Comments were sought on the proposal from the public, interest groups and local and State government agencies. During the public review period fifteen (15) submissions were received. A summary of these submissions was forwarded to the proponent for their response (Appendix 2). Of the fifteen submissions received, 8 were from State government agencies, 2 from Local government agencies and 5 were public submissions.

The principal topics of concern raised in the submissions were:

Biophysical Impacts

- changes to groundwater levels (supply);
- potential impacts on surface water systems;
- impacts on declared rare flora;

Pollution Potential

- protection of groundwater (quality);
- management of wastes and emissions;
- options for disposal of tailings (to reduce the size of the footprint);

Social Surroundings

- impacts on Aboriginal heritage;
- the import and handling of sulphur through the Esperance Port;

Other

- Environmental Management Programme and Environmental Management System and appropriate monitoring; and
- decommissioning and rehabilitation.

The EPA has considered the submissions received and the proponent's response in its evaluation of Anaconda's proposal.

3.3 Review of topics

3.3.1 Identification of topics

Eighteen topics were raised during the environmental impact assessment process including those topics identified in the guidelines for the CER, subsequent consultations and the submissions described above. The topics are as follows:

Biophysical Impacts

- loss of land systems;
- changes to landform;
- impact on locally and regionally significant vegetation associations, Declared Rare and Priority flora;
- impacts on Threatened and Priority fauna species and animal habitats;
- impact on surface water;
- impacts on the water table due to the extraction of groundwater (supply);

Pollution Potential

- protection of groundwater (quality);
- solid and liquid waste disposal (tailings dam/evaporation pond);

- disposal of waste (excluding tailings dam and evaporation pond);
- gaseous emissions (including greenhouse gases and odours);
- dust;
- noise;
- import and handling of sulphur at the Esperance Port;

Social Surroundings

- Aboriginal heritage;
- risks and hazards;
- road transportation;

Other

- Environmental Management Programme and Environmental Management System;
- decommissioning and rehabilitation.

The EPA has evaluated the above topics and considers that a number of them can be managed by the proponent in accordance with their environmental management commitments and in compliance with Department of Environmental Protection regulations and guidelines or through approvals required from other agencies (see Table 2). Each topic is discussed below in order to identify those issues warranting further evaluation by the EPA.

3.3.2 Identification of issues requiring EPA evaluation

Biophysical Impacts

Loss of land systems

Anaconda (Dames and Moore, 1996a) indicate that although the development of the project will disturb or result in the loss of certain land units or land systems within the project area, these units and systems are generally well represented elsewhere in the region. CALM in its submission recommended that minimisation of impacts on poorly conserved and poorly represented land systems should be considered by the proponent, and should be addressed in the Environmental Management Programme and Environmental Management System.

Impacts to land systems are reduced through a range of management measures such as protecting vegetation, minimising erosion potential, managing surface drainage, return of overburden to previously mined pits, and rehabilitation of disturbed areas. The general management principles and practices required to reduce impacts to land systems are common for most mining operations and are included in a number of other topics discussed. Factors which help to reduce the loss of land systems, such as project design, mine planning and management are inherent in the project's Environmental Management Programme and Environmental Management System. These issues are evaluated in more detail in Section 4.10 of this report.

Separate evaluation of this topic by the Environmental Protection Authority is not required.

Changes to landform

The proposal involves the mining of nine principal ore bodies using conventional open-pit techniques. The open pits will generally be no deeper than 45m below natural ground level, with the bulk of the ore excavated from depths of less than 30m. Several "starter pits" will coalesce over a 25 year production programme into two or three pits per ore body using strip mining practices. The final dimensions of the pits will be in the order of 200m to 600m wide by 1 to 3km long.

A calcrete resource located 30km north east of the treatment plant site will be mined using conventional open pit techniques. The open pits will generally be no more than 8m below natural ground level with a disturbed area of 500m by 500m at any time for a nominal calcrete thickness of 2m.

The proposal also involves changes to the surface landform with the establishment of

- topsoil storage areas, waste dumps (20m high), borrow pits, ore stockpiles, processing plant, infrastructure requirements; and
- a tailings dam ($15km^2$) and evaporation pond ($4km^2$).

The Department of Minerals and Energy considers that a mine plan is required which shows the mining/rehabilitation sequence for at least the first two years with an indicative plan out to five years. The potential impacts of changes to landforms are reduced through a range of management measures such as protecting vegetation, minimising erosion potential, managing surface drainage, return of overburden to previously mined pits, and rehabilitation of disturbed areas. The general management principles and practices required to reduce changes to landform are common for most mining operations and are included in a number of other topics discussed. For example, factors which help to minimise the loss of landform, such as project design, mine planning, rehabilitation and management are inherent in the project's Environmental Management Programme and Environmental Management System and in the decommissioning and rehabilitation of the project. These issues are evaluated in more detail in Section 4 of this report.

Separate evaluation of this topic by the Environmental Protection Authority is not required.

Impact on locally and regionally significant vegetation associations, Declared Rare and Priority flora

The establishment of the Murrin Murrin Nickel project would impact on vegetation through:

- direct disturbance as a result of clearing for the mines, the solid and liquid waste disposal sites ($15km^2$), the processing plant and project infrastructure (eg: gas pipeline 70km);
- changes to surface drainage characteristics which would particularly affect areas of mulga woodlands;
- changes to groundwater availability as a result of dewatering for mining;
- loss of approximately 500 individuals of the Declared Rare Flora species, *Hemigenia exilis.*

Submissions indicated concerns about the potential shadow effects on vegetation as a result of disruption to sheet flow, the monitoring of vegetation for gas emission impacts and protection of *Hemigenia exilis.* The general management principles and practices required to reduce impacts to vegetation are common for most mining operations and are included in a number of other topics discussed. For example, factors which help to reduce the loss of vegetation, such as project design, mine planning, management of surface drainage, rehabilitation and management are inherent in the project's Environmental Management Programme and Environmental Management System and in decommissioning and rehabilitation aspects of the project. These issues are evaluated in more detail in Section 4 of this report.

Management of the Declared Rare Flora, *Hemigenia exilis*, is required to ensure that objectives for its conservation and management are met.

This topic has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Impacts on Threatened and Priority fauna species and animal habitats

The development of the mine pits, overburden disposal areas, tailings dam, evaporation pond and establishment of the processing plant and mine infrastructure will require clearing and disturbance to fauna habitat.

The proponent indicates that there are no unique habitats and no impacts on rare, restricted or endangered fauna. CALM recommends that the proponent addresses a site specific fauna survey in the Environmental Management Programme and Environmental Management System, and that they liaise with CALM regarding siting of infrastructure and the management of any significant species encountered. Other submissions were concerned about the potential for poisoning of fauna from the evaporation ponds. As a result of CALM's concerns the

proponent has included an additional commitment (Commitment 18, see Appendix 4) to undertake additional fauna studies.

This topic has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Impacts on surface water systems

The introduction of landform changes discussed above, particularly the tailings disposal area (15km^2) and the evaporation pond (4km^2), will modify surface drainage characteristics.

CALM recommends that the monitoring and amelioration of effects of modification to existing drainage patterns should be addressed in the EMP and EMS, through the production of a surface hydrology management plan. The Water and Rivers Commission (WRC) recommends that in Commitment 6 (Cement Creek monitoring) an estimate of creek flow-rate should be included when water samples are taken for quality testing purposes. Other submitters were concerned that the project will cause a reduction in stream flow in Cement Creek.

This topic has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Impact on the water table due to the extraction of groundwater

The extraction of water from borefields for project use (30,000m^3/d), will impact upon groundwater levels and may adversely affect water supply for other users (eg: pastoralists, Laverton townsite) and the environment.

State and Local government agencies were concerned that the CER contained little information about the actual production capacity of the borefields, and the impact of drawing from the resource on other users. Public submissions also reflected concerns from pastoralists regarding the risk to groundwater supply and the need for comprehensive monitoring of Anaconda's use of this critical resource.

This topic has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Pollution potential

Protection of groundwater

The storage of materials and mining and processing operations, particularly disposal of slurry to the tailings dam and process water to the evaporation pond, has the potential to pollute the groundwater.

Government submissions highlighted the need for protection of aquifers from hydrocarbon contamination within the Laverton Water Reserve and that fuel and hazardous bulk chemical storage areas should be properly bunded. Measures to control acid leachate from stockpiled sulphur and sulphur rich tails should be taken. Comments also included the impact of salinising lakes (intersecting the groundwater table) being formed as a result of open-cut mining of the nickel-cobalt ore bodies and calcrete area. Public submissions were concerned about the possible contamination of groundwater.

The primary concern in relation to the protection of groundwater is associated with the performance of the tailings dam and evaporation pond and accordingly, this is discussed as a separate topic (see above). Other wastes (ie: building rubble, general refuse, sewage etc) have been addressed by the proponent in Section 7.14 of the Consultative Environmental Review, and can be managed through Department of Environmental Protection Works Approval and Licence, Water and Rivers Commission, Health Department and Local Government Agency processes.

The impact of possible salinising lakes forming in the mined out pits is a topic which has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Solid and liquid waste disposal (tailings dam and evaporation pond)

A tailings dam impoundment facility will cover a surface area of approximately 15km^2 after 25 years of operation of the project. The final tailings area is expected to be 21m high. An evaporation pond which will cover an estimated area of 4km^2 will also be required. The proponent indicates (Dames and Moore, 1996a) that the major issue associated with the tailings dam and the evaporation pond is the potential impact of these facilities on the groundwater levels and quality.

Government submissions commented on the lack of information on the geotechnical aspects of the tailings and evaporation dams and the need to consider options for disposal of tailings which would reduce the size of the footprint. Public comments indicate that discussion of tailings storage and waste water management is inadequate and that detailed engineering and design work on the dam is still to be completed. The potential for leakage from the tailings impoundments, the prospects for rehabilitation and decommissioning are also issues of concern.

This topic has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Disposal of wastes (not including tailings dam and evaporation pond)

The construction and operation of the project will generate a number of different types of waste. Other than wastes associated with tailings and process water discussed above, the wastes of most concern include general wastes and overburden. The EPA notes that general wastes, such as waste oils, sewage etc, should be managed in accordance with the requirements of local government authorities and relevant government departments. This issue is therefore manageable within the context of existing regulatory requirements and through subsequent approvals required for the proposed Environmental Management Programme and Environmental Management System.

Overburden and waste from the starter pits will be deposited at waste dumps and rehabilitated in accordance with best industry practice following which overburden and waste from strip mining panels will be deposited on the floor of an adjacent and completely mined out panel.

The return of overburden to the mined out pits is an initiative which is supported by the EPA. Where overburden is unable to be returned to the mined out pits it should be stabilised and rehabilitated to agreed specifications. The management of waste dumps for the proposal can be undertaken in an environmentally acceptable manner, through compliance with the requirements of the Department of Minerals and Energy.

Further evaluation of this topic by the Environmental Protection Authority is not required.

Gaseous emissions (including greenhouse gases and odours)

Gaseous emissions of environmental concern relating to the operation of the project are oxides of nitrogen from the power station's gas turbines and sintering plant and sulphur dioxide from the sulphuric acid plant and the hydrogen sulphide circuit flare. Carbon dioxide emissions are related to power generation and the neutralisation of the process streams with calcrete.

State and local government submissions comment on the need for compliance with air quality criteria, the influence of thick fogs on dispersion rates and occupational health matters. Public comments suggest the need for emission monitoring devices at Minara Station Homestead.

This topic has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Dust

This topic was included in the guidelines for the preparation of the CER. Construction and operational mining activities, materials transport and handling, stockpiles and storage of ore, low grade dumps, sulphur, calcrete and gypsum will generate dust. The nearest residence to the project is the Minara homestead, which is approximately 2km from the closest point of the Murrin Murrin 3 ore body and is 15km from the processing plant. The calcrete mining area is also approximately 2km from the Mt Margaret Mission at its closest point.

Detailed dust management and monitoring measures will be included in the Environmental Management Programme to be prepared by the proponent to the satisfaction of the EPA. Dust associated with processing facilities would also be addressed within the Department of Environmental Protection's works approval and licensing provisions under the *Environmental Protection Act* (1986). The EPA believes that adequate controls exist under the pollution control provisions of the *Environmental Protection Act* (1986) to control dust should a problem arise.

With the exception of potential dust associated with the import and handling of sulphur through the port of Esperance, no further evaluation of this topic is required by the EPA. Issues associated with the import of sulphur through Esperance are discussed below.

Noise

Adverse noise impacts are potentially associated with the development of any mining and processing proposal. No blasting is planned for the clay ore, although paddock blasting of ferruginous capping may be required. Paddock blasting of the calcrete will be required at the calcrete mining area. The nearest residence is 15km from the proposed plant location where the majority of the project activities would take place. Mining activities may occur within 2km of the Minara Homestead (nickel-cobalt ore) and the Mount Margaret Mission (calcrete).

Noise management has been addressed by the proponent in section 7.13 of the Consultative Environmental Review, and compliance with the Noise Abatement (Neighbourhood Annoyance) Regulations is a requirement. The EPA believes that adequate controls exist under the pollution control provisions of the *Environmental Protection Act* (1986) to control noise associated with the processing plant should a problem arise. However, there are currently no statutory regulations that govern road traffic noise.

This topic has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Import and handling of sulphur at the Esperance Port

Elemental sulphur used for the production of sulphuric acid will be delivered as 30,000 to 40,000t shipments to the Esperance Port and stored within the wharf area. Loadout of sulphur from the Esperance Port stockpiles will be direct to Westrail wagons with 1,500 to 2,000t per consignment and a total of 10 to 14 train movements (a movement is defined as one way between Kalgoorlie and Malcolm siding) per week.

The proponent has indicated that the Esperance Port Authority will be responsible for the legislative requirements relating to the handling and storage of sulphur at the Port and accordingly has not described environmental impacts and management associated with this operation.

Local government and public submissions have sought confirmation from the EPA that this operation will be subject to a separate environmental impact assessment.

This topic has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Impacts on Aboriginal Heritage

The Department of Aboriginal Affairs indicated the need to review ethnographic and archaeological reports due to the high density of archaeological sites reported in the project area.

The proponent has discussed the management of Aboriginal Heritage in section 7.18 of the CER and must comply with the provisions of the *Aboriginal Heritage Act* (1972).

The EPA considers that the predicted impacts of the project on Aboriginal heritage values can be adequately managed through processes outside the *Environmental Protection Act* (1986).

Further evaluation of this topic by the Environmental Protection Authority is not required.

Risks and hazards

The proponent has identified and qualitatively assessed in Section 8 of the CER, the potential for off-site hazards resulting from the project. The hazards identified by the proponent are those that have the potential to cause a risk beyond the site boundary. Hazards associated with the project may be created by either the processing operations or by materials brought to the site such as fuels and chemicals. The proponent has provided a commitment in relation to the plant operations and recommended procedures for the gas pipeline which is the responsibility of a third party.

One submission commented on the risk assessment and thought that it had been thoroughly covered.

Risks and hazards have been adequately addressed by the proponent in Section 8 of the CER and Commitment 17 and would be managed through compliance with the requirements of the Department of Minerals and Energy.

Further evaluation of this topic by the Environmental Protection Authority is not required.

Road transportation

During the construction phase, the project will result in a short term increase in daily traffic flow on the main approach roads to the site (particularly the Leonora-Laverton Road). In addition, the transport of raw materials and products during the operations phase may cause impacts through spillage of loads and will also increase heavy vehicle traffic volumes along the Leonora-Laverton Road and other local roads.

Local government submissions express concerns that the increased number of truck movements (assumed to be double or triple road trains) will lead to rapid deterioration of the current road surface.

This matter should be addressed by the local government authorities and relevant State government agencies such as Main Roads Western Australia in conjunction with the proponent.

Further evaluation of this topic by the Environmental Protection Authority is not required.

Other

Environmental Management Programme and Environmental Management System

The development of a mining and processing operation of this scale requires the implementation of a comprehensive programme of environmental management and monitoring to ensure that the impacts of the project are appropriately managed during all project phases.

Consideration of an adequate Environmental Management Programme and Environmental Management System requires Environmental Protection Authority evaluation.

Decommissioning and rehabilitation

The EPA has in past assessments recognised that rehabilitation management should not impose short or long term costs on the community of Western Australia. This is particularly important when the probable success of rehabilitation cannot be evaluated in the short to medium term.

Government submissions raised concerns regarding the absence of a rehabilitation plan for the Calcrete Quarry.

The issue of decommissioning and rehabilitation requires Environmental Protection Authority evaluation.

3.3.3 Summary

Table 2 summarises the process used by the EPA to evaluate the topics raised during the environmental impact assessment process. The table identifies the topics, the relevant proposal characteristics, and comments received from specialist government agencies and the public. If a

Table 2. Identification of issues requiring Environmental Protection Authority evaluation

Topics	Proposal characteristics	Government Agency Comments	Public comments	Identification of issues
Biophysical impacts				
Loss of land systems	Construction and operation of the project will result in the loss of land systems within the region.	**CALM**- minimise impacts on poorly conserved land systems.		Considered in the evaluation of the Environmental Management Programme - refer table 5 (Issue 10). Separate EPA evaluation not required.
Changes to landform	Multiple mine pits, overburden disposal areas, borrow pits, processing plant, tailings dam and evaporation pond will change the existing landform.	**DME**-a mine plan is required.		Considered in the evaluation of the Environmental Management Programme - refer table 5 (Issue 10). Separate EPA evaluation not required.
Impact on locally and regionally significant vegetation associations, Declared Rare and Priority flora.	Direct disturbance (clearing) will impact upon vegetation. DRF species *Hemigenia exilis* will be directly impacted. Indirect impacts such as changes to existing drainage patterns could lead to changes in vegetation. The impact of emissions such as SO_2 from the project could affect vegetation.	**CALM**-Commitment 4 should extend to management of remnant populations of *Hemigenia exilis* within the Project area. Management should be addressed in the EMP and the EMS. **Shire of Laverton**-flora and vegetation survey were well conducted and the commitments given to preserve and examine the potential for propagating *Hemigenia exilis* are excellent. **DME**-no plan to show how gazetted flora and unconserved plant communities will be managed.	If vegetation is disturbed it should be redeveloped (sic).	Impacts to flora and vegetation are considered in the evaluation of the Environmental Management Programme - refer table 5 (Issue 10). DRF requires protection and separate EPA evaluation required (Issue 1, Table 5).
Impact on Threatened and Priority fauna species and animal habitats.	Mine pit development, overburden disposal areas, tailings dam and mine and processing infrastructure will require clearing and disturbance of habitat.	**CALM**-recommends a site specific fauna survey in the EMP and EMS, and liaison with CALM regarding siting of infrastructure and the management of any significant species encountered.	A part time person to check on evaporation ponds for evidence of poisoning to birds and kangaroos and control of feral animals plus checking on unauthorised persons affecting flora and fauna would be advantageous.	EPA evaluation required.

Topics	Proposal characteristics	Government Agency Comments	Public comments	Identification of issues
Biophysical impacts				
Impact on surface water.	Mining and processing activities, such as location of tailings dam, evaporation ponds, mine pits, haul roads and associated infrastructure will impact upon surface flow characteristics.	**CALM**-recommends a surface hydrology management plan in the EMP and EMS. **WRC**- an estimate of creek flow-rate should be included in Commitment 6.	The location of the tailings dam and the evaporation pond pose a risk of contamination of Cement Creek, reduces stream flow and increases sediment loads.	EPA evaluation required.
Impact on the water table due to the extraction of groundwater.	The extraction of water for project use (30,000m^3/d) , will impact upon groundwater levels and may adversely affect water supply for other users (eg: pastoralists) and the environment.	**The Shire of Laverton-** concerned about supply to pastoralists and the Laverton townsite. Insufficient information about the production capacity of the borefields, and drawdown effects. **WRC**-good quality water resources in the area are not plentiful. Little information available on the aquifer associated with the calcrete deposits and the effects of mining on local hydrogeology. A hydrogeological study should be carried out at the calcrete mine site.	Pastoralists are concerned with the risk to groundwater resources, with particular reference to supply. A series of monitoring bores needs to be placed in all pastoral leases south and south west of Anaconda's proposed borefields including the area south to Lake Carey and Lake Raeside.	EPA evaluation required.
Pollution potential				
Solid and liquid waste disposal (tailings dam/evaporation pond	Large impoundment structures with the potential for leakage (7.5Mt/year of slurry to tailings dam; 430m^3/hr of process water to evaporation pond) and contamination of soils, surface and ground water systems. Rehabilitation potential depends upon long term physical and chemical characteristics of waste.	**WRC**- reworking local soils alone may not be effective in preventing adverse impacts of salts & metals on superficial aquifers. Other lining options may not be economically attractive. WRC recommends monitoring vegetation health near the disposal areas as a guide to leachate movement in surficial soils. **Shire of Laverton**-an assessment should be made of the likely impact of seepage from the tailings dam on the existing ground water. **DME**-complete lack of information on the geotechnical aspects of the large tailings and evaporation dams. Commitments to prevent seepage by providing impervious structures appear tentative.	Leakage of fluids from the disposal areas will affect groundwater supply for Minara Homestead, surrounding paddocks, and all users downstream of Anaconda's proposed plant site. The CER's discussion of tailings storage and waste-water management is inadequate. Detailed engineering and design work on the dam is still to be completed and no test data has been collected at the proposed dam location.	EPA evaluation required.

Topics	Proposal characteristics	Government Agency Comments	Public comments	Identification of issues
Pollution potential				
Protection of groundwater.	Storage of materials and operation of the plant, particularly disposal of slurry to the tailings dam and process water to the evaporation pond, has the potential to pollute groundwater.	**WRC**-protect aquifers from hydrocarbon contamination. Fuel and hazardous bulk chemical storage areas should be properly bunded. Minimise acid leachate generation from stockpiled sulphur & sulphur rich tails. Concerned about the impact of salinising lakes (intersecting the groundwater table) forming as a result of open-cut mining. **Shire of Laverton**-seeks a commitment from the proponent that the water supply quantity and quality for the Laverton townsite will be guaranteed for the life of the project.	Concerns regarding the possible contamination of groundwater.	Main issue of tailings dam and evaporation pond addressed in waste disposal (Issue 5, Table 5) and Environmental Management Programme (Issue 10, Table 5). There is potential for saline lakes to form in mined out pits and separate EPA evaluation required (Issue 6, Table 5).
Disposal of waste (excluding tailings dam and evaporation pond)	Operation of the plant will produce general wastes and overburden.	**Shire of Laverton-**disposal of sewage and sullage to an approved waste disposal site would be neither practicable or acceptable.		General wastes addressed by local government authority and relevant government agencies (eg: Health Dept.). DEP's works approval and licensing requirements also apply. Overburden disposal is considered in the evaluation of other topics - refer table 5 (Issues 10 and 11). Further EPA evaluation not required.

Topics	Proposal characteristics	Government Agency Comments	Public comments	Identification of issues
Pollution potential				
Gaseous emissions (including greenhouse gases and odours)	Operation of the plant will generate odorous gases and large quantities of greenhouse gases.	**Shire of Laverton**-there are no commitments given to monitor atmospheric emissions. Concerned about occupational health from emissions and the effect of thick fogs on dispersion rates of emissions. **CALM**-recommends that the proponent expand the terms of the proposed monitoring to include gaseous emissions.	No mention has been made of emission monitoring devices at Minara Station Homestead (nearest downwind residences).	EPA evaluation required.
Dust	Construction and mining activities, materials transport, handling and storage (ie: ore, sulphur, calcrete, low grade dumps, gypsum) will give rise to dust.	**DEP**-the management of dust is a normal requirement associated with construction and mining activities.		Addressed by the proponent in Section 7.12.5 of the CER. Subject to DME and DEP requirements. Further EPA evaluation not required.
Noise	Mining and processing activities will increase ambient noise levels. Materials and product handling and transport will increase ambient noise levels.	**Shire of Laverton**-concerned about noise levels at the proposed Accommodation Village.		EPA evaluation required.
Import and handling of sulphur at the Esperance Port.	Total requirement of 490,000 tpa of sulphur for the production of sulphuric acid. Sulphur delivered as 30,000 to 40,000t shipments to the Esperance Port and stored within the wharf area. Loadout direct to Westrail wagons with 1,500 to 2,000t per consignment and a total of 10 to 14 train movements per week.	**Esperance Shire Council**-could not comment due to the lack of detail on this aspect. Sought confirmation from DEP that a specific CER be prepared for the importation of sulphur through Esperance. **DEP**-the import and handling of sulphur at the Esperance Port may cause concern for some Esperance residents, especially those already concerned by the handling of iron ore at the Port.	All port activities relating to this proposal should be subject to a separate Consultative Environmental Review.	EPA evaluation required.

Topics	Proposal characteristics	Government Agency Comments	Public comments	Identification of issues
Social surroundings				
Impacts on Aboriginal Heritage.	Impacts on sites of significance to Aboriginal people.	**Aboriginal Affairs Department**-in view of the high density of archaeological sites reported in the project area, requested to review ethnographic and archaeological reports.	No ethnographic or archaeological survey of the proposed Calcrete Mining Area and the Gum Well and Borodale Borefields.	Impacts on Aboriginal heritage values can be managed through the *Aboriginal Heritage Act 1972*. Further EPA evaluation not required.
Risks and hazards	Operation of the plant will introduce risks and hazards.	**Shire of Laverton**-risk assessments have been thoroughly covered. Consultation required between the proponent and the local Counter Disaster Committee at Laverton to resolve an Emergency Response Plan in the event of a major plant emergency.		Qualitative risk assessment addressed by the proponent in Section 8 of the CER and commitment 17 and subject to compliance with DME and DOSHWA requirements. Further EPA evaluation not required.
Road transportation	Potential for spill of raw materials, process chemicals and products whilst being transported. Increased vehicle movements on the Laverton-Leonora Road.	**MRWA**-liaison has taken place with the proponent to resolve any issues. **Shire of Laverton**-the increased number of truck movements (assumed to be double or triple road trains) will lead to rapid deterioration of the current road surface.		This issue should be addressed by the local government authorities and Main Roads Western Australia in conjunction with the proponent. No further evaluation required by EPA.
Environmental monitoring				
Environmental Management Programme (EMP) and Environmental Management System (EMS).	An EMP is to be developed for environmental management of the project's construction phase. An EMS will be developed for environmental management of the project's operations and decommissioning phase.	**DME**-environmental management largely deferred to "post approval" EMP. Proponent's ability to manage impacts must be understood before approval can be granted. Concerned that the CER describes the area (ha) to be disturbed by the starter pits and waste dumping but no mining sequence is provided. Mine plan required which shows the mining/rehabilitation sequence for at least the first two years, with an indicative plan out to five years.		EPA evaluation required.

Topics	Proposal characteristics	Government Agency Comments	Public comments	Identification of issues
Decommissioning				
Decommissioning and rehabilitation.	Residual longer term impacts at the completion of mining operations will be mainly associated with the stabilisation of post-mining landforms, tailings dam and evaporation ponds.	**DME**-there is no mining/rehabilitation plan for the Calcrete Quarry despite the potential for significant impacts to the ground and surface water regime and consequential ecological impacts on Lake Carey.		EPA evaluation required.

topic is considered environmentally significant it becomes an issue and is further evaluated by the EPA (as summarised in Table 5). Section 4 of this report provides the detail of this evaluation.

The issues identified in Table 5 as requiring further evaluation by the EPA are:

- impact on locally and regionally significant vegetation associations, Declared Rare and Priority flora;
- impacts on Threatened and Priority fauna species and animal habitats;
- impact on surface water;
- impact on the water table due to the extraction of groundwater;
- protection of groundwater quality (salinity) from lakes forming in the mined out pits;
- solid and liquid waste disposal (tailings dam/evaporation pond);
- gaseous emissions (including greenhouse gases and odours);
- noise;
- import and handling of sulphur at the Esperance Port;
- Environmental Management Programme and Environmental Management System; and
- decommissioning and rehabilitation.

4. Evaluation of key environmental issues

4.1 Impact on locally and regionally significant vegetation associations, Declared Rare and Priority flora

Objective

To protect Declared Rare and Priority flora and ensure no significant loss of locally and regionally significant vegetation associations and plant habitats.

Policy information

To meet the requirements of the *Wildlife Conservation Act*, (1950-1979) and maintain biodiversity in the State (EPA, 1996b).

The *Wildlife Conservation Act* protects Declared Rare Flora (DRF) and requires specific approval to be given before any known DRF are removed.

Technical information

A description of flora and vegetation is provided in Section 4.6 and Appendix E of the proponent's CER (Dames and Moore, 1996a). The main points from the CER are as follows:

1. A total of 44 plant communities were defined and mapped for the project area of which five are considered to be locally and regionally significant.
2. A total of 255 vascular plant species (including four introduced species) from 123 genera and 48 families were recorded in the project area.
3. One Declared Rare Flora - Presumed Extinct species, *Hemigenia exilis*, was recorded in the project area. A total of six populations containing in excess of 800 individuals of *Hemigenia exilis* were found to occur in the Murrin Murrin project area and nine populations of some 2,000 plants were also found outside the project area.

CALM (1995), quoted in the CER (Dames and Moore, 1996a), indicates that the classification Declared Rare Flora-Presumed Extinct was developed for taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or taxa of which all known wild populations have been destroyed more recently.

The proponent (Dames and Moore, 1996a) indicates that four populations (approximately 500 individuals) of *Hemigenia exilis* will be directly affected by mining operations in the 25 year life of the project, while two populations will not be disturbed by the project. The populations outside the project area will not be affected by the development of Anaconda's project.

To date, the proponent has implemented a range of measures to protect the known populations of *Hemigenia exilis* within the project area. Initiatives implemented by the proponent include:

- additional local and regional searches for *Hemigenia exilis*;
- collection of seeds for the CALM Threatened Seed Centre; and
- provision of seeds and cuttings to the Kings Park and Botanic Gardens for storage and propagation by cutting, grafting and tissue culture.

Comments from key agencies/interest groups

In relation to rare flora, CALM has commended the proponent's commitment and willingness in regard to *Hemigenia exilis* to:

- survey for additional locations outside the project area;
- protect known populations within the project area;
- support research into germination; and
- monitor known locations within the project area.

CALM has recommended that the proponent's Commitment 4 should extend to management of remnant populations of *Hemigenia exilis* within the project area. CALM recommends that the proponent needs to provide a report giving clear information on the populations of these species and the impacts/management options that will be proposed, as such impacts will need to be evaluated. CALM recommends that management should also be addressed in the proponent's Environmental Management Programme and Environmental Management System.

CALM considers that, as grazing and accidental damage are likely to be management issues, appropriate management strategies would include fencing, destocking and feral animal control (particularly goats).

In relation to plant communities, CALM is concerned that the location of regionally significant plant communities within the project area is not clearly identified. It is also not clear as to:

- what impacts are proposed for these communities;
- what alternatives have been considered for infrastructure siting; and
- what management is proposed to minimise impacts on these communities.

The Shire of Laverton considers that the flora and vegetation survey have been well conducted and the commitments given in relation to *Hemigenia exilis* are excellent.

The Department of Minerals and Energy (DME) is concerned that there is no plan to show how gazetted flora and unconserved plant communities will be managed in the context of the project.

One submission expressed the view that where vegetation is disturbed, it should be redeveloped (sic).

Response from the proponent

The proponent's response to the issues raised in submissions and discussed above is included in Appendix 2 (Questions 1.1, 1.7, 1.8, 1.9, 5.1 and 5.3). In its response, the proponent (Dames and Moore, 1996b) has indicated that it would meet CALM's concerns by the following:

- that the proponent is committed to undertaking the construction, operation and decommissioning of the project in a manner that minimises disturbance to all known *Hemigenia exilis* in the project area;
- that the strategies and procedures for the environmental management of this species will be addressed in the EMP and EMS;
- management strategies such as fencing, destocking and feral animal control will be implemented where appropriate on any pastoral lease owned by the proponent;
- the environmental management of flora and vegetation will be addressed further in the construction phase EMP and operation phase EMS, in consultation with the DEP, DME and CALM (Commitments 1 and 2); and
- that in relation to locally and regionally significant plant communities the location of the evaporation pond has been moved further to the southwest to minimise the impact on portions of plant community 1f (open woodland of *Allocasuarina huegeliana, Acacia quadrimarginea, Acacia ramulosa and Brachychiton gregori*) which is uncommon in the region.

Environmental Protection Authority Evaluation

Elements of the project which pose the greatest impact to vegetation are likely to be those which involve large scale clearing and include the mining, tailings dam and evaporation pond areas. Other elements such as borefields and infrastructure (eg: gas pipeline and water pipelines) also involve land clearing although the impacts are usually confined to narrow linear easements where there is greater potential to avoid sensitive areas or follow existing cleared alignments such as roads and fencelines.

In relation to the Declared Rare Flora, *Hemigenia exilis*, the EPA notes the proponent's willingness to undertake a range of measures to assist in increasing the amount of knowledge about this species as outlined in Section 7.5 of the CER (Dames and Moore, 1996a). The EPA recognises that the proponent is required to comply with the provisions of the *Wildlife Conservation Act*, 1950 and notes that the proponent has given a commitment to do so (Commitment 4).

Notwithstanding the proponent's commitments and other highly commendable initiatives the EPA considers that, in view of the critical status of this species, the proponent should prepare a plan for the conservation and management of *Hemigenia exilis* within the project area in consultation with and to meet the requirements of the Department of Conservation and Land Management. The plan should include management objectives, and strategies for achieving these objectives. Recommendation 2 reflects this requirement.

It is the EPA's view that the conservation and management plan should be part of a much wider management approach to ensure protection of this species beyond the mining tenements and pastoral leases occupied or leased by the proponent. However, it is recognised that the Department of Conservation and Land Management and not the proponent would have primary responsibility for ensuring protection initiatives are implemented beyond the boundaries of the project area.

Direct disturbance to vegetation through clearing or indirect disturbance as a result of changes to drainage patterns can be reduced through a range of measures including proper design and management of the project (Commitment 3). This issue will be further addressed in the Environmental Management Programme (Commitment 1) and Environmental Management System (Commitment 2). The EPA has concluded that the commitments made by the proponent, and the measures outlined in the CER, meet the EPA's objectives in relation to the management of potential impacts on locally and regionally significant vegetation associations.

4.2 Impact on Threatened and Priority fauna species and animal habitats

Objective

Threatened and Priority fauna species and their habitat should be protected.

Policy information

To meet the requirements of the *Wildlife Conservation Act*, (1950-1979) and maintain biodiversity in the State (EPA, 1996b).

The *Wildlife Conservation Act* protects Threatened and Priority fauna species and requires specific approval to take or kill protected fauna.

Technical information

The proponent (Dames and Moore, 1996a) states that:

- the description of likely fauna for the project area has been provided by a desktop survey of relevant scientific literature and other data;
- the habitats of the project area have the potential to support approximately 102 species of birds, 19 native mammals, nine introduced mammals, seven frogs and 74 reptiles species;
- the fauna habitats in the project area are well represented throughout the region and none are considered to be significant;
- the loss of fauna habitat due to clearing may lead to the disturbance of some fauna;
- impacts will be minimised by a range of measures including:
  - minimising the extent of disturbance to the vegetation of the project area;
  - maintain existing pastoral bores and watering points, where possible;
  - feral animal control;
  - covering drill holes and trenches wherever possible, capping of exploration drill holes;
  - prohibiting firearms and domestic pets, etc.

Comments from key agencies/interest groups

The Department of Conservation and Land Management (CALM) recommends that the proponent addresses a site specific fauna survey in the Environmental Management Programme and Environmental Management System, and that they liaise with CALM regarding siting of infrastructure and the management of any significant species encountered.

CALM considers:

- the potential for birds to utilise "wet areas" within the project site (eg: tailings dam, evaporation pond) is very high, particularly in drier years. Given the size and the duration of operation of the wet areas, management and mitigation options should be considered by the proponent. These should be addressed via the EMS; and
- the issue of maintaining existing water points for the protection of fauna requires some evaluation. The provision of water to "domesticate" kangaroos is likely to be at the expense of total grazing control (ie: feral goats, increased kangaroo numbers), and may continue to have impacts on other native fauna and flora (including rare flora).

CALM recommends that the proponent considers expanding the terms of the EMS to cover the management of pastoral leases under the control of the proponent.

One submitter considered that a part time person to check on evaporation ponds for evidence of poisoning to birds and kangaroos, control of feral animals, and unauthorised activities affecting fauna and flora, would be advantageous.

Response from the proponent

Measures to minimise disturbance to fauna are outlined in Section 7.7 of the CER (Dames and Moore, 1996a). In responding to issues raised in submissions (question 5.2, Appendix 2), the proponent (Dames and Moore, 1996b) has indicated it will undertake additional fauna studies to ensure that adequate information is available for the purposes of managing the project as well as educating the workforce. The scope of these studies will be determined in consultation with the Department of Environmental Protection and the Department of Conservation and Land Management and will be undertaken to meet the requirements of the EPA. The proponent has included an additional commitment (Commitment 18, see Appendix 4) to confirm its intention to undertake these studies.

The proponent has also indicated that:

- the maintenance of existing watering points is primarily to reduce the impact of the project on pastoral activities, not to "domesticate" kangaroos. The proponent indicates that there should be no net change in the number of watering points in the region as a result of the development of this project; and
- the EMS will address strategies and procedures for the management of fauna habitats and species as well as the environmental management of any pastoral leases under the control of the proponent.

Environmental Protection Authority Evaluation

The proponent has outlined a range of measures in Section 7.7 of the CER (Dames and Moore, 1996a) to manage the potentially adverse impacts of the project on fauna. In addition, the management of fauna is included in the Environmental Management Programme (Commitment 1) and is inherent in the Environmental Management System (Commitment 2) for the operation of the project which will provide a structured approach to Best Practice environmental management. In response to submissions the proponent has provided an additional commitment (Commitment 18) to undertake additional fauna studies.

The management measures outlined in the CER, and the commitments made by the proponent achieve the EPA's objective in relation to impacts on fauna and fauna habitat.

4.3 Impact on surface water

Objective

No significant adverse changes to existing drainage systems, vegetation/land systems, and dependent fauna.

Technical information

Physical changes to the land surface as a result of the construction of haul roads, mine pits, infrastructure, tailings dam and evaporation pond, have the potential for significant changes to surface water flow characteristics. The proponent (Dames and Moore, 1996a) states that:

- the proposed location of the mine infrastructure has been selected to minimise the surface water impacts;
- the plant site and accommodation village are both positioned on high points which do not have drainage flowing into the area;

- the tailings dam has been positioned as close as possible to the edge of a catchment boundary;
- the Murrin Murrin South development area and some of the pits in the Murrin Murrin North are also close to a catchment boundary;
- the Calcrete Mining Area intercepts the drainage between Lake Carey and a system of dry lakes to the northwest; and
- it is proposed that the surface water runoff be diverted around structures and re-directed into the main channels, wherever possible.

The proponent (Dames and Moore, 1996a) expects the effects of the project will be limited to:

1. Modification of existing drainage patterns

The proponent suggests that changes to the existing drainage are unavoidable and result in irreversible impacts. Diversion channels will be constructed to reflect the natural channel characteristics and provide alternative flow paths. The evaporation pond is expected to cover approximately 2km of a tributary of Cement Creek.

2. Reduction in downstream flow.

Direct rainfall into the operating mining areas, treatment plant area, evaporation pond and tailings dam will reduce the available surface water runoff. The largest area involved is the tailings dam which is expected to collect runoff from approximately 16km^2 when it reaches its full extent. This would constitute less than 5% of the total catchment area of the Cement Creek (540km^2) and is therefore expected to result in a small decrease in the available runoff.

3. Potential water quality impacts

The diverted surface water runoff will be confined to channels and is not expected to be contaminated by mining works. However, the volume of sediment may be altered, particularly during the construction period. The amount of sediment in the stream water will probably reflect the amount of vegetation clearing and may lead to undesirable erosion problems. The movement of surface soils during construction will be kept as low as practicable by clearing areas only where necessary and revegetating wherever possible.

The stream flow in Cement Creek downstream of the plant area, airstrip and accommodation village will be monitored for contamination through the measurement of pH, TDS, total suspended solids (TSS) and conductivity. Similar water quality monitoring is also proposed for Katata Creek. Sedimentation ponds will be installed if necessary.

Comments from key agencies/interest groups

The Water and Rivers Commission recommends that in commitment 6 (Cement Creek monitoring) an estimate of creek flow-rate should be included when water samples are taken for quality testing purposes.

The Department of Conservation and Land Management (CALM) has three concerns regarding the modification to existing drainage patterns, namely;

- the potential to increase erosion as a result of concentrating flows into main channels;
- the potential to increase erosion due to linear developments in "sheetflow" areas; and
- the potential "shadow" effects on vegetation as a result of disruption to sheet flow. Clear examples of shadow effects can be seen along the Leonora-Laverton Road.

CALM recommends that the monitoring and amelioration of effects of modification to existing drainage patterns should be addressed in the Environmental Management Programme and Environmental Management System, through the production of a surface hydrology management plan.

CALM suggests some amelioration measures to minimise the disruption to sheetflow which could be considered include:

- restoring the surface profile of borefield pipelines;
- minimising roading;

- allowing water to pass over constructed roads;
- providing culverting under constructed roads, and diffusing water on the downstream side (ie: return to sheetflow); and
- diffusing water diverted from the project area upstream of drainage channels and creeklines.

A public submission expressed concern that approximately two kilometres of a tributary of Cement Creek will be inundated by the evaporation pond. The submitter suggested that there would be a reduction in stream flow and an increase in sediment loads and that there are inadequate baseline data to monitor the impact of the project on the volume of stream flow in Cement Creek. Another submission expressed concern at the risk to water quality in Cement Creek due to the location of the tailings dam and evaporation pond.

Response from the proponent

The proponent's response to the issues raised in submissions and discussed above is included in Appendix 2 (Questions 1.3, 1.8 and 5.4). In its response, the proponent has indicated the following:

- that stream flow in Cement Creek and Katata Creek will be monitored for contaminants through the measurement of pH, total dissolved solids (TDS), total suspended solids (TSS) and conductivity and that the rate of streamflow may be included if it can be measured accurately;
- that Commitment 6 has been modified to include the water quality monitoring programme;
- that the monitoring and amelioration of effects of modification to existing drainage patterns will be addressed in the EMP and EMS;
- that strategies and procedures for the environmental management of this issue will be developed in consultation with CALM and other relevant agencies and will include the preparation of a surface hydrology management plan; and
- the Mt Margaret community is the only major downstream user of Cement Creek. The proponent is not aware of any other major downstream users of Cement Creek or Katata Creek who may be affected by the development of the project. These creeks generally flow intermittently, though permanent or semi-permanent pools may be present. Therefore they are mainly used as an opportunistic water source for stock, pastoralists, or other users (Dames and Moore, *pers. comm.*).

Environmental Protection Authority Evaluation

Potential impacts on surface water systems during the operation of the project will result from the changes in surface water runoff characteristics as a result of changing landforms. Most of the tributaries in the project area are ephemeral, with drainage flowing into a network of large shallow lakes. Downstream use of creek flow by pastoralists, stock and the Mt Margaret community is opportunistic rather than dependent.

The proponent has outlined a range of management measures in relation to this issue in Section 7.10 of the CER (Dames and Moore, 1996a). The proponent has indicated that an Environmental Management Programme (Commitment 1) for the construction phase of the project will provide further detail on surface water management and an Environmental Management System (Commitment 2) for the operation of the project will provide a structured approach to Best Practice environmental management. In responding to submissions, the proponent has modified Commitment 6 and indicated that a surface hydrology management plan will be prepared.

The EPA has concluded that the commitments made by the proponent, and the measures outlined in the CER and in response to submissions, meet the EPA's objectives in relation to the management of potential impacts on surface water systems.

4.4 Impact on the water table due to the extraction of groundwater

Objective

To ensure that the proposed extraction of 30,000m^3 per day of groundwater does not result in drawdown of the water table such that indigenous vegetation is threatened or other user rights jeopardised.

Policy information

The site falls within the Goldfields Groundwater Area and water resources use is administered via abstraction controls under Part III of the Rights in Water and Irrigation Act. The proponent should ensure that no detrimental impacts on water quality or availability occur as a consequence of the project (EPA, 1996b)

Technical information

Approximately 30,000m^3/d of process water at less than 4,000mg/L total dissolved salts and less than 2,000mg/L chloride concentration is required over the 25 year life of the project (Dames and Moore, 1996a). The six borefields originally intended to be developed to meet the total demand of 30,000m^3/d are known as Korong South, Korong North, Valais, Corktree, Borodale and Gum Well borefields (Dames and Moore, 1996a). However, in responding to submissions, Anaconda has indicated in its letter of 28 March 1996 that the Gum Well and Borodale Borefields have been replaced in the proposed water supply system by the Charlie Borefield, which is located to the northwest of the proposed plant site (Figure 2).

Additional technical information on each of the borefields is contained in Sections 4.4 and 7.11 of the CER. A description of the Charlie Borefield and a preliminary borefield configuration estimate (which will be the basis of Anaconda's hydrological report to the Water and Rivers Commission for subsequent licensing of groundwater bores) is provided below.

As stated in Section 3.2.4 of the CER (Dames and Moore, 1996a), the project requires approximately 30 megalitres of water per day. Anaconda currently proposes to source this water from the following borefields:

- Korong North (1.4 megalitres)*;
- Valais (12.1 megalitres);
- Corktree (10.1 megalitres) and
- Charlie (6.5 megalitres).

(* Korong South borefield may not ultimately be required as part of the water supply for this project)

The Charlie Borefield is located along an elongated drainage channel oriented in a south to north direction within the Nambi pastoral lease (Figure 2). Bores have been developed at the southern end near Charlie Well, in the central sections near Nambi Homestead and at the northern discharge adjacent to the Lake Ballard salt lake system (Figure 2). Water of between 800 and 2,500mg/L total dissolved salts has been located along the drainage channel, within an aquifer system defined by fine to coarse-grained quartz sands and rock fragments. The aquifer varies in depth between 30 and 60m. The hydraulic properties measured during test pumping indicate yields between two and six litres per second from the bores spaced evenly along the system. A total water yield of approximately six megalitres per day is currently being modelled to determine storage and recharge characteristics.

The proponent (Dames and Moore, 1996a) indicates that:

- borefield operations are not expected to unduly affect the stock watering bores as the operation's water supply is from aquifers at a greater depth than those of the stock bores.
- there exists a clay strata between the two aquifers which tends to separate them, and

- where stock watering bores are affected, the shortfall will be made up from the proponent's water supply as per the Water and Rivers Commission Groundwater Well Licence conditions.

Comments from key agencies/interest groups

The Shire of Laverton provided the following comments in regard to water supply:

- that Sections 4.4 and 7.11 of the CER provide very little information about the actual production capacity of the borefields, and the impact of these large water draws on the water source for pastoralists;
- the impact of the water supply from long term (five-seven years) drought cycles has not been considered although some assumptions have been made about water replenishment rates from rainfall;
- that it is expected by Council that the Water and Rivers Commission will impose the most stringent licence conditions and monitoring requirements;
- that Council is concerned that the ongoing, long term supply of a sufficient quantity of water of good quality for the Laverton townsite may be compromised by this project; and
- that the proponent should provide a commitment which guarantees water supply quantity and quality for the Laverton townsite for the life of the project.

The Water and Rivers Commission (WRC) indicated that good quality water resources in the area are not plentiful. The WRC commented on the lack of information currently available on the aquifer associated with the calcrete deposits, the effects that mining may have on local hydrogeology and recommends that a hydrogeological study be carried out at the mine site.

Public submissions also expressed concern about the risk to groundwater supply and a suggestion was made that a series of monitoring bores needs to be placed in all pastoral leases south and south west of the proponent's proposed borefields and they need to cover the area extending south to Lake Carey and Lake Raeside (Figure 2).

Response from the proponent

The proponent's response to the issues raised in submissions and discussed above is included in Appendix 2 (Questions 3.5, 3.6, 3.8, 3.9 and 5.5). In its response, the proponent has indicated the following:

- the proponent will upgrade existing Groundwater Exploration licences and apply for Groundwater Production Licences from the Water and Rivers Commission (WRC) prior to development of borefields. The borefields will be operated and monitored in accordance with requirements of WRC licence conditions;
- the borefields to be developed and operated for the project will have no adverse impacts on the water supply for the Laverton townsite as they are in separate and distinct hydrogeological systems. The proponent proposes to implement a comprehensive monitoring programme as part of the hydrological studies to conclusively demonstrate this aspect;
- diesel generators and associated fuel storage at the borefields will be contained within impervious and bunded enclosures to prevent hydrocarbon contamination;
- the proponent will guarantee the supply of water to the Juvenile Justice Camp during abstraction from the Valais borefield;
- the proponent will minimise any impact of its borefield abstraction on pastoral activities and ensure that pastoral water supplies are maintained (Commitment 15). If pastoral bores are affected the proponent has indicated that the shortfall will be made up from the proponent's water supply in accordance with WRC Groundwater Well Licence conditions;
- the proponent will continue to consult with affected pastoralists;

- the proponent does not anticipate water table depletion in pastoral wells 10 to 20 kilometres to the south of the Valais borefield on Minara Station; and
- the proponent proposes to monitor the condition of vegetation in the vicinity of the borefields and in control areas to determine the effects (if any) of drawdown.

Environmental Protection Authority Evaluation

The EPA notes that the project site falls within the Goldfields Groundwater Area and that a decision by the Water and Rivers Commission (WRC) on the acceptability of the proponent's borefields is required before a licence would be issued under Part III of the Rights in Water and Irrigation Act. Where uncertainties exist in relation to the adequate protection and management of groundwater resources, the WRC has a responsibility to require developers to provide them with appropriate detailed studies prior to decision making or the granting of any approvals to develop a borefield. The environmental impact assessment process can indicate where such uncertainties exist. However, where such studies indicate that water supply issues cannot be adequately protected or managed then it is the responsibility of the WRC to refuse the proposal or seek alternative measures to address the issues of concern.

The proponent has indicated that an Environmental Management Programme (Commitment 1) for the construction phase of the project will provide further detail on flora and vegetation management as well as environmental monitoring and reporting, and, an Environmental Management System (Commitment 2) for the operation of the project will provide a structured approach to Best Practice environmental management. The EPA notes that vegetation in the vicinity of the borefields and in control areas will be monitored.

The EPA has concluded that the commitments made by the proponent, and the measures outlined in the CER and in response to submissions, meet the EPA's objectives in relation to the management of potential impacts on the water table due to the extraction of groundwater.

4.5 Protection of groundwater quality (salinity) from lakes forming in the mined out pits

Objective

To avoid contamination of the groundwater from lakes which may form in the mined-out pits.

Technical information

Nine principal ore bodies have been identified within the Murrin Murrin North and Murrin Murrin South project development areas and mining will be carried out using conventional open-pit techniques. The open pits will be generally no deeper than 45m below natural ground level, with the bulk of the ore excavated from depths of less than 30m.

The calcrete resource is 1 to 5m thick and lies beneath approximately 0.5 to 1m of topsoil. Mining will be carried out using conventional open pit techniques.

Comments from key agencies / interest groups

The Water and Rivers Commission indicated that there is no discussion of the possibility of salinising lakes (intersecting the groundwater table) being formed as a result of open-cut mining of the nickel-cobalt and calcrete ore bodies. If these are likely to occur, the proponent should discuss means of minimising the exposed surface area on project completion and the potential impacts on local water users.

Response from the proponent

In responding to this issue, the proponent (Dames and Moore, 1996b) indicates that the water table lies below the known ore resources and will not be exposed in mining operations except at a deep ore intersection of the Murrin Murrin 2 deposit, which accounts for less than 5% of this ore body. The proponent will ensure that lakes do not develop in this pit by backfilling to a level above the water table. Therefore saline lakes will not be formed as a result of the pits becoming flooded by groundwater.

The existing water table level at the Calcrete mining area is approximately 10m below natural ground level and mining operations are not proposed to extend into the groundwater aquifer (Dames and Moore, 1996b).

Environmental Protection Authority Evaluation

The EPA notes the proponent's response to submissions which indicates that with the exception of the Murrin Murrin 2 deposit, mining activity will not intersect the water table. The EPA also notes the proponent's intention to specifically backfill the Murrin Murrin 2 pit above the water table to prevent the formation of lakes in this pit. The EPA notes that rehabilitation and safety issues associated with mined out pits is a responsibility of the Department of Minerals and Energy. Rehabilitation and public safety will also be addressed in the proponent's Environmental Management Programme and Environmental Management System, discussed in Section 4.10. The EPA has concluded that these measures meet the EPA's objectives in relation to the management of potential impacts associated with this issue.

4.6 Solid and liquid waste disposal (tailings dam and evaporation pond)

Objective

To ensure that environmental impacts arising from the disposal of tailings are kept as low as practicable and that best practice is implemented.

Policy information

The construction and operation of tailings disposal facilities is subject to works approval and licensing requirements under Part V of the Environmental Protection Act and requires the approval of the State Mining Engineer. Under the provisions of Section 84 of the Mining Act, specific conditions may be imposed for the purpose of preventing, reducing, or making good, injury to the surface of the land on mining leases and general purpose leases.

Technical information

The proponent (Dames and Moore, 1996a), indicates that tailings discharge from the process will consist of two major streams, the neutralised leach residue slurry and bleed solution from the sulphide precipitation. The slurry, at about 40% solids is pumped to a tailings dam for long term storage at a rate of approximately 460tph or 3.75Mtpa of dry solids. This dam is expected to be approximately 3.5km by 4.5km at the end of the project. The tailings dam is designed to provide sufficient surface area for evaporation of supernatant water and any rainfall within the dam catchment. However, the supernatant will be decanted and pumped to the evaporation pond, to increase the final solids density within the tailings dam. In addition, the dam cells will undergo cycles of slurry discharge and drying to increase the final settled densities.

The bleed waste solution produced following filtration of the mixed sulphide precipitate will be neutralised with calcrete slurry before discharge into the evaporation pond. In addition, gypsum slurry produced from the solution neutralisation circuit will be discharged to the

evaporation pond. The gypsum deposition rate will be approximately 1Mtpa and the pond will be approximately 2km by 2km.

The proponent indicates (Dames and Moore, 1996a) that the major issue associated with the tailings dam and the evaporation pond is the potential impact of these facilities on the groundwater levels and quality. The CER states that detailed engineering design work for the tailings dam and evaporation pond is still being conducted by the proponent and that the base and sides of the tailings dam and evaporation ponds will be treated (eg: rolling and compaction) to reduce the permeability if required. A groundwater monitoring programme would also be established up and down gradient of these areas to monitor changes in the depth of the water table and changes to the water quality, particularly total dissolved salts (TDS).

Comments from key agencies/interest groups

The Shire of Laverton considers that proponent commitments 12 and 13 (see Appendix 4) should be implemented at the design stage of the tailings dam and evaporation pond and that commitment 14 (see Appendix 4) should be included as a licence condition.

The Department of Minerals and Energy (DME) indicates that:

- there is a complete lack of information on the geotechnical aspects of the large tailings and evaporation dams;
- commitments to prevent seepage by providing impervious structures appear to be very tentative; and
- the geotechnical investigations should have been part of the CER and no approval would be considered by DME until the design and management of these structures has been rigorously examined by government.

The Department of Environmental Protection considered that a more detailed evaluation of potential alternative tailings disposal options should be discussed by the proponent, particularly options such as in-pit disposal and alternative methods/designs for depositing tailings which could reduce the size of the tailings 'footprint'.

Public submissions indicated concern at the inadequate discussion in the CER of tailings storage and waste-water management, and that detailed engineering and design work on the dam is still to be completed.

Response from the proponent

The proponent's response to the issues raised in submissions and discussed above is included in Appendix 2 (Questions 2.1 to 2.5). The proponent advises (Dames and Moore, 1996b) that a range of options was assessed in selecting the technique for disposal of tailings including:

In-pit deposition

In-pit deposition is not an option until sufficient disused workings have been exhausted of ore for the tailings to be impounded. This is not expected to be the case before about eight years of production. In the later stages of the project's operations it may be possible to store the tailings in disused mine workings once an adequate area has been exhausted of ore and is of suitable geometry to organise satisfactory decantation locations, beach profiles and cyclic deposition to dry, desiccate and compact the tailings sufficiently for subsequent rehabilitation access.

Co-disposal of Waste Rock and Tailings

The waste rock of the Murrin Murrin operations comprises ferruginous material and lateritic clays which have little void space between stockpiled material to accommodate the tailings. The high moisture content of the overburden would not provide for water take up from the tailings. Therefore, co-disposal of waste material and tailings was not considered an option for this project.

Central Thickened Discharge (CTD) Sub Aerial Deposition

Present indications of the tailings nature is that their fine sizing and plasticity are likely to result in extremely flat beach profiles at pumpable solids contents. As a result, CTD may not show cost nor environmental benefits for the tailings disposal. The results of tailings testwork being carried out will enable a better assessment of this option once the beaching profile and dewatering response is understood.

Peripheral Discharge Sub Aerial Deposition

Preliminary test work results indicate the tailings slurry to be fine-grained with a significant silt and clay fraction. The tailings characteristics, as presently understood, indicate that conventional peripheral discharge, central decantation sub aerial deposition practices can be an effective means of tailings impoundment. The site chosen has flat topography, moderate to low permeability soils and is of sufficient area free of Aboriginal heritage sites, declared rare flora and endangered species to accommodate the plant site, tailings dam and evaporation pond within economic pumping distances.

In regard to the proponent's preferred disposal option, the results of geotechnical investigations and seepage analysis provided by the proponent in response to submissions suggests that reworking of local material may be effective in preventing adverse impacts of salts and metals on aquifers.

Bleed water feed to the evaporation pond will contain magnesium sulphate, produced from the nickel cobalt extraction process, and approximately one million tonnes per annum of calcium sulphate (gypsum) produced from the use of calcrete to neutralise the process solutions. The low permeability of the foundation material in conjunction with the tailings and gypsum are expected to adequately limit seepage and restrict adverse impacts on the groundwater aquifers. The proponent will design and install a groundwater monitoring programme up and down-gradient of the tailings dam and evaporation pond prior to construction of these facilities (Commitment 14).

In its response to submissions (Dames and Moore, 1996b), the proponent indicates that the detailed engineering work for the tailings dam and evaporation pond is yet to be conducted. However, the proponent will design and operate the tailings dam and evaporation pond in accordance with the requirements of the EPA and Department of Minerals and Energy to ensure no unacceptable impact on the existing groundwater regime (Commitment 12). The proponent will also undertake further assessment of the tailings disposal options, a more detailed geochemical and geotechnical assessment of the tailings material, additional hydrogeological investigations and a modelled assessment of the disposal site to prevent excess seepage (Commitment 13). The proponent has modified Commitment 13 to include the assessment of tailings disposal options (see Appendix 4).

The proponent proposes to develop and implement an Environmental Management Programme and Environmental Management System that ensures sound environmental management of the project (Commitments 1 and 2).

Environmental Protection Authority Evaluation

In relation to the tailings dam and evaporation pond the EPA notes that the detailed engineering work is still being conducted by the proponent and that there remains a lack of certainty regarding the ultimate performance characteristics of the impoundments and consequently, a lack of adequate scientific certainty regarding impacts to local and regional groundwaters from these structures. Therefore, while the EPA recognises that impoundment structures are essential for the project's operations, it is considered that a more detailed understanding of the performance characteristics will be necessary prior to construction and operation of these facilities. This will be provided through the additional work required by Commitment 13, the Environmental Management Programme (Commitment 1), and requirements under the Mines Act and Works Approval under the Environmental Protection Act.

The EPA has concluded that the commitments made by the proponent (Commitments 12, 13 and 14), and the measures outlined in the CER and in response to submissions can meet the

EPA's objectives in relation to the management of potential impacts associated with the tailings dam and evaporation pond. The EPA notes that Commitment 13 provides for the re-examination of the in-pit disposal option five years after the commencement of operations. The EPA's conclusion does not remove the necessity for the proponent to obtain approvals which may be required by other agencies (eg: Mining Act, Works Approval and Licensing).

4.7 Gaseous emissions (including greenhouse gases and odours)

Objective

To ensure that gaseous emissions, including greenhouse gases and odours, both individually and cumulatively, do not cause an environmental or human health problem in the area surrounding the proposed processing plant. The proponent should use all reasonable and practicable measures to reduce the discharge of wastes, including gases (EPA, 1996a).

Policy information

The EPA has promulgated two Environmental Protection Policies (EPPs) for atmospheric pollutants for the Kwinana and Kalgoorlie areas. The EPA uses the Kwinana EPP standards and limits as guidelines for the assessment of new industrial projects (where there are no existing sources) and for existing industrial plants which are seeking approval for modifications (Environmental Protection Authority, 1992).

In the Kwinana EPP, a limit is defined as "a concentration not to be exceeded" and a standard is defined as "a concentration which it is desirable not to exceed". The standard is interpreted as the value which the ground level concentration must be below for 99.9% of the time.

The standards and limits for sulphur dioxide and particulates used in the EPP for the Kwinana policy area are summarised in Table 3 below.

Table 3: Standards and limits used in the EPP for the Kwinana Policy Area

Species	Area	Averaging Period	Standard ($\mu g/m^3$)	Limit ($\mu g/m^3$)
Sulphur Dioxide	Industrial Estate	1 hour	700	1400
		24 hour	200	365
		Annual	60	80
	Residential	1 hour	350	700
		24 hour	125	200
		Annual	50	60
Particulates PM_{10}	Residential	24 hour	-	120
		Annual	-	40

The National Health and Medical Research Council (NH&MRC) guidelines require that the ambient concentration of nitrogen dioxide (NO_2) does not exceed 170ppm or $320\mu g/m^3$ (as a one hour average, and not to be exceeded more than once a month).

Guidelines for maximum concentrations of oxides of nitrogen (NO_x) emissions from stacks and vents may also apply to industrial plants in addition to guidelines for ground level concentrations of NO_x emissions. The relevant (NH&MRC) guideline figure which is applicable to the proposed power station exhaust stacks (ie, for gas turbines greater than 10MW), is $0.07g/m^3$. Gas burners with low levels of NO_X production are available commercially.

Carbon dioxide is a greenhouse gas and worldwide industrial emissions are considered to be a major contributor to global warming. The Federal Government, in accordance with international agreements, has announced an intention to stabilise carbon dioxide emissions in Australia by the year 2000. The Commonwealth has urged a program of co-operative agreements between industry and the government to reduce greenhouse emissions.

The EPA recently considered greenhouse gas emission policies in general, including the approach taken by the Commonwealth government and the review undertaken by the DEP into the status of WA's approach.

The EPA provisional policy with respect to greenhouse gases recognises the significant contribution to greenhouse gases that large resource processing projects can make. Accordingly, the EPA considers that a proponent should:

1. calculate the greenhouse gas emissions for their project;
2. estimate the international offsets achieved by implementation of their proposal;
3. indicate the 'no-regrets' measures adopted to reduce greenhouse gas emissions; and
4. enter into a voluntary agreement with the State, in which they will commit to 'no regrets' measures and approaches to abate greenhouse gas emissions, and to enhance sinks.

'No regrets' refers to those measures for reduction of emissions of greenhouse gases. These include measures to increase energy efficiency, to protect and expand forests, and to limit the emissions of chlorofluorocarbons. To the extent that these efforts have a net benefit, or at least no net cost, in addition to addressing the enhanced greenhouse effect, they have become known as 'no regrets' options (Greenhouse Gas Coordination Council 1994).

Technical information

The atmospheric emissions of possible environmental concern relating to the operation of the project have been identified by the proponent (Dames and Moore, 1996a) as point sources for sulphur dioxide, nitrogen dioxide and hydrogen sulphide. These point source emissions are mainly associated with project operations at the processing plant facility and not the mining operations. The closest residence is 15km from these sources and the predicted ground level concentrations of emissions are well below specified levels at this point.

Dust emissions are examined in Section 3 of this report and no further evaluation of this topic is required by the EPA.

Nitrogen Dioxide

Nitrogen dioxide is a reddish brown gas which is soluble in water and is a strong oxidant. The major sources of man-made emissions to the atmosphere derive from the combustion of fossil fuels. In most situations, nitric oxide is emitted and is then transformed into nitrogen dioxide in the atmosphere. At low concentrations, nitrogen dioxide can cause irritation of the mucous membranes and may cause or exacerbate respiratory problems such as asthma and bronchitis (EPA, 1996a).

Nitrogen dioxide emissions from the Murrin Murrin project are primarily a product of combustion associated with the proposed power station's gas turbines, the sintering plant and the hydrogen sulphide flare with expected emissions during normal operations listed in Table 4.

The expected emissions are well below the National Health and Medical Research Council (NH&MRC) guidelines which require that the ambient concentration of nitrogen dioxide does not exceed 170ppm or 320$\mu g/m^3$ (as a one hour average, and not to be exceeded more than once a month).

Table 4: Atmospheric emission characterisation: Point sources - normal operations (from Dames and Moore, 1996a)

Source	Stack height (m)	Emission Volume (Am^3/hr)	Emission Temp (^0C)	Sulphur Dioxide (g/s)	Oxides of Nitrogen[1] (g/s)
Sulphuric acid plant	80	465,000	70	124	-
Gas Turbines (per unit)[2]	40	300,000	90	negligible	3
Sinter Plant	40	100,000	90	negligible	<1
Hydrogen Sulphide Flare	80	175,000	60	110	<15[3]

Notes: 1. Oxides of nitrogen expressed as nitrogen dioxide.

2. Total of 2 units. Normally only one unit will be operational at any one time.

3. Estimate only.

Sulphur Dioxide

Sulphur dioxide is a colourless gas which has a pungent odour and can irritate and be absorbed in the respiratory tract. The sensitivity of humans to sulphur dioxide varies considerably and asthmatics may suffer adverse reactions at quite low levels.

The gas also dissolves in moisture forming dilute sulphurous acid, which then forms sulphuric acid and sulphates, which can be readily absorbed onto small airborne particles. This increases the potential for adverse effects on humans and for environmental impacts such as leaf damage to plants and reduced water quality in wetlands (EPA, 1996a).

Sulphur dioxide emissions from the Murrin Murrin project will be associated with the proposed sulphuric acid plant and the hydrogen sulphide flare with expected emissions during normal operations listed in Table 4.

Carbon Dioxide

Carbon dioxide is a greenhouse gas and worldwide industrial emissions are considered to be a major contributor to global warming. It is estimated by the proponent (Dames and Moore, 1996a) that, with an ore throughput of 4Mtpa, the project would emit a total of 0.6 Mtpa of carbon dioxide. The major sources of carbon dioxide emissions are related to power generation and the neutralisation of the process streams with calcrete. Use of natural gas within the plant will account for 0.38 Mtpa and the calcrete process will account for 0.22 Mtpa.

Carbon dioxide emissions from the Murrin Murrin project will constitute a increase of approximately 0.2% of Australia's total carbon dioxide emissions based on 1990 estimates.

Odour

The proponent (Dames and Moore, 1996a) states that, although hydrogen sulphide will be produced and used in the hydrogen sulphide precipitation circuit, no atmospheric emissions of this gas will occur as it will be flared prior to discharge. The flare will combust the hydrogen sulphide to form sulphur dioxide and this emission has been discussed above.

Comments from key agencies / interest groups

The Shire of Laverton noted that the proponent has not provided any commitments to monitor atmospheric emissions to ensure compliance with air quality criteria given in Table 7.3 of the proponent's CER (Dames and Moore, 1996a). The Shire is also concerned about occupational health of workforce residents at the mining camp in relation to exposure levels to gases and the implications of atmospheric conditions such as thick fogs (which sometimes affect the area) on the dispersion rates of gaseous emissions.

The Department of Conservation and Land Management (CALM) recommends that the proponent monitor vegetation in the vicinity of the plant area for gas emission impacts.

Public submissions identified the need for emission monitoring devices at Minara Station Homestead, the nearest downwind residence.

Response from the proponent

The proponent's response to the issues raised in submissions and discussed above is included in Appendix 2 (Questions 2.6, 2.12, 2.15, 2.16, 2.17, 2.21, 4.4 and 5.5). In its response, the proponent has indicated the following:

- on the basis of air dispersion modelling, the proponent's operations will not result in unacceptable air quality impacts beyond the project area and it has no plans to install air quality monitoring stations;
- the proponent does not believe that the project will generate any significant quantities of carbon monoxide as efficient combustion processes will be used. Therefore, the proponent does not anticipate any problems meeting EPA guidelines;
- the proponent does not believe that the project will generate any significant quantities of nitrous oxide;
- the proposed location of the accommodation village is approximately 7km south-east of the proposed plant site and air dispersion modelling showed that the predicted ground level concentrations of gaseous emissions were well below the ambient air quality guidelines at these distances; and
- the scope of the project's monitoring programmes will be developed in consultation with the EPA, DEP, DME, CALM and other relevant decision making authorities and may be expanded to include additional vegetation and fauna monitoring.

Environmental Protection Authority Evaluation

Following advice from the Department of Environmental Protection and the proponent's response to questions raised, the EPA considers that gaseous emissions from the proposed Murrin Murrin project are manageable. In arriving at this conclusion, the EPA notes that the predicted concentrations for nitrogen dioxide and sulphur dioxide are within limits specified in guidelines to the proponent.

It is the EPA's view that proponents should use all reasonable and practicable measures to reduce the discharge of wastes, including gases (EPA, 1996a). The identification, and implementation (where appropriate), of such measures is regarded by the EPA as an important component to be addressed in the proponent's Environmental Management System (Commitment 2). Measures, such as the incorporation of low NO_x technology into power station gas turbines, should be examined as part of the "structured approach to Best Practice environmental management" (Dames and Moore, 1996a) provided by the Environmental Management System.

Detailed specifications for discharge of emissions, monitoring and reporting will be established by the Department of Environmental Protection in licence conditions set under Part V of the Environmental Protection Act. The proponent will specify emissions criteria in tender documents for the supply of equipment and undertake compliance testing during commissioning to confirm compliance (Commitment 19).

In view of its provisional policy position for greenhouse gases described above, the EPA considers that Recommendation 3 is appropriate.

4.8 Noise

Objective

To ensure that the amenity of surrounding residents is not unduly affected by noise emissions emanating from the project (EPA, 1996b).

Policy information

There are currently no statutory regulations that govern road traffic noise. However, Main Roads Western Australia has a policy that traffic noise at residential locations should be restricted to an L_{10} 18 hour of 63dB(A) wherever practicable. The DEP considers that this level should be 58dB(A) wherever practicable. The DEP also considers that instantaneous (maximum) levels should not exceed 80dB(A) but preferably should be closer to 65dB(A).

The proposed plant would need to comply with the Noise Abatement (Neighbourhood Annoyance) Regulations (1979).

Technical information (source: Dames and Moore, 1996a)

The major sources of noise associated with the project include:

- the excavators and ore trucks associated with the mining activities;
- processing plants and emission sources including the:
  - screening and grinding mill;
  - hydrogen sulphide flare;
  - emergency pressure relief releases;
  - power station;
  - pumps, exhaust fans and conveyors;
- transport noise associated with the import of raw materials and the export of the products and by-products; and
- blasting that may be required in some areas.

The sound pressure level resulting from a source with a sound power level of 110dB(A) (a single excavator) has been calculated for a number of distances and found by the proponent to be within acceptable limits (Dames and Moore, 1996a). The project is isolated from residential areas or any residences. The nearest residence to the project is the Minara homestead, which is approximately 2km from the closest point of the Murrin Murrin 3 ore body and also is separated by a low ridge that precludes "line of sight" and acts as a natural barrier. This residence is approximately 15km from the processing plant. The calcrete mining area is also approximately 2km from the Mt Margaret Mission at its closest point.

The majority of the processing equipment associated with the gas plant and the nickel-cobalt refinery will be housed within buildings and this will reduce the environmental impact of the noise emissions from this equipment. Noise and vibrations generated by paddock blasting will be low due to the small charge required. Blasting activities will be restricted to daylight hours.

The proponent states that the proposed mining and processing operations of the project are not predicted to result in unacceptable noise levels at any occupied residence and has provided a commitment (Commitment 10) that it will comply with the requirements of the Noise Abatement (Neighbourhood Annoyance) Regulations (1979).

The road transport of sulphur from Malcolm Siding (refer Figure 1) to the plant is expected to represent the most significant increase in heavy traffic associated with the project along Laverton-Leonora road. The transport of sulphur is expected to result in approximately 64 truck movements (32 each way) on a daily basis. However, as the project is located remotely and Malcolm Siding is to the east of Leonora, these truck movements do not have to pass through any residential areas and are not expected to result in any significant impacts.

Comments from key agencies/interest groups

The Shire of Laverton is concerned that the project camp site may be impacted by excessive noise emissions emanating from the mining and processing operations. The Shire recognises that this may be more of an occupational hazard than an environmental issue.

Response from the proponent

In responding to submissions (Question 4.4, Appendix 2), the proponent (Dames and Moore, 1996b) indicates that the proposed location of the Accommodation Village is approximately 7km south-east of the proposed plant site. It is also well away from any of the mining areas and major access routes and was chosen to minimise the impacts of air emissions and noise associated with the project.

Environmental Protection Authority Evaluation

The EPA notes the commitments made by the proponent, in particular, that the management of noise is included in the Environmental Management Programme (Commitment 1) and is inherent in the Environmental Management System (Commitment 2) for the operation of the project which will provide a structured approach to Best Practice environmental management. The proponent has also provided a commitment to comply with the provisions of the Noise Abatement (Neighbourhood Annoyance) Regulations (1979). The EPA believes that adequate controls exist under the pollution control provisions of the *Environmental Protection Act* (1986) to control noise associated with the processing plant should a problem arise. In relation to truck movements from Malcolm Siding to the processing plant, the EPA notes the remote location of the project and considers that the potential for surrounding residents to be adversely affected by noise impacts is low.

The management measures outlined in the CER, and the commitments made by the proponent achieve the EPA's objective in relation to management of noise impacts.

4.9 Import and handling of sulphur at the Esperance Port

Objective

To ensure the import and handling of sulphur at the Esperance Port is subject to consideration by the EPA and is undertaken in a manner which does not cause pollution.

Policy information

The import and handling of elemental sulphur at the Esperance Port is the responsibility of the Esperance Port Authority. Referral of the proposal to import sulphur is required under Section 38 of the Environmental Protection Act.

Technical information

The proponent (Dames and Moore, 1996a) indicates that elemental sulphur will be used in the project to produce the sulphuric acid and hydrogen sulphide required for the process.

For the reasons stated in Section 3.2.2 of the proponent's CER (Dames and Moore, 1996a), the sulphur will be imported from Canada and will be supplied as prill sulphur. The sulphur will be delivered as 30,000 to 40,000t shipments to the Esperance Port and stored within the wharf area.

Load-out of sulphur from the Esperance Port stockpiles will be direct to Westrail wagons, with 1,500 to 2,000t per consignment and a total of 10 to 14 train movements (a movement is defined as one way between Kalgoorlie and Malcolm Siding) per week. Westrail wagons will

be off loaded at the Malcolm Siding to a small stockpile. Sulphur will then be trucked from this stockpile to the plant site.

All substances transported to site by road or rail from Perth, Kalgoorlie and/or Esperance will be transported, handled and stored in accordance with the relevant regulations and standards from Department of Minerals and Energy, Main Roads and Westrail (Dames and Moore, 1996a).

The proponent (Dames and Moore, 1996a) indicates that the Esperance Port Authority will be responsible for the legislative requirements relating to the handling and storage of sulphur at the Port and on this basis does not provide detailed environmental impact assessment of the issue. Similarly, the proponent has indicated that Westrail is responsible for the procedures it employs during the transport of the sulphur by rail to Malcolm Siding. Once off-loaded at Malcolm Siding, the sulphur will be stockpiled on a sealed surface with drainage basins to contain any surface water runoff. Anaconda is responsible for the management of the sulphur stockpile at the Siding and the transport of the sulphur to the processing plant.

Comments from key agencies / interest groups

The Esperance Shire Council advised that due to the lack of detail regarding the implications of the storage and handling of sulphur at the Port and its transportation through Esperance, informed comment cannot be offered. The Esperance Shire Council sought confirmation that a specific Consultative Environmental Review (CER) would be prepared for the importation of sulphur through Esperance as it relates to the townsite.

The Esperance Port Authority noted that the importation of sulphur through the Port of Esperance will require a separate approval and advised that it has commenced a process to advise the DEP of the proposed handling and storage method for the importation of the sulphur.

On the basis of preliminary discussions with the Esperance Port Authority, the DEP has identified the potential environmental topics associated with the import and handling of sulphur through the Port of Esperance as spillage of prill; potential for dust, noise and odour; risk and hazards; visual issues; reclamation; cumulative operations; deballasting; and drainage management. It is the DEP's view that these impacts warrant referral to the EPA in accordance with Section 38 of the Environmental Protection Act.

Public submissions also considered that the CER provided insufficient detail to enable informed comment to take place and requested that all port activities relating to the Murrin Murrin project are the subject of a separate CER.

Response from the proponent

The proponent's response to this issue is included in Appendix 2 (Question 4.1). In its response (Dames and Moore, 1996b), the proponent has indicated that the Esperance Port Authority currently proposes to submit an Environmental Referral for the handling and storage of sulphur at the Esperance Port to the EPA in April 1996 to trigger the environmental assessment process. The proponent indicates that the first consignment of sulphur is scheduled to be imported in the first quarter of 1998, prior to the start of operations at Murrin Murrin.

Environmental Protection Authority Evaluation

The EPA notes that an integral part of the processing requirements for the Murrin Murrin project is the sulphur needed to produce sulphuric acid and hydrogen sulphide. The EPA also notes the decision by the proponent not to include an assessment of the import of sulphur through the Port of Esperance on the basis that it does not manage the land and is not responsible for the activities which take place on land managed by the Esperance Port Authority.

The EPA notes that on the 11 April 1996, a proposal for the importation of sulphur through the Port of Esperance was referred to it by the Esperance Port Authority. The EPA understands

from the Esperance Port Authority's referral documentation that the proposal is intended to meet Anaconda's requirements for handling and storage of sulphur, and may also serve other companies requirements (Dames and Moore, 1996c). The level of environmental impact assessment on this proposal has been set by the EPA at Consultative Environmental Review, subject to the outcome of any appeal determinations.

Anaconda Nickel should note that the EPA's advice contained in this Bulletin will not preempt decisions on the import and handling of sulphur through the Port of Esperance evaluated through formal environmental impact assessment of that proposal . The import and handling of sulphur through the Port of Esperance will be considered by the EPA on its own merits and reported on in a separate Bulletin.

The EPA considers that issues associated with the transport of sulphur between the Port of Esperance and Malcolm Siding and for the unloading of sulphur at Malcolm Siding are minor and can be adequately addressed by Westrail in consultation with the proponent. The transport of sulphur from Malcolm Siding to the processing plant is the responsibility of the proponent and management of this component of the project is inherent in the Environmental Management System (Commitment 2) for the operation of the project which will provide a structured approach to Best Practice environmental management.

4.10 Environmental Management Programme and Environmental Management System

Objective

To ensure the project is managed during construction, operational and decommissioning phases, to reduce unnecessary impacts and to properly manage unavoidable impacts to an acceptable level.

Technical information

Prior to the commencement of the project, the proponent will prepare and implement an Environmental Management Programme which will address the environmental management of the construction phase. This is reflected in proponent Commitment 1 (see Appendix 4). The proponent (Dames and Moore, 1996a) indicates the EMP will contain details on:

- the environmental responsibilities;
- the environmental commitments for the project;
- regulatory framework;
- flora and vegetation management (including weed control)
- fauna management;
- erosion control;
- surface and groundwater management;
- dust management;
- noise management;
- waste disposal and management;
- management of construction camps and temporary facilities;
- borrow pit management;
- bushfire management;
- management of Aboriginal Heritage;
- management of existing land uses;
- management of public safety;

- management of environmental incidence;
- environmental induction and education;
- community liaison;
- rehabilitation;
- environmental monitoring and reporting; and
- procedures and timing associated with the review of the EMP.

An Environmental Management System (EMS) is the application of the quality system concept to environmental issues. The proponent (Dames and Moore, 1996a) states that the EMS incorporates many of the principles developed in quality standards and applies them to environmental management. The proponent (Dames and Moore, 1996a) quoting from Natoli (1995) states that in particular, an EMS requires:

- the development, description and implementation of procedures;
- the monitoring, recording and reporting of environmental impacts and performance; and
- the formulation of strategies to minimise environmental impacts.

The proponent (Dames and Moore, 1996a) indicates that, prior to commencement of the project's operations phase, the proponent will prepare an EMS which will address the environmental management of the project's operations. The EMS will provide a structured approach to Best Practice environmental management which includes the basic principles of other quality-management systems. It will integrate environmental management into the proponent's daily operations, long term planning and other quality management systems. However, certification will be voluntary. The proponent has provided a commitment to develop an EMS (see Appendix 4)

Comments from key agencies / interest groups

The Department of Minerals and Energy (DME) is concerned that environmental management measures are largely deferred to a "post approval" EMP process. DME considers that the proponent's ability to manage impacts must be understood before approval can be granted and that approval must be deferred until there are viable mine/rehabilitation plans for the ore mining areas and calcrete mining area.

DME states that a mine plan is required which shows the mining/rehabilitation sequence for at least the first two years, with an indicative plan out to five years.

Response from the proponent

The proponent's response to this issue is included in Appendix 2 (Questions 1.6 and 4.1).The proponent will submit a mine plan showing the proposed mining and rehabilitation operations for the first few years as part of the construction phase EMP. The mine plan will be progressively updated during the development of this project and will be submitted to the Department of Minerals and Energy for its approval prior to the commencement of each phase of these works (Dames and Moore, 1996b).

Environmental Protection Authority Evaluation

The EPA considers it imperative that there be a management mechanism in place for the potential environmental impacts associated with the ongoing development of the project. This should also include appropriate monitoring frameworks, so that, over time, management measures can be further refined as required.

The EPA also recognises that approvals for this project are required under the Mining Act , that the Water and Rivers Commission will set conditions under the Rights in Water and Irrigation Act for the abstraction of groundwater, and that Works Approval and Licensing is required under Part V of the Environmental Protection Act. The Department of Minerals and Energy's

concerns in relation to mine/rehabilitation plans for ore mining areas and calcrete mining areas can be addressed through Mining Act approvals.

In view of the pressures placed on the local environment, Anaconda has an on-going responsibility in its pursuit of sustainable development, to enlist the technologies and financial resources they command to reduce environmental degradation.

The EPA considers that the CER has demonstrated that the environmental issues arising from this proposal are capable of being adequately addressed through appropriate management and monitoring. The proponent has commitments to ensure appropriate management and monitoring of the proposal. Of these, Commitment 1 requires the preparation of a construction phase Environmental Management Programme which is to be prepared in consultation with the Department of Environmental Protection, the Department of Minerals and Energy, the Department of Conservation and Land Management and other agencies to meet the requirements of the EPA. Commitment 2 will see the development of an Environmental Management System for the operation of the project. The commitment to the development of a quality assured management system and continuous improvement is an initiative which is supported by the EPA.

The EPA concludes that the proponent's commitments and the detail contained in the CER and in response to submissions allow the achievement of the EPA's objective of managing the proposal during construction, operations and decommissioning, to avoid unnecessary impacts and to properly manage unavoidable impacts to an acceptable level.

4.11 Decommissioning and rehabilitation

Objective

To ensure an acceptable rehabilitation and decommissioning programme is put in place which incorporates a "closure strategy" agreed to by the Western Australian Government.

Policy information

Past assessments by the EPA of a range of mining proposals provide a policy framework for consideration of the rehabilitation and decommissioning phase of the project, and the expectations of the EPA.

The EPA has recognised that for rehabilitation to be most effective it must be integrated into the mining plans early on in the project's development, and not left to the conclusion of mining (EPA, 1991).

It is of paramount importance to the State that rehabilitation management does not impose short or long term costs on the community of Western Australia. This is particularly relevant when the success of rehabilitation cannot be evaluated in the short to medium term (EPA, 1994).

When approving other mining projects, the Minister for the Environment has required that there be a specific mechanism put in place for the development of the final decommissioning scenario for the site.

Technical information

The longer term impacts arising from the completion of mining operations at Murrin Murrin will be mainly associated with the stabilisation of post-mining landforms, the tailings dam and evaporation pond.

The proponent (Dames and Moore, 1996a) indicates that:

- rehabilitation of disturbed areas will be undertaken on a progressive basis using best industry practice;

- the success of the rehabilitation programme will depend on planning for rehabilitation well in advance of disturbance;
- planning for rehabilitation will include the selection of rehabilitation performance objectives or completion criteria;
- emphasis will be placed on the development of a stable landform compatible with the contiguous landscape, with a non-erodable surface conducive to revegetation; and
- the selection of specific completion criteria and development of a monitoring programme will be addressed in the EMP and EMS.

Decommissioning will involve the dismantling and removal of all buildings, equipment and infrastructure not required by the State for other purposes. The mine pits will also be decommissioned and all disturbed areas will be rehabilitated in accordance with best industry practice (Dames and Moore, 1996a).

Comments from key agencies / interest groups

The Department of Minerals and Energy (DME) indicated that a mine plan is required which shows the mining/rehabilitation sequence for at least the first two years, with an indicative plan out to five years. DME also indicates that there is no mining/rehabilitation plan at all for the Calcrete Quarry despite the potential for significant impacts to the ground and surface water regime and consequential ecological impacts on Lake Carey.

Other submissions considered that rehabilitation performance objectives for the project should be provided now.

Response from the proponent

The proponent's response to these issues are included in Appendix 2 (Questions 1.5, 1.6 and 4.11). The overall objective of the proponent's rehabilitation programme will be to develop a stable landform compatible with the contiguous landscape with a non-erodable surface conducive to revegetation. Site specific completion criteria will be defined according to the characteristics and rehabilitation requirements of each site, in consultation with the relevant decision making authorities and other parties (Dames and Moore, 1996b).

The proponent (Dames and Moore, 1996b), indicates that a mining and rehabilitation plan for the calcrete mining area which recognises and manages the potential impacts on groundwater and surface water regimes and ecological impacts on Lake Carey will be developed as part of the construction phase EMP (Commitment 1).

Environmental Protection Authority Evaluation

The EPA concludes that for some elements of the environment, there remains a lack of certainty regarding the extent of environmental change attributable to the long term operation of the Murrin Murrin project. In regard to the tailings dam, although the preliminary indications for management of this structure have become apparent, more detailed studies are still required. These studies will better define the long term performance characteristics and rehabilitation potential of the tailings dam and evaporation pond and clarify the effect of these facilities on the environment, particularly groundwater. The EPA notes that Commitment 13 provides for the re-examination of in-pit disposal of tailings five years after the commencement of operations. Some aspects of the project will also lead to irreversible impacts to the environment (eg: formation of mined out pits, overburden stockpiles, reduction of groundwater supply).

The management of rehabilitation and decommissioning is inherent in a number of proponent's commitments and in information contained in the CER (Dames and Moore, 1996a) and the response to submissions (Dames and Moore, 1996b). Attention to rehabilitation and decommissioning requirements at the earliest stage of project development will provide decision makers with a high degree of confidence that an acceptable post mining condition can be achieved.

The EPA recognises that it may not be practical for Anaconda to detail specific plans for the rehabilitation of the project site early in the project life, bearing in mind its life expectancy of 25 years, and that the end use of the land is not clear at this stage. However, the EPA considers that the process of planning for decommissioning, and the development of a 'walk away' solution, should be formally instigated early within the mine life. Accordingly, a plan describing the process of decommissioning should be developed within 5 years of commissioning the project (Recommendation 4, Section 5).

5. Conclusion and recommendation's

5.1 Conclusion

Following review of the proponent's Consultative Environmental Review, the issues raised in the public submissions, advice received from government departments, relevant literature and the proponent's revised environmental management commitments, the EPA concludes on the information currently available, that the proposal by Anaconda Nickel NL for the development of the Murrin Murrin Nickel-Cobalt project can be managed to meet the EPA's objectives.

5.2 Recommendation's

Noting the conclusion reached, the EPA submits the following recommendations to the Minister for the Environment.

Recommendation 1

That the Minister for the Environment note that the EPA has concluded that the proposal can be managed to meet the EPA's objectives, subject to the proponent's revised environmental management commitments and the EPA's recommended conditions and procedures (see Recommendation 5).

Recommendation 2

That prior to construction, the proponent be required to prepare a plan for the conservation and management of *Hemigenia exilis* within the project area which meet the requirements of the Department of Conservation and Land Management.

Recommendation 3

That the Environmental Management Programme (EMP) prepared by the proponent under Commitment 1, and the Environmental Management System (EMS) prepared by the proponent under Commitment 2, include the following information to the satisfaction of the Environmental Protection Authority on advice of the Department of Environmental Protection:

Greenhouse gas emissions :

- **calculations of the greenhouse gas emissions associated with the proposal (using appropriate methodology developed for Australia);**
- **note the Governments' desire to stabilise greenhouse gas emissions by the year 2000 and progressively reduce them thereafter. Also note the Revised**

Greenhouse Strategy for Western Australia 1994 and the United Nations Framework Convention on Climate Change (FCCC); and

- employment of best endeavours to comply with the Government position and FCCC Convention on greenhouse gas emissions with reporting on progress.

Reports of the results are to be submitted annually to the Department of Environmental Protection for audit, and are to be made publicly available.

Recommendation 4

That within five years of commissioning the Murrin Murrin project, or at such later time considered appropriate by the Minister for the Environment on the advice of the Department of Environmental Protection, the proponent be required to prepare and subsequently implement a plan which:

- describes the process for the decommissioning and rehabilitation of the project area;

- provides for the long term management of ground and surface water systems affected by the tailings disposal area and evaporation pond area; and

- provides for the development of a 'walk away' solution for the decommissioned mine pits, the process plant, tailings dam and evaporation pond and associated infrastructure,

to the satisfaction of the Environmental Protection Authority on the advice of the Department of Environmental Protection, the Department of Minerals and Energy and the Water and Rivers Commission.

Note: A 'walk away' solution means that the site shall either no longer require management at the time the proponent ceases operations, or if further management is deemed necessary, the proponent shall make adequate provision so that the required management is undertaken with no liability to the State.

Recommendation 5

That, if the Minister for the Environment provides environmental clearance that the proposal may be implemented, that clearance be subject to the Conditions set out in Section 6 of this report.

Table 5: Summary of Environmental Protection Authority recommendations

Issues	Objective	Evaluation Framework	Proponent's Commitments	EPA Recommendations
Biophysical				
1 Impact on locally and regionally significant vegetation associations, Declared Rare and Priority flora.	To protect Declared Rare and Priority flora and ensure no significant loss of locally and regionally significant vegetation associations and plant habitats.	Compliance with provisions of Wildlife Conservation Act. Affected vegetation associations mostly widespread throughout the region.	EMP to address flora and vegetation management (Commitment 1) and EMS provides for best practice environmental management (Commitment 2). Minimise disturbance to *Hemigenia exilis* and comply with Wildlife Conservation Act (Commitment 4).	Prior to construction, the proponent should prepare a plan for the conservation and management of *Hemigenia exilis* within the project area to meet the requirements of the Department of Conservation and Land Management. RECOMMENDATION 2
2 Impact on Threatened and Priority fauna species and animal habitats	Threatened and Priority fauna species and their habitat should be protected.	Compliance with provisions of Wildlife Conservation Act. Fauna habitats in the project area are well represented throughout the region.	EMP to address fauna management (Commitment 1) and EMS provides for best practice environmental management (Commitment 2). Scope of additional fauna studies will be determined in consultation with CALM and DEP (Commitment 18).	Proponent's commitments are considered adequate.
3 Impact on surface water.	Ensure no significant adverse changes to existing drainage systems, vegetation/land systems, and dependent fauna.	Modification of existing drainage patterns, reduction in downstream flow and potential water quality impacts should be managed.	Monitoring and management addressed by proponent in commitments 1 (EMP), 2 (EMS) and 6 (minimise transport of sediments and monitor Cement Creek and Katata Creek)	Proponent's commitments are considered adequate.
4 Impact on the water table due to the extraction of groundwater.	To ensure that the proposed extraction of 30,000m3 per day of groundwater does not result in drawdown of the water table such that indigenous vegetation is threatened or other user rights jeopardised.	Water resources use in the area is administered via abstraction controls under Part III of the Rights in Water and Irrigation Act. Adequacy of information on groundwater availability and detrimental impacts.	Monitoring and management addressed by proponent in commitments 1 (EMP), 2 (EMS) and commitment 15 (pastoral water supplies maintained)	Information requirements addressed through WRC licencing process. Proponent's commitments are considered adequate.

Issues	Objective	Evaluation Framework	Proponent's Commitments	EPA Recommendations
Pollution potential				
5 Solid and liquid waste disposal (tailings dam/evaporation pond).	To ensure that environmental impacts arising from the disposal of tailings are kept as low as practicable and that best practice is implemented.	Works Approval and Licence, and Mining Act requirements. Appropriate location, design, rehabilitation, monitoring, and decommissioning and the implementation of best practice.	Monitoring and management addressed by proponent in commitments 1 (EMP), 2 (EMS) and commitment 12 (Design and operation), 13 (Further assessment and investigation), 14 (Monitoring) and 3 (Rehabilitation).	Proponent's commitments are considered adequate.
6 Protection of groundwater (salinity) from lakes forming in the mined out pits.	Avoid contamination of the groundwater from lakes which may form in the mined-out pits.	Mining except in the Murrin Murrin 2 deposit is above the water table.	Proponent to backfill mined out pits and will specifically backfill Murrin Murrin 2 deposit above the water table and progressively rehabilitate other pits (Commitment 3).	Proponent's response to submissions is considered adequate.
7 Gaseous emissions (including greenhouse gases and odours)	To ensure that gaseous emissions, including greenhouse gases and odours, both individually and cumulatively, do not cause an environmental or human health problem in the area surrounding the proposed processing plant. The proponent must use all reasonable and practicable measures to reduce the discharge of wastes, including gases. (EPA, 1996 Bull 804)	NO_2, SO_2 and H_2S meet specifications in EPA guidelines and are subject to Works Approval and Licence requirements. Comply with EPA requirements for Greenhouse gas emissions.	Monitoring and management addressed by proponent in commitment 2 (EMS) and commitment 9 (CO_2 emissions calculated on an annual basis). Specification of emissions criteria in tender documents and compliance testing during commissioning (Commitment 19)	The proponent's EMP and EMS should include requirements for greenhouse gas emissions. RECOMMENDATION 3
8 Noise	To ensure that the amenity of surrounding residents is not unduly affected by noise emissions emanating from the project.	Noise Abatement (Neighbourhood Annoyance) Regulations (1979). As the project is located in a remote area, traffic noise levels have a low potential to affect surrounding residents.	Comply with the Noise Abatement (Neighbourhood Annoyance) Regulations (1979) (Commitment 10).	Proponent's commitments are considered adequate.

Issues	Objective	Evaluation Framework	Proponent's Commitments	EPA Recommendations
Pollution potential				
9 Import and handling of sulphur at the Esperance Port.	To ensure the import and handling of sulphur at the Esperance Port is referred to the EPA for the setting of an appropriate level of environmental impact assessment.	Referral required under Section 38 of the Environmental Protection Act. The import and handling of elemental sulphur at the Esperance Port is the responsibility of the Esperance Port Authority.	The operations at the Esperance Port are the responsibility of the Esperance Port Authority.	Referral to EPA in accordance with S38 of the EP Act is required.
Environmental monitoring				
10 Environmental Management Programme and Environmental Management System	To ensure the project is managed during construction, operational and decommissioning phases, to avoid unnecessary impacts and to properly manage unavoidable impacts to an acceptable level.		Monitoring and management addressed by proponent in commitments 1 (EMP) and 2 (EMS).	Proponent's commitments are considered adequate.
Decommissioning				
11 Decommissioning and rehabilitation.	To ensure an acceptable rehabilitation and decommissioning programme is put in place which incorporates a "closure strategy" agreed to by the Western Australian Government.	Precedent of past mining projects, which require that long term rehabilitation and decommissioning options are considered early on in the projects development, to best integrate rehabilitation options with the mine plan.	Addressed in proponent commitments 1 (EMP), 2 (EMS), 3 (rehabilitation to minimise disturbance of biological communities) 4 (DRF), and 5 and 6 (progressively rehabilitate disturbed areas).	The process for planning for decommissioning and the development of a 'walk away' solution, should be instigated earlier in the life of the project. RECOMMENDATION 4.

6. Recommended environmental conditions

Based on its assessment of this proposal and the recommendations in this report, the Environmental Protection Authority considers that the following Recommended Environmental Conditions are appropriate.

PROPOSAL: MURRIN MURRIN NICKEL-COBALT PROJECT

CURRENT PROPONENT: ANACONDA NICKEL NL

This proposal may be implemented subject to the following conditions:

1 Proponent Commitments
The proponent has made a number of environmental management commitments in order to protect the environment.

1-1 In implementing the proposal, the proponent shall fulfil the commitments made in the Consultative Environmental Review and in response to issues raised following public submissions; provided that the commitments are not inconsistent with the conditions or procedures contained in this statement.

The consolidated environmental management commitments (April 1996) were published in Environmental Protection Authority Bulletin 816 (Appendix 4) and a copy is attached.

2 Implementation
Changes to the proposal which are not substantial may be carried out with the approval of the Minister for the Environment.

2-1 Subject to these conditions, the manner of detailed implementation of the proposal shall conform in substance with that set out in any designs, specifications, plans or other technical material submitted by the proponent to the Environmental Protection Authority with the proposal.

2-2 Where, in the course of the detailed implementation referred to in condition 2-1, the proponent seeks to change the designs, specifications, plans or other technical material submitted to the Environmental Protection Authority in any way that the Minister for the Environment determines, on the advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

3 Proponent
These conditions legally apply to the nominated proponent.

3-1 No transfer of ownership, control or management of the project which would give rise to a need for the replacement of the proponent shall take place until the Minister for the Environment has advised the proponent that approval has been given for the nomination of a replacement proponent. Any request for the exercise of that power of the Minister shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the project in accordance with the conditions and procedures set out in the statement.

4 Protection of Declared Rare Flora, *Hemigenia exilis*
Declared Rare Flora should be managed within the project area so that no significant loss of the species occurs.

4-1 Prior to construction, the proponent shall prepare a plan for the conservation and management of *Hemigenia exilis* within the project area, to meet the requirements of the Department of Conservation and Land Management.

4-2 The proponent shall implement the plan required by condition 4-1 to the requirements of the Department of Conservation and Land Management.

5 Environmental Management Programme and Environmental Management System

The Environmental Management Programme and Environmental Management System should address greenhouse gas emissions.

5-1 At appropriate times, the proponent shall address, in the Environmental Management Programme to be prepared under Commitment 1, and in the Environmental Management System to be prepared under Commitment 2, the following additional matters relating to greenhouse gas emissions:

1. calculations of the greenhouse gas emissions associated with the proposal, using appropriate methodology developed for Australia;

2. noting governments' desire to stabilise greenhouse gas emissions by the year 2000 and progressively reduce them thereafter. Also noting the Revised Greenhouse Strategy for Western Australia 1994 and the United Nations Framework Convention on Climate Change (FCCC); and

3. employment of best endeavours to comply with the position noted in 2 above and the FCCC Convention on greenhouse gas emissions, with reporting on progress.

to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection.

6 Decommissioning

The satisfactory decommissioning of the project, removal of plant and installations and rehabilitation of the site and its environs is the responsibility of the proponent.

6-1 Within five years following commissioning, or at such later time considered appropriate by the Minister for the Environment on advice of the Department of Environmental Protection, the proponent shall prepare a plan which:

1. describes the process for the decommissioning and rehabilitation of the project area;

2. provides for the long term management of ground and surface water systems affected by the tailings disposal area and evaporation pond area; and

3. provides for the development of a 'walk away' solution for the decommissioned mine pits, the process plant, the tailings dam and the evaporation pond and all associated infrastructure,

to the requirements of the Environmental Protection Authority on the advice of the Department of Environmental Protection, the Department of Minerals and Energy and the Water and Rivers Commission.

Note: A 'walk away' solution means that the site shall either no longer require management at the time the proponent ceases operations, or if further management is deemed necessary, the proponent shall make adequate provision so that the required management is undertaken with no liability to the State.

6-2 The proponent shall implement the plan required by condition 6-1.

7 Time Limit on Approval

The environmental approval for the proposal is limited.

7-1 If the proponent has not substantially commenced the project within five years of the date of this statement, then the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment shall determine any question as to whether the project has been substantially commenced.

Any application to extend the period of five years referred to in this condition shall be made before the expiration of that period to the Minister for the Environment.

Where the proponent demonstrates to the requirements of the Minister for the Environment on advice of the Department of Environmental Protection that the environmental parameters of the proposal have not changed significantly, then the Minister may grant an extension not exceeding five years.

8 Compliance Auditing

To help determine environmental performance and compliance with the conditions, periodic reports on the implementation of the proposal are required.

8-1 The proponent shall submit periodic Performance and Compliance Reports, in accordance with an audit programme prepared by the Department of Environmental Protection in consultation with the proponent.

Procedure

1 Unless otherwise specified, the Department of Environmental Protection is responsible for assessing compliance with the conditions contained in this statement and for issuing formal clearance of conditions.

2 Where compliance with any condition is in dispute, the matter will be determined by the Minister for the Environment.

Note

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.

7. References

BHP 1996, *Murrin Murrin Nickel Cobalt Feasibility Study Geotechnical Investigations*, Anaconda Nickel NL, unpub.

Dames and Moore 1996a, *Murrin Murrin Nickel - Cobalt Project*, Consultative Environmental Review, unpub.

Dames and Moore 1996b, *Proponent's Response to Submissions Murrin Murrin Nickel - Cobalt Project Consultative Environmental Review*, unpub.

Dames and Moore 1996c, *Environmental Referral: Importation of sulphur through the Port of Esperance*, unpub.

Greenhouse Coordination Council 1994, *Revised Greenhouse Strategy for Western Australia 1994.*

Environmental Protection Authority 1991, *Proposed Mesa J iron ore development - Pannawonica,* Report and Recommendations of the Environmental Protection Authority, Bulletin 547, Environmental Protection Authority, Perth, Western Australia

Environmental Protection Authority 1992, *Development of an Environmental Protection Policy for Air Quality at Kwinana,* Bulletin 644, Environmental Protection Authority, Perth, Western Australia

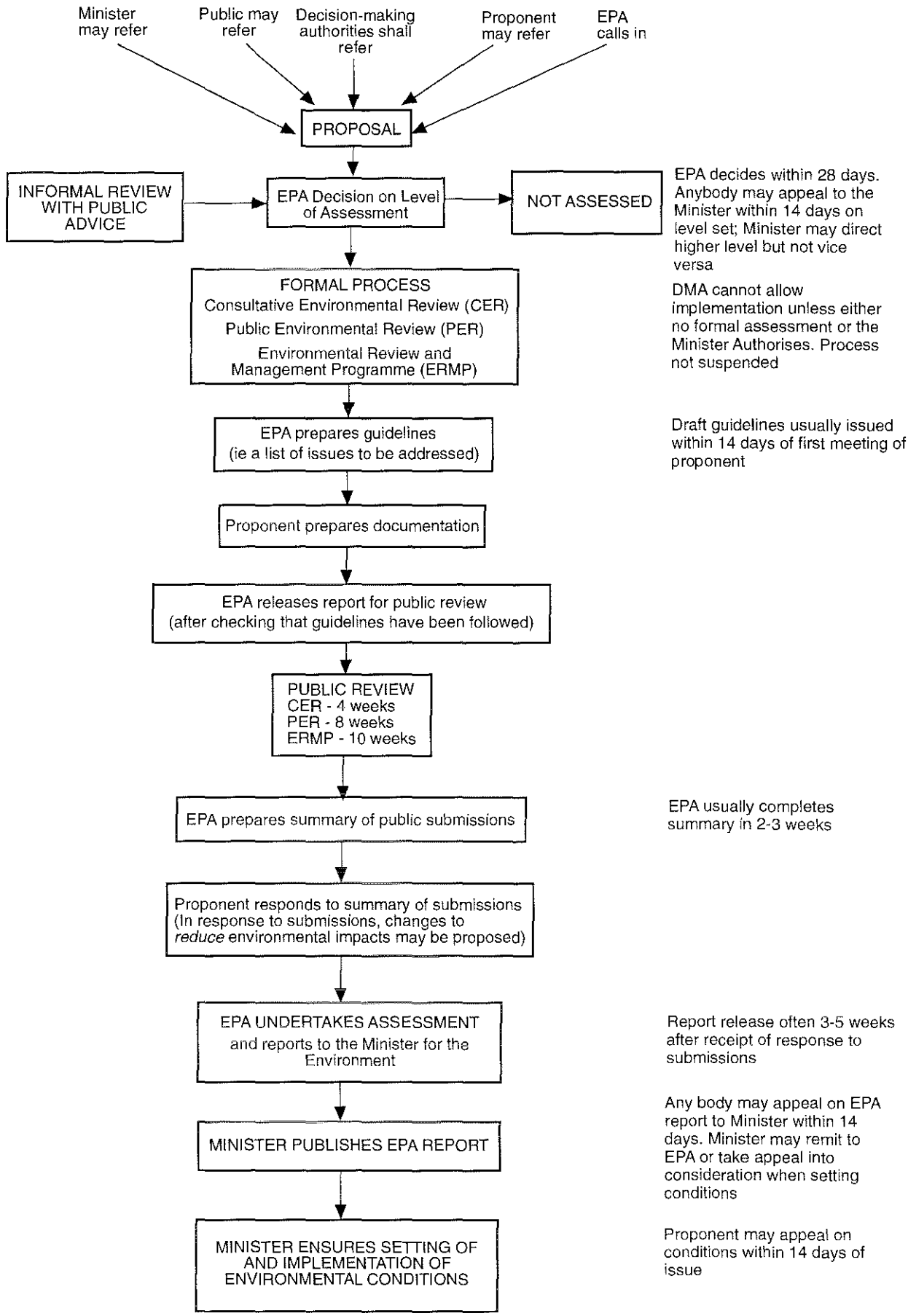
Environmental Protection Authority 1994, *Boddington Gold Mine: Rehabilitation Strategy,* Report and Recommendations of the Environmental Protection Authority, Bulletin 766, Environmental Protection Authority, Perth, Western Australia

Environmental Protection Authority 1996a, *Mid West Iron and Steel, Geraldton Steel Plant, Narngulu Industrial Estate, Geraldton,* Report and Recommendations of the Environmental Protection Authority, Bulletin 804, Environmental Protection Authority, Perth, Western Australia

Environmental Protection Authority 1996b, *Narrikup export abattoir*, Report and Recommendations of the Environmental Protection Authority, Bulletin 808, Environmental Protection Authority, Perth, Western Australia

Appendix 1

Environmental Impact Assessment flow chart


Minister may refer
Public may refer
Decision-making authorities shall refer
Proponent may refer
EPA calls in
PROPOSAL
INFORMAL REVIEW WITH PUBLIC ADVICE
EPA Decision on Level of Assessment
NOT ASSESSED
EPA decides within 28 days. Anybody may appeal to the Minister within 14 days on level set; Minister may direct higher level but not vice versa
FORMAL PROCESS
Consultative Environmental Review (CER)
Public Environmental Review (PER)
Environmental Review and Management Programme (ERMP)
DMA cannot allow implementation unless either no formal assessment or the Minister Authorises. Process not suspended
EPA prepares guidelines (ie a list of issues to be addressed)
Draft guidelines usually issued within 14 days of first meeting of proponent
Proponent prepares documentation
EPA releases report for public review (after checking that guidelines have been followed)
PUBLIC REVIEW
CER - 4 weeks
PER - 8 weeks
ERMP - 10 weeks
EPA prepares summary of public submissions
EPA usually completes summary in 2-3 weeks
Proponent responds to summary of submissions (In response to submissions, changes to *reduce* environmental impacts may be proposed)
EPA UNDERTAKES ASSESSMENT and reports to the Minister for the Environment
Report release often 3-5 weeks after receipt of response to submissions
MINISTER PUBLISHES EPA REPORT
Any body may appeal on EPA report to Minister within 14 days. Minister may remit to EPA or take appeal into consideration when setting conditions
MINISTER ENSURES SETTING OF AND IMPLEMENTATION OF ENVIRONMENTAL CONDITIONS
Proponent may appeal on conditions within 14 days of issue

Appendix 2

Summary of submissions and proponent's response
(source: Dames and Moore, 1996b)

TABLE OF CONTENTS

LIST OF FIGURES

PROPONENT'S RESPONSE TO SUBMISSIONS
MURRIN MURRIN NICKEL-COBALT PROJECT
CONSULTATIVE ENVIRONMENTAL REVIEW
for
Anaconda Nickel NL

This report presents a summary of the issues raised by Decision Making Authorities (DMAs), members of the public and other interested parties during the four week public review of the Murrin Murrin Nickel-Cobalt Project Consultative Environmental Review (CER). The CER was prepared for the Proponent, Anaconda Nickel NL, by Dames & Moore (1996).

The environmental issues raised in the submissions were summarised by the Department of Environmental Protection (DEP) and included:

- protection of groundwater;
- changes to surface drainage patterns;
- management of wastes and emissions;
- options for disposal of tailings (to reduce the size of the footprint);
- impact on Declared Rare Flora (DRF); and
- the import and handling of sulphur through the Esperance Port.

These issues, and the Proponent's response, are presented in Sections 2.0-5.0 of this report.

The DEP also requested that the Proponent respond to the submission from the Department of Conservation and Land Management (CALM) in its entirety. The issues raised in that submission and the Proponent's response to these issues are presented in Section 6.0.

1.0 BIOPHYSICAL IMPACTS

1.1 There is no plan to show how gazetted flora and unconserved plant communities will be managed in the context of this Project.

The Proponent is committed to undertake the construction, operation and decommissioning of the Project in a manner that minimises disturbance to populations of the DRF species, *Hemigenia exilis* (Commitment 4). The strategies and procedures proposed for environmental management of this species are summarised in Section 7.5 of the CER and include the physical protection of known populations, workforce education, scientific research (laboratory and field trials), seed collection for use in rehabilitation and monitoring. In addition, an application "to take" individuals of *H.exilis* located on the orebodies will be submitted to the Minister for the Environment prior to the commencement of the Project.

The Proponent will also minimise the disturbance of *H.exilis* habitats by implementing the management strategies and procedures developed for the overall protection of flora and vegetation in the Project Area (summarised in Sections 7.4 and 7.6 of the CER). The primary objective of this management will be to reduce disturbance where possible and rehabilitate disturbances where they occur (Commitment 3). Further details on the management of the flora and vegetation will be provided in the construction phase Environmental Management Programme (EMP) and operations phase Environmental Management System (EMS), which will be submitted for approval by the Environmental Protection Authority (EPA).

1.2 Will the Proponent make a commitment to monitor vegetation health in the vicinity of the tailings dam and evaporation pond as a guide to leachate movement in the shallow subsurface? (This would supplement the proposed monitor bore array - Commitment 14).

The Proponent is committed to designing and operating the tailings dam and evaporation pond in accordance with the requirements of the EPA and the Department of Minerals & Energy (DME) to ensure that the tailings dam and evaporation pond do not result in unacceptable impacts on the existing groundwater regime (Commitment 12). A groundwater monitoring programme will be established up- and down-gradient of these areas to monitor for any changes in the depth of the water table and changes to the water quality. The monitoring programme will commence prior to the construction of these facilities and will be designed and operated to the satisfaction of the DME, DEP and the Waters & Rivers Commission (WRC) (Commitment 14).

A vegetation monitoring programme may be a useful supplement to this groundwater monitoring programme. The Proponent accepts that there may be some merit in undertaking such a programme but is concerned that the difficulties and limitations associated with the design and implementation of the programme will limit the usefulness and scientific rigour of the data. These include:

- the influence that other factors may have on the condition of the vegetation. This "background noise" may be the result of natural arid zone processes (such as fire, insect attack and erratic rainfall patterns) or artificial factors (such as changes to existing surface drainage patterns) and may mask the impacts associated with leachate movement;
- cumulative impacts, where a significant change in the vegetation condition occurs as a result of the combined action of a number of factors which by themselves would not cause as significant an impact. It may be difficult to determine which factor is responsible for which portion of the impact, which in turn limits the ability to identify the most appropriate remedial action;
- difficulties associated with selecting appropriate "control" sites;
- the lack of adequate baseline data against which to compare the changes that might occur as a result of leachate movement. At best, it may be possible to collect one year of baseline data before the construction of the tailings dam commences. The usefulness of these data will strongly depend on whether the vegetation experiences "typical" or average conditions during this time, or whether the vegetation is subject to extreme conditions (such as drought, above-average rainfall, flooding or fire);
- difficulties in identifying subtle but potentially significant changes in vegetation condition, particularly if a visual condition rating system is used. Most condition rating systems tend to identify only gross changes in the vegetation; and
- whether "sensitive" species (i.e. those species which are good indicators of ecological stress and common to all areas to be monitored) can be identified.

In addition, changes in the vegetation condition tend to occur "after the event", where there may be a significant lag between the start of the change and the occurrence of a quantifiable reaction by the vegetation. In contrast, the objective of the groundwater monitoring programme will be to identify the change and undertake the required remedial work before any adverse impacts occur.

The Proponent will determine the need for a vegetation condition monitoring programme to assess the effects of the construction and operation of the tailings dam and evaporation pond on the condition of the vegetation in the vicinity of these facilities in consultation with the relevant DMAs. This programme, if required, will developed in consultation with the relevant DMAs prior to the commencement of the construction phase and implemented to the meet the requirements of the EPA and DME. Any such programme would be described in the EMP and EMS to be developed for this Project (Commitments 1 and 2).

1.3 The monitoring of Cement Creek should be included as a commitment (in Commitment 6) and an estimate of creek flow-rate should be provided when water samples are taken for quality testing purposes.

As stated in Section 7.10.3 of the CER, the stream flow in Cement Creek and Katata Creek will be monitored for contaminants through the measurement of pH, total dissolved solids (TDS), total suspended solids (TSS) and conductivity. The parameters to be measured may include the rate of streamflow, if this can be measured accurately. The monitoring programme will be undertaken at the start of streamflow and as the water level rises. These monitoring programmes will be described in the EMP and EMS for the Project.

Commitment 6 has been modified to include the water quality monitoring programme, as indicated below:

COMMITMENT 6

The Proponent will minimise the off-site transport of sediments by minimising exposed surfaces, identifying and treating on-site areas prone to erosion and progressively rehabilitating disturbed areas. The Proponent will also undertake a water quality monitoring programme for Cement Creek and Katata Creek. These monitoring programmes will be developed and implemented to meet the requirements of the EPA, DME and WRC.

1.4 Will the Proponent conduct a hydrogeological study at the Calcrete Mining Area to determine:

a. the amount of dewatering required to satisfy the information needs for an abstraction licence issued by the Water and Rivers Commission;
b. the quality of the groundwater and disposal methodology;
c. the environmental effects of dewatering and its disposal;
d. the effect of dewatering on other known resource users e.g. the Mt Margaret community and Mt Morgans minesite; and
e. the long term effects of the Project on the hydrogeology of the area.

The existing water table level is approximately ten metres below natural ground level and mining operations are not proposed to extend into the groundwater aquifer. Therefore, dewatering operations will not be required. However, the Proponent will undertake a hydrogeological survey of the proposed Calcrete Mining Area prior to the commencement of the mining operations as part of the development and implementation of the EMS (Commitment 2). The long term hydrogeological effects of the calcrete mining operations will also be monitored as part of the EMS to ensure sound environmental management of these operations.

1.5 How many pits will be required at the Calcrete Mining Area, what is the ultimate extent (ha) of disturbance and will the Proponent provide a mining/rehabilitation plan for the Calcrete Mining Area which recognises and manages the potential impacts on groundwater and surface water regimes, and consequential ecological impacts on Lake Carey?

Approximately 900,000t or 391,000bcm of calcrete is required per year. The mining of this material will require the excavation and progressive rehabilitation of one or two pits each year but the extent of the disturbance depends on the thickness of the calcrete in each area (known to vary from two to eight metres thick).

The development and operation of these pits, access roads, stockpile area and vehicle hardstand areas would disturb approximately 500m x 500m of land (25 hectares) per year. The ultimate extent of disturbance after twenty five years would therefore be in the order of 225 hectares.

However, panel mining techniques would be used to minimise surface disturbance and the pits would be progressively rehabilitated (Commitment 3).

As stated in the response to Item 1.4 (above), the Proponent will undertake a hydrogeological survey of the proposed Calcrete Mining Area. The findings of this survey and the surface hydrology study will be used to clarify the potential impacts on the groundwater surface water regimes (including Lake Carey) described in the CER. It is proposed that any surface water runoff will be diverted about structures and re-directed into the main channels to minimise the impacts of the modification to existing drainage patterns, reduction in the downstream flow and potential water quality impacts (Commitment 6). The size and precise location of bunds, diversion channels and culverts will be determined at the detailed engineering design phase, when more detailed mapping is available.

A mining and rehabilitation plan for the Calcrete Mining Area which recognises and manages the potential impacts on groundwater and surface water regimes and ecological impacts on Lake Carey will be developed as part of the construction phase EMP (Commitment 1).

1.6 Concern has been expressed about the deferral of environmental management measures to a "post approval" EMP process. For example, when will the Proponent submit a mine plan showing the mining/rehabilitation sequence for at least the first two years, with an indicative plan out to five years?

The Proponent will submit a mine plan showing the proposed mining and rehabilitation operations for the first few years as part of the construction phase EMP. The mine plan will be progressively updated during the development of this Project and will be submitted to the DME for its approval prior to the commencement of each phase of these works.

1.7 Why hasn't an assessment been conducted of the degree of impact upon the five vegetation communities that have been identified as locally and regionally significant?

Plant community 1d (a woodland of *Acacia aneura, Acacia victoriae, Acacia tetragonophylla* and *Casuarina pauper* on gravelly, calcrete platforms) is present on the western boundary of the Corktree Borefield and on the southern boundary of the Valais Borefield. However, a significantly larger portion of this community is present to the south of this borefield. The development of these borefields may result in a small amount of disturbance to this community. This community does not occur in the main areas of disturbance (i.e. Murrin Murrin North, Murrin Murrin South and the Calcrete Mining Area).

Plant community 1f (an open woodland of *Allocasuarina huegeliana, Acacia quadrimarginea, Acacia ramulosa* and *Brachychiton gregori*) is known to occur at three locations on ridges in the Murrin Murrin North project development area but is not common in the region. One of these populations is located adjacent to the proposed location of the evaporation pond and may be cleared during the pond's construction but the Proponent will minimise the disturbance of the remaining populations in the Project Area.

Plant community 2f (a shrubland of *Acacia aneura, Acacia acuminata* spp. *burkittii, Acacia stowardii* and *Acacia ramulosa* on greenstone ridges) is significant because it supports populations of the DRF species, *H. exilis*. This community is present in the Project Area at the Murrin Murrin South project development area on the Murrin Murrin 3 and 5 deposits. Approximately 38% of the community in this area will be disturbed as a result of the development of these ore bodies.

Plant community 2g (a shrubland of *Acacia assimilis* spp. *assimilis, Acacia acuminata* ssp. *burkittii* over mixed shrubs on ridges) occurs in the Project Area on a low ridge between Murrin

Murrin 3 and 5. It is locally uncommon and is considered to be locally significant. Only 7% of this population at Murrin Murrin South will be disturbed as a result of the mining operations.

Plant community 3a (a woodland of *Eucalyptus clelandii, Acacia aneura* and *Casuarina pauper* on calcrete platforms surrounded by lateritic breakaways) is considered to be significant because it has a limited distribution in the region and is not well represented in nature reserves. It was recorded at one location at Murrin Murrin North, immediately to the southwest of the proposed treatment plant site. Portions of this community adjacent to the area may be cleared during the construction of the plant, but the Proponent will endeavour to protect this community from disturbance, where possible.

The disturbance of these communities will also be minimised by the implementation of the strategies and procedures developed for the overall management of the flora and vegetation of the Project Area (Section 7.4 of the CER, Commitment 3).

1.8 Will Hemigenia exilis be affected by run-off shadowing? For example, in the Mulga woodlands (no assessment is possible due to the lack of mapping of H. exilis distribution).

The known distribution of *H. exilis* in the Project Area and the region was not included in the CER at CALM's request (see Section 4.6.2 of the CER).

It is unlikely that *H. exilis* will be affected by run-off shadowing as it tends to grow on ridges which bound local catchment areas. The Proponent is committed to constructing, operating and decommissioning the Project in a manner that minimises disturbance to *H. exilis* populations (Commitment 4) and implement the environmental management strategies and procedures for the protection of this species to meet the requirements of the EPA, CALM and DME.

1.9 Commitment 4 does not give a firm commitment or strategy to compensate in some way for the loss of approximately 20% of the known population of H. exilis.

More than 3,800 individuals of *H. exilis* are now known to occur in 25 populations in the region as a result of additional surveys. Of these, up to 500 individuals will be affected by the proposed mining operations in the 25 year life of the Project. This represents a loss of no more than 13% of the known population. This loss will commence approximately five years after the mining operations commence and will occur progressively during the life of the Project.

The strategies and procedures currently implemented and proposed by the Proponent for the protection of *H. exilis* are described in Section 7.5 of the CER. The progressive loss of up to 13% of this species will be compensated for by:

- progressively rehabilitating disturbed areas. Seed from this species will be used in the rehabilitation of suitable habitats;
- protecting the known habitats from disturbance, wherever possible, using those management strategies and procedures developed for the overall protection of flora and vegetation; and
- increasing the level of knowledge about the biology and ecology of this species as a result of the Proponent's comprehensive programme of local and regional surveys for additional populations, laboratory tests and field trials which are being developed and implemented in consultation with CALM.

Propagation trials are also being carried out but further research is required to predict the response of this species in cultivation and its ability to be transplanted.

1.10 The assessment of land systems (Section 7.8 of the CER) is inadequate relative to the long-term area of impact of the Project. Land systems representative of the Greenstone Belt may be under pressure on a regional basis due to mining activity.

The land systems representative of the Greenstone Belt in the Northeastern Goldfields include the Graves, Laverton, Lawerance, Leonora, Moriarty, Mulline, Campsite, Bevan, Hootanui and Nubev land systems (Pringle *et al.*, 1994; A.M.E. van Vreeswyk, pers. comm., 1996). Those land systems present in the main area of disturbance in the Project Area (i.e. Murrin Murrin North, Murrin Murrin South and the Calcrete Mining Area) include the Bevon, Leonora, Laverton, Hootanui and Nubev systems. An assessment of the impact of the Project on the land systems in the Project Area concluded that those land units or systems which would be disturbed by the Project are generally well represented elsewhere in the region and that this impact was not considered to be significant.

2.0 POLLUTION PREVENTION

2.1 What range of disposal options for tailings have been considered by the Proponent? Could in-pit disposal or the use of other tailings depositional techniques be used to reduce the size of the tailings footprint for this Project and hence the area of the environment affected?

A range of tailings disposal options were assessed by the Proponent in selecting the technique described in Section 3.5.1 of the CER. These options are summarised below.

- **In-pit Deposition**

  The fine nature of the tailings could be expected to result in slow settling times and low densities. Settled densities in disused mine workings are expected to be less than those achievable through conventional Goldfields sub aerial deposition and impoundment practices due the potential restrictions on decantation locations and subsequent drying and desiccation. The slow rate of dewatering of these tailings would possibly require the tailings to be left to dewater for several years on completion of deposition, prior to commencing rehabilitation, in order to establish a thick enough crust to support the weight of equipment applying soil and sub soil material.

  Clayey strata in the weathered bedrock comprising the pit walls would be expected to restrict seepage of leachate into the groundwater aquifers, particularly in combination with fine-grained tailings. The geology of the clay material needs to be investigated for potential frequency and distribution of fissures which would decrease their low permeability. Deposition trials may be required to establish the parameters by which in-pit impoundment could be carried out.

  In-pit deposition is not an option until sufficient disused workings have been exhausted of ore for the tailings to be impounded. This is not expected to be the case for ore bodies within suitably economic pumping distance before about eight years of production. Commencing in-pit deposition in the proximity of mining operations may complicate these operations through the presence of wet or saturated clay-like materials.

  In the later stages of the Project's operations it may be possible to store the tailings in disused mine workings once an adequate area has been exhausted of ore and is of suitable geometry to organise satisfactory decantation locations, beach profiles and cyclic deposition to dry, desiccate and compact the tailings sufficiently for subsequent rehabilitation access.

- **Co-disposal of Waste Rock and Tailings**

  The waste rock of the Murrin Murrin operations comprises ferruginous material and lateritic clays which has little void space between the stockpiled material to accommodate the tailings. The high moisture content of the overburden would not provide for water take up from the tailings.

  Therefore, co-disposal of waste material and tailings was not considered an option for this Project.

- **Central Thickened Discharge (CTD) Sub Aerial Deposition**

  Present indications of the tailings nature is that their fine sizing and plasticity are likely to result with extremely flat beach profiles at pumpable solids contents. As a result, CTD may not show cost nor environmental benefits for the tailings disposal. The results of tailings testwork being carried out will enable a better assessment of this option once the beaching profile and dewatering response is understood.

- **Peripheral Discharge Sub Aerial Deposition**

  The tailings characteristics, as presently understood, indicate that conventional peripheral discharge, central decantation sub aerial deposition practices can be an effective means of tailings impoundment.

  Seepage of leachate into the groundwater can be restricted to acceptable limits by ensuring that the permeability of the impoundment floor and walls is sufficiently low. This may require the treatment of *in situ* materials, the introduction of clay materials from mining operations, or possibly the use of a liner system.

  The impoundment can potentially be built high enough with a 1.5 factor of safety to minimise the tailings footprint. Cyclic deposition and drying are required to attain the required shear strength and only four cells need initially be constructed to obtain this cycle over the first seven years. This may allow for in-pit deposition at a later date which would further reduce the tailings footprint to that required by peripheral discharge.

  The site chosen has flat topography, moderate to low permeability soils and is of sufficient area free of Aboriginal heritage sites, declared rare flora and endangered species to accommodate the plant site, tailings dam and evaporation pond within economic pumping distances.

The detailed engineering design work for the tailings dam and evaporation pond is yet to be conducted by the Proponent. However, the Proponent is committed to designing and operating these facilities in a manner which ensures that they do not result in unacceptable impacts on the existing groundwater regime (Commitment 12). Further, the Proponent will undertake a more detailed geochemical and geotechnical assessment of the tailings material, additional hydrogeological investigations, a modelled assessment of the disposal site to prevent excess seepage, and an assessment of the tailings disposal options (Commitment 13). The Proponent has modified Commitment 13 to include the assessment of tailings disposal options as follows:

COMMITMENT 13

Prior to the construction and operation of the tailings dam and the evaporation pond, the Proponent will undertake the following:

- *A more detailed assessment of tailings solids and liquids geochemistry, including predicted compositions relevant to environmental guidelines and standards. This assessment will focus on Total Dissolved Solids, major ions and metals (via an elemental analysis).*
- *An assessment of the predicted particle form and geotechnical characteristics of the tailings, including settling characteristics, and settled and compacted permeabilities.*
- *A more detailed evaluation of potential alternative tailings disposal options, including provision for the re-examination of the in-pit disposal option five years after the commencement of operations.*
- *A modelled feasibility assessment for the tailings dam to achieve consistently low permeability to prevent excess seepage, depending on the predicted tailings permeability. The acceptable permeability will be assessed on the basis of the predicted seepage rates and effects on the groundwater.*
- *A detailed investigation of the hydrogeology of the tailings dam and evaporation pond sites to assess the depth to groundwater ("perched" or otherwise), aquifer characteristics, groundwater flow rates, and groundwater quality. The potential rise in groundwater levels and the dilution rates for seepage from these facilities will then be assessed, and predictions made regarding the resultant quality of the underlying groundwater and the requirement to decrease the permeability of the tailings dam to prevent unacceptable environmental impacts.*

This work will be undertaken to meet the requirements of the EPA, DME and WRC.

2.2 *Geotechnical investigations of the tailings dam and evaporation pond should have been included in the CER. It is possible that reworking of local soils alone may not be effective in preventing adverse impacts of salts and metals on the superficial aquifers, whilst other lining options (e.g. HDPE) may not be economically attractive. It has been recommended that early site investigations and seepage modelling studies be conducted, and that Ministerial approval is conditional on the satisfactory outcome of these studies.*

Geotechnical investigations of the tailings dam and evaporation pond foundations were being carried out at the time of preparing the CER and were not available for publication with the CER. The findings of these investigations were collated in a technical report entitled "Murrin Murrin Nickel-Cobalt Project Feasibility Study - Geotechnical Investigations" (BHP Engineering, 1996), which will be provided to the DEP and EPA.

Results of geotechnical investigations and seepage analysis carried out at both locations indicate that:

- The sub-surface conditions are variable over the site. The general sub-surface profile at the tailings dam site is described as clayey silt overlying ferricrete, highly weathered ultra mafic rock (clay) and highly weathered basalt, whilst the profile at the evaporation pond site is described as clayey silt overlying ferricrete, highly weathered rock (clay) or calcrete.

- The upper 15m of potential *in situ* foundation material exhibit moderate to low permeabilities with *in situ* permeability test values of between:

  - 6×10^{-6} and 6×10^{-9} metres per second for the tailings dam area; and
  - 5×10^{-5} and 1×10^{-7} metres per second for the evaporation pond area.

- Lower permeabilities were found below a depth of approximately 15m.

- Groundwater was not encountered in any of the site geotechnical investigation boreholes and is reported at approximately 30 m depth from exploration drilling.

These results indicate that, with reworking, local material may be effective in minimising seepage and preventing adverse impacts of salts and metals on the aquifers. Given that testwork continues through to detailed design of the tails dam and evaporation pond, the feasibility study currently being undertaken by the Proponent assumes a 200mm compacted clay liner is installed over 30% of the storage area. This assumption is used for feasibility costing purposes as a contingency for the final design. The rationale is that the dam floor may not need the liner (according to the results of the testwork carried out to date). However, this requirement will be subject to the final design.

Preliminary testwork results indicate the tailings slurry to be fine-grained with a significant silt and clay fraction which will:

- result in an estimated settled density of 55-62% and a dry density of 0.85 to 1.00 tonnes per cubic metre;
- require the tailings to be rotated through at least four cells to enable drying, desiccation and maximising of dry density;
- require a sub-aerial deposition dam of the order of 120 million cubic metres capacity after 30 years design life; and
- result in initial seepage being reduced significantly when the tailings consolidate with an estimated permeability of 1×10^{-8} metres per second.

Bleed water feed to the evaporation pond will contain magnesium sulphate, produced from the nickel cobalt extraction process, and approximately one million tonnes per annum of calcium sulphate (gypsum) produced from the use of calcrete to neutralise the process solutions. Four ponds will be required to evaporate the water and deposit, dry, desiccate and maximise the gypsum dry density for the order of 30 million cubic metres over 30 years design life. A gypsum permeability of nominally 1 x 10^{-9} metres per second will result with initial seepage being reduced significantly.

Further geotechnical investigations, groundwater seepage modelling, tailings compaction and dewatering testwork are currently being carried out and will be completed prior the detailed design of the tailings dam and evaporation pond (Commitment 13). The Proponent will design and operate the tailings dam and evaporation pond in accordance with the requirements of the EPA and DME to ensure these structures' operation does not result in unacceptable impacts on the existing groundwater regime (Commitment 12).

2.3 *There is concern with the complete lack of information on the geotechnical aspects of the large tailings and evaporation dams and the tentative commitments to prevent seepage from these structures. Will the Proponent clarify its objectives in regard to protection of groundwater resources and adjacent vegetation condition? For example, if significant seepage is detected by the groundwater monitor bores, how will the permeability of the pond floor be corrected?*

The Proponent proposes to:

- develop and implement an EMP and EMS that ensures sound environmental management of the Project (Commitments 1 and 2);
- progressively rehabilitate disturbed areas to minimise disturbance of biological communities (Commitment 3);
- design, construct and operate an environmentally sound tailings dam and evaporation pond (Commitment 12);
- ensure the integrity of the solid and liquid waste disposal facilities (Commitment 13); and
- monitor the impact of the waste disposal facilities on local groundwater resources (Commitment 14).

It is currently proposed that the final tailings dam comprise eight cells, with four being initially constructed for the first seven years of tailings impoundment. The evaporation pond will be constructed using the final design of four cells. The low permeability of the foundation material (treated as necessary), and of the tailings, is expected to adequately limit seepage and restrict adverse impacts on the groundwater aquifers. Modelling of groundwater seepage would be undertaken during the design of the dam and the pond. Should unacceptable seepage be observed after consolidation of the initial tailings or gypsum, the cells will be dried and an intermediate liner of compacted clay or other suitable material installed that is adequate to minimise seepage. Pumping may also be carried out, if required.

2.4 *Comparative information is required on all significant contaminants in evaporation pond water and tailings leachate, and groundwater quality, to enable assessment of likely impacts if seepage occurs. When will this information be provided? When will the geotechnical assessments be conducted, the method(s) of sealing the floor of the impoundments be identified and to whose satisfaction?*

The preliminary results of the evaporation pond water and tailings dam leachate analysis indicate that these will be saline with a high proportion of magnesium salts. Some metals' concentrations will also be elevated. More detailed work, using samples of the proposed process water, is required to give meaningful predictions of actual pond water leachate qualities. Having established indicative qualities, work will be conducted on the hydrochemical persistence of any metals or compounds of environmental significance.

Further geotechnical analysis, groundwater investigation, tailings compaction and dewatering testwork and additional leachate analysis, will be completed prior to the groundwater seepage modelling. The results of these studies will be used as the basis for the detailed dam and pond design (Commitment 13).

The Proponent expects to submit this information in the third quarter of 1996 for Works Approval to construct the tailings dam and evaporation pond. The design, construction and operation of the tailings dam and evaporation pond will be undertaken to meet the requirements of the EPA, DME and WRC (Commitment 12).

2.5 *The long-term stability of the tailings impoundment, and rehabilitation potential, is dependent on how well the tailings dewater, amongst other factors. Residues from pressure leaching of ore containing high silica values may not dewater readily. How will the Proponent account for this contingency?*

The proposed sub-aerial tailings dam is described in the BHP Engineering report (BHP Engineering, 1996), which will be provided to the EPA and DEP.

An assessment of the final embankment stability carried out for both static and seismic events demonstrated that the dam will probably be stable. Should the tailings testwork currently being carried out contradict the assumptions made during this assessment, additional flocculants could be added to the tailings to accelerate their consolidation or additional cells could be used to enhance the tailings desiccation and compaction, and hence the dam stability.

2.6 *Thick fogs blanket the area from time to time, sufficient to close local airports. Has the Proponent's gaseous emissions modelling considered the reduced dispersion rates during these atmospheric conditions, and consequent effects on ground-level concentrations? Will air quality monitoring station(s) be established to assess the effects of both routine and abnormal conditions?*

The air dispersion modelling was undertaken using a comprehensive meteorological data set for Kalgoorlie. The Kalgoorlie data set was chosen as it represented the best meteorological data available in the region for use in air dispersion modelling. The modelling was conducted using one year of continuous data and, as such, should represent the range of meteorological conditions normally encountered in the region. The meteorological data contained numerous periods where very stable (i.e. poor dispersion characteristics) existed and we believe that these conditions have been adequately addressed.

On the basis of the air dispersion modelling results, the Proponent does not believe that its operations will result in unacceptable air quality impacts beyond the Project Area. Therefore, the Proponent has no plans to install air quality monitoring stations.

2.7 *What arrangements has the Proponent made, or will make, for sewage and sullage disposal from the temporary construction camp? The suggestion that this waste will be removed from site by licensed contractors for disposal into an approved waste disposal site is considered neither practicable or acceptable.*

The Proponent will dispose of sewage and sullage from the temporary construction camp via an on-site sewage treatment system comprising septic tanks and a leach drainage system. The Proponent will ensure that the waste disposal facilities will comply with the requirements of the *Health Act* and local council by-laws.

2.8 *What measures will be taken to minimise acidic leachate generation from stockpiled sulphur and/or how will stormwater runoff from the sulphur storage areas be managed?*

Weak sulphuric acid is formed when fine particles of elemental sulphur are exposed to water. The sulphur will be stored at the Esperance Port in a partially enclosed shed with a roof to protect against the generation of acidic run-off and to prevent contamination of the sulphur by sea spray. Sealed pads and bunds will be used to contain the run-off, which will be neutralised before release.

The stockpiles to be located at the Malcolm railway siding and on-site at the treatment plant will be open air stockpiles with a sealed base. The stockpiles will be bunded and the run-off directed into drainage basins or sumps. The sumps will allow for settlement and separation of sediment or sulphur prills from the water. The sump water from the treatment plant's stockpiles will be used directly in the slurry production whilst the sump water from the stockpiles at Malcolm siding will be neutralised and used in the train discharge dust suppression circuit. The drainage basins or sumps will be designed to contain a 1 in 100 year rain event.

The Esperance Port Authority is responsible for the handling and storage of sulphur through the Esperance Port. The Proponent is responsible for the management of the sulphur stockpiles at the Malcolm railway siding and at the treatment plant.

2.9 *There is no discussion of the possibility of salinising lakes (intersecting the groundwater table) being formed as a result of open cut mining of the orebodies and calcrete deposits. Will the Proponent indicate the potential for this phenomenon and if necessary, prepare a rehabilitation plan with the objective of minimising the exposed surface areas on a sequential basis to preclude potential impacts on local water resources.*

The water table lies below the known ore resources and will not be exposed in mining operations except at a deep ore intersection of the Murrin Murrin 2 deposit, which accounts for less than 5% of this ore body. This pit will be backfilled above the water table to ensure that these lakes do not develop. Therefore, saline lakes will not be formed as a result of the pits becoming flooded by groundwater.

Strategies and procedures for the rehabilitation and monitoring of disturbed areas will be developed in consultation with the DME and other relevant DMAs and will be addressed in the EMP and EMS (Commitments 1 and 2). The EMS will be developed and implemented prior to the commencement of the mining operations and will provide a mining and rehabilitation plan. Panel mining techniques will be used and overburden will be placed in adjacent mined-out pits to reduce the extent of the exposed surface area. Rehabilitation will be undertaken on a progressive basis using best industry practice so that the extent of the disturbance at any time is minimised. This approach will also reduce the disturbance of existing biological communities, particularly populations of DRF (Commitments 3 and 4).

2.10 *Fuel and hazardous bulk chemical storage areas should be bunded with low permeability materials to effect containment and recovery (in excess of requirements described in AS1940-1993).*

The handling and storage of hazardous chemicals was addressed in Section 8.4.3 of the CER. The fuel and hazardous materials storage areas will be designed in accordance with AS1940-1993, any other requirements deemed applicable by the DME under the *Explosives and Dangerous Goods Act* 1961-1986 and any specific requirements of the DEP. This will ensure that particular attention will be paid to designing these facilities to effect the containment and recovery of spills.

2.11 The water balance at page 3-7 of the CER is confusing. Where is the water treatment waste (45m^3/hr) discharged to, and what is the expected quality of this water?

The water treatment waste is the water resulting from treatment by reverse osmosis and ion exchange of approximately 180 cubic metres/hour to produce high quality water of low dissolved salts for steam generation, sulphuric acid production, potable water and the nickel cobalt refinery.

Depending on the quality of water supplied to the water treatment plant (less than 1,000 mg/l TDS), the waste treatment water would be of the order 4,000 mg/l or less and would be used in the production of slurry to the treatment plant.

2.12 What is the quality of the vapour generated in the flash tank (Mixed Sulphide Leaching, Section 3.4.7.1 of the CER) which is vented to atmosphere?

This vapour is produced as a result of a reduction of pressure and is vented to the atmosphere through a demister as water vapour. No impurities are vented with the water vapour.

2.13 In Section 3.5.2 of the CER, there is an apparent discrepancy in that plant site drainage is stated to be contained on-site for the 1 in 100 year storm event, but the sedimentation ponds are to "be designed for the 10 year, 24 hour storm event". Please explain.

It is considered appropriate for different design criteria to be applied to different structures according to the environmental and economic risks associated with their ultimate use and capacity. However, as the drainage and storage ponds are part of an integrated system, the Proponent considers that it would be appropriate to use the same average recurrence interval for both structures. The Proponent is now designing all of these structures to a 1 in 100 year average recurrence interval and a 24-hour storm duration has been selected as the criterion for the capacity of the pond.

2.14 Apparently, oil recyclers will not take mine waste oil, so the disposal of oil needs clarification (Section 3.5.3 of the CER).

It is common practice for oil recyclers to collect waste oil from mines in the Goldfields providing that the oil is not contaminated with water or other substances. In order to be economical, the oil generally needs to be collected in lots of at least 5,000 litres. Consequently, the oil is stored on-site in tanks, and collected and transported off-site by the recycling contractors when the tanks are full.

2.15 The third paragraph of page 3-16 of the CER suggests that additional hydrogen sulphide (H_2S) will be flared under upset conditions (therefore more sulphur dioxide [SO_2] produced). However, on page 3-17 and Table 3.4 it says that the H_2S-derived SO_2 emissions will be less under upset conditions. How?

During operation of the plant, hydrogen sulphide is produced continuously for use in the sulphide precipitation circuit. Excess gas will be flared by the hydrogen sulphide flare. The upset conditions identified are primarily associated with the startup or shutdown of the hydrogen sulphide plant. During plant startup, for example, the hydrogen sulphide emissions will increase from a low value (nominally 10g/s as sulphur dioxide) to the expected normal operating emission rate of 110g/s (as sulphur dioxide). Therefore, the normal operating conditions represent the maximum expected emission rates of sulphur dioxide from the hydrogen sulphide flare.

2.16 No mention is made of CO emissions. Is any produced (refer EPA guidelines)?

The Proponent does not believe that the Project will generate any significant quantities of carbon monoxide as efficient combustion processes will be used. Therefore, the Proponent does not anticipate any problems meeting the EPA guidelines.

2.17 Is nitrous oxide (N_2O) likely to be produced? Also, other greenhouse gases (e.g. hydrocarbons).

The Proponent does not believe that the Project will generate any significant quantities of nitrous oxide.

The major greenhouse gas that will be produced by the Project is carbon dioxide. While small emissions of hydrocarbons (eg. during vehicle refuelling, incomplete combustion) may occur, these are not expected to be significant in terms of the greenhouse gases.

2.18 Will the acid plant produce a wastewater and if so, how will it be managed?

The acid plant does not produce waste water. The acid produced by this plant is used in the treatment plant whilst cooling water is recycled through a cooling tower and/or used for the production of slurry in the treatment plant.

2.19 Please identify the organic solvent referred to on page 3-13 of the CER.

Cyanex 272 is the solvent used in the solvent extraction circuit to extract impurities in the process solution. The chemical will be stored on-site in either bulk tanks or drums. This chemical is flammable and produces toxic emissions during combustion. However, suitable precautions will be taken during the handling and storage of this chemical.

2.20 Will the acid plant use vanadium pentoxide (V_2O_5) catalyst and if so, how will the spent catalyst be managed?

Vanadium pentoxide will be used as a catalyst in the production of sulphuric acid. The spent catalyst will be returned to the supplier for regeneration. This material is classified as a hazardous chemical and protective clothing and equipment must be used when handling this substance. The appropriate handling procedures will be implemented by the Proponent as part of the Project's occupational health and safety procedures.

2.21 The conclusions in Section 7.12 of the CER, particularly with regard to SO_2 emissions, cannot be confirmed because there is no figure showing SO_2 contours, modelled area or lease boundaries.

The predicted concentrations of sulphur dioxide in and beyond the Project boundaries were presented in Table 7.4 and Table 7.5 of the CER for normal and upset conditions respectively. Contour plots of the predicted ground level concentrations were not presented in the CER as the major impacts were predicted to occur in close proximity to the plant. The predicted maximum 1-hour average ground level concentrations of sulphur dioxide for normal operating conditions are presented on Figure 1 to illustrate this fact.

2.22 *If the generalised stratigraphy (i.e. colluvium over hardcap) shown in Figure 3.3 of the CER is indicative of the evaporation and tailings ponds sites, then there would appear to be potential for shallow lateral flow of seepage. This would expose adjacent vegetation to a higher risk of impact. How will this potential impact be managed?*

The stratigraphy illustrated in Figure 3.3 of the CER is for the orebodies. It does not represent the geological profile of the tailings dam and the evaporation pond sites. The results of geotechnical investigations and seepage analysis carried out at both of these locations indicate that the sub-surface conditions are variable and that the general sub-surface permeability profile exhibits a moderate to low permeability in the upper ten metres. *In situ* permeability test values were:

- between 6×10^{-6} and 6×10^{-9} metres per second for the tailings dam area; and
- between 5×10^{-5} and 1×10^{-7} metres per second for the evaporation pond area.

The proposed dam construction technique is outlined in the BHP Engineering report (BHP Engineering (1996). This provides for a starter embankment with an upstream compacted clay core, a key trench backfilled with compacted clay, and a 200 mm thick liner of compacted clay. This should minimise the potential for lateral seepage through the embankments. Vertical seepage is to be minimised by treatment of the dam and pond floors. Therefore, the potential for shallow lateral flow of seepage would appear to be minimised as per Commitment 12.

The environmental management of potential impacts from seepage is outlined in response to Item 2.3.

2.23 *On page 7-35, "approved waste disposal sites" are mentioned in a general sense. Where are the current approved sites for the types of waste mentioned, and what process will the Proponent follow to gain an approved site if one is required in the vicinity of the mine?*

The Leonora landfill site is located approximately four kilometres east of the town on the Leonora-Laverton Road. The Laverton landfill site is located approximately three kilometres from that town. These are Category B landfills and comply with the DEP's Code of Practice for landfill sites. The Proponent will discuss the use of these landfills with the relevant Shire councils, if required. However, the Proponent currently plans to dispose of the general refuse identified in Section 7.15 of the CER in an on-site waste disposal facility. Approval for this facility will be sought during the EMP approval process.

3.0 SOCIAL SURROUNDINGS

MOUNT MARGARET MISSION

3.1 *What safety measures (e.g. fencing, signage) will be provided to deter public access to mine pits, ponds, overburden dumps, etc. particularly at the Calcrete Mining Area in relation to the nearby Mount Margaret Mission?*

Access to mining and processing operations will be restricted for the safety of both members of the public and the Proponent's workforce as well as for the security of the operations, as per DME regulations, guidelines and industry standards, as applicable. Measures that may be implemented include:

- posting signs at active mining areas;
- closing those access tracks not required by the Project and marking those tracks with sign posts;

- using designated traffic controls to restrict public access to operations;
- constructing safety windrows around excavations and dumps;
- constructing abandonment bunds around excavations; and
- using security sentries to warn of and prevent access during blasting operations.

Processing operations will be fenced and sign-posted to restrict public access. All entrances will be manned by security personnel.

The Mount Margaret community is located 2.5km from the Calcrete Mining Area at its closest point. This distance exceeds the minimum distance of 500m allowed as a buffer to blasting operations under DME regulations. A line of hills separates the Calcrete Mining Area and the community from direct line of sight and noise contact.

Mining operations are expected to affect approximately 20% of the proposed Calcrete Mining Area. The Proponent prefers to carry out these operations in the northern part of the tenement area as:

- the potential for contamination of the calcrete by chloride salt from hypersaline groundwater is significantly less in that area;
- the area is closer to the public road, which would reduce the costs of hauling the calcrete to the plant; and
- the southern part of the tenement would act as a buffer zone between the Mount Margaret community and the calcrete mining operations. This buffer would minimise any disturbance of the community from low energy "paddock blasting".

The Proponent will minimise dust generation (Commitment 8) and comply with the *Noise Abatement (Neighbourhood Annoyance) Regulations* 1979 (Commitment 10) to minimise the impact of it's operations on the Mount Margaret community.

3.2 What effect will dewatering at the Calcrete Mining Area have on other known water resource users, for example, the Mount Margaret community?

Dewatering operations will not be required in the Calcrete Mining Area as the existing water table level is approximately ten metres below the natural ground level and mining operations are not proposed to extend into this aquifer. Further, the Mount Margaret community draws potable supplies from a groundwater bore located within an aquifer separate to, and east of, the palaeochannel over which the calcrete deposit is located.

LAVERTON

3.3 Would the Proponent consider accommodating senior operational personnel, who are not on a roster basis, within the Laverton townsite?

The Proponent proposes to accommodate rostered shift personnel at an on-site Accommodation Village. Personnel recruited from the region and dayshift rostered personnel such as senior or management staff will be accommodated at the on-site village or houses in the region. Laverton will be considered for accommodating dayshift personnel such as senior or management staff.

3.4 Will the Proponent assume responsibility, or facilitate action by Main Roads for monitoring of potential deterioration of the Leonora-Laverton Road due to traffic increases arising from the Project and consequently the potential increased maintenance requirements.

Main Roads Western Australia is responsible for the management and maintenance of the Leonora-Laverton Road. The Proponent will ensure that all transport undertaken using this road (and other main roads) will be carried out in accordance with Main Roads' standards and regulations. The Proponent would also be willing to discuss with Main Roads ways in which it could facilitate the management of this road.

3.5 *Is the Proponent prepared to make additional commitments in regard to the Laverton Water Reserve and protection of Laverton borefield, as follows:*

(i) It will operate and monitor the Project borefields in accordance with requirements of licence conditions set by the Water and Rivers Commission.

(ii) It will guarantee no adverse effects on water supply quantity and quality for the Laverton townsite, including the future borefield proposal north of Lancefield.

(iii) Diesel generators and associated fuel storage at the borefields, particularly the Valais and Korong borefields, will be contained within impervious (e.g. HDPE) bunded enclosures to prevent hydrocarbon contamination.

(iv) It will guarantee the supply of water to the Juvenile Justice Camp during abstraction from the Valais borefield.

The Proponent will upgrade existing Groundwater Exploration licences and apply for Groundwater Production licences from the WRC prior to development of borefields to supply the construction and operation phases of the Project. The borefields will be operated and monitored in accordance with requirements of licence conditions set down by the WRC.

Representatives of the WRC (when it was known as the Water Authority of Western Australia) have confirmed that this organisation, which also manages the Laverton township water supply, has no plans at present to develop a borefield or water supplies north of Lancefield and the Wedge Pit. The borefields to be developed and operated by the Proponent will have no adverse impacts on the water supply for the Laverton townsite as they are in separate and distinct hydrogeological systems. The Proponent proposes to implement a comprehensive monitoring programme as part of the hydrological studies to conclusively demonstrate this aspect.

Diesel generators and associated fuel storage at the borefields will be contained within impervious and bunded enclosures to prevent hydrocarbon contamination. These facilities will designed in accordance with AS1940 (as discussed for Item 2.10). The environmental management of these areas will be addressed in the Project's EMS (Commitment 2).

The Proponent will guarantee the supply of water to the Juvenile Justice Camp during abstraction from the Valais borefield as contracted to do in the agreement to operate the Valais borefield.

PASTORAL INDUSTRY

3.6 *How will the Proponent ensure that access to water supplies by the pastoral industry is not affected given the large quantities of good quality water which will be required over the long life of the Project? (Commitment 15)*

Few pastoral wells are located in the vicinity of the proposed borefields and associated areas of abstraction from deep seated aquifers. These wells have limited supplies of relatively near-

surface water (Figure 3). The Proponent will survey all existing pastoral wells in the vicinity of the borefields to ascertain the reference level to Australian Height Datum of their water table prior to development of the borefields. These wells would be monitored regularly to ensure that the borefield pumping is not disrupting pastoral water supplies.

The Proponent will minimise any impact of it's borefield abstraction on pastoral activities and ensure that pastoral water supplies are maintained (Commitment 15). If pastoral bores are affected, the shortfall will be made up from the Proponent's water supply as per the WRC Groundwater Well Licence conditions.

The Proponent will also continue to consult with affected pastoralists about the location of pipelines between the borefields and the plant, and on the pastoralists' access to water supplies. It is possible that additional stock watering points may be installed along the pipeline routes.

3.7 *Will the Proponent ensure that the use of access roads to borefields will not interfere with stock management (e.g.) integrity of fences and in particular, closing of gates by monitoring/maintenance personnel?*

The alignment of the borefield access roads or tracks will be selected in consultation with the relevant landholders and other affect parties. In addition, the Proponent will establish a programme of liaison with the landholders prior to the commencement of construction to ensure the use of these tracks can be co-ordinated with stock management activities, including stock grazing and watering. Particular attention will be paid to avoiding the disturbance of mustering or other critical activities. This programme will also provide a mechanism for dealing with any issues, problems or conflicts which may arise as a result of the use of these tracks.

Existing gates will be used where possible though additional gates may be required in some fences. The location of these gates will be identified in consultation with the pastoral lease holder. In addition, every effort will be made to maintain fences. The Proponent will be responsible for repairing any damage to fences or gates incurred as a result of the construction and operation of the Project.

The workforce will be instructed on the importance of opening and closing gates correctly. All vehicle movement will be restricted to the designated access tracks, where practicable. The direct disturbance of stock will also be avoided, particularly adjacent to water holes. Compliance to these regulations will be strictly enforced.

3.8 *What arrangements have, or will, be made to prevent the loss of stock water in the vicinity of the mine and processing site, due to on-site groundwater abstraction during the construction phase and for dust suppression during the operational phase?*

The Proponent proposes to draw water from only one bore due to the lack of water in the immediate vicinity of the mine and processing site. The potential bore hole location is some five kilometres from the nearest stock water well and located in a separate hydrogeological system. However, the Proponent will minimise any impact of it's borefield abstraction on pastoral activities and ensure that pastoral water supplies are maintained (Commitment 15). If pastoral bores are affected, the shortfall will be made up from the Proponent's water supply as per the WRC Groundwater Well Licence conditions.

3.9 *During the mid 1980s, depletion of wells 10 to 20km south of Valais borefield on Minara Station did occur when Western Mining was pumping Valais borefield continuously. Will the Proponent install a series of monitoring bores in all pastoral leases south and southwest of Anaconda's proposed borefields and also cover the area extending south to Lake Carey and Lake Raeside.*

The palaeochannel drawn from by the Valais borefield is a deep structure orientated in a general east to west direction. Therefore, most drawdown response would be expected in this orientation and not to the south or southwest.

Examination of the borefield monitoring data supplied by Western Mining from its 20 year operation of the Valais borefield has indicated the regional drawdown response was confined to the immediate vicinity of the borefield. For example, monitor bores located about two kilometres from the main pumping centre had a drawdown response of up to two metres compared to the response of ten metres at the bores within the palaeochannel. This drawdown recovered after rainfall recharge events.

As a result, the Proponent does not anticipate water table depletion in pastoral wells 10 to 20 kilometres to the south of the Valais borefield on Minara Station. However, the Proponent will establish monitoring bores in borefield catchments and palaeochannel systems as part of the Groundwater Production licence conditions from the WRC. Monitoring would not extend to Lake Carey or Lake Raeside as these areas are not within the hydrogeological envelope of the borefields. As stated above, the Proponent will minimise any impact of it's borefield abstraction on pastoral activities and ensure that pastoral water supplies are maintained (Commitment 15). If pastoral bores are affected, the shortfall will be made up from the Proponent's water supply as per the WRC Groundwater Well Licence conditions.

3.10 Most of the natural gas pipeline route passes through Minara Pastoral Lease and also crosses the biggest creek system in the area (Bummers Creek). When is the detailed route selection information likely to be forthcoming and will it be available?

As stated in Section 3.2.3 of the CER, a third party will be responsible for selecting the alignment of the natural gas spur pipeline and obtaining the required legislative approvals for construction and operation. The selection of the pipeline alignment will be undertaken in consultation with the potentially affected landholders, relevant DMAs and other interested parties, and the project will be referred to the EPA, which will determine the appropriate level of environmental impact assessment. Whilst the timing of this process of route selection and assessment will be beyond the control of the Proponent, the construction of the pipeline must be completed by the fourth quarter of 1997 to allow the Project to be commissioned on schedule.

ABORIGINAL HERITAGE

3.11 The ethnographic and archaeological survey reports should be submitted to the Aboriginal Affairs Department and approvals sought for site disturbance, where necessary. It would be preferable if Commitment 16 stated this as well.

Commitment 16 states that the Proponent will comply with the *Aboriginal Heritage Act* (1972-1980). Fulfilling this commitment means that the Proponent must obtain Ministerial consent to use the land containing Aboriginal sites (under Section 18 of the Act) or consent from the Aboriginal Cultural Material Committee (ACMC) to carry out an archaeological excavation or remove material (under Section 16 of the Act). An application for site disturbance submitted by the Proponent would be supported by the relevant ethnographic and archaeological survey reports, which would be assessed by the Department of Aboriginal Affairs. The Department would then report to the ACMC which in turn would report to the Minister for Aboriginal Affairs. Additional information on this approval process is provided in the "Guidelines for Aboriginal Heritage Assessment in Western Australia" (Department of Aboriginal Sites, 1994).

4.0 MISCELLANEOUS

4.1 Would the Proponent show the relationship between project mining areas, waste storages, infrastructure and access routes to its approved tenement boundaries?

Details about the land tenure of the Project Area are provided in Section 1.6 of the CER. The Proponent will obtain ownership or beneficial ownership of appropriate tenements required to carry out the proposed construction and operation of the Project. The final location of the waste disposal areas, infrastructure and access routes will be confirmed and shown on plans relative to the Proponent's approved tenement boundaries on completion of the feasibility study and detailed design of the mining areas. These plans will be submitted to the EPA and DME, for approval.

4.2 It is noted that the proposed importation of sulphur through the Port of Esperance will require a separate approval. Given that there are still substantive items of environmental management to be resolved at Murrin Murrin, what is the Proponent's programme for the provision of this management detail relative to the sulphur import approval process? (Two submissions have requested that the sulphur importation proposal be subject to a separate CER).

Following discussions with the DEP, it is understood that this item is seeking information on the timing of the provision of additional information about the environmental management of the Murrin Murrin Nickel-Cobalt Project, in relation to the timing of the environmental approvals process for the proposal to import sulphur through the Port of Esperance.

Additional details about the environmental management of the Project will be provided in the construction phase EMP and operations phase EMS. The EMP will include details about the proposed monitoring programmes and must be approved by the EPA before the commencement of the construction phase in the third quarter of 1996. The EMS will be submitted for approval prior to the commencement of operations in the first quarter of 1998. The additional information on the design and operation of the tailings dam and evaporation pond (Commitments 12 and 13) will also be completed during the pre-construction phase.

The Esperance Port Authority is responsible for obtaining the relevant environmental approvals to construct and operate the port facilities required for the importation of sulphur. It is also likely that the Port's EMP will require review to include the handling and storage of sulphur. The Port Authority currently proposes to submit an Environmental Referral to the EPA in April 1996 to trigger the environmental approvals process. The length of time required to achieve these approvals will depend on whether the Project is assessed formally or informally by the EPA. However, the first consignment of sulphur must be imported prior to the start of operations at Murrin Murrin in the first quarter of 1998.

4.3 There are some key commitments made by the Proponent which need to be implemented, and approvals for specific management measures sought, prior to the commencement of construction activity. Will the Proponent outline its implementation program for these commitments, including the time allowed for regulatory scrutiny?

Those measures which need to be implemented during the pre-construction phase are:

- the preparation of the construction phase EMP (Commitment 1);
- the preparation of the final design of the tailings dam and evaporation pond (Commitment 12);

- the additional studies required to ensure the integrity of the solid and liquid waste disposal facilities (Commitment 13);
- the design, installation and implementation of the groundwater monitoring programme (Commitment 14);
- liaison with pastoral lease holders regarding the use of local water resources and to minimise the impact of the Project on pastoral activities (Commitment 15); and
- the procurement of any relevant clearances under the *Aboriginal Heritage Act* (Commitment 16).

These activities will be completed prior to construction commencing in the third quarter of 1996. The schedule for the completion of these activities has not yet been finalised but will be developed in consultation with the relevant DMAs to ensure that sufficient time is allowed for regulatory scrutiny.

The Proponent will also need to procure certain operating licences, including the WRC Groundwater Well Licences. These licences cannot be obtained until approval to proceed has been granted by the Minister for the Environment.

4.4 *Is the proposed location of the Accommodation Village at a sufficient distance from the plant site and mine workings to be assured that employees and contractors are not adversely affected by noise and/or gaseous emissions? There is particular concern about the exposure levels to sulphur dioxide by the village residents.*

The proposed location of the Accommodation Village is approximately 7km south-east of the proposed plant site. It is also well away from any of the mining areas and major access routes. The Accommodation Village location was chosen to minimise the impacts of air emissions and noise associated with the Project. Table 7.8 of the CER, for example, presented the predicted sound pressure levels associated with a 110dB(A) source as a function of distance. This table shows that at a distance of 7km the sound pressure level was predicted to have decreased to 25dB(A), which would be lower than the background noise levels expected to occur in the area. Similarly, the air dispersion modelling showed that the predicted ground level concentrations of gaseous emissions were well below the ambient air quality guidelines at these distances.

4.5 *There will need to be some consultation between the Proponent and the local Counter Disaster Committee at Laverton to resolve an Emergency Response Plan in the event of a major plant emergency.*

The Proponent recognises the importance in consulting with the Counter Disaster Committee at Laverton in developing an Emergency Response Plan for the Project to ensure maximum efficiency in responding to local and regional emergencies.

4.6 *There has been no consideration given to the impact of the Project on the existing overloaded radio digital concentrator telephone system. Will the Proponent ensure that Telstra upgrades the current system as soon as possible before this Project commences?*

The process of upgrading the telephone system is not under the Proponent's control. However, the Proponent will ensure that relevant Project communications are carried out in accordance with Telstra's standards and regulations and would be willing to discuss with Telstra ways in which it could facilitate the management of this system.

4.7 *Section 7.15 of the CER states that the potential impacts on surrounding communities will be minimised by "minimising the number of single people where possible". This is not seen to be desirable by the local council, and may be in breach of the legislation on anti-discrimination and equal opportunity.*

A multi-skilled workforce will be sought to construct and operate the Project and will be sourced from within the Goldfields region and elsewhere. Employment will be offered to personnel on the basis of their qualifications and experience, not their gender or marital status.

4.8 An issue listed by Main Roads (page 6-6 of the CER) does not appear to have been addressed. "Fulfilment of Main Roads requirements for site access", said to be answered in Section 7.12.5, does not appear to be.

This issue was addressed in Section 7.16 of the CER which states that all substances transported to site by road will be transported, handled and stored in accordance with the relevant Main Roads regulations and standards. The Proponent understands that Main Roads' requirements include the sealing of all turn-outs onto main roads and will liaise with the department to ensure that these requirements are fulfilled.

4.9 Asbestiform minerals are not considered an issue in the CER due to the deep occurrence (relative to the orebodies) of these minerals. However, Section 3.2.1 notes that "surface exposures" also occur. How will these surface exposures be managed if disturbed during the operational life of the Project?

Asbestiform minerals have not been encountered within the ore zones due the degree of weathering and laterisation that has occurred in these zones. Therefore, asbestiform minerals are not considered to be an issue for this Project.

Surface exposures of asbestiform minerals in rock outcrops located in the vicinity of the ore bodies will be identified by the surface mapping required for mine planning and surface activities will be excluded from these areas.

Where exposures of asbestiform minerals cannot be contained or left undisturbed, management practices will be put in place as per the applicable DME regulations, guidelines and industry standards. Such practices include the monitoring of airborne dust particles for asbestiform minerals to detect concentrations which require management action or threshold limits which require regulatory response.

4.10 How will blasting at the Calcrete Mining Area be managed in terms of potential nuisance (and safety aspects) due to proximity to the Mt Margaret community?

Calcrete blasting operations will be undertaken within a 500 x 500 m area on an annual basis. The blasting operation is required to improve the excavation productivity rather than the fragmentation of the calcrete. The calcrete is soft enough to be readily crushed after mining and prior to slurrying in a ball mill. Hence, a low powder factor (amount of explosive per cubic metre) will be used in "paddock blasting" the calcrete.

Safety aspects related to the calcrete mining operations are addressed in response to Item 3.1. The Proponent will also minimise the impact of these operations on the Mount Margaret community by minimising the generation of dust (Commitment 8) and complying with the *Noise Abatement (Neighbourhood Annoyance) Regulations* 1979 (Commitment 10).

4.11 Section 7.21 of the CER discusses rehabilitation in general terms and states "the planning for rehabilitation well in advance of disturbance" (is important) and "The planning will include the selection of rehabilitation performance objectives or completion criteria". Why can't the rehabilitation objectives be stated now? These are important for this stage of the approval process.

As stated in Section 7.21 of the CER, the overall objective of the Proponent's rehabilitation programme will be to develop a stable landform compatible with the contiguous landscape, with a non-erodible surface conducive to revegetation. The success achieved in attaining this goal will be determined by assessing:

- the similarity between the rehabilitated landforms and the natural landforms in adjacent areas;
- the stability of the landform and its resistance to erosion;
- whether appropriate drainage patterns have been developed or will develop;
- the degree to which the surface conditions are conducive to plant establishment;
- whether the site conditions and existing habitat components provide resources for fauna;
- compliance with the relevant water quality standards; and
- public safety issues.

Site-specific completion criteria will be defined according to the characteristics and rehabilitation requirements of each site, in consultation with the relevant DMAs and other parties. These criteria will be used to determine the point at which an ecosystem will become self-managing and achieve a sustainable condition if no further human intervention occurs. In other words, the rehabilitation programme will cease when the site can be managed for its designated land use without any greater management inputs that other land in the area being used for similar purposes.

4.12 The risk assessment appropriately focuses on hazards with the potential to cause "immediate" harm to off-site people (i.e. acute hazards). However, it is suggested that the hazard identification (Section 8.1 of the CER) should include some screening assessment of all hazardous chemicals that will be kept at the site, for completeness and to avoid questions regarding proper hazard management. This may be best achieved by a simple table that lists all hazardous chemicals and why/why not they require further consideration.

As discussed in Section 8.4.3 of the CER, the Project is not expected to use a large number of hazardous chemicals for the processing of the ore. These chemicals were identified in Appendix G, which presented the preliminary risk assessment carried out for this Project. The only significant quantities of a hazardous chemical to be used on the site is the organic solvent extraction reagent (identified as Cyanex 272 in response to Item 2.19). Small quantities of the catalyst vanadium pentoxide (V_2O_5) and chemicals used for laboratory purposes will also be present. All hazardous chemicals will be handled and stored in accordance with the *Explosives and Dangerous Goods Act* 1961-1986 and *Dangerous Goods Regulations* 1992. Material Safety Data Sheets will also be available on-site. These sheets provide information and data on each chemical's:

- chemical description and ingredients;
- physical description and properties;
- trading name and other names;
- hazard classification;
- uses;
- health hazards and first aid advice;
- precautions for use; and
- safe handling procedures (for storage, transport, spills and disposal, fire and explosions).

5.0 DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT SUBMISSION

5.1 RARE FLORA

The Proponent has to date demonstrated a commendable commitment and willingness, in regard to Hemigenia exilis, to:

- *survey for additional locations outside of the Project Area;*
- *protect known populations within the Project Area;*
- *support research into germination; and*
- *monitor known locations within the Project Area.*

Commitment 4 should extend to management of remnant populations of Hemigenia exilis within the Project Area. The Proponent needs to provide a report giving clear information on the populations of these species and the impacts/management options that will be proposed, as such impacts will need to be evaluated. Management should also be addressed in the EMP and the EMS.

As grazing and accidental damage are likely to be management issues, appropriate management strategies would include fencing, destocking and feral animal control (particularly goats).

The potential impacts of the Project on *H. exilis* populations in the Project Area and the proposed management of these impacts were discussed in Section 7.5 of the CER. However, as stated in Section 4.6.2, CALM requested that population location details not be disclosed in the CER.

The Proponent is committed to undertaking the construction, operation and decommissioning of the Project in a manner that minimises disturbance to all known *H. exilis* in the Project Area. The Strategies and procedures for the environmental management of this species are described in Section 7.5 of the CER and will also be addressed by the Project's EMP and EMS developed in consultation with the DEP, DME and CALM. The Proponent will liaise closely with these departments to ensure that the management of this species is undertaken in a responsible and effective manner.

Management strategies such as fencing, destocking and feral animal control will be implemented where appropriate on any pastoral leases owned by the Proponent.

5.2 FAUNA

It is surprising that no site specific survey was undertaken, given the size and duration of the Project, and the paucity of reliable information for this area. Desktop surveys are limited in their ability to:

- *Provide a basis for reaching conclusions regarding the impact of the Project and the conservation significance of the Project Area. For example, the following statements infer that site-specific data have been collected:*
  - *"Therefore, the Project Area has no outstanding conservation qualities for vertebrate fauna, and accordingly has no special regional significance" (Section 4.7.2 of the CER).*
  - *"Therefore, this Project will not adversely affect any mammal species of conservation significance" (Section F4.3 of Appendix F of the CER).*
  - *"Accordingly, this Project will not adversely affect any herpetofauna of conservation significance" (Section F4.4 of Appendix F of the CER).*

- *Provide sufficient data regarding species actually present and their habitats for the purposes of management, workforce education and workforce induction (Section 7.7 of the CER).*

- *Determine the presence of specific species for which there is a paucity of information regarding their preferred habitat and range. For instance, CALM has a record of an active mallee fowl's nest on Glenorn Station (recorded 19/9/95) within mulga woodland.*

The lack of site-specific surveys is common to many formal assessments. Many now rely for data on either old or inadequate earlier surveys. This means that the database for flora and fauna is not being updated and improved.

Adequate effort should be directed to site-specific studies for biodiversity. It is recommended that EPA guidelines be amended to reflect this need, perhaps along the lines of NPNCA guidelines.

CALM recommends that the Proponent addresses a site-specific fauna survey in the EMP and EMS, and that it liaise with CALM regarding siting of infrastructure and the management of any significant species encountered.

It is important to ensure that the statements and conclusions presented in the CER are considered in the context in which they were made. The statements quoted in the first dot point (above) do not infer that site specific data were collected. The CER clearly states in Section 4.7 and Appendix F that the fauna studies undertaken for this Project comprised a desktop review of relevant scientific literature and other data including a printout from the Western Australian Museum's vertebrate fauna database.

One of the main difficulties associated with undertaking a fauna field survey as part of the preparation of the CER is that the results of the survey would represent a "snapshot in time" of the status of the fauna assemblages resident in the Project Area at the time of the survey. It is unlikely that migratory, nomadic, cryptic or rare fauna would be adequately sampled. Therefore, what is required is a systematic series of field surveys over a number of years and sampling all seasons. In the absence of these data, it is possible to describe the fauna habitats of the Project Area and to predict the likely fauna assemblages using data from other surveys in the region including the recent biological survey of the Eastern Goldfields (Hall *et al.*, 1994).

However, these difficulties do not negate the need for site-specific field surveys to confirm the results of the desktop studies and to facilitate the development of specific management strategies and procedures for significant species. Therefore, the Proponent will undertake additional fauna studies to ensure that adequate information is available for the purposes of managing the Project as well as educating the workforce. The scope of these studies will be determined in consultation with the DEP and CALM, and will be undertaken to meet the requirements of the EPA. The Proponent will also liaise with the DEP and CALM to ensure that the disturbance of significant fauna habitats and species is avoided, where possible.

The Proponent has included an additional commitment to confirm the intent to undertake these studies. This commitment is presented below.

COMMITMENT 18

The Proponent will undertake additional fauna studies to ensure that adequate information is available for the purposes of managing the Project as well as educating the workforce. The scope of these studies will be determined prior to the commencement of the construction phase in consultation with the DEP and CALM and will be undertaken to meet the requirements of the EPA.

Other comments regarding fauna and protection of fauna are:

- *The potential for birds to utilise "wet areas" within the Project Area (e.g. tailings dam, evaporation pond) is very high, particularly in drier years. Given the size and the duration of operation of the wet areas, management and mitigation options should be considered. These should be addressed via the EMS.*

- *The issue of maintaining existing water points for the protection of fauna requires some evaluation. The provision of water to "domesticate" kangaroos is likely to be at the expense of total grazing control (i.e. feral goats, increased kangaroo numbers), and may continue to have impacts on other native fauna and flora (including rare flora).*

CALM recommends that the Proponent considers expanding the terms of the EMS to cover the management of pastoral leases under the control of the Proponent. In this way, any direct impacts on flora and fauna from the Project may be offset by the conservative management of flora and fauna over a much larger area (see also issues under Land Systems, Item 5.3).

The maintenance of existing watering points is primarily to reduce the impact of the Project on pastoral activities, not to "domesticate" kangaroos. There should be no net change in the number of watering points in the region as a result of the development of this Project.

The EMS will address strategies and procedures for the management of fauna habitats and species as well as the environmental management of any pastoral leases under the control of the Proponent.

5.3 LAND SYSTEMS/PLANT COMMUNITIES

Regionally significant plant communities have been identified within the Project Area (Section 4.6.1 of the CER). It is not clear from Figures 4.6a and 4.6b, nor the text, where these communities exist. It is also not clear as to:

- *what impacts are proposed for these communities;*
- *what alternatives have been considered for infrastructure siting; and*
- *what management is proposed to minimise impacts on these communities.*

The potential impact of the Project on the flora and vegetation of the Project Area and the management of these impacts was discussed in Sections 7.4-7.6 of the CER and in response to Item 1.7. The environmental management of the flora and vegetation will be addressed further in the construction phase EMP and operation phase EMS, in consultation with the DEP, DME and CALM (Commitments 1 and 2).

The issues considered in selecting the site of the major components of the Project are summarised in Section 2.0. The alignment of the natural gas pipeline and water pipeline have not yet been finalised but will be selected in consultation with the relevant DMAs.

Many of the land systems within the Project Area (four of the six land systems present) and the pastoral station purchased by the Proponent (20 of the 30 present), are not represented or are not adequately represented within conservation reserve systems in the Northeastern Goldfields. Furthermore, the Hootanui and Mileura land systems are poorly represented in the Northeastern Goldfields area (0.3% and 0.6% respectively of the total area surveyed by Pringle et al., 1994). The cumulative impacts attributable to the pastoral and mining industries on any of these land systems has not been well examined.

The minimising of impacts on poorly conserved and poorly represented land systems should be considered by the Proponent, and should be addressed in the EMP and EMS.

The purchase of Glenorn pastoral lease affords opportunities for the Proponent to contribute to the improvement in the conservation status of unreserved and poorly represented land systems in the Northeastern Goldfields, through conservative management of the lease. Whilst this issue may be outside of the scope of the CER, the Proponent should consider conservative management in the EMS, i.e. demonstrate a nett environmental gain. CALM would be pleased to discuss a Memorandum of Understanding for the management of Glenorn lease, similar to those CALM has negotiated with other mining companies.

The impact of the Project on the land systems of the area is addressed in Section 7.8 of the CER and in response to Item 1.10. Strategies and procedures for the environmental management of the rangelands under the control of the Proponent and the management of the land systems in the Project Area will be developed in consultation with CALM and other relevant DMAs

5.4 SURFACE HYDROLOGY

CALM has three concerns regarding the modification to existing drainage patterns (Sections 7.10.1 and 7.10.2 of the CER) namely:

- *the potential to increase erosion as a result of concentrating flows into main channels;*
- *the potential to increase erosion due to linear developments in "sheetflow" area; and*
- *the potential "shadow" effects on vegetation as a result of disruption to sheet flow. Clear examples of shadow effects can be seen along the Leonora-Laverton Road.*

The monitoring and amelioration of effects of modification to existing drainage patterns should be addressed in the EMP and EMS, through the production of a surface hydrology management plan.

Some amelioration measures to minimise the disruption to sheetflow which could be considered include:

- *restoring the surface profile of borefield pipelines;*
- *minimising roading;*
- *allowing water to pass over constructed roads;*
- *providing culverting under constructed roads, and diffusing water on the downstream side (i.e. return to sheetflow); and*
- *diffusing water diverted from the Project Area upstream of drainage channels and creeklines.*

The Proponent will address the monitoring and amelioration of effects of modification to existing drainage patterns in the EMP and EMS. Strategies and procedures for the environmental management of this issue will be developed in consultation with CALM and other relevant DMAs and will include the preparation of a surface hydrology management plan.

5.5 MONITORING

It is noted that the Proponent has a commitment to monitoring a number of issues, and that these will be addressed in the EMS. Some other monitoring issues which should be considered include:

- *monitoring of vegetation for gas emission impacts;*
- *monitoring of creek systems for erosion;*
- *monitoring vegetation for shadow effects; and*
- *monitoring of "wet areas" for avifauna utilisation.*

CALM recommends that the Proponent expands the terms of the proposed monitoring programme to include gas emission, erosion, water shadow effects and avifauna.

The Proponent currently proposes to monitor:

- DRF populations;
- areas undergoing rehabilitation; and
- the effects of drawdown on the condition of vegetation in the vicinity of the borefields and in control areas.

However, the scope of the Project's monitoring programmes will be developed in consultation with the EPA, DEP, DME, CALM and other relevant DMAs and may be expanded to include additional vegetation and fauna monitoring (such as those aspects identified by CALM).

5.6 OTHER

It is noted that sandalwood and other potentially valuable timbers occur within the Project Area. CALM would welcome the opportunity for an early inspection and to arrange for the salvage of timbers prior to construction, if feasible.

The Proponent will liaise with CALM to arrange for timber salvage, as required.

6.0 REFERENCES

BHP Engineering (1996) Murrin Murrin Nickel-Cobalt Project Feasibility Study - Geotechnical Investigations. Prepared for Anaconda Nickel NL in March 1996.

Dames & Moore (1996) Murrin Murrin Nickel-Cobalt Project Consultative Environmental Review. Prepared for Anaconda Nickel NL. Job No. 31059-001-363.

Department of Aboriginal Sites (1994) Guidelines for Aboriginal Heritage Assessment in Western Australia. Draft guidelines prepared in January 1994.

Hall, N.J., McKenzie, N.L. and Keighery, G.J. (Eds.) (1994) The Biological Survey of the Eastern Goldfields of Western Australia. Part 10: Sandstone-Sir Samuel and Laverton-Leonora Study Areas. Records of the Western Australian Museum Supplement No. 47.

Pringle, H.J.R., van Vreeswyk, A.M.E. & Gilligan, S.A. (1994a) An Inventory and Condition Survey of the Northeastern Goldfields, Western Australia. Technical Bulletin No. 87. Department of Agriculture, Western Australia.

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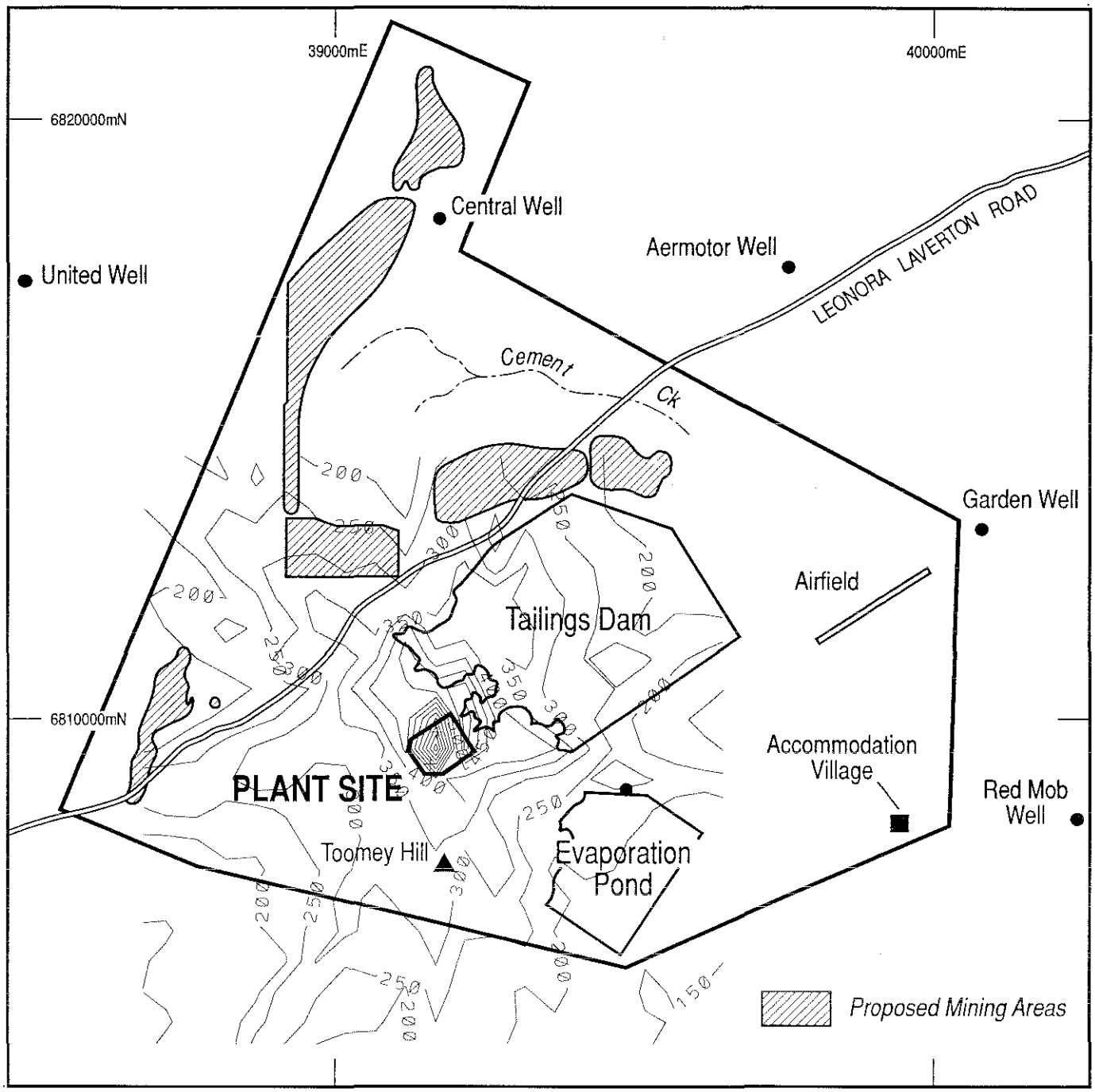

Murrin Murrin Nickel - Cobalt Project
Proponent's Response to Submissions

PREDICTED MAXIMUM 1-HR AVERAGE GROUND LEVEL CONCENTRATIONS OF SULPHUR DIOXIDE (μg/m³)

Appendix 3

List of submitters

1. Aboriginal Affairs Department
2. Department of Conservation and Land Management
3. Department of Minerals and Energy
4. Department of Resources Development
5. Esperance Port Authority
6. Main Roads, Western Australia
7. Water and Rivers Commission
8. Water Corporation
9. Esperance Shire Council
10. Shire of Laverton
11. Ms S Pugl Grainger Pastoral Co.
12. Mr D Johnson Residents for Esperance Development
13. R S Braddock
14. Mr P Sheiner
15. M G & D M Thomas P/L

Appendix 4

Proponent commitments

PROPONENT COMMITMENTS

1. Prior to commencement of the project, the proponent will prepare and implement an Environmental Management Programme for the construction phase, in consultation with the DEP, DME, CALM and other relevant agencies to meet the requirements of the EPA. Further, the proponent will ensure that its contractors will comply with the environmental management strategies and procedures described in the EMP.

2. The proponent will develop and implement and Environmental Management System for the operation of the project prior to the start of operations. This EMS will be developed in consultation with the DEP, DME and CALM, and to the satisfaction of the EPA. Further, the proponent will ensure that its contractors will comply with the environmental management strategies and procedures described in the EMS.

3. The proponent will progressively rehabilitate disturbed areas to minimise disturbance of biological communities. The rehabilitation will be completed to the satisfaction of the EPA in accordance with the approved EMP and EMS.

4. The proponent will undertake the construction, operation and decommissioning of the project in a manner that minimises disturbance to *Hemigenia exilis* populations. The proponent will also comply with the requirements of the *Wildlife Conservation Act* 1950. Further, the proponent will require its contractors to comply with this commitment. This will be undertaken to the satisfaction of the EPA and CALM, in accordance with the approved EMP and EMS.

5. The proponent will minimise erosion by minimising the extent of land disturbance and progressively rehabilitating disturbed areas. This will be undertaken to the satisfaction of the EPA and DME in accordance with the approved EMP and EMS.

6. The proponent will minimise the off-site transport of sediments by minimising exposed surfaces, identifying and treating on-site areas prone to erosion and progressively rehabilitating disturbed areas. The proponent will also undertake a water quality monitoring programme for Cement Creek and Katata Creek. These monitoring programmes will be developed and implemented to meet the requirements of the EPA, DME and WRC.

7. The proponent will implement dust mitigation measures including containment and suppression during construction to the satisfaction of the EPA and DME.

8. The proponent will minimise dust generation during operation of the facility by the following measures:

   - regular cleaning of areas likely to accumulate dust;
   - sealing of major roadways within the processing plant; and
   - use of water sprays on mine areas, ore and calcrete haulage routes, stockpiles and other project areas, as required.

   This programme will be completed to the satisfaction of the EPA and DME.

9. The total carbon dioxide emission for the project will be calculated by the proponent on an annual basis and reported to the DEP.

10. The proponent will ensure that noise from the project will comply with the requirements of the *Noise Abatement (Neighbourhood Annoyance) Regulations* 1979. If noise levels attributable to the project exceed EPA criteria, the proponent will take measures to reduce the impact.

11. The proponent will design and operate the overburden waste dumps such that they are stable and resistant to erosion, to the satisfaction of the EPA and DME.

12. The proponent will design and operate the tailings dam in accordance with the requirements of the EPA and DME to ensure that the tailings dam and evaporation pond do not result in unacceptable impacts to the existing groundwater regime. The tailings dam and evaporation pond will be treated to minimise permeability, if required.

13. Prior to construction and operation of the tailings dam and the evaporation pond, the proponent will undertake the following:

- A more detailed assessment of tailings solids and liquids geochemistry, including predicted compositions relevant to environmental guidelines and standards. This assessment will focus on Total Dissolved Solids, major ions, and metals (via an elemental analysis).

- An assessment of the predicted particle form and geotechnical characteristics of the tailings, including settling characteristics, and settled and compacted permeabilities.

- A more detailed evaluation of potential alternative tailings disposal options, including provision for the re-examination of the in-pit disposal option five years after the commencement of operations.

- A modelled feasibility assessment for the treatment of the tailings dam floor to achieve consistently low permeability to prevent excess seepage, depending on the predicted tailings permeability. The acceptable permeability rate will be assessed on the basis of the predicted seepage rate and effects on the groundwater.

- A detailed investigation of the hydrogeology of the tailings dam and evaporation pond sites to assess the depth to groundwater ('perched' or otherwise), aquifer characteristics, groundwater flow rates, and groundwater quality. The potential rise in groundwater levels and the dilution rates for seepage from these facilities will then be assessed, and predictions made regarding the resultant quality of the underlying groundwater and the requirement to decrease the permeability of the tailings dam to prevent unacceptable environmental impacts.

This work will be undertaken to meet the requirements of the EPA, DME and WRC.

14. The proponent will design and install a groundwater monitoring programme up and down-gradient of the tailings dam and the evaporation pond prior to the construction of these facilities. The monitoring programme will be designed and operated to the satisfaction of the DME, DEP and WRC.

15. The proponent will minimise the impact of the project on pastoral activities and ensure that pastoral water supplies in the project area are maintained.

16. The proponent will comply with the provisions of the *Aboriginal Heritage Act* 1972-1980.

17. The following commitments are made relating to the plant operations;

- hazardous chemicals and fuel storage areas will be bunded, and constructed in accordance with AS 1940 - 1933;

- systems will be installed (either as procedures or by design) that would ensure shutdown following a release of either hydrogen or natural gas;

- rigorous procedures will be in place to prevent air ingress into vessels containing either natural gas or hydrogen, at either plant start-up or shutdown;

- the flare exhaust stack will be sited such that there is no potential for off-site thermal radiation effects and at a height sufficient to ensure adequate dispersion of toxic emissions; and

- a hazard and operability (HAZOP) will be conducted during the detailed design of the plant processing facilities.

18. The proponent will undertake additional fauna studies to ensure that adequate information is available for the purposes of managing the project as well as educating the workforce. The scope of these studies will be determined prior to the commencement of the construction phase in consultation with the DEP and CALM and will be undertaken to meet the requirements of the EPA.

19. The proponent will specify emissions criteria in tender documents for the supply of equipment for the Plant. Compliance testing will be carried out by the proponent during the commissioning of the Plant to confirm that the emissions from the plant equipment are within the specified limits. This commitment will be implemented to meet the requirements of the EPA.

Appendix 5

Proposal characteristics

Table 1: Raw materials*

Table 2: Process outputs, markets, modes of transport and packaging*

Table 3: Atmospheric emission characteristics-Frequency of occurrence and duration of upset conditions*

(* Source: Dames and Moore, 1996a)

TABLE 1

RAW MATERIALS

Raw Material	Usage Rate	Source	Transport	Frequency of Import	Size of Shipment	On-site Storage
Nickel cobalt ore	4 Mtpa	On-site mining operations	Dedicated haulage roads	continuous	60-100 tonnes	Stockpiles of 100,000 tonnes
Sulphur	490,000 tpa	Canada	• Sea freight to Esperance • Rail to Malcolm Siding • road haulage to site (40km)	monthly daily daily	• 30,000-40,000 tonnes • 1,500-2,000 tonnes • 60 tonnes	60,000 tonnes (Esperance) 2,000 tonnes (Malcolm)
Natural Gas	20,000 GJpd	Goldfields Gas Pipeline	Spur pipeline (70km)	continuous	N/A	N/A
Industrial Gases • oxygen • hydrogen • hydrogen sulphide • ammonia	 50,000 tpa 14,000 Nm^3ph 33,000 tpa 21,000 tpa	Industrial Gas Plant	Pipeline	continuous	N/A	 Minimal Minimal Minimal Minimal
Organics	6.3 tpa	Perth	Road	monthly	0.5 tonnes	~ 1 month's useage
Calcrete	900,000 tpa	On-site mining operations	Road	daily	60-100 tonnes	20,000 tonnes
Water	30,000 m^3pd	Valais, Corktree, Korong North, Korong South, Gum Well, Borodale borefields	Pipeline	continuous	N/A	30,000m^3
Flocculant	1,500 tpa	Perth or Kalgoorlie	Road, rail	weekly	bulk bags or silos, 30 tonnes	~ 1 month's usage
Polyacrylic acid	221 tpa	Perth	Road	weekly	drums	~ 1 month's usage
Filter Aid	45 tpa	Perth	Road	monthly	bulk bags	~ 1 month's usage
Soda Ash	500 tpa	Perth	Road	weekly	Pallets	1 month's usage
Caustic	300 tpa	Perth	Road	weekly	Drums	60 t tank • 4 Mlpa stored at each borefield

TABLE 2 PROCESS OUTPUTS, MARKETS, MODES OF TRANSPORT AND PACKAGING (4.0Mtpa of FEED ORE)

Product	Production Rate (tpa)	Destination	Transport	Frequency of Export	Size of Shipment (t)	Packaging
Nickel metal briquettes	27,000	Overseas markets	road, ship	daily monthly	40 2,200	2t bulka bags 20t containers
Cobalt sulphate crystals	8,200	Overseas markets	road, ship	weekly monthly	40 680	2t bulka bags palletised
OR						
Cobalt metal	1,550	Overseas markets	road, ship	weekly monthly	40 125	2t bulka bags 20t containers
Mixed nickel cobalt sulphide powder	29,000	Overseas markets	road, ship	weekly monthly	40 2,400	2t bulka bags 20t containers
Ammonium sulphate crystals	60,000	Overseas markets and WA markets	rail, ship, road	weekly monthly as required	1,200 5,000 40	bulk
Tailings (pH 6-7)	3,750,000	disposed on-site				

ATMOSPHERIC EMISSION CHARACTERISTICS

TABLE 3 FREQUENCY OF OCCURRENCE AND DURATION UPSET CONDITIONS

Source	Stack Height (m)	Emission Volume (Am^3/hr)	Emission Temp. (°C)	Sulphur Dioxide (g/s)	Oxides of Nitrogen[1] (g/s)
Case 1 - Total Gas Failure - Once every two to five years. Duration 30 minutes					
Sulphuric Acid Plant	80	465,000	70	124	-
Hydrogen Sulphide Flare	80	175,000	60	110	<15[3]
Case 2 - Sulphuric Acid Plant Startup (10 times/year). Duration 1-2 hours					
Sulphuric Acid Plant	80	465,000	70	250	-
Gas Turbines (per unit)[2]	40	300,000	90	negligible	3
Sinter Plant	40	100,000	90	negligible	<1
Hydrogen Sulphide Flare	80	175,000	60	110	<15[3]
Case 3 - Hydrogen Sulphide Venting to Flare (numerous times/year). Duration <30 minutes					
Sulphuric Acid Plant	80	465,000	70	124	-
Gas Turbines (per unit)[2]	40	300,000	90	negligible	3
Sinter Plant	40	100,000	90	negligible	<1
Hydrogen Sulphide Flare	80	175,000	60	10	<15[3]

Notes:
1 Oxides of nitrogen expressed as nitrogen dioxide.
2 Total of 2 units. Normally only one unit will be operational at any one time.
3 Estimate only.