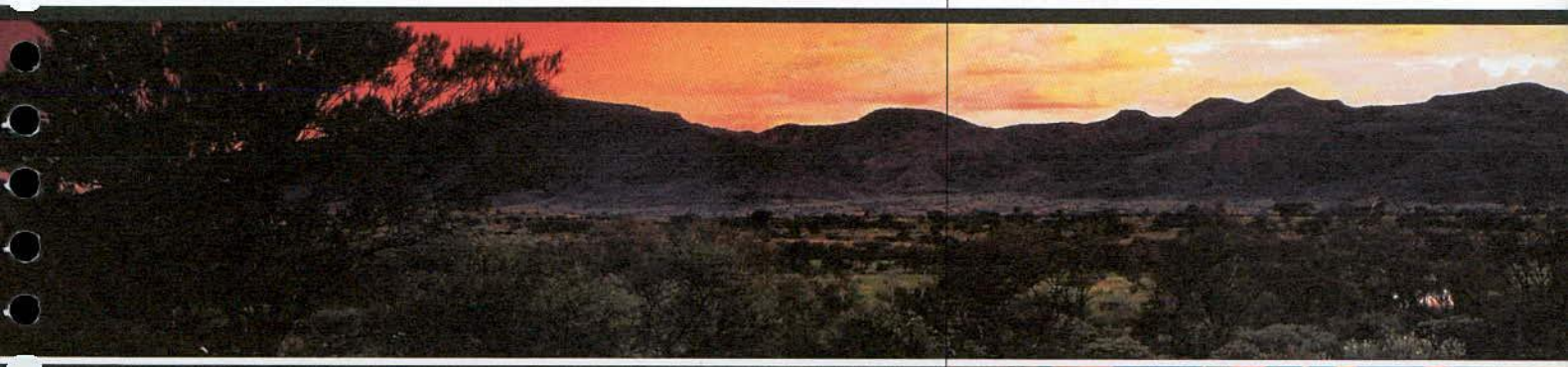
West Angelas Project



Environmental Review and Management Programme Summary Document

NORTH

ROBE

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ENVIRONMENTAL CONSULTANTS

PURPOSE OF SUMMARY DOCUMENT

Robe River Mining Co. Pty Ltd. proposes to develop an iron ore mine in the Pilbara region of Western Australia, approximately 130 kilometres west of Newman and 100 kilometres east of Paraburdoo.

This summary document is an overview of the Environmental Review and Management Programme. It is designed to give the public a basic understanding of the environmental impact assessment process, key features of the West Angelas Project proposal, the existing environment, project impacts and management, and environmental systems and reporting used by Robe.

The West Angelas proposal was referred to the Environmental Protection Authority (EPA), which determined that the level of environmental assessment be set at Environmental Review and Management Program (ERMP) under Part IV of the *Environmental Protection Act, 1986*.

It is recommended that the more detailed ERMP document is read to obtain a clear understanding of the project in order to make a more informed submission.

The ERMP will be available for public review between 16 March 1998 and 11 May 1998.

Copies can be examined at:

Department of Environmental Protection
Library Information Centre
8th Floor, Westralia Square
141 St George's Terrace
Perth WA 6000

The following libraries:
- Karratha Community Library
- J S Battye Library, Perth
- South Hedland Public Library

The following Pilbara shire offices:
- Ashburton Shire, Tom Price
- Roebourne Shire, Karratha
- East Pilbara Shire, Newman

Copies of the ERMP may be purchased for the sum of $10.00 each (including postage and packaging) from:

Robe River Mining Co. Pty. Ltd.
Level 9, 12 St George's Tce
Perth WA 6000 9421 4747

Robe River Mining Co. Pty. Ltd
GPO Box P1224
Perth WA 6001
(mail order copies)

This summary document is available free of charge from the above address.

Submissions on this proposal are invited by 11 May,1998.

Please address your submission to:

Chairman
Environmental Protection Authority
8th Floor, Westralia Square
141 St George's Terrace
Perth WA 6000
Attention: Murray Hogarth

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1 INTRODUCTION

1.1. BACKGROUND AND OVERVIEW

The proposed West Angelas mine site is located approximately 130 kilometres to the west of Newman and approximately 300 kilometres south east of Robe's current operations near Pannawonica (Figure 1).

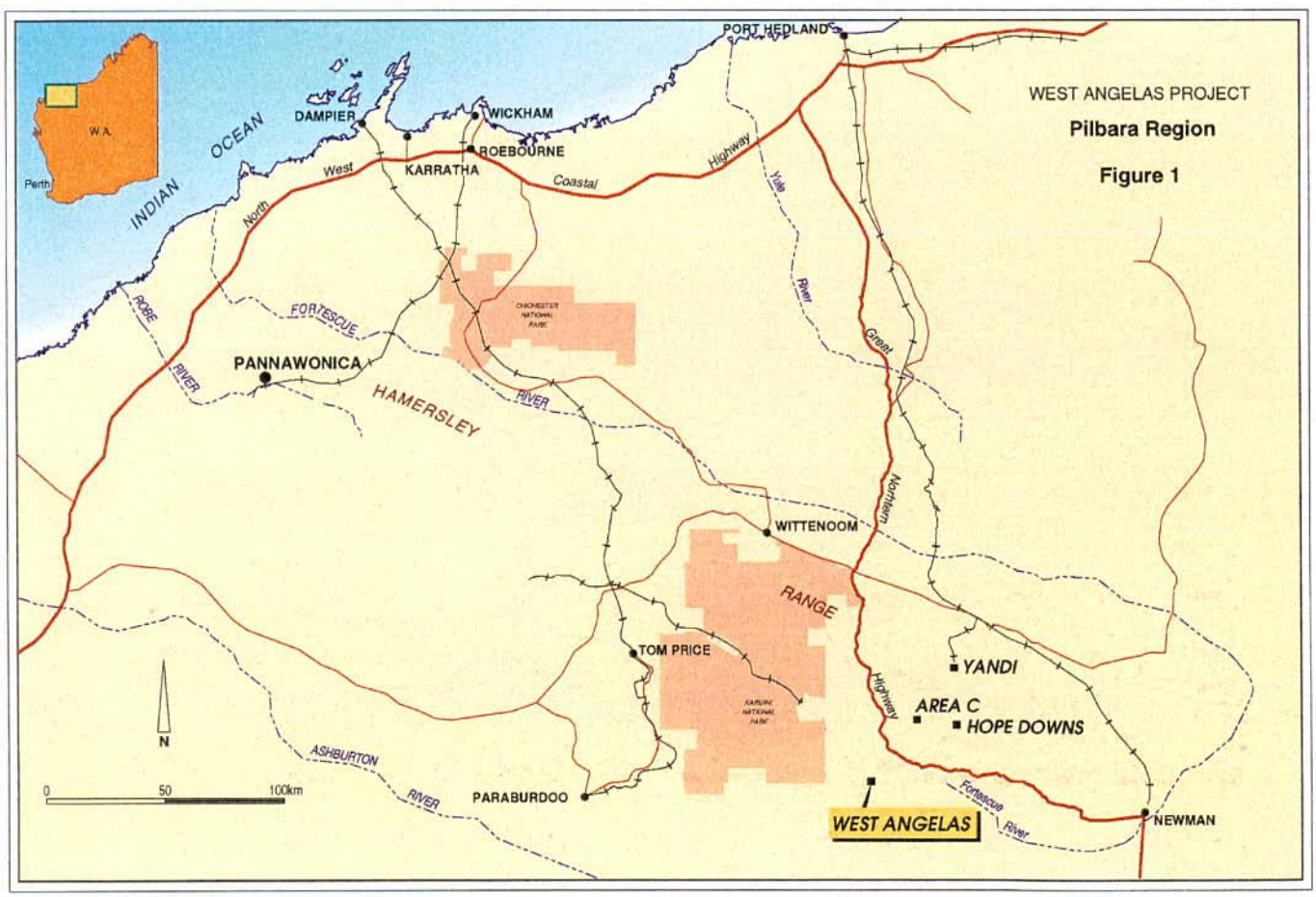
During the period 1972 - 1977, an extensive drilling program in the West Angelas area of Western Australia's eastern Pilbara region confirmed a number of high grade iron ore deposits with a combined mineral resource of approximately 1014 million tonnes. The two main deposits, termed Deposit A and Deposit B, were found to be the key areas of mineralisation, having a measured iron resource of 458 and 236 million tonnes respectively.

Robe River Mining Co. Pty. Ltd. (Robe) is proposing to mine Deposits A and B at West Angelas, and any economic ore proven from associated ore bodies, Deposits C – H (Figure 2). Transport of West Angelas ore requires the construction of a rail link between the proposed West Angelas mine and Cape Lambert, and an associated increase in the capacity of the port facilities at Cape Lambert to enable the shipping of West Angelas ore.

The project is being designed to have a mining and production capacity of 20 million tonnes per annum, with 6.5 million tonnes produced in year one of production, building up to 20 million tonnes in year eight, with an expected project life of 25 to 30 years. Construction will take about 30 months and it is anticipated sales of ore will commence in 2001.

At present, Robe operates an iron ore crushing, screening, stockpiling, blending and ship loading facility at Cape Lambert, with iron ore presently being transported to this facility by rail from the Pannawonica Mesa J operation. This facility will require upgrading to handle the West Angelas ore.

Robe's operations are subject to the *Iron Ore (Robe River) Agreement Act 1964 – 1987* (WA).



1.2 ENVIRONMENTAL APPROVAL PROCESS

The EPA's environmental impact assessment process allows members of the public and government authorities to obtain details of the proposal being assessed and to comment on any matters of interest or concern to the EPA.

The Department of Environmental Protection (DEP) issues guidelines prior to assessment outlining areas of environmental concern. Following further discussion with the DEP and a period of government and public consultation the proponent (Robe) responds to all environmental concerns and provides full project details in the West Angelas Environmental Review and Management Programme (ERMP) and an accompanying summary document.

The ERMP document is made available to the public for comment. The EPA considers all comments received from government agencies and the public and provides a summary of submissions to the proponent for their response.

Following receipt of the proponent's response to the summary of submissions, the EPA will complete its assessment of the proposal and submit an Assessment Report to the Minister for the Environment. The Minister then provides advice to the State Government about whether the proposal meets the EPA's objectives.

The EPA's Assessment Report is released for a two week period during which the public can scrutinise the conclusions and, if considered warranted, appeal to the Minister against the recommendations. The Minister for the Environment will assess any appeals received and ultimately determine whether or not the proposal can proceed. If the Minister decides that the proposal can proceed, legally binding conditions are set stating the environmental requirements that the proponent must comply with.

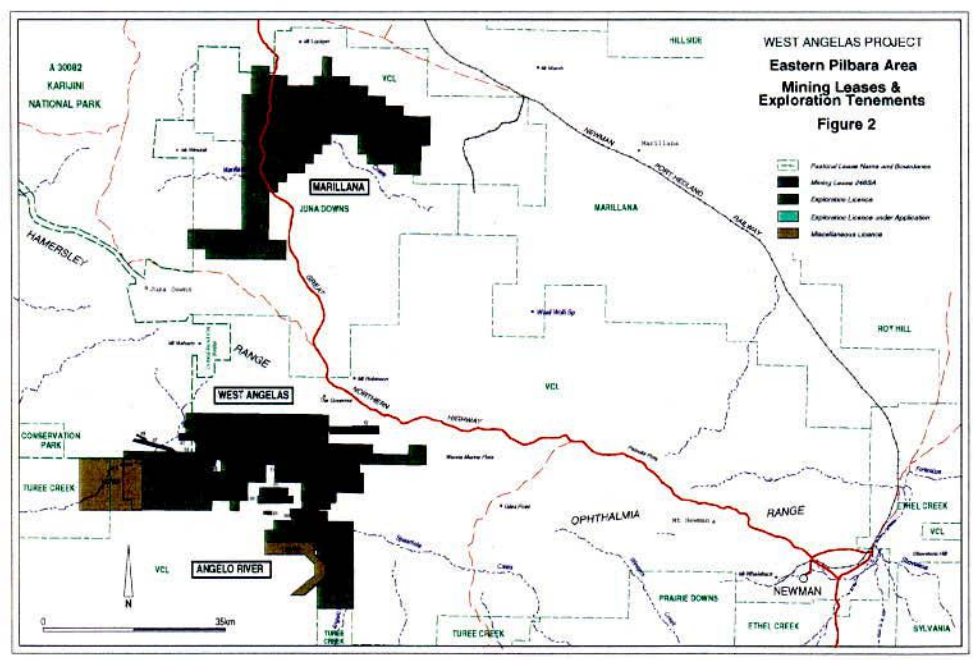
1.3 THE PROPONENT

The proponent for the project is Robe River Mining Co. Pty. Ltd. (Robe) project manager for Robe River Iron Associates (RRIA), which is a joint venture of North Limited (53%), Mitsui Group of Companies (33%), Nippon Steel Australia Pty Ltd (10.5%) and Sumitomo Metal Australia Pty Ltd (3.5%).

Robe's iron resources are currently estimated at between 3 and 4 billion tonnes. Its major deposits are found in mesas stretching for 100 kilometres along the ancient Robe River valley in the Pilbara.

Robe's current mining operations at Mesa J are located 1400 kilometres by road north of Perth, near the town of Pannawonica and 200 kilometres south west of the company's processing and port facilities at Cape Lambert. Iron reserves of Robe Pisolite provide the cornerstone of Robe sinter fines and lump output. Approximately 27,500,000 tonnes of fines and lump was produced in the ore year 1996-1997.

Robe employs approximately 860 people with the Pilbara operations managed from Cape Lambert, while administrative support services are based in Perth.



1.4 BENEFITS OF THE PROJECT

Demand for iron ore is increasing from China, Taiwan and Korea with an established market in Japan. The Pilbara region generates iron ore valued at more than $2.5 billion per year and Robe is Australia's third largest iron ore producer and the fourth-ranked sea-borne iron ore exporter in the world.

Development of the West Angelas Marra Mamba ore types represent a second generation of the iron ore industry in the Pilbara. They provide a new ore which increases the diversity of products and expands market opportunities.

The mining of the iron ore deposits at West Angelas will result in substantial national and state benefits, including:

- investment in excess of $1 billion capital, most of which will be directed into the Western Australian economy;
- increased export value of Western Australian iron ore product to international customers;
- additional Commonwealth and State Government revenues through collection of royalties, taxation, licence fees and other charges;
- direct employment in the eastern Pilbara, peaking at around 1200 people during construction and over 450 during operation;
- more efficient use of existing infrastructure at Cape Lambert and the township of Wickham;
- increased demand for goods and services creating business and employment opportunities; and
- potential for development of downstream processing.

In addition to the direct benefits of a mining proposal, there are flow-on benefits to the non-mining sector. The multiplying factors of mining for the rest of the economy have been estimated:

- any increase in output of mining results in a two fold increase in the output of non-mining industry;
- a $1 million increase in mining wages and benefits results in a $2 million increase in the non-mining sector; and
- for every 100 jobs created in the mining industry approximately 300 non-mining jobs result.

From an economic perspective, the West Angelas project will provide both direct and indirect employment opportunities for people in the Pilbara, as well as a substantial investment in infrastructure.

The Pilbara Region's economy and its future growth and development are largely dependent on the continued viability of resource development projects.

Development of Marra Mamba ore types will be crucial for advancement of the iron ore industry in Western Australia, as the premium quality low phosphorous ore deposits of the Brockman Formation are gradually being depleted.

Iron ore is a derived demand due to its status as a raw material in the steel production process. The lump and sinter fines products which will be produced from the West Angelas mine area are of considerably higher quality than the pisolitic sinter fines output from current production at Mesa J. As such, West Angelas addresses the current trend and future priorities in blast furnace steel making, which is being driven by technologies such as the Electric Arc Furnace (EAF). Furthermore, EAF's are forecast to increase their share of crude steel production to around 44 per cent by the year 2010, accounting for some 90 per cent of all growth in crude steel output during the next 15 years.

Without the ability to respond to these steel-making trends, Robe's long term viability as a competitive exporter of iron ore would be questioned.

West Angelas iron ore will be suitable to provide a consistent alternative supply of EAF product to the predominantly South East Asian and China markets.

West Angelas ore contains higher grade fines and a higher proportion of lump ore to provide variety in the blends and products available, providing a diversified product for Robe.

2 ALTERNATIVES CONSIDERED

The principal project alternatives investigated are those relating to upgrading the port facilities, water supply options, worker accommodation and the route of the railway. This section describes the alternatives considered and the selection process used to determine the final choice.

2.1 PORT FACILITIES

Options considered for expansion of the wharf:

- one shiploader two berths;
- two shiploaders two berths; and
- two shiploaders and extended berthing facilities to accommodate three or four vessels.

Investigations established that the first and second options would be unacceptable for operational reasons, such as excessive demurrage costs or loader to loader interference. The third option allows the shiploaders to operate with minimal interference and increased port throughput.

The increased ship loading capacity requires a corresponding ore stockpile capacity. The proposed stockpile expansion necessitates the enlargement of the existing stockpile by an additional 40 hectares. The enlargement requires the reclamation of land.

There are no viable alternatives to the land reclamation proposed on the eastern side of Cape Lambert due to the constraints imposed by the topography, lease boundary and location of sensitive habitats on the western side of Cape Lambert.

2.2 WATER SUPPLY OPTIONS

Preliminary investigations indicated that there was little groundwater potential close to the West Angelas deposits. Six potential locations were considered, namely Turee Creek (A) and (B), Packsaddle Basin, Angelo River, Hope Downs Creek and Spearhole Creek. The sites were ranked on the basis of potential groundwater yield, cost of development, environmental constraints and logistical constraints. Based on the results of this ranking process and exploratory drilling, development potential is focused on the Turee Creek (B) option, located 31 kilometres west of the mine.

2.3 WORKER ACCOMMODATION

The West Angelas mine site is too far away from Newman for regular daily commuting (Figure 1). Four sites were considered for the accommodation village and evaluated on the basis of topography and aesthetics, microclimate, social issues, cost, environmental disturbance, accessibility, and infrastructure. The sites considered were: the current exploration camp; a site on the southern slopes of the West Angelas valley; the "Western Site", 12 kilometres from the mine site at the western end of the West Angelas hills; and, a site on the southern side of Mt Hilditch and Mt Ella.

The Western Site is the preferred location as it is considered to best reflect a compromise between social, environmental and cost issues.

2.4 RAILWAY ROUTE SELECTION

In assessing the impact of the railway alignments, consideration was taken of environmental management issues raised by the EPA and safety, engineering, economic and social criteria.

The option of dual tracking Hamersley Iron's Central Pilbara and Paraburdoo - Dampier railways was extensively considered in the route evaluation process. In four sections of this route the constraints imposed by topography, substrate type, surface drainage hydrology and existing Hamersley Iron (HI) railway design dictate that to minimise environmental impact, and achieve world's best practice, alternative route options must be considered in each of these sections.

Within the Millstream Chichester National Park, the rail line will be part of a Miscellaneous Licence granted through Robe's State Agreement Act.

The route options discussed below and the selected alignment are shown on Figure 3.

Routes crossing Millstream Chichester National Park

George River route:

- CALM indicated that the central and eastern portions of Millstream Chichester National Park would be zoned as a wilderness area. This route would therefore result in significant noise impacts and provide access tracks that could unacceptably increase public use of the area;
- CALM has requested that all services remain within an acknowledged corridor through the Millstream Chichester National Park;
- Hicks Gap has significant non-indigenous heritage value; and
- the country is very rugged and has high landscape values thus this rail formation would be expensive to construct.

Due to the high degree of environmental sensitivity, Robe eliminated the George River route from further consideration.

Mt Herbert route:

This route also passes through the area that may be zoned as a major recreation area and is not within the area nominated by CALM as a potential service corridor. Accordingly, the Mt Herbert route was deleted from further consideration.

Hamersley Parallel (Western) route:

In order to meet CALM's request that Robe's Railway be contained within a corridor adjacent to Hamersley Iron's Railway, eight alignments were studied, all within three to four kilometres of the Hamersley railroad. Six of the eight routes presented significant topographic or surface drainage constraints in addition to the difficulty in achieving a practical and safe gradient in ascending the Chichester Range. If these routes were chosen significant earthworks would be necessary with associated landscape impacts.

The most westerly of two routes examined near the Hamersley railroad, known as the Hamersley Parallel (Western) route:

- satisfies the request to maintain a single service corridor through the National Park;
- allows the least impact on the landscape and on visual amenity of the options investigated;
- has the least noise impacts on the tourist focal points in the National Park and the least noise impact on the proposed wilderness zone; and
- has the least potential adverse impacts in terms of public use of the area.

The Hamersley Parallel (Western) route is the selected route.

Lower Millstream-Chichester area: Mt Leal route compared with the existing Hamersley Iron route

The existing Hamersley Iron rail alignment intersects a low lying flood wash area where run-off from the immediate hilly areas is only just commencing to form into defined drainage paths. By locating the railway further east, a major portion of the floodplain is avoided, together with the associated drainage problems. The Mt Leal route crosses higher ground and so avoids the likely occurrence of collapsing soils that tend to be more common in flood wash areas. Locating the railway further east also reduces the length of railway to be constructed by 6.5 kilometres

Therefore, the Mt Leal route is the selected option.

Hamersley Station: Direct 8 Mile Well route compared with 4 Corners Bore route

The Direct 8 Mile Well route passes over fertile grazing land that is part of Hamersley Station and would present a physical barrier to stock movements.

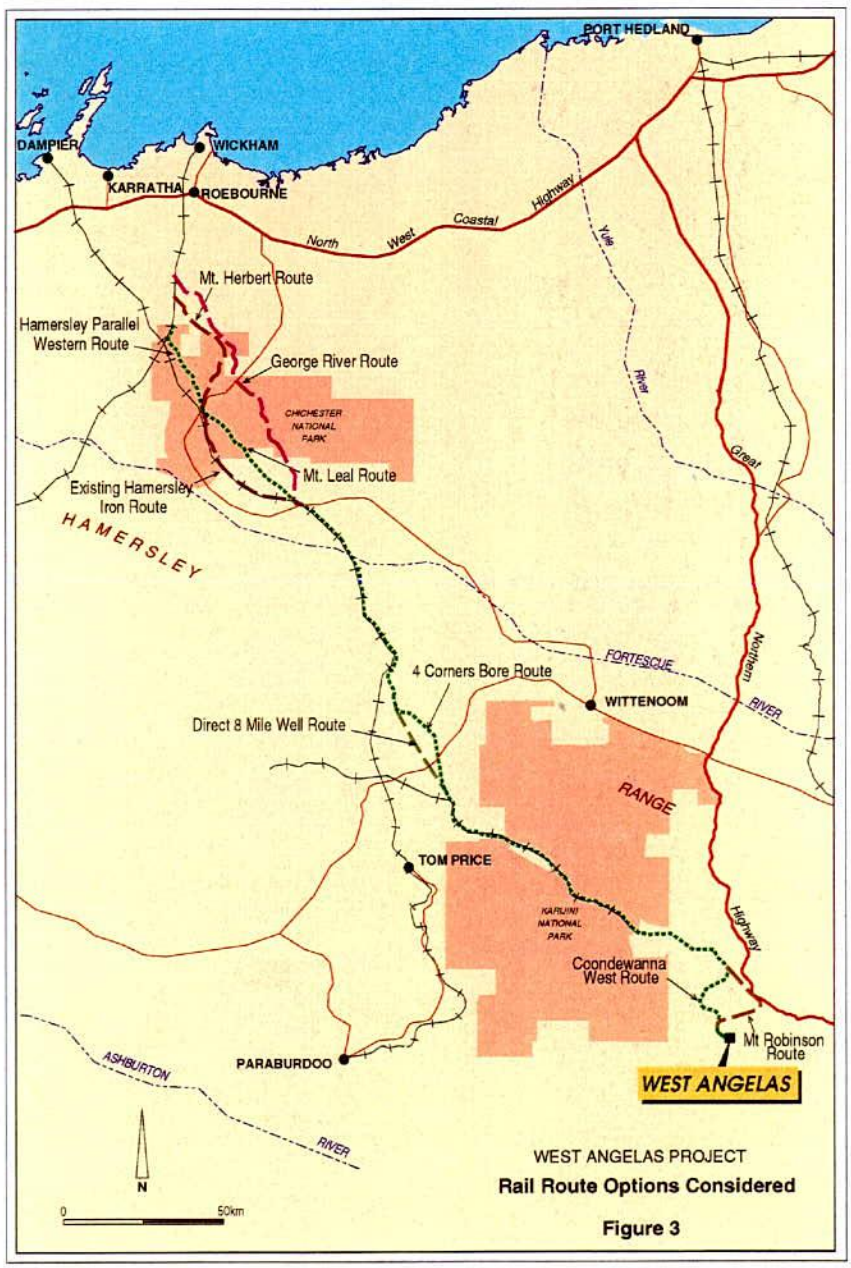
This route would also be located on collapsing clay soil which requires embankment foundation stabilisation. Although the 4 Corners Bore route is 1.5 kilometres longer, construction costs would be much the same.

Therefore, the 4 Corners Bore route is the selected option.

Coondawanna Flats - Coondawanna West route compared with Mt Robinson route

The Coondawanna West option passes to the north of West Angela Hill, looping slightly west around Coondawanna Flats then strikes north-west towards Packsaddle. The Mount Robinson Route heads north-east to the Great Northern Highway, parallels it for about eight kilometres and then travels north-west to Packsaddle. The Mount Robinson Route is 7.5 kilometres longer, and was suggested by CALM as an alternative which had less potential impact on mulga and could serve future mining operations. Mulga is a management issue and impacts can be mitigated by appropriate drainage structures and culverts.

The Coondawanna Flats route has been selected due to its shorter length resulting in considerable savings in both capital and operating costs.



3 PROJECT DESCRIPTION

3.1 MINING

It is proposed to commence mining of Deposit A and B initially and then move to Deposits C-H, depending on demand.

The mining at West Angelas will be conducted using conventional open pit methods (Figure 4).

As part of the mine planning process computer modelling will be used to maximise placement of overburden inside the mine pit as extraction of ore proceeds throughout the mine life, thus minimising further surface disturbance.

A total of 12 to 15 per cent of the mining at Deposit A will be below the water table. However, due to the impermeable nature of the geological strata, the volume of dewatering required is expected to be low. Skid mounted sump pumps are proposed to be utilised for dewatering.

Rainfall that collects in the bottom of the pit will also be pumped out. Dewatering water would be mostly used on-site, but in exceptional circumstances such as heavy rainfall events it would be released into drainage channels.

The mined material in this region is oxidised, so acid-mine drainage is not expected to be an issue.

Upon completion of mining, overburden wastes will be used to backfill the mine pit to above the natural water table.

Each of the main ore processing plants (primary and secondary crushing, screening, sampling and loadout facilities) will be equipped with water sprays to minimise dust generation at these points. Additionally, ducted extraction systems will be provided to extract dust particles generated in those areas where dust has not been settled by the water sprays.

The products from the plant will be <37.5 mm lump and <6.3 mm fines material, which will be stockpiled separately prior to loading onto trains for transport to Cape Lambert. Stockpile capacity will be sufficient to load two trains of either lump or fine ore.

Rail operations are expected to be a maximum of 22 trains per week, each train composed of 170 cars.

A Long-Airdox bulk loading chute and automatic control system will be used for train loading. A single bin loadout system will be adopted for loading ore cars with the ore.

Support infrastructure for mining will include a private access road to the West Angelas mine site off Great Northern Highway, a heavy vehicle and plant maintenance workshop and warehouse, offices, radio facilities, accommodation village, an airstrip and an explosives storage facility constructed according to mining regulations (Figure 5).

Water requirements for the project are estimated to be 17 megalitres per day supplied by the Turee Creek B borefield. Water will be pumped to the mine area in an above ground steel pipeline. An access track will be constructed alongside the pipeline.

Fuel will be delivered to the West Angelas mining area by trains from Cape Lambert and stored in bunded bulk fuel tanks.

Power for the mine site will originate from either:

(i) a mine site gas fired power station; or

(ii) an overhead transmission line drawing from that to be built by Pilbara Energy Pty Ltd (PEPL) to service BHP's Mining Area C and other future projects in the area.

For construction of a gas fired power station at West Angelas, a low pressure gas pipeline would be laid underground to connect to the Goldfields Gas Transmission natural gas pipeline at the Boonanchi Wells valve station located approximately 55 kilometres south-east of West Angelas.

Should power be supplied by PEPL, 50.5 kilometres of overhead transmission line would be constructed from the PEPL line at Area C to the West Angelas mine site.

At this stage, the gas fired power station and pipeline is the preferred option.

To provide access for mine site personnel during construction and mining the existing airstrip at West Angelas will require upgrading to a 2300 metre long gravel runway.

3.2 MATERIAL FOR THE RAILWAY

All borrow areas will be within one kilometre of the rail route corridor, more than 150 metres from public roads, more than 50 metres from watercourses. Where viable, borrow areas will be adjacent to the proposed rail line and closely spaced to minimise the volume of material removed from each area.

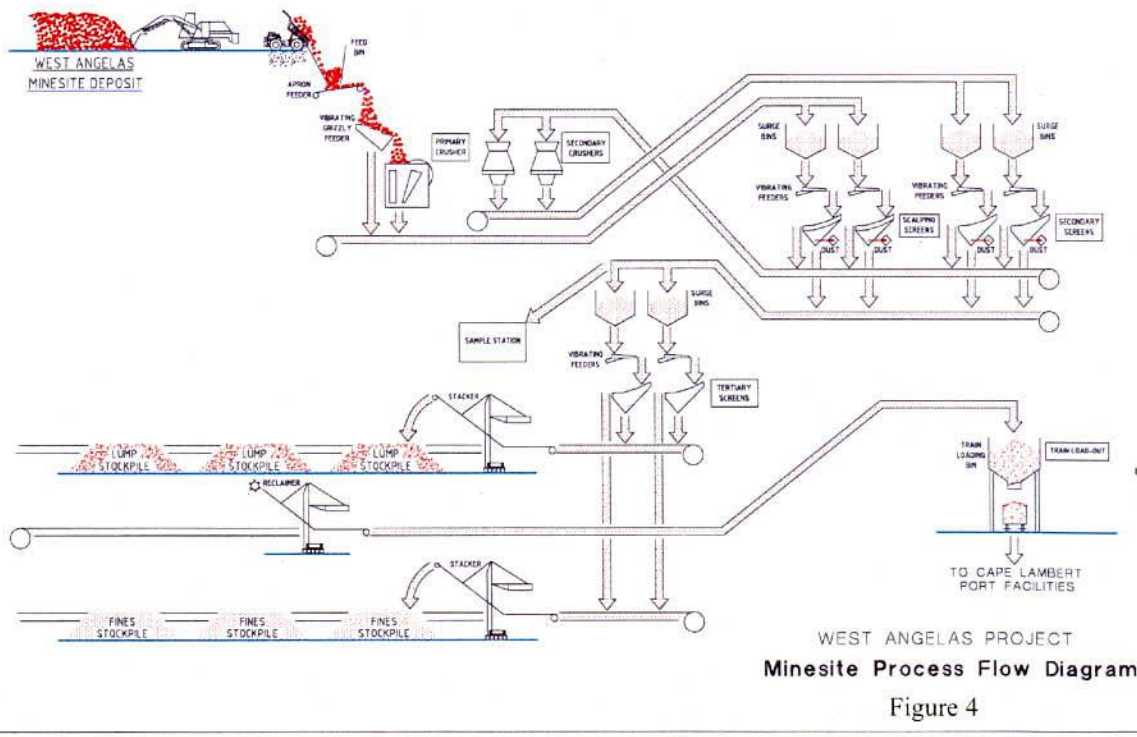
There will be one, or at the most two, quarries along the rail route for the supply of track ballast and concrete aggregates over the life of the project. Provided there is sufficient stone, the existing 10 KP quarry at Cape Lambert will be expanded and a concrete sleeper manufacturing plant temporarily constructed adjacent to the site for a period of two years.

A second quarry is likely to be established. An exploration lease is currently being sought for a two kilometre by six kilometre area near Hamersley Iron's new Hill D quarry. Depending on the availability of materials a third quarry site may be required but it does not form part of this proposal.

3.3 CAPE LAMBERT PORT EXPANSION

With increased export volumes from West Angelas, ore shipping is expected to increase from 185 to 397 ships per year. To allow for the additional West Angelas product moving through the Cape Lambert facilities, the port facility will require an expansion, including:

- one new shiploader;
- a 250 metre extension to the existing wharf and associated dredging on both sides of the wharf;
- deepening and widening of the departure channel for a distance of over one kilometre seawards from the new wharf head to accommodate > 230,000 DWT vessels; and
- small modifications to existing facilities.



WEST ANGELAS PROJECT

Minesite Process Flow Diagram

Figure 4

Dredging volumes are estimated to be about 590,000 m^3.

The structures to be constructed on the land portion of the Cape Lambert facility are:

- rotary ore car dumper;
- product stockpile pad with five fines plus four lump stockpiles;
- tertiary screening facility; and
- new rail and plant control and maintenance facilities.

The estimated power demand for the new facilities at Cape Lambert will be about seven megawatts and will be supplied from the existing Cape Lambert power station.

The additional product stockpile pad will comprise a northern extension into the sea parallel to the existing facility. This will require the construction of a new sea wall and reclamation of approximately 44 hectares of land (Figure 6).

The new sea wall will be built to the same 1:50 year wave and surge conditions as the existing sea wall.

Modelling has shown that its stability is not sensitive to changes in water levels.

Rock armour will be taken from Robe's existing quarry. Due to the quantity of large armour required, it may become necessary to expand the area of the existing quarry lease.

Some fill required for the stockpile pad will be obtained from sand dunes and a hill within the Cape Lambert lease area.

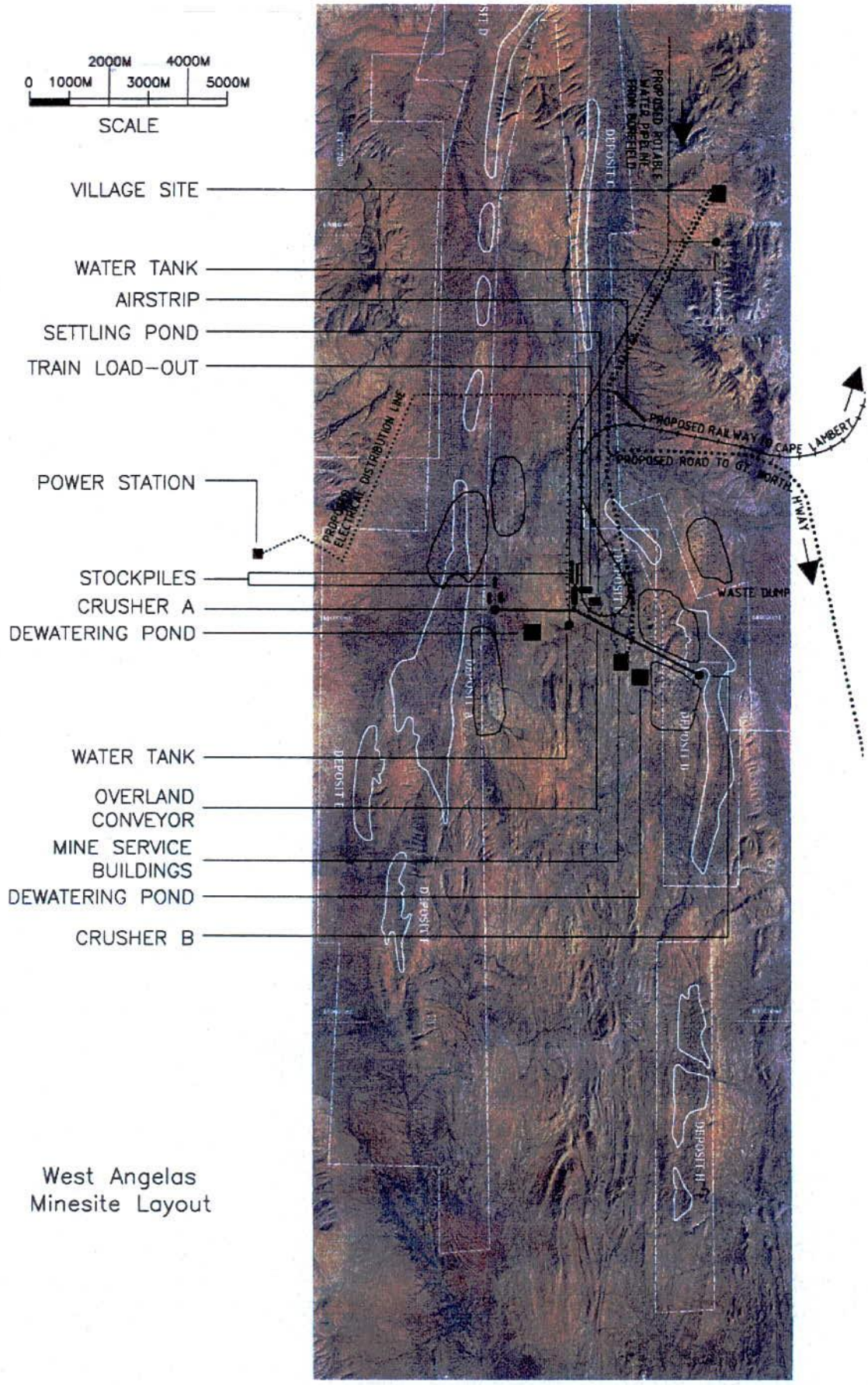
3.4 CONSTRUCTION WORKFORCE

During construction up to 1200 people including up to 450 people in railway construction camps may need to be accommodated. During operation of the West Angelas mine, approximately 180 people will be working on site employed on a fly in/fly out basis. Accommodation for employees will be provided in a village to be constructed at the base of the West Angelas hills. A separate temporary camp will be utilised for construction contractors.

For the railway it is proposed that construction camps would be established at about 100 kilometre intervals. Suitable campsites for between 100 and 450 people have been selected at:

- near Camp Anderson on the Hamersley Iron rail line;
- near the Hill D quarry site; and
- near the BHP Packsaddle camp.

A permanent rail maintenance camp is not being considered.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SCALE
VILLAGE SITE
WATER TANK
AIRSTRIP
SETTLING POND
TRAIN LOAD-OUT
POWER STATION
STOCKPILES
CRUSHER A
DEWATERING POND
WATER TANK
OVERLAND CONVEYOR
MINE SERVICE BUILDINGS
DEWATERING POND
CRUSHER B
West Angelas
Minesite Layout
PROPOSED POTABLE WATER PIPELINE FROM BOREFIELD
PROPOSED RAILWAY TO CAPE LAMBERT
PROPOSED ROAD TO GT NORTH HWAY
PROPOSED ELECTRICAL DISTRIBUTION LINE
WASTE DUMP
DEPOSIT C
DEPOSIT D
DEPOSIT E
DEPOSIT H

Figure 5

4 COMMUNITY CONSULTATION

During the formative stages of the proposal Robe undertook consultation directly with nine government agencies, including local shires, the Conservation Council of Western Australia, affected landholders and other mining companies with an interest in the proposal.

Robe also placed advertisements in the print media inviting people to view displays located in either the Shire office or library at Newman, Tom Price, Karratha and Roebourne, and invited comment on the proposal. The displays were available for viewing over a four week period at each location commencing the last week of September 1997. At the displays, Brochures describing the project were freely available for people to take. All sites reported interest in the project and collection of brochures by people viewing the display. This oportunity was provided in addition to those already provided by the EPA processes.

A Summary Document was also sent to any members of the public inquiring about the project. During the public consultation period a total of three people made direct contact with Robe representatives. All were interested in potential employment prospects.

A programme of community consultation will continue during the public review period, with follow-on programs conducted during the construction and operations of the plant.

Aboriginal spokespersons for the Bunjima Niapaili Innawonga, Ngaluma, Injibandi, Gorawarrah Mininindrah and Guruma people have been extensively consulted regarding issues concerning Aboriginal heritage and Native Title.

Robe will be involved in discussions with all relevant native title claimants and the State Government in accordance with the *Native Title Act, 1993* (Cwlth).

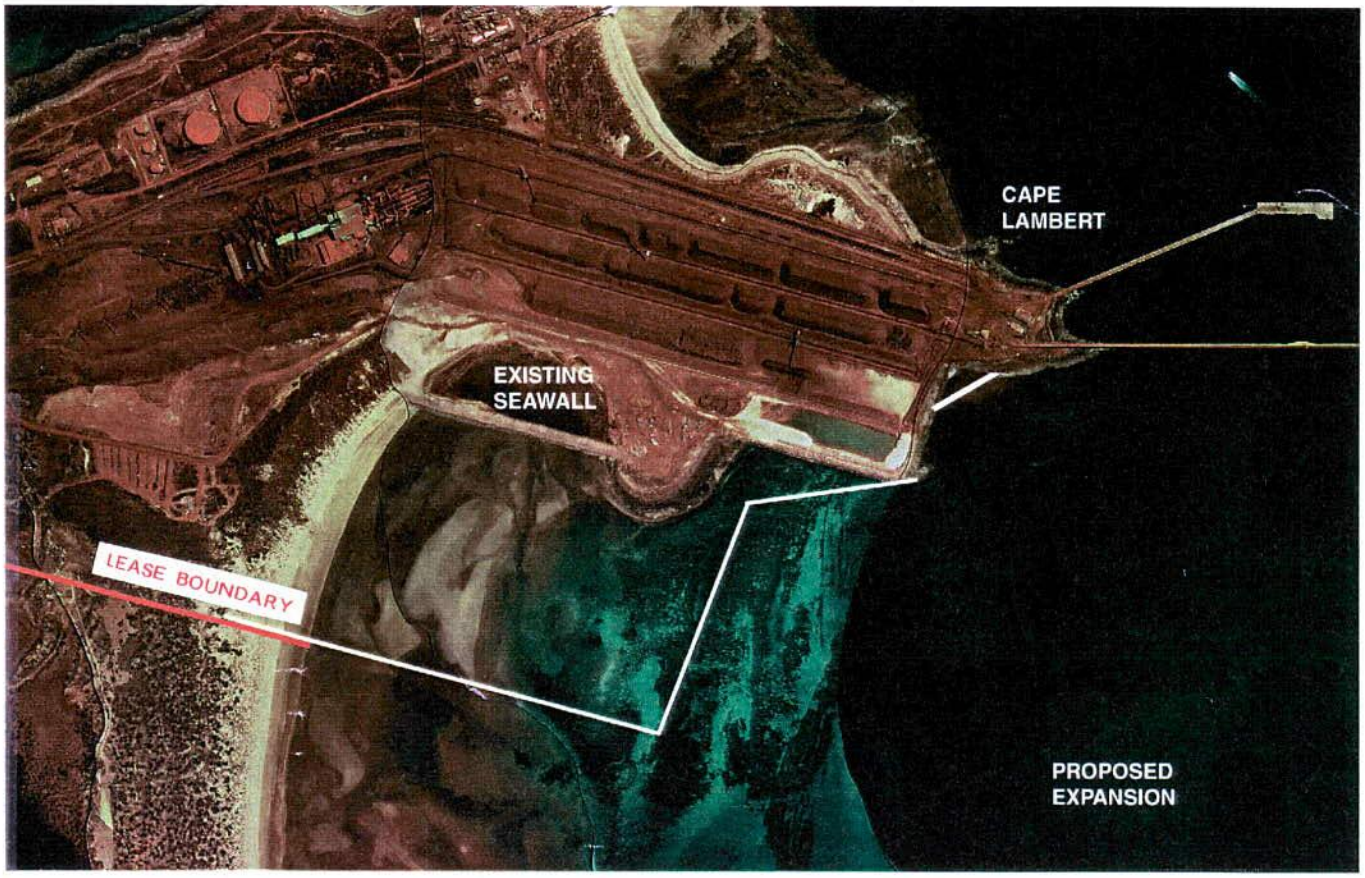

Figure 6: Stockpile Reclamation Area

5 EXISTING ENVIRONMENT

CLIMATE

The West Angelas project is located in the eastern Pilbara, which has an arid-tropical climate characterised by low and episodic rainfall.

Typically, rainfall for the region is a late summer/early autumn event although some rainfall occurs during winter/spring. Tropical cyclones, usually between January and April, contribute the majority of the rainfall. The average annual rainfall is 430 mm.

A major feature of the rainfall is the unreliability and variation in annual recordings. The capricious nature of the rainfall is of biological significance.

Around West Angelas, the temperature range is large and maxima are high. Summer temperatures may reach as high as 49°C, with a mean maximum of 30°C, while winter temperatures generally have a mean maximum of 23°C.

GEOLOGY AND SOILS

The geology of the West Angelas area consists of an anticline of Marra Mamba Iron Formation, plunging to the west. The anticline is the western extremity of the Wonmunna Anticline. Structurally, this anticline is paralleled both to the north and south by synclines of Brockman Iron Formation overlying lesser outcrops of the Mt McRae Shale, Mt Sylvia Formation and Wittenoom Formation.

Mineralisation consists of a series of discontinuous deposits located on both the north and south limb of the regional anticline. Along the northern limb are Deposits B, C, G and H, and the southern limb hosts Deposits A, D, E and F.

The Marra Mamba Iron Formation outcrops as low to moderate relief hills and ridges within the West Angelas area.

Soils of the Pilbara region have been defined and mapped at the 1: 2,000,000 scale. The dominant soil types covering the project area are shallow coherent and porous loamy soils with weak pedologic development.

GROUND AND SURFACE WATER

There are two groundwater systems in the region around West Angelas, both of which drain east to west. The northern-most system drains from the West Angelas/Karijini area, with an aquifer occurring within an alluvial sequence between 65 - 120 metres below the surface. The southern system drains catchments to the south of a high-standing east-west oriented Brockman anticline. The aquifer occurs within an alluvial and scree sequence occurring between 50 - 130 metres below the surface.

There is no permanent surface water at West Angelas. Watercourses with minor first and second order catchments cross the West Angelas deposits. Watercourses in the region drain into the Fortescue River.

The proposed railway passes through the Harding Dam catchment, and crosses a range of watercourses including minor first order streams and the Fortescue River. The railway also crosses watercourses that feed into the Millstream aquifer that is used for public water supply.

VEGETATION AND FLORA

Other than vegetation mapping conducted at a 1: 1,000,000 scale in 1975 and 1980, and survey work undertaken for the Marandoo Iron Ore Project, there is little published information on vegetation and flora of the West Angelas project area (including the railway alignment). Therefore Robe commissioned a major botanical survey of the West Angelas region and rail alignments which has added significantly to our knowledge of the Pilbara vegetation and flora.

The vegetation survey methodology was similar to that used at Marandoo. The methodology recognises both over and understorey strata, focuses on perennial species and maps vegetation based on floristic associations.

However, even with the new survey information, assessment of the conservation value of vegetation and flora still has significant limitations. For example, assessment of

conservation value based on flora diversity depends on comparison with other areas surveyed and the proportion of the flora in the region recorded during the surveys. The proportion of the flora recorded depends on factors such as the season and time since last fire.

It is estimated that at West Angelas 85-95 per cent of the flora in the area would have been recorded, and 75-85 per cent of the flora would have been recorded along the railway alignment.

Assessment of whether or not a species is rare depends on factors such as survey effort and the state of the taxonomy of the species. Therefore the ERMP lists "species of conservation interest" which describes the survey results for species which may be rare. For the purposes of the ERMP species of conservation interest are assumed to be rare.

The flora survey results are expected to change the conservation status of many species by removing some which are more common than thought and adding others.

The survey results and conservation assessments for the West Angelas Survey Area (which extended beyond the project area) and for each railway section (see Figure 3) are summarised below. Each area was assessed for its regional conservation value, vegetation types with conservation interest value, the general flora conservation value of the area, species of conservation interest and the most important sites with flora of conservation interest.

It should be noted that for the railway sections the results are derived from a two kilometre wide corridor of which only a small part will be affected by the railway, and that results from the sections are not comparable because they cover different lengths of railway alignment.

West Angelas Survey Area

The West Angelas Survey Area has a high diversity of vegetation particularly in the mulga areas, has vegetation unaffected by grazing and is large and so the conservation value for vegetation is very high. Sixty two vegetation associations were described of which 14 had some conservation value. Three of the 14 associations with some conservation value were of significant conservation value.

Many of the associations of conservation value will not be affected by the project.

The general flora conservation value of the area is demonstrated by the recording of 625 species, which is considered to be a high level of diversity for the area surveyed.

Sixty four species of conservation interest were identified, including one species of Declared Rare Flora *Lepidium catapycnon* and 14 priority species. Two survey sites and the Cracking Clay vegetation association were identified as important sites with flora of conservation interest.

Coondawanna West rail section

In the Coondawanna West rail section the mulga and claypan vegetation which occurs for much of the route is considered to have very high conservation value because it has a high diversity and is in good condition. Forty four associations were described of which 13 were dominated by *Acacia aneura*. Twenty four of the 44 associations were only recorded on the Coondawanna West rail section, and a further five were recorded at three or less sites, demonstrating some conservation value.

The general flora conservation value of the area is considered to be moderate, with the mulga areas having a moderate to high value.

Sixteen species of conservation interest were identified, including three priority species. Three survey sites were identified as important sites with flora of conservation interest.

Marandoo rail section

Thirty seven vegetation associations were described of which two were identified as having some conservation value. Most of the vegetation associations recorded in this section extended into Karijini National Park.

Forty three species of conservation interest were identified, including six priority species.

Four survey sites were identified as important sites with flora of conservation interest.

Four Corners Bore rail section

The vegetation along this section is common, except for the short grassland of *Themeda* spp. Twenty one vegetation associations were described of which one is considered to be "significant but not of high conservation value" and a further six are of conservation interest.

The general flora conservation value of the area is considered to be moderate, with the grassland of *Themeda* spp. having a moderate to high value.

Ten species of conservation interest were identified, including two priority species. One survey site and the Hamersley homestead plain vegetation association were identified as important sites for flora of conservation interest.

Mt Leal rail section

The Mt Leal rail section and the areas adjoining it have remarkably little disturbance and therefore have significant conservation value. Forty vegetation associations were described of which 15 were only recorded in the Mt Leal rail section therefore having some conservation value. Two of the 15 associations were of major conservation value.

The general flora conservation value of the area is considered to be moderate, with the Cracking Clay and damp areas having a higher value.

Nineteen species of conservation interest were identified, including six priority species. Five survey sites were identified as important sites with flora of conservation interest.

Hamersley Parallel (Western) rail section

The conservation value of the vegetation in this section stems from its current inclusion in the Millstream Chichester National Park. Twenty three vegetation associations were described of which three were not recorded elsewhere giving them some conservation value.

The general flora conservation value of the area is considered to be moderate.

Nineteen species of conservation interest were identified, including four priority species. Two survey sites were identified as important sites with flora of conservation interest.

FAUNA

Fauna in the area has been well described as a result of various developments proposed for the region. These studies have generally covered wide areas and therefore a wide range of habitats, and several have covered relatively long periods of time. Previous surveys have recorded between 150-250 fauna species.

Surveys of the mine site and rail corridor were undertaken by *ecologia* utilising CALM survey grid design and a similar methodology to previous studies, particularly for habitat classification.

Sixteen fauna habitat types were identified, and six of these occurred at the West Angelas mine site.

Habitat types identified:

Cracking Clay habitat - is considered to be regionally significant. Cracking Clay habitat has its own floristic composition and supports specialist vertebrate fauna. The Cracking Clay habitat covering Hamersley Station is regionally significant because it is not fragmented, not well represented elsewhere and supports important fauna. Cracking Clay habitats occurred at the West Angelas mine site and along the preferred railway alignment sections identified as 4 Corners Bore route and the Hamersley Parallel (Western) route.

Mulga Woodlands - the status of Mulga Woodlands is under consideration by CALM. In the interim it should generally be considered as locally or regionally significant. Mulga Woodlands occurred at the West Angelas mine site and along the railway alignment sections identified as Mt Robinson Route, Marandoo Corridor, and 4 Corners Bore route.

Other areas identified as being important for fauna include:

- Harding River and associated riverine vegetation;
- Caves for Ghost Bats at West Angelas;
- Pebble-mound Mouse habitat should be considered locally significant;
- Mulga woodland near Mt Bruce is significant for Grey Honeyeater breeding; and
- Mulga woodland on the Western Coondawanna Flats.

Species of local or regional significance otherwise not listed elsewhere include two mammals, Lakeland Downs Mouse *Leggadina lakedownensis* and Long-tailed Planigale *Planigale ingrami,* one frog Pilbara Toadlet *Pseudophryne douglasi* and two undescribed reptile species, *Varanus* sp. aff. *gilleni* and *Ctenotus* sp. aff. *helenae.* These species were recorded in the Four Corners Bore route (*L. lakedownensis*, *P. ingrami* and *Varanus* sp. aff. *gilleni*), Mt. Robinson (*Ctenotus* sp. aff. *helenae* & *P. douglasi*) and Mt. Herbert (*Varanus* sp. aff. *gilleni*) sections of the rail corridor.

MARINE

Five marine habitats (Silty Sand, Shallow Rocky Reef, Sandy Mud, Coral Reef and Rock Wall) and three coastal habitats (Sedimentary Shore, Rocky Shore and Oceanic) were identified in the marine biological survey of Cape Lambert.

Key points noted in the marine biological survey were that the:

- Coral Reef habitat on the western side of Cape Lambert had 80 per cent coral cover and is considered to be locally significant/ important;
- Silty Sand, Sedimentary Shore and Rocky Shore habitats may be utilised by migratory birds, and that migratory shorebird habitat occurred on both sides of Cape Lambert;
- Priority 4 fauna, the Green Turtle *Chelonia mydas* and Hawksbill Turtle *Eretmochyles imbricata* were recorded over Silty Sand or Rocky Reef habitat;
- watering pot shell (Clavagellidae) which are uncommon were observed in the Silty Sand Habitat; and,
- healthy mangroves occurred on the western side of Cape Lambert, and 10-12 small mangrove trees were recorded on the eastern side.

Surveys undertaken prior to dredging for the existing facilities found that the habitats that occurred at the spoil disposal sites appeared to be widespread throughout the Cape Lambert coastal region. The sediments of the spoil grounds were relatively lacking in epifauna (animals growing upon the surface), and the benthic fauna was limited to species tolerant of broad scale sediment movement and relatively high turbidity. Re-colonisation of the spoil grounds has occurred.

LAND USE

Land uses within the project area include pastoral, National Park, surface and ground water catchment, mining and ore transport, tourism and Aboriginal uses. Land tenure is either pastoral lease, mining lease, water reserve, National Park, CALM 5(g) reserve or vacant crown land.

Five pastoral leases are in the project area. The Karijini National Park and Millstream Chichester National Park are 'A' Class Reserves. The Marandoo iron ore mine, managed by Hamersley Iron, is located centrally in Karijini National Park. A one kilometre wide infrastructure corridor linking Marandoo to the eastern and western boundaries of Karijini National Park was excised by Parliament in 1991 and is now a 5(g) CALM Act reserve. Robe's existing railway line passes through the Water Reserve for Harding Dam and the catchment of surface waters that feed the Millstream aquifer, which is part of the public water supply system. Except for the Harding Dam and Mt Sheila, tourist locations in the region are generally located within the national parks. Cape Lambert is operated under a Special Lease for Mining Operations.

HERITAGE

Aboriginal heritage surveys, both archaeological and ethnographic, have been conducted for the West Angelas project area, and a number of Aboriginal Heritage sites have been recorded. Community consultation with native title claimants has also been undertaken.

No significant Aboriginal sites will be impacted by the project.

6 PROJECT IMPACTS AND MANAGEMENT

The impacts and management proposed for the environmental factors identified by the EPA for the West Angelas project are outlined below.

BIOPHYSICAL

6.1 VEGETATION COMMUNITIES

Potential adverse impacts on vegetation communities includes clearing and other indirect impacts such as weeds, changes to fire frequency and alteration of sheet flow drainage in mulga areas.

Impacts from drawdown at the borefield are not expected because the groundwater is 50-70 below below the surface.

About 600 hectares will be cleared for infrastructure purposes in addition to the vegetation above the ore deposits and the area required for overburden/waste rock storage. Deposits A and B will require clearing of about 2100 hectares Where practical the location of facilities and any associated clearing will be planned with due regard to the results of the vegetation and flora surveys to avoid areas of higher conservation value.

Robe's existing procedures ensure that clearing occurs as planned, that topsoil is stockpiled and used in rehabilitation works, that rehabilitation works occur as soon as possible after cleared areas are no longer needed, that rehabilitation is monitored and remedial work is carried out if necessary. Earthworks sites such as borrow pits are to be re-contoured to resemble ground slopes before rehabilitation. Existing procedures will be transferred to the West Angelas Project. The success of Robe's existing rehabilitation strategies is illustrated by the awarding of a 1997 Certificate of Merit for environmental excellence. Robe currently reports results of rehabilitation works and trials to the Western Australian Government under the *Iron Ore (Robe River) Agreement Act 1964* (as amended).

Weeds in the project area include Buffel Grass and Ruby Dock. A Weed Management Program will be prepared for the West Angelas Project that mirrors the existing program at Pannawonica, but has regard for the information from the flora surveys and the West Angelas Project details, including the railway.

Fire management will primarily focus on personnel training and restricting access to new roads and tracks. Robe's procedures for the Pannawonica - Cape Lambert railway, which will be transferred to West Angelas, are demonstrably successful. In 28 years of railway operation only one fire which resulted from railway grinding operations was not rapidly extinguished.

Minimising alteration of drainage patterns in mulga areas will be achieved by the use of sills at each culvert to re-spread sheet flow.

6.2 DECLARED RARE AND PRIORITY FLORA

The management measures described for vegetation communities (above) will help to avoid impacts on species of conservation interest. Consistent with the existing management procedures, areas will be re-surveyed if information from the 1997 surveys does not provide sufficient information for detailed planning of clearing operations to avoid species of conservation interest.

Propagation of species of conservation interest and the incorporation of these species into revegetation programs will also be considered.

Robe will comply with the requirements of the *Wildlife Conservation Act 1950.*

6.3 TERRESTIAL FAUNA AND SPECIALLY PROTECTED (THREATENED) FAUNA

Impacts on terrestrial fauna arise from direct loss of habitat and fragmentation of habitat. The fauna survey determined which habitats were significant as general and specific (threatened fauna) fauna habitat. The project will be designed to avoid or minimise impacts on these habitats and incorporate: assessment of the vegetation's value as fauna habitat; measures to ensure clearing is minimised and restricted to identified areas; and, rehabilitation practices consistent with the existing habitat type when facilities are decommissioned.

Other management measures that will be implemented to minimise impacts on fauna include:

- borrow pits will have slopes to permit the safe passage of animals;
- capping drill holes and bunding or fencing pits and tailings dams to prevent impacts accidental fauna deaths;
- caves which provide habitat for the Ghost Bat will be protected from direct and indirect impacts where possible; and
- Cracking Clay and Mulga habitats will be avoided where possible.

Implementation of the above management measures will ensure little or no change to the current status of terrestrial fauna and specially protected fauna.

6.4 MARINE FLORA AND FAUNA

Biophysical environmental impacts on marine flora and fauna may arise from the wharf extension, dredging of the berthing areas, disposal of dredge spoil material and from the creation of the stockpile area.

Impacts from the wharf extension are expected to be minor as the structure is constructed on piles embedded in the Sandy Mud habitat.

Potential impacts from dredging include loss of habitat from dredging and spoil disposal and indirect impacts from unacceptable water quality resulting from dredging operations. Poor water quality can result from a range of conditions such as when areas which could possibly be contaminated by paint flakes containing tributyl tin from ships are disturbed by dredging, or anoxic (oxygen depleted) sediments are disturbed. The habitat to be lost through dredging is common, and former spoil disposal grounds will be used for spoil disposal. Investigations of former disposal grounds show re-colonisation by benthic flora and fauna. A dredging management plan will be prepared to address water quality issues.

Construction of the stockpile area will result in the loss of a small area of shorebird habitat, 10-12 small mangrove trees and could create unacceptable levels of turbidity. As shorebird habitat occurs on both sides of Cape Lambert in a local context the area lost is minimal. Similarly, a healthy stand of mangroves occurs on the western side of Cape Lambert. Construction of the seawall prior to filling of the stockpile area will be undertaken to minimise generation of turbidity.

6.5 WATERCOURSES

At the mine site, watercourses cross some of the deposits to be mined. Drainage diversion management plans will be prepared prior to commencement of mining operations for each deposit to address issues of concern to the EPA such as impacts associated with changes to flow rates and drainage patterns for watercourses.

Localised areas of accelerated and increased surface water flow rates may result from the creation of impervious areas such as roads and buildings. Run-off will be intercepted and diverted to natural drainage lines downstream of the project area. These localised changes are not expected to be significant.

The railway alignment crosses numerous watercourses ranging from first order streams to major rivers. Temporary upstream ponding and downstream scouring can occur if culverts are not correctly designed. Where the railway alignment parallels existing railways, Robe will duplicate the existing standard (in terms of size and capacity) and type of drainage structure; otherwise, a 1:20 or 1:30 Average Recurrence Interval for storm events design criteria will be used. Consideration will be taken of existing streambed material and riparian vegetation to ensure minimal scouring or change of stream direction.

6.6 GROUNDWATER

Vegetation at the proposed Turee Creek (B) borefield is unlikely to be affected because the groundwater is at least 40 to 50 metres below the surface. The most significant effect of the borefield development is likely to be on regional

groundwater levels. The drawdown is likely to be very small or negligible beyond a distance of three to five kilometres from the bores. After 30 years of groundwater abstraction small drawdowns may extend into Karijini National Park. Groundwater from this aquifer may seep into gorges in the Park therefore, an environmental management plan to monitor regional groundwater drawdown will be prepared for the borefield.

A total of between 12 and 15 per cent of the Deposit A ore body is below the water table. Due to the relatively impermeable nature of the geological strata, the volume of water extracted from the aquifer during mining is likely to be low and would not have significant impacts.

However, if the mining pit is left open there is potential for continued evaporation and lowering of the water table. The mine pit will be backfilled above the water table to prevent groundwater loss. Neither the short-term or long term impacts will be significant.

6.7 LANDFORM

Mining will alter landform as a result of pit construction and construction of overburden dumps. Stable post-mining landforms will remain. The Department of Minerals and Energy guidelines on overburden dumps include landform as a consideration, and will be complied with.

The location of the railway, close to Hamersley's alignment, within both national parks minimises landform impacts. Stable landforms will be necessary for the railway.

POLLUTION MANAGEMENT

6.8 PARTICULATES / DUST

Dust will be generated at the West Angelas mine site and at Cape Lambert. The nearest residential area to the mine is the mine village approximately eight kilometres away, and the nearest residential area to Cape Lambert is Point Samson, approximately two and a half kilometres away. Existing dust control measures utilised at the Pannawonica mine site and at Cape Lambert will be replicated at the West Angelas project. Robe is currently reviewing impacts and monitoring requirements for dust entering the environment at Cape Lambert.

Experience has shown that dust generation from rail haulage is not a significant environmental issue.

Asbestos in the form of crocidolite is known to occur within zones of the Marra Mamba Iron Formation. Mining may therefore encroach upon these zones, the risk being especially great when developing the footwall to final pit limits. Existing management practices applied at Pannawonica and the Department of Minerals and Energy's Asbestos Management in Mining Guidelines will be complied with to minimise occupational health exposure and ensure asbestos-rich minerals are not left exposed at the completion of mining.

6.9 GREENHOUSE GASES

A range of activities including electricity production from natural gas, use of diesel-fuelled locomotives and the use of trucks, excavators and other machinery generates greenhouse gases. Robe, as a subsidiary of North Limited, have prescribed to a draft Action Plan for the Greenhouse Challenge Program, which aims to reduce greenhouse gas emissions.

Current management practices as detailed in the Greenhouse Challenge program will result in a 10 per cent overall reduction in greenhouse gas emissions by 2001 for North Limited. Robe is currently considering a number of additional measures beyond those quantified in the Greenhouse Challenge Program to reduce greenhouse gas emissions per tonne of ore produced.

The total CO_2 gas emissions for the project, based on 12 million tonnes per annum of ore mined and data from existing operations, would be expected to be between 118 and 156 kilotonnes CO_2 produced per annum.

In accordance with EPA policy requirements, Robe will prepare an environmental management plan prior to completion of the construction phase which addresses the accurate amount of greenhouse gasses emitted from the project during its life cycle and which details final measures to be adopted to reduce greenhouse gas emissions.

6.10 GASEOUS EMISSIONS

As natural gas will be used for power generation negligible sulphur dioxide emissions will be produced.

The likely ground level concentrations of nitrogen dioxide at the mining camp located eight kilometres from the power station were modelled using the HG SYSTEM series of models. The expected levels in a worst case scenario, with the wind blowing a plume directly towards the camp, would be approximately 160 $\mu g/m^3$, which is well below Australian and international health standards.

6.11 GROUND AND SURFACE WATER QUALITY

Changes to ground and surface water quality at the mine and Cape Lambert may arise from:

- materials used in surface operations such as waste oils;
- mining operations below the water table;
- erosion of constructed earthworks; or
- increased levels of turbidity from localised areas of accelerated and increased surface water flow;

Robe River has a wide range of existing management practices in place at the Pannawonica mine site, for the railway operations and at Cape Lambert to ensure that potential ground or surface water contaminants are collected and disposed of appropriately. These management practices will be followed at the West Angelas project; for example, oily waste collection points consisting of a silt trap and a sump are placed at all heavy and light vehicle refueling points.

The existing Pannawonica – Cape Lambert railway passes through the Harding Dam surface water catchment and specific management measures are currently in place for this area. The proposed railway would pass through the Harding Dam catchment and the surface water catchment that feeds the Millstream public water supply aquifer. The potential for an accident that results in pollution of surface waters from railway operations is considered to be negligible. However, Robe has an existing procedure in place should a spillage occur. There has been no fuel spillage from railway operations since the commencement of railway operations in 1972.

An oily waste treatment plant, based on that being successfully used at Pannawonica, is proposed for the remote Deposit B lay-down area and primary crusher.

The tailings dam will contain water that has been used to wash ore. No chemicals are used in this process and minerals in the ore do not become dissolved so groundwater contamination is not an environmental issue.

The village location at the mine site is well separated from the groundwater, so human waste impacts on the groundwater are not expected.

The mined material in this region is oxidised, so acid-mine drainage is unlikely to be an issue.

There are no pools or waterbodies in the watercourses near the West Angelas mine. Prevention of contaminants reaching the environment is the preferred approach, but any minor surface water contamination would be diluted before reaching waterbodies.

Whilst the mine is operational, surface water which runs into the mine pit will be pumped out.

Surface water run-off from the mine pits and haul roads will be discharged into settlement ponds with capacity to hold a 1 in 3 year Average Recurrence Interval rainfall event

before discharge into natural channels, as currently occurs at Pannawonica. Drainage design for other areas such as the tailings dam and mine access roads will emphasise infiltration and retention rather than directing run-off to natural creek systems. Water sensitive designs will be used where possible, such as around buildings. Together these measures will assist in maintaining surface water quality.

Increased levels of turbidity from earthworks are likely to result in negligible environmental impacts because the Pilbara region is characterised by episodically-high river flows with high levels of turbidity.

Construction of the waste dump adjacent to the mining pits will occur in accordance with Department of Minerals and Energy Guidelines to ensure that erosion and turbid run-off is minimised.

In summary, current management practices at Robe's Pannawonica site will be replicated at the West Angelas project.

6.12 MARINE WATER AND SEDIMENT QUALITY

Existing measures are in place for land-based operations to prevent contaminants reaching the environment.

For shipping operations management measures (often supported by international agreements or legislation) are in place for ballast water, bilge water, sewage wastes, fuel/ oil spillages, solid wastes, boat maintenance (including management of anti-fouling agents), and cargo spills. Current management practices will be continued.

SOCIAL SURROUNDINGS

6.13 HERITAGE

The archaeological and ethnographic surveys undertaken in the West Angelas project area have identified a number of Aboriginal sites of significance. Based on the findings of these surveys and further consultation with Aboriginal elders no sites of Aboriginal significance will be impacted upon by the project.

Robe will continue to consult with Aboriginal communities and elders, and will comply with the *Aboriginal Heritage Act (1972 - 1980).*

Examination of non-aboriginal heritage listings such as those held by the Heritage Council, National Trust of WA and local government has found that the West Angelas project will not adversely affect any heritage sites.

6.14 RISK AND HAZARD

A 50.5 kilometre gas pipeline may be constructed as an offshoot of the Goldfields Gas Pipeline to supply gas to West Angelas. The pipeline will be located more than one kilometre from residential areas along its entire length, will comply with Australian Standards and be licenced under the *WA Petroleum Pipelines Act, 1969.*

The pipeline will therefore not present unacceptable risks to public health and safety.

6.15 CONSERVATION RESERVES

The EPA identified Conservation Reserves as a specific environmental factor applying to the railway route from West Angelas to Cape Lambert. The route passes through the Millstream Chichester National Park and within the 5 (g) reserve, which passes through Karijini National Park. Section 2 describes the topics of concern to the EPA and how they are to be addressed in relation to route selection. Other EPA topics of concern have been addressed under the relevant environmental factor above.

7 ENVIRONMENTAL MANAGEMENT SYSTEMS AND REPORTING

Robe has in place an integrated Health, Safety and Environmental Management System which encompasses the same general framework as ISO 14000 and BS 7750 but follows the DuPont practice which focuses more on people's behaviours than paperwork.

Robe's parent company, North Limited, undertakes annual Environment, Safety and Health reporting. In 1997 the annual report included external audits of all operations, assessment by a steering committee which included independent experts and recommendations for action to improve performance. These are being implemented on an ongoing basis.

Robe has also committed to the Australian Minerals Industry Code for Environmental Management, which has a strong emphasis on environmental performance accountability and community consultation, and which requires signatories to report publicly on environmental performance and implementation of the Code.

Clause 7AC of the Iron Ore (Robe River) Agreement Act requires Robe to carry out a continual program of investigation, research and monitoring to ascertain the effectiveness of the measures it is taking pursuant to the protection and management of the environment. Robe must prepare annual and detailed triennial reports to this effect, and each triennial report needs to contain a programme of environmental protection and management proposals for the following three years.

Robe wishes to link its current environmental management reporting with any reporting requirements, which may be required by the Minister for the Environment for this proposal.

SUMMARY TABLES

Summary tables which outline key characteristics of the proposal (Table 1) and respond to the EPA's guidelines in a summary format (Table 2), follow.

Table 1: Summary of key characteristics associated with the mining proposal

Aspect	Proposal characteristic
Ore mining rate	20 Mtpa
Total estimated production (Deposits A & B)	~ 450 Mt
Life of project (Deposits A to H)	25-30 years
Mine pit area Deposit A Deposit B	 460 ha 335 ha
Maximum depth of pit Deposit A Deposit B	 210 m 160 m
Area of Overburden Storage Deposit A Deposit B	 938 ha 380 ha
Dewatering requirements	Minor except after heavy rainfall
Dewatering discharge	Normally to process plant
Water supply source	Turee Creek B
Water supply requirements Construction Operation	 2 ML/day 4 ML/day
Incorporating desliming plant	13 ML/day
Power source Gas pipeline option Overhead powerline option	 55 km 50.5km
Transport infrastructure Airstrip Railway	 2300 m 340 km
Water pipeline	30 km above ground
Location of mine accommodation village	12 km north-west of mine
Workforce Construction Operation	 400-570 180
Train Movements	22 trains per week (170 cars per train)
Ship loading	15-20 Mtpa
Reclamation for port stockpile	40 ha
Wharf extension	250 m

Table 2: Summary of the Issues and Management of the West Angelas Iron Ore Project

Factor and *Site specific factor* (if any)	EPA objective	Work required for the environmental review	Existing status	Existing Management	Baseline studies	Potential impacts	Proposed Management/ Predicted outcome
BIOPHYSICAL							
Vegetation Communities	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.	Baseline studies to identify existing vegetation communities. Assessment of potential impacts (direct and indirect) on vegetation communities as a result of mining activities and railway construction. Propose measures to manage impacts.	Minesite is uncleared. Conservation value of the vegetation very high. Railway route uncleared, but disturbance has occurred where rail route is parallel to Hamersley Iron's railway. Conservation value of vegetation variable - considered to be high within or adjacent to National Park. Vegetation at Cape Lambert is locally or not significant.	Robe's Pannawonica operations require: progressive assessment of vegetation significance; that measures be put in place to restrict clearing to planned areas; storage and re-use of topsoil, and rehabilitation as facilities are decommissioned. Weed management program is also in place. Measures to prevent fires are in place.	One major (Trudgen & Associates) and three minor vegetation and flora survey undertaken for this ERMP. Otherwise mapping a 1:1 000 000 scale or site specific surveys only.	Clearing of approximately 600 ha for mine camps and infrastructure, 2 100 ha for Deposits A & B in the first 5-10 years of operation, then the remaining deposits. Clearing along the railway alignment, and potential disruption of surface sheet flow to mulga.	Current management practices will be transferred to the West Angelas Project. Drainage design along the railway will reflect or improve on existing standard set by Hamersley Iron's railway, and where it is not located near Hamersly's railway ensure sheet flow is maintained to mulga communities.
Declared Rare and Priority Flora	Protect Declared Rare and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act 1950.*	Baseline studies to identify any Declared Rare and/or Priority Flora. Assessment of potential impacts (direct and indirect) on Declared Rare and Priority Flora as a result of mining activities and railway construction. Propose measures to manage impacts.	West Angelas Survey Area has 16 species of conservation interest Along the railway alignment the number of species of conservation interest and flora sites of interest respectively are Coondawana West 44 & 3; Marandoo 43 & 4; Four Corners Bore, 10 & 2; Mt Leal 19 & 5; Hamersley Parallel (Western) 19 & 2.	As described for Vegetation Communities above.	As above. Most existing survey work is project specific, rather than species specific.	As above.	As above. Robe will comply with the *Wildlife Conservation Act 1950* and consider propagation of species of conservation interest in revegetation works.
Terrestrial Fauna	Maintain the abundance, species diversity and geographical distribution of terrestrial fauna.	Baseline studies to identify existing terrestrial fauna throughout the areas to be affected by the proposal. Assessment of potential impacts (direct and indirect) on terrestrial fauna as a result of mining and associated activities. Propose measures to manage impacts.	Area is remote. Impacts from pastoral use only.	As described for Vegetation Communities above.	Fauna Assessment Survey (*ecologia* Environmental Consultants, 1997) and Biological Assessment Survey (Integrated Environmental Services, 1978).	Loss of habitat, trapping of animals in pits and holes, increased feral fauna populations.	As per Vegetation Communities factor above - existing management procedures consider conservation value for fauna. Borrow pits will be contoured & drill holes capped. Waste/ food disposal will occur in accordance with Code of Practice for Rural Landfills. Little or no change to current status of terrestrial fauna.
Specially Protected (Threatened) Fauna	Protect Specially Protected (Threatened) Fauna, consistent with the provisions of the *Wildlife Conservation Act 1950.*	Baseline studies to identify existing threatened fauna throughout the areas to be affected by the proposal. Assessment of potential impacts (direct and indirect) on terrestrial fauna as a result of mining and associated activities. Propose measures to manage impacts.	Species protected by the Wildlife Conservation Act, 1950 which occur in the project area include: Grey Honeyeater, Ghost Bat, Grey Falcon, Peregrine Falcon & Spotted Nightjar. Species protected by international migratory bird agreements include some shorebirds and the Fork-tailed Swift.	N/A	Fauna Assessment Survey (*ecologia* Environmental Consultants, 1997) and Biological Assessment Survey (Integrated Environmental Services, 1978)	Loss of mulga and disturbance. Ghost Bats may be affected.	Minimise loss of mulga habitat (see Vegetation Communities factor above). To protect Ghost Bats maintain 100 m buffer zone, no barbed wire unless statutory requirement and monitor populations. Little change to the current status of specially protected fauna.

Table 2: Summary of the Issues and Management of the West Angelas Iron Ore Project

Factor and *Site specific factor* (if any)	EPA objective	Work required for the environmental review	Existing status	Existing Management	Baseline studies	Potential impacts	Proposed Management/ Predicted outcome
Marine Flora, Marine Fauna and Specially Protected (Threatened) Marine Fauna	Maintain the ecological function, abundance, species diversity and geographic distribution of marine flora, including mangroves. Maintain the abundance, species diversity and geographic distribution of marine fauna. Protect Specially Protected (Threatened) Fauna, consistent with the provisions of the *Wildlife Conservation Act 1950.*	Baseline studies to identify existing marine flora, including mangroves, existing marine fauna, and existing threatened marine fauna around the proposed wharf extensions at Cape Lambert. Assessment of the potential impacts (direct and indirect) on marine flora including mangroves, fauna and on threatened marine fauna as a result of upgrading of the Cape Lambert facilities. Propose measures to manage impacts.	Cape Lambert includes existing spoil grounds which have rehabilitated to match the surrounding habitat. Various marine habitats with locally significant coral and mangroves on the western side and generally common/low conservation value habitat types on the eastern side. Ten to twelve small mangrove trees on the eastern side. Shorebird habitat on both sides of the Cape.	Refer to pollution management environmental factors below	Marine Environmental Impact Assessment (*ecologia*, 1997)	Minor loss of shorebird habitat from extension of stockpile area, short-term impacts from turbidity during dredging and seawall construction.	Construction of the seawall prior to backfilling to minimise turbidity. Preparation and implementation of a Dredging Management Plan. Small area of shorebird habitat loss. No long-term impacts on offshore marine habitat.
Watercourses	Maintain the integrity, functions and environmental values of drainage systems.	Baseline studies to identify watercourses, and types of surface water flow throughout the areas to be affected by the proposal. Baseline studies of wetlands throughout the areas to be affected by the proposal. Assessment of the potential impacts on surface water flow rates, drainage patterns, sediment transport, and wetlands, as a result of mining activities and railway construction. Propose measures to manage impacts.	Watercourses with large catchments cross some of the deposits to be mined. The railway crosses a range of watercourse types from major rivers to minor creeks. There are no watercourses at Cape Lambert.	Hamersley Iron's Railway has set the design/ management standard where Robe's railway runs in parallel.	Refer Figure 5.5 of this ERMP (prepared by Streamtec Consultants, 1997)	Changes in streamflow volumes from watercourse diversions around mine deposits. Along the railway, upstream ponding and downstream scouring if culverts not correctly designed.	Drainage diversion management plans will be prepared prior to commencement of mining operations for each deposit. Where the railway alignment parallels existing railways, Robe will duplicate the existing standard (i.e. size and capacity) and type of drainage structure; otherwise a 1:50 Average Recurrence Interval for storm events design criteria will be used.
Groundwater	Maintain the quantity of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.	Detail of water requirements for the mining, processing, and other associated operations (including dewatering). Assessment of the implications this may have on regional groundwater. Propose measures to manage impacts.	Expected water requirements 17ML per day. The groundwater which flows through the potential water supply source may discharge into gorges in Karijini National Park. At the minesite the aquifer has a low hydraulic conductivity. At the borefield and minesite the watertable is well below the surface.	N/A	Groundwater resource assessment (Woodward Clyde, 1997)	About 15% of orebody is below the watertable, but the discharge of groundwater is expected to be minimal. Groundwater extraction from the borefield may extend into Karijini National Park after about 30 years.	The mine pit will be backfilled to above the watertable. Both the short-term and long term impacts will not be significant. An environmental management plan to monitor regional groundwater drawdown will be prepared for the borefield.

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Factor and *Site specific factor* (if any)	EPA objective	Work required for the environmental review	Existing status	Existing Management	Baseline studies	Potential impacts	Proposed Management/ Predicted outcome
Landform	Establish stable, sustainable landform consistent with surroundings.	Assessment of potential impacts of the proposal, including the mine, railway, and port, on existing landforms. Detail of measures proposed to rehabilitate the impacted areas to an acceptable standard which will integrate the post mining landform with the surrounding environment. Assessment of potential impacts on visual amenity due to the development of the mine site and infrastructure associated with the mine site. Propose measures to manage impacts.	Landform characteristics such as slope vary significantly both at the minesite and along the railway line.	N/A	N/A	Mining pit and overburden dumps will remain after mining. Railway reverts to Government of Western Australia. Minimal impact on landforms at Cape Lambert.	Compliance with Department of Minerals and Energy guidelines on overburden dumps which include landform as a consideration. Stable post-mining landforms will remain. Location of the railway close to Hamersley's alignment within National Park minimises landform impacts. Rehabilitation will occur where appropriate (see Vegetation Communities factor above).
POLLUTION MANAGEMENT							
Particulates / Dust	Ensure that the dust levels generated by the proposal do not adversely impact upon welfare and amenity or cause health problems by meeting statutory requirements and acceptable standards.	Assessment of potential increase in dust resulting from the construction and operation of the mine, infrastructure, and other associated activities. Assessment of potential impacts of increased dust on the amenity of surrounding land users from the construction and operation of the mine and associated activities. Proposed measures to manage impacts. Baseline studies to identify areas likely to contain asbestos and the form of this asbestos. Assessment of the potential risk to the public from mining operations and the decommissioned pits. Propose measures to manage risk.	Drilling logs have recorded asbestos in the Viveash Riebekite zone and mining may encroach on this horizon when developing the footwall to the final pit limits.	Dust and asbestos management procedures are in place at Pannawonica and Cape Lambert operations, and rail operations are managed so dust is not a problem during ore transport.	Drilling logs have been checked for occurrence of asbestos.	Increased levels of asbestos fibre or dust in the air.	Current management practices will be transferred to the West Angelas Project. Robe is reviewing dust impacts and monitoring requirements for dust entering the environment at Cape Lambert. The Department of Minerals and Energy Asbestos Management in Mining Guidelines will be complied with.
Greenhouse gases	Ensure that greenhouse gas emissions meet acceptable standards and requirements of Section 51 of the Environmental Protection Act 1986 (all reasonable and practicable measures are taken to minimise greenhouse gas discharge).	Detail of potential sources of greenhouse gases and estimates of the quantities of these gases produced annually.	Greenhouse gases would be generated from mining and transport-related operations.	Robe, as a member of the North group, is a participant in the Greenhouse Challenge program, which includes monitoring and emission minimisation procedures.	Monitoring through Greenhouse Challenge program.	Greenhouse gas emissions will occur from mining and transport-related operations.	Current management practices as detailed in the Greenhouse Challenge program, will result in a 10% overall reduction in Greenhouse Gas emissions to 2001.

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Factor and *Site specific factor* (if any)	EPA objective	Work required for the environmental review	Existing status	Existing Management	Baseline studies	Potential impacts	Proposed Management/ Predicted outcome
Gaseous emissions *(SO_2)*	Ensure that SO_2 emissions meet the air quality standards and limits stated in the Kwinana EPP and requirements of Section 51 of the Environmental Protection Act 1986 (all reasonable and practicable measures are taken to minimise SO_2 discharge).	Estimate quantities and concentrations of SO_2 emissions which will be generated by the project, in particular, the power station. Comparison of estimates with relevant standards and limits. Proposed measures to minimise SO_2 emissions.	Natural gas is used as a fuel source at Cape Lambert and so SO_2 emissions are negligible.	N/A	N/A	Nil - new power station at mine site will be powered by natural gas.	No increase in SO_2 emissions.
Gaseous emissions *(NO_x)*	Ensure that NOx emissions meet acceptable standards and requirements of Section 51 of the Environmental Protection Act 1986 (all reasonable and practicable measures are taken to minimise NOx discharge).	Estimate quantities and concentrations of NO_x emissions which will be generated by the project, in particular, the power station. Comparison of estimates with relevant standards and limits. Proposed measures to minimise NO_x emissions.	No existing power station near West Angelas. Cape Lambert power station has existing approvals for generation capacity required for this project.	N/A	Modelling undertaken for power station at minesite (Burns & Roe Worely, 1997)	Worst case analysis for minesite power station shows levels of NOx at nearest residential area well below health standards.	No management necessary, as adverse impacts are insignificant.
Groundwater quality	Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993).	Detail of water requirements for the mining, processing, and other associated operations. Detail of drainage, dewatering, and fate of water used/pumped. Detail of the possibility of acid mine drainage occurring, and potential impacts on the surrounding environment. Assessment of the implications this may have on local and regional groundwater quality. Propose measures to manage impacts.	Ore body is oxidised, so acid mine drainage is not an environmental issue. Railway passes through surface water catchment which feeds Millstream aquifer.	Pannawonica minesite and existing rail operations have measures in place to ensure potential contaminants are collected and disposed of appropriately.	Woodward Clyde (1997)	Increased usage of potential contaminants, and increased potential for contamination when mine operations below the water table. Potential for salinisation of groundwater through ongoing evaporation if mine pit not backfilled.	Current management practices will be transferred to West Angelas project. Mine pit will be backfilled to 2 m above the highest known water table. No significant change to groundwater quality is expected.
Surface water quality	Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993).	Detail of water requirements for the mining, processing, and other associated operations. Detail of drainage, dewatering, and fate of water used/pumped. Detail of the possibility of acid mine drainage occurring, and potential impacts on the surrounding environment. Assessment of the implications this may have on local and regional surface/ground water quality. Proposed measures to manage impacts.	Existing railway passes through Harding Dam catchment. Episodic/ cyclonic nature of rainfall in the Pilbara leads to high sediment loads in surface waters when they flow.	Pannawonica minesite existing rail operations and Cape Lambert operations have measures in place to ensure potential contaminants are collected and disposed of appropriately. Mine waste dumps are constructed to minimise erosion/ sediment laden run-off.	N/A	Increased usage of potential contaminants.	Current management practices will be transferred to West Angelas project. Waste dumps will be constructed in accordance with Department of Minerals and Energy guidelines. No significant change to surface water quality is expected.

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Factor and *Site specific factor* (if any)	EPA objective	Work required for the environmental review	Existing status	Existing Management	Baseline studies	Potential impacts	Proposed Management/ Predicted outcome
Marine water and sediment quality	Maintain or improve the quality of marine water consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993). Maintain or improve marine water and sediment quality consistent with Environmental Quality Objectives (EQO's) and Environmental Quality Criteria (EQC's) defined in the Southern Metropolitan Coastal Waters Study (1996).	Assessment of the potential impacts on marine water quality as a result of activities associated with the upgrade and operation of the Cape Lambert facility. Proposed measures to manage impacts.	Sediment quality is currently being investigated.	Shipping operations management measures (often supported by international agreements or legislation) are in place for ballast water, bilge water, sewage wastes, fuel/oil spillages, solid wastes, boat maintenance (including use of anti-fouling agents), and cargo spills. At Cape Lambert management measures are in place to ensure potential contaminants are collected and disposed of appropriatly.	Being done	Increased shipping operations, if not well managed, could increase the potential for contaminants to reach the environment.	Current management practices will be continued.
SOCIAL SURROUNDINGS							
Heritage *Aboriginal culture and heritage* *Non-indigenous heritage*	Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act 1972*, and Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area. Comply with statutory requirements in relation to areas of cultural or historical significance.	Identify Aboriginal cultural and heritage sites of significance through archaeological and ethnographic surveys of the project area and through consultation with local Aboriginal groups and the Aboriginal Affairs Department. Baseline studies to identify any non-indigenous heritage sites. Identify potential impacts on any identified sites. Proposed measures to manage impacts.	There are no areas of Aboriginal or heritage significance in the path of the railway or minesite.	N/A	Summaries of previous work, re-consultation with informants and government databases (O'Connor, 1997: Quartermaine, 1997). Contact with local government authorities.	None	Robe will continue to consult with Aboriginal communities and elders, and will comply with the *Aboriginal Heritage Act. 1972*
Public health and safety *Risk and hazard*	Ensure that risk is managed to meet the EPA's criteria for individual fatality risk off-site and the DME's requirements in respect of public safety.	Identification of the hazards and an assessment of the risks associated with the project, in particular, those associated with the operation of the natural gas pipeline. Proposed methods to reduce both hazards and risk.	N/A	N/A	N/A	Gas pipeline to mine power station creates a hazard.	Pipeline to be located away from residential areas and comply with Australian Standards and *WA Petroleum Pipelines Act, 1969.*

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OTHER							
Conservation Reserves (Millstream-Chichester National Park and Karijini National Park) *Ecological function, public use and amenity*	Ensure that the functions of Conservation Reserves are not compromised.	Baseline studies of each rail route option covering the following topics: • vegetation/flora; • fauna and habitats; • landscape; • visual amenity; • noise; • watercourses/ drainage patterns; and • public use. Assessment of the potential impacts of each route on the functions of the National Park having regard to the topics identified above. Comparison/ranking of the impacts for each alternative option. Proposed measures to manage impacts.	Hamersley Iron's railway passes through Millstream Chichester National Park and through Karijini National Park in a corridor excised from the park. Part of Robe's railway to Pannawonica passes through Millstream Chichester National Park.	Existing management has been described in appropriate sections above.	See above. Summarised in Section 2.3 of this report.	Impacts depend on rail route chosen and design, construction and operation of the railroad.	Rail route chosen is close to Hamersley Iron's Railway in Millstream Chichester National Park and goes through the corridor through Karijini National Park. Refer to each environmental factor listed under "work required for public review" for management proposed. The rail route chosen minimises adverse environmental impacts.