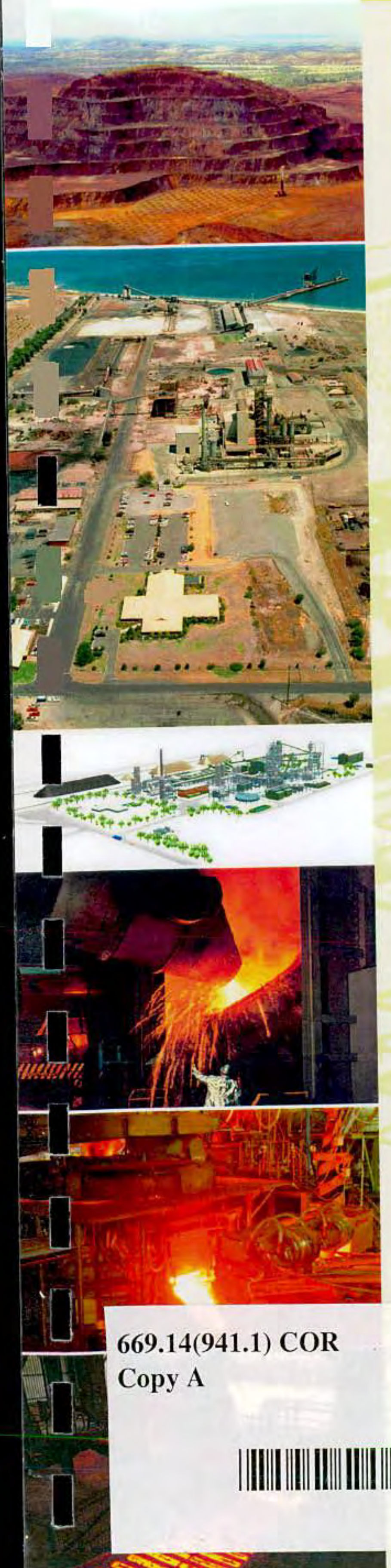
HIsmelt
Operations) Pty Limited

PUBLIC ENVIRONMENTAL REVIEW

April 2002

Commercial HIsmelt® Plant Kwinana Western Australia



corporate environmental

HIsmelt (Operations) Pty Limited

Commercial HIsmelt® Plant
Kwinana Western Australia

Public Environmental Review

April 2002

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Invitation to Make a Submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. If you are able to, electronic submissions emailed to the DEP/EPA Project Assessment Officer would be most welcome.

HIsmelt (Operations) Pty Ltd proposes to construct and operate a Commercial HIsmelt Plant at Kwinana, Western Australia in accordance with the *Environmental Protection Act, 1986*, a PER has been prepared which describes this proposal and its likely effects on the environment. The PER is available for a public review period of 4 weeks from **22 April 2002** closing on **20 May 2002.**

Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government.

Why write a submission?
A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in the EPA's report.

Why not join a group?
If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission
You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements of the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable; and
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering; and
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is:**20 May 2002.**

Submissions should ideally be emailed to
john.guld@environ.wa.gov.au

OR addressed to:
The Environmental Protection Authority
PO Box K822
Westralia Square
PERTH
Or
141 St George's Terrace
WA 6842
PERTH WA 6000]

Attention: John Guld

PUBLIC ENVIRONMENTAL REVIEW

COMMERCIAL HISMELT® PLANT
KWINANA WESTERN AUSTRALIA
HISMELT (OPERATIONS) PTY LIMITED

Executive Summary

Introduction

HIsmelt (Operations) Pty Limited (the Proponent), acting as the manager on behalf of an unincorporated Joint Venture with a number of other companies, proposes to construct and operate a commercial HIsmelt® Process Plant (the Plant) at Kwinana in Western Australia. The Plant, the associated facilities and operations are referred to as the Project. The Plant will be located at the site occupied by the existing HIsmelt Research and Development Facility (HRDF) within the Kwinana Industrial Area (KIA), 40km south of Perth.

The Stage 1 Plant will produce around 820,000 tonnes per annum (tpa) of pig iron. If the Stage 1 Plant is found to be technically and commercially viable, it is proposed to install an additional iron-making Plant (Stage 2) to double production to around 1.6 Mtpa of pig iron subsequently.

The HIsmelt® Process (the Process) is a direct smelting technology for the production of liquid iron (hot metal) using iron ore fines, coal and fluxes. HIsmelt Corporation, a wholly owned subsidiary of Rio Tinto, has been developing the Process since 1981. The Plant will be the first commercial application of the Process and when proved successful is expected to be the forerunner of a new generation of iron making plants around the world that will use this technology.

The Project will utilise the reserves of Western Australia's iron ore fines, which are currently not suitable for blast furnace feed due to their high phosphorus content. Iron ore fines will be shipped to Kwinana from Dampier and railed from Koolyanobbing in Western Australia. Coal will be shipped from the east coast of Australia to Kwinana.

The Project will include a power generation facility that will utilise the offgas generated in the Process to produce electricity. An Air Separation Unit (ASU) will be established to supply oxygen and nitrogen to the Plant. It is currently envisaged that the ASU will be built and operated by Air Liquide WA on the HIsmelt site.

Pig Iron produced in the Plant will be shipped for use in steel mills either within Australia or overseas. The unloading and loading of raw materials and the product will be undertaken at Fremantle Ports' Kwinana Bulk Terminal Berth No. 2 (KBB2).

Construction of the Stage 1 Plant is planned to commence in late 2002 and is expected to take approximately 24 months. Commissioning and ramp up of the Stage 1 Plant to full production will occur over a two year period. Construction of the Stage 2 Plant will be dependent upon the success of the Stage 1 Plant and is expected to commence at the earliest in 2006.

The Project was referred to the Western Australian Environmental Protection Authority (EPA), who determined that the Project would be assessed as a Public Environmental Review (PER) with a four week public review period. The PER provides the relevant details of the Project and the proposed management techniques to enable the environmental acceptability of the Project to be assessed.

The key characteristics of the Project are presented in Table ES1.

Table ES1
Commercial HIsmelt Plant Key Characteristics
(Estimates at time of preparation of the PER)

Element	Stage 1	Stages 1 and 2
Project Purpose	To construct and operate a HIsmelt Process Plant in Kwinana to produce pig iron.	
Project Location	Leath Road, Kwinana Industrial Area, Western Australia.	
Life of Project (yrs)	20	20
Project Components	• Process Plants. • Transport of Materials and Product.. • Water Supply. • External Electrical Supply. • Natural Gas Supply.	
Plant Components	• Raw Material Delivery and Storage. • Raw Material Reclamation and Preparation. • Ore Preheater. • Smelt Reduction Vessel. • Offgas System. • Flue Gas Desulphurisation System. • Pig Iron and Slag Production. • Power Generation Facility. • Air Separation Unit (Oxygen and Nitrogen Plant). • Water Supply Facilities and Circuits. • Effluent Treatment Facility. • Stormwater and Wastewater Collection Facilities. • Electrical Power Supply Facilities. • Natural Gas Supply Facilities. • Administration Facilities. • Plant Access Roads and Car Parking.	
Plant Operating Hours (per day)	24	
Operating Hours (per year)	7660 - 8760	
Pig Iron Production (ktpa)	820	1640
Slag Production (ktpa)	225	450
Gypsum Production (ktpa)	11.1	22.2
Iron Ore Fines (ktpa, by ship)	650	1300
Iron Ore Fines (ktpa, by Rail)	650	1300
Imported Coal (ktpa wet)	560	1120
Lime (ktpa)	70	140
Dolomite (ktpa)	70	140
Lime Kiln Dust (ktpa)	6	12
Natural Gas (TJ/a)	1480	2960
Ore Stockpiles (kt)	56 and 10	56 and 10
Coal Stockpile (kt)	57	57
ASU - Oxygen Production (tpd) - Nitrogen Production (tpd)	880 800	1760 1600
Greenhouse Gas Emissions (tonnes of CO_2/tonne of hot metal)	1.86	1.86
Greenhouse Gas Emissions (Mtpa CO_2 gross)	1.5	3
SOx Emissions - normal operations g/sec (tpa)	9 (250)	18 (500)
NOx Emissions g/sec (tpa)	21.8 (603)	43.6 (1206)
Particulate Emissions g/sec (tpa),	2.3 (64)	4.6 (128)
Water Usage kL/hr (GL/a)	405 (3.2)	810 (6.4)
Water Source (Kwinana Wastewater Recycling Plant is at the proposal stage).	Scheme - Assumed Kwinana Wastewater Recycling Plant - Preferred	
Construction Period (months)	20 – 24	20-24

Table ES1 (contd)

Element	*Stage 1*	*Stages 1and 2*
Power Generation - No of Turbines	*1*	*1*
Power Generation (MW)	*20*	*20*
Emergency Power Supply (Standby from the grid) (MW)	*10*	*10*
Plant Area (ha)	*21.1*	*36*
Solid Waste (tpa)	*6-10*	*12-20*
Process Effluent (Plant expected to be in water balance).	*0*	*0*
No of Truck Movements (per day)	*73*	*146*
No of Ore Train Movements (per week)	*10*	*20*
Ship Movements (per year)	*30 - 50*	*60 - 100*
Workforce Numbers	*65*	*125*
Construction Noise	*Comply with Environmental Protection Noise Regulations, 1997.*	
Operational Noise at Residential Areas.	*At least 5dB(A) below the assigned noise levels at residential areas.*	
Operational Noise – Boundary dB(A)	*65*	*65*
Road Noise Increase in L_{Aeq} dB(A)	*0.0*	*0.0*
Rail Noise Increase in L_{Aeq} dB(A)	*0.1*	*0.2*
Noise – Shipping Operations	*At least 5dB(A) below the assigned noise levels at residential areas.*	
Risk at Plant Boundary	*Less than fifty in one million per year.*	
Risk at Residential Area	*Less than one in one million per year.*	

Benefits of the Project

The Project will provide significant benefits to the nation, state and local community including the following:

- *Proving the viability of the HIsmelt® Process at a commercial scale will provide the global iron and steel industry with an alternative to the conventional blast furnace iron-making route.*
- *The Process has significant environmental advantages over blast furnace technology.*
- *Greenhouse gas emissions per tonne of pig iron produced will be significantly lower than from conventional currently installed iron making technology.*
- *Dioxins will not be generated in the HIsmelt Process.*
- *The product will be a high quality pig iron.*
- *Australia's raw material producers would become more competitive in supplying material to EAF plants.*
- *There would be additional Australian iron ore and coal sales.*
- *Western Australia would be seen to be in the forefront of world class iron making technology.*
- *A significant proportion of the estimated $400 million capital expenditure for each Plant will be directed to industries within Western Australia.*
- *Considerable value would be added to Western Australia's reserves of lower value iron ore fines.*
- *A more sustainable use of the Western Australia's iron ore resource.*
- *The establishment of a new value added industry to Western Australia.*
- *Kwinana would be recognised as the location of a world's first commercial HIsmelt® Process Plant.*
- *Direct employment during construction and operations.*
- *Indirect employment opportunities such as through local maintenance and service contractors.*

Evaluation of Alternatives

The Proponent considered many options during the development of the Project such as the selection of technologies, plant location, raw materials, transport of materials, water supply and waste disposal.

The Process has been developed by HIsmelt Corporation as an improved method of producing liquid pig iron. The only alternative technologies currently available for the production of pig iron at a commercial scale are considered to be blast furnace, mini blast furnace and the Corex® Process.

The HIsmelt® Process does not require coke ovens, sinter plants or pellet plants, which results in a significant improvement in environmental performance compared to the blast furnace iron-making process. The Process has a lower capital investment, it can directly use a range of coals and has the flexibility of operation to match the mini blast furnace, therefore, it will offer an alternative to the mini blast furnace. The Process is considered to be more flexible for customer's requirements than the Corex Process.

A number of potential locations within Western Australia were investigated for the Plant site based on their suitability and an economic perspective, which included the Pilbara, Oakajee, Kwinana, Bunbury and Esperance. Kwinana is considered to be the preferred location.

One of the significant advantages of locating the Plant at the Kwinana site is the ability to utilise much of the existing HRDF plant, and the services of the neighbouring bulk material handling operations for the import and export of materials. The site for the Plant, which is already cleared, has been used for similar industry since 1954. There are industrial services and utilities such as electricity, water and natural gas already available on the site. There are established road, rail and shipping transport facilities available.

Low volatile coals from Queensland, China, Vietnam and South Africa were investigated for use in the Plant. Charred coal from Collie was also considered. The studies found that a blend of Queensland coals would be the most suitable coal feed for the initial operation of the Plant.

The Proponent considered the use of both seawater and freshwater for cooling water. However, the seawater option was not pursued for environmental and economic reasons. At the time of the preparation of the PER the only guaranteed supply of fresh water is scheme water. However, the Water Corporation is proposing to establish a Wastewater Recycling Plant in Kwinana, therefore, it is expected that an additional source of water may be available for use in the Process prior to commissioning of the Stage 1 Plant. If available the recycled water will be the Proponent's preferred source of water for the Project.

Total Dissolved Solid (TDS) concentrations in the water used for cooling and gas cleaning in the Plant will increase due to evaporation and the dissolution of gaseous species, therefore a portion of the water must be removed (blowdown) and replaced with fresh water. The Proponent investigated alternatives for the disposal of the blowdown, with the preferred options being:

- *All cooling tower blowdown will be directed to the gas cleaning (wet scrubber) circuit, which will reduce water consumption and eliminate a potential effluent stream.*
- *Any potentially contaminated blowdown will be directed to a process water tank for treatment, prior to use for the cooling of slag and pig iron.*

An analysis conducted on the optimum use of the waste heat energy found that the most energy efficient, and lowest cost, scenario was a Waste Heat Recovery System to produce steam and electricity. This resulted in the site being self sufficient in energy and represents an almost optimum use of the Process energy.

Project Description

The Stage 1 Plant will be designed to process around 1.3Mtpa of iron ore and 560,000 tpa of coal to produce around 820,000 tpa of pig iron. The Stage 2 Plant will be effectively a duplication of the Stage 1 Plant.

The major components of the Plants will comprise:

- *Raw Material Delivery and Storage.*
- *Raw Material Reclamation and Preparation.*
- *Ore Preheater.*
- *Smelt Reduction Vessel.*
- *Offgas System.*
- *Pig Iron and Slag Production.*
- *Power Generation Facility.*
- *Air Separation Unit (Oxygen and Nitrogen Plant).*
- *Water Circuits and Effluent Treatment Facility.*

It is currently envisaged that the iron ore fines will be initially sourced equally from both Portman' s Koolyanobbing Mine and from Hamersley Iron's Pilbara mines.

Iron ore fines will be shipped from the Pilbara in 45,000t capacity Handymax vessels. Approximately 16 ships per year will be required to transport the ore for each Plant. The existing facilities at the Fremantle Ports' KBB2 will be used for the unloading and transfer of ore to the HIsmelt site. The ore will be unloaded from the ship and transferred to a series of conveyors to stockpiles on the HIsmelt site.

Approximately five trains per week will be required to transport the iron ore fines from Portman's Koolyanobbing Mine for the Stage 1 Plant. The number of trains may double if Stage 2 proceeds and an equivalent amount of ore is sourced from the Koolyanobbing Mine. The ore will be discharged at the Fremantle Ports' rail unloading facility and conveyed to stockpiles. The ore will be reclaimed from the stockpiles using front-end loaders prior to being conveyed to the Plant.

Coal will be sourced from Queensland and delivered to Kwinana in 45,000t capacity ships. Approximately 13 ships per year will be required to transport the coal for the Stage 1 Plant. If the Queensland coal is also used for the Stage 2 Plant there would be an additional 13 ships per year. Coal from the ships will be conveyed to the coal stockpile from where it will be reclaimed using front-end loaders and conveyed to the Plant where it will be screened and crushed.

Fluxes such as lime and dolomite will also be required in the Process. Approximately 40 trucks per week will be required to transport the lime to the site for each Plant. Two ship deliveries of dolomite will be required per year for each Plant.

The Process will be undertaken in a molten iron bath using coal as the reductant and energy source. The core element of the Process is the Smelt Reduction Vessel (SRV), which will contain a molten iron bath into which ferrous feed material, coal and fluxes will be injected. The ore will be smelted in the SRV to produce molten iron and a slag that will contain the gangue. The use of a Hot Air Blast will result in hot gas (offgas) exiting the furnace. A Preheater module will use the thermal and chemical energy of a portion of the offgas to heat and partially reduce the iron ore fines prior to injection into the SRV. This will improve the energy efficiency and productivity of the Plant and reduce the greenhouse gas emission rate per tonne of product.

The processes that will occur within the molten iron bath are as follows:

- *Carbon from the coal will be dissolved into the metal bath.*
- *The iron-bearing materials will be rapidly reduced to form molten iron.*
- *Post combustion of the gaseous reaction products by the HAB will produce the thermal energy to sustain the process.*
- *Gangue and ash will be separated from the ore and coal to form slag.*
- *Manganese and phosphorus will be contained in the slag allowing very clean metal to be produced.*

The pig iron will comprise predominantly metallic iron with a carbon content of around 4% and low levels of other constituents. Pig iron will be cast into five kg "pigs", which will be stockpiled and then shipped to overseas or Australian customers in 40,000 tonne shipments approximately twice per month for each Plant.

Slag will be produced in the Process at an estimated annual production rate of 225,000tpa for each of the Plants. Slag will be processed either on site by a contractor or off site at a slag processing facility, for use as an aggregate or road base material. Approximately 20-30 trucks per day will be required for the transport of the slag from each of the Plants.

High quality gypsum will be produced in the Flue Gas Desulphurisation (FGD) System in the Plant. The gypsum will be stored in a concrete bin prior to being delivered to customers. Approximately two trucks per day per Plant will be required to transport the gypsum from site.

Water for the Process will be scheme water supplied by the Water Corporation. However, should the Water Corporation's proposed Kwinana Wastewater Recycling Plant be approved and operational then the recycled water from that plant would be the preferable source of process water.

The Plant wastewater treatment system will be designed to separate the waste streams into Non-Contact Cooling Water Blowdown, and Scrubbing Circuit Blowdown (Contact Blowdown). The blowdown will be recycled either in the scrubbing circuit or used for cooling of the pig iron and slag.

The Process will generate only a relatively small quantity of solid wastes. The solid waste will comprise a mixture of iron oxide, carbon, dust and slag and will be disposed off-site in a suitable and approved disposal facility.

Existing Environment

The Kwinana area is described as having a Mediterranean climate characterised by hot dry summers and mild wet winters. The mean annual maximum and minimum temperatures for Kwinana are 23°C and 14.4°C, respectively. Rainfall in the Kwinana region is seasonal and the majority is confined to the winter months. Mean monthly rainfall is highest in June at 165.8 mm, with an average of 18 rain days.

Winds in the Kwinana region result from both large-scale (synoptic) winds and local thermally influenced winds. Typically, strong offshore breezes occur during the daytime followed by corresponding onshore breezes as the land cools during the evening.

The degradation of air quality in the Kwinana area was an issue identified by the Government in the early 1990s with the subsequent establishment of an Environmental Protection (Kwinana) (Atmospheric Wastes) Policy (EPP) in 1992. The EPP defines limits and standards for ground level concentrations for Total Suspended Particulates (TSP) and sulphur dioxide (SO_2). The concentrations of TSP and SO_2 are monitored in Kwinana and the surrounding area. Nitrogen oxides (NO_x) concentrations are also measured in the area.

SO_2 concentrations at the six monitoring sites have been found to be well below the EPP criteria since 1995. Data from the two air quality monitoring stations that record NO_x have shown that the maximum 1-hour concentrations of NO_2 over an 11 year period is around 103$\mu g/m^3$.

TSP were monitored at regional monitoring sites at Hope Valley and Wattelup between 1990 and 1991. The data indicated that the annual average TSP concentration was around 40μg/m³ and the maximum 24-hour concentration was 100 μg/m³. The maximum dust concentrations recorded at the HIsmelt site during July 1999 to December 2000, a period when the HRDF was on care and maintenance, was 143μg/m³.

Monitoring of ambient noise levels at the site was undertaken in July 2001 which showed that the average L_{A10} *levels were around 52 to 55dB(A).*

The Kwinana site is located in the Coastal Belt subdivision of the Swan Coastal Plain in the Quindalup Dunes, which is a relic foredune plain of the Holocene period. The geological profile of the site is typical of the coastal deposits found in the area. It consists of Safety Bay Sand (recent) unconformably overlying Tamala Limestone, and the Leederville Formation (Pinjar Member).

The site is relatively flat with an average elevation of around 5m AHD. Soils in the area of the Becher/Rockingham Plain are typically of the Quindalup Association and are mostly immature with little profile development. In addition to the natural soils the site also contains fill materials.

The Safety Bay Sand and the Tamala Limestone Formations contain unconfined aquifers, which are considered to form the Superficial Aquifer. The site is located within the Jandakot Mound division of the Superficial Aquifer. The direction of groundwater flow is generally to the northwest. Fresh groundwater overlies the saline marine water in the Aquifer. As groundwater flowing from the Jandakot Mound approaches the coast at Cockburn Sound it is forced over the dense saline wedge and then discharges into the shallow near shore zone.

Groundwater monitoring data from the bores around the site show that the depth to groundwater over the site is between 3.5m and 4.5m below the surface. Results of the historical groundwater analyses show that the parameters monitored have been at relatively constant levels and have generally been within the criteria.

The HIsmelt site and the surrounding area have been extensively investigated for soil and groundwater contamination. The investigations found that the site has generally low concentrations of industrial contamination, and that the contamination should not constrain continued use of the site for industrial purposes.

The site is within an area that has been extensively cleared and used for industry over several decades. There are no areas of remnant vegetation remaining on the site that will be cleared for the Project.

Due to the clearing of vegetation on the site for previous developments, there are no faunal habitats for native species with the exception of those small areas that have been established as greening areas around the site.

Projects in the Kwinana area have the potential to impact on the marine environment of Cockburn Sound. Cockburn Sound is the most intensively used marine embayment in Western Australia.

Water quality studies have identified contaminants in the industrial discharges entering Cockburn Sound. Widespread contamination of the sediments in Cockburn Sound was found in studies undertaken in the late 1970s.

Zooplankton in Cockburn Sound were found to be typical of temperate coastal regions. Cockburn Sound provides a very important fish nursery and feeding habitat with over 130 species of fish and 14 large crustaceans and mollusc species been recorded. Two acknowledged marine pests; European Fan Worm (Sabella cf. Spallanzanii) *and Asian Date Mussel* (Musculista senhousia) *have been found in the benthic fauna of Cockburn Sound.*

The review of the Department of Indigenous Affairs Register of Aboriginal sites revealed that there are no previously recorded Aboriginal sites located within the Plant site area.

The Plant site is located within the industrial area of the Town of Kwinana. For the purpose of the PER demographic data have also been included for the adjoining Cities of Rockingham and Cockburn. Data from the 1996 Australian Bureau of Statistics (ABS) indicate the population levels were 19,186 for the Town of Kwinana, 58,167 for the City of Rockingham and 57,335 for the City of Cockburn.

Unemployment rate estimates show that unemployment levels in Kwinana have increased from 12.1% in June 1997 to 12.6% in June 2001. The highest percentage grouped occupation in Kwinana and Rockingham is for tradespersons and related workers with 18.7% and 20.3%, respectively.

Consultation

HIsmelt has given a high priority to consultation during the planning and environmental assessment phases of the Project. An extensive consultation programme was implemented during the preparation of the PER and will continue during the public review period, with follow on activities to be conducted during the construction and life of the Project.

Environmental Issues and Management

General Environmental Management
HIsmelt (Operations), as part of the Rio Tinto Group, is committed to responsible environmental management and is currently developing environmental management strategies and procedures that will minimise or ameliorate the potential environmental impacts of the Project.

An Environmental Management Plan (EMP) will be prepared for the Project. The EMP will propose the management activities to be undertaken to ensure that the environmental objectives are met. An EMS will also be developed and implemented to ensure that the Plant achieves the highest level of environmental performance.

Construction
An EMP will be prepared for the construction phase of the Project. The EMP will be applied at the site by the Proponent and the contractors undertaking the construction operations.

Air Quality
The Kwinana region is covered by the EPP. The EPA requires that the air pollutants that are not covered in the Kwinana EPP are to meet the National Environmental Protection Measure (NEPM) standards.

Emissions of SO_2 from the Plants will be minimised by the use of coal with a low sulphur content, and a Flue Gas Desulphurisation (FGD) System, which will remove a minimum of 95% of the SO_2 from the offgas.

The predicted concentrations of SO_2 from the Stage 1 Plant, and from both the Stage 1 and 2 Plants operating will be relatively low. Predicted maximum 1-hour concentrations will be between 2.6% to 4.2% of the Kwinana EPP criteria for the Stage 1 Plant, and 4.9% to 9.0% of the EPP criteria for the Stage 1 and 2 Plants operating. Predicted 24-hour concentrations of SO_2 will be between 2.2% to 3.5% of the EPP standard for Stage 1, and 4.5% to 8.4% of the EPP standard for Stages 1 and 2. Annual average concentrations will be around 1.3% and 2.7% of the annual EPP standard for Stage 1 and Stages 1 and 2, respectively.

Comparison with the modelled concentrations for the HRDF's maximum permissible emission rate of 35g/sec, allocated to HIsmelt in the 1992 determination, indicates that concentrations from the Stage 1 Plant will be around half of those predicted for the HRDF. Concentrations from both the Stage 1 and 2 Plants operating would be approximately the same as for the 1992 determination, therefore, no increase in the maximum permissible rate allocated in 1992 would be required for the operation of the Commercial HIsmelt Plant.

The emission of airborne particulates from the Plant will be managed by; the use of wet scrubbers to clean the process offgas, covering of launders, and capturing of fumes in bag filter cleaning systems.

Maximum concentrations of the particulates emitted are predicted to occur on-site and then rapidly decrease with distance. For TSP the maximum concentrations are predicted to be up to 16.7% of the criteria in the EPP Industrial Area A decreasing to 2.5% of the criteria in the EPP Residential Area C. The PM_{10} (particles with a diameter less than 10μm) concentrations are predicted to be less than 6% of the NEPM standard at the nearest residence.

NO_x emissions from the Plant will be minimised by using burners that are designed to keep emissions as low as reasonably practicable where process gas will be used as a fuel, and low NOx burners will be installed for applications where natural gas will be used as the fuel.

Maximum 1 hour NO_x concentrations are predicted to occur within 1km from the Plant within the EPP Industrial Area A. The maximum concentrations are estimated to be 121μg/m^3 for the Stage 1 Plant, and 186μg/m^3 for both the Stage 1and Stage 2 Plants operating. At the nearest residence within the Buffer Area B the highest concentrations of NO_X predicted are 43μg/m^3 for Stage 1 and 69μg/m^3 for Stages 1 and 2. The predicted maximum concentrations of NO_2 at residential areas with the Stage 1 and 2 Plants operating together is 75 μg/m^3, which is equivalent to 30% of the NEPM standard.

Emissions of NO_x from the Plant are estimated to be 640tpa of NO_x from Stage 1, and 1280tpa from the Stage 1 and 2 Plants operating. This is equivalent to 4.8% and 9.6% of the 1998/1999 industry NO_x emissions from Kwinana, and 1% and 2% of the 1998/1999 total Perth emissions.

Photochemical smog forms when pollutants such as NOx and reactive organic compounds react together under the influence of sunlight and high temperature. The principal component of smog formation is ozone and consequently it is used to define smog levels. The primary contributors to photochemical smog are emissions of oxides of nitrogen and non-methane volatile organic compounds (NMVOC). Only negligible, if any, amounts of NMVOCs will be emitted by the HIsmelt Plants. It is considered that the addition of the Stage 1 and 2 Plants will have a negligible impact on Perth's ozone levels.

Carbon monoxide concentrations from the HIsmelt Plant at the nearest residential area are predicted to be less than 0.16% of the NEPM standard.

Integrated iron and steel plants have been identified as major sources of Dioxin and Furan emissions. The offgas handling system for the Plant was selected to ensure that no Dioxins and Furans would be emitted to the atmosphere. Sampling and analysis of the offgas will be undertaken to confirm that there are no Dioxins and Furans or other persistent organic chemicals emitted to the atmosphere.

Experience from the HRDF, and information relating to other iron and steel making processes, indicates that metallic elements such as zinc, lead and cadmium (that may be present in the iron ore, coal and fluxes) will be predominantly contained in the SRV offgas stream as metallic vapour. Wet scrubbing, at a temperature between 900°C and 1000°C will remove these heavy metals from the offgas stream. Sampling of the offgas will be undertaken to confirm that there are no heavy metals of significance emitted to the atmosphere.

Odours may be generated on site due to the release of hydrogen sulphide from the sulphur contained in the metal, slag and offgas. The most likely potential source of odour will be from the cooling of the slag. The water that will be used will be treated with lime, which will reduce the potential for hydrogen sulphide to form.

Greenhouse

The combustion of fossil fuels, particularly coal, is a significant contributor of CO_2 emissions. The Process uses coal as a reductant and involves the combustion of the gaseous reaction products (CO and H_2). This will result in each Plant emitting around 1.5Mtpa of greenhouse gases to the atmosphere.

The CO_2 emissions will be minimised by employing optimum energy efficiency in Plant design and operation. The HIsmelt® Process, due to its ability to utilise raw coal and un-agglomerated iron ore fines, has the potential to achieve the lowest greenhouse emissions per unit of production for a coal-based smelting process. The commercialisation of the Process will provide the global iron and steel industry with an alternative ironmaking route that is capable of significantly lowering global greenhouse emissions.

Carbon balances were derived for blast furnaces that are similar in size to the proposed HIsmelt Plant. This allowed the total greenhouse emissions per tonne of molten iron to be calculated for each process. The emissions from the blast furnaces ranged between 2248 to 2427kg of CO_2 per tonne of hot metal (thm) compared to 1868 kg of CO_2/thm for the HIsmelt Plants.

The development of the Process represents a considerable investment by Rio Tinto in research and development expenditure over the past 16 years, which ultimately will deliver global benefits in the form of lower energy usage and lower greenhouse emissions per tonne of iron and, therefore, per tonne of steel.

Rio Tinto was one of the first companies to sign on to the Australian Greenhouse Office's Greenhouse Challenge Programme. Rio Tinto has implemented a climate change strategy, which provides a framework to reduce risks and maximise opportunities arising from local, national and international greenhouse responses.

Rio Tinto is committed to research and development of new technologies that will reduce greenhouse emissions such as; Enhanced Bio-Fixation of CO_2, Energy Efficiency and Advanced Smelting Cells.

Dust

Fugitive dust may be generated at the site from Project operations. The Kwinana EPP defines standards and limits for concentrations of TSP for the EPP Areas. The NEPM for Ambient Air Quality sets an ambient particulate standard for PM_{10}.

A Dust Management Plan will be prepared and implemented as part of the EMP for the site and will include measures for:

- *raw material unloading and transfer;*
- *use of water sprays on stockpiles and disturbed areas;*
- *covering of conveyors and transfer points, where practicable;*
- *regular cleaning and control of dust; and*
- *monitoring both visually and by high volume sampling.*

The dust monitoring programme initially established for the HRDF will continue to ensure that dust levels from the site are within the EPP standards and limits.

Dust may be generated during the transport of the ore by rail from Koolyanobbing to Kwinana. To allow for the bulk density of the iron ore in the wagons, the rail freight provider is proposing to only half fill the wagon, therefore, it is unlikely that any significant quantities of ore dust will be blown from the wagons.

The ore and coal unloading operations have the potential to generate dust and spillage. Dust management at the KBB2 unloading area will be the responsibility of Fremantle Ports.

Noise

Environmental noise is governed by the Environmental Protection (Noise) Regulations 1997. As the Plant will be a 24–hour operation, the L_{A10} night time level will be applied at Hope Valley, Wattleup, Medina and North Rockingham. To comply during the night period, noise emissions from the Plant are required to be:

- *40 dB(A) at the most constraining residences within Hope Valley and Wattleup; and*
- *30 dB(A) at the most constraining residences in Medina and North Rockingham.*

Modelling of the noise emissions was undertaken using the Environmental Noise Model (ENM) program. Predicted noise levels from the Stage 1 Plant will be at least 5dB(A) below the assigned noise levels at the surrounding residences. The predicted noise levels from the Stage 1 and 2 Plants operating will also be at least 5dB(A) below the assigned noise levels. Therefore, the noise levels at the residential areas from the Stage 1 Plant and the Stages 1 and 2 Plants will comply at all times with the Environmental Protection (Noise) Regulations, 1997.

A noise monitoring survey will be undertaken to ensure that noise levels are as predicted.

The shipping, unloading and loading operations to be undertaken by Fremantle Ports at the KBB2 have the potential to generate noise. Fremantle Ports undertook modelling to predict the noise emissions associated with the shipping operations related to the HIsmelt Project. The modelling results show that noise emissions are predicted to comply with the Environmental Protection (Noise) Regulations, 1997.

It is estimated that there will be an additional 73 truck movements per day for Stage 1 and 146 for Stage 2. Noise from the trucks transporting materials for the Project along Rockingham Road are predicted to have no significant increase in the existing noise levels at the residences.

It is anticipated that there will be around ten rail movements per week related to Stage 1 of the Project. This will result in a net increase of three movements per week on the Forrestfield to Kwinana section of rail (once the seven existing train movements to the BHP site cease in 2003), which is a 1% increase to existing train movements for Stage 1. There will be around 13 train movements per week (two per day), which is a 6% increase to existing train movements when both Stage 1 and Stage 2 Plants are operating.

Calculations indicate that the noise level increase in L_{Aeq} for train movements would be in the order of 0.1dB(A) to the existing conditions for the Stage 1 Plant and an additional 0.1dB(A) between the Stage 1 and Stage 2 Plants. Although this is a total increase of 0.2dB(A), this is not considered significant as the calculations were conservative due to noise levels for maximum power and speed being applied, and the existing noise levels at the time of commissioning of Stage 2 will be higher than current levels.

Vibration

Significant vibration levels are not expected to result from the operation of the Plant. The vibration from the proposed trains is likely to be similar to those already emitted by the existing trains.

Surface Water Runoff and Washwaters

A Surface Water Management Plan will be prepared and implemented as a component of the site EMP. The Plan will include the management for both clean stormwater runoff, and for potentially contaminated runoff and washwaters. Stormwater management at the site will be based on the principle of directing the clean runoff to soak wells or settling ponds.

Stockpile management measures will be implemented to minimise the potential for runoff. A base layer comprising of a very low permeability material such as clay, crushed slag or a synthetic liner, will be placed within the stockpile area to minimise the potential for seepage of any runoff or leachate to impact on the groundwater. A drainage system for the stockpile area will be established, which will allow the runoff to drain to a common sump from where it will be pumped to the process water tank.

Washwaters from around the raw material bins, and drainage from the cooling water circuits will also be directed to a sump prior to being pumped to the process water tank.

The capacity of the process water tank may be exceeded during periods of extreme rainfall events. The potential for establishing an additional facility for the storage of runoff from heavy rainfall events will be investigated during the detailed design phase of the Project. In the event that additional storage is not considered feasible, the overflow would be discharged through an approved outfall such as the Water Corporation's Point Peron outfall. Any discharge would be subject to approval from the Water Corporation and the DEWCP.

<u>Slag</u>
Slag will be produced as a by-product of the Process. Discussions are currently being held with potential customers for the slag by-product. Any stockpiling of slag on-site will be kept to a minimum. The results of leaching tests on slag from the HRDF indicate that the slag material is benign and it meets the Department of Environmental Protection Guidelines for Acceptance to Solid Waste Landfill.

<u>Hazardous Materials</u>
A Hazardous Materials Management Plan will be prepared and implemented as a component of the site EMP.

The transport, storage and use of hazardous materials on the site will be in compliance with Australian Standard 2508, the Australian Dangerous Goods Code, the Dangerous Goods Regulations, 1992, and the Dangerous Goods (Transport) Regulations, 1999 as the minimum standards. The site's Safety and Environmental Management Systems will also have specific standards for hazardous material control, storage, use and disposal.

<u>Waste Management</u>
Solid waste streams generated during the operation of the Plant will be mainly from gas cleaning, refractory replacements, and general solid waste.

A Waste Management Plan will be prepared as a component of the site EMP. The Plan will be based on the principles of Reduce, Recycle and Reuse and will define the waste disposal practices on site.
The main wastewater generated by the Plant will be scrubber blowdown from the clarifier circuit, which will be directed to the process water tank for use in cooling of the pig iron and slag. During normal operations, with the exception of extreme rainfall periods, no effluent will require disposal off site.

Contact blowdown and stockpile runoff will be treated with lime as it enters the process water tank to raise the pH so that any residual heavy metals will precipitate. The precipitates, together with any suspended solids will settle in the cone section of the tank. The resulting sludge will be pumped out periodically and then be de-watered in a filter system.

Water in the process tank will be sampled and analysed to provide baseline analysis of the process water. In the event that water from the process water tank is to be discharged through the Water Corporation's Point Peron outfall, samples of the discharge will be analysed and the results will be provided to the Water Corporation.

<u>*Site Contamination*</u>
The site has been extensively investigated for soil and groundwater contamination. A Stage II assessment for on-site contamination will be undertaken prior to the commencement of construction.

The potential for site contamination from Project operations will be minimised by the appropriate design of areas where materials are used and stored, and the management and collection of any surface water and washwaters.

<u>*Marine Environment*</u>
The site is located on the eastern foreshore of Cockburn Sound. Process raw materials and the pig iron product will be shipped through Cockburn Sound. The shipping, unloading and loading of these materials has the potential to impact on the marine environment of the Sound. The significant issues associated with these operations are due to contamination from dust, tributyltin (TBT), ballast water, oil spills and the spillage of materials. Fremantle Ports will be responsible for the management of shipping in Cockburn Sound and the material transfer operations at the KBB2.

The EPA, together with the Cockburn Sound Management Council (CSMC), has developed a draft EPP for Cockburn Sound which outlines the environmental values, objectives and criteria for managing Cockburn Sound. The HIsmelt site is located within the EPP terrestrial base catchment area.

A draft EMP for Cockburn Sound and its Catchment has also been prepared by the CSMC. The Proponent will be guided by the principles of no net loss of ecological or social, function in Cockburn Sound as recommended in the EMP.

The Proponents management of the potential impacts on the marine environment from the shipping activities will include:

- *the selection of reputable shipping contractors;*
- *management by Fremantle Ports; and*
- *compliance with the Draft Cockburn Sound EPP and EMP.*

TBT contamination is a concern in Cockburn Sound as high levels were found during surveys undertaken in 1994 and 1999. It is expected that even with increased shipping activities TBT levels in local marine sediments will reduce to levels that will not impact on the marine environment.

The Australian Quarantine and Inspection Service has issued Mandatory Ballast Water Requirements that are enforced under the Quarantine Act, 1908. *The Requirements aim at reducing the risk of introducing exotic marine organisms into Australian waters.*

Oil can harm the marine environment by smothering marine life and can bioaccumulate in organisms thus affecting organisms higher in the food chain. Fremantle Ports has an oil spill response capability and are well equipped and prepared to respond to any spills that occur within the vicinity of Fremantle Ports' waters.

There is the potential for spillage of iron ore and coal, whilst being unloaded at the KBB2. Fremantle Ports has considerable experience in the management of bulk cargoes and in minimising or eliminating spillage from cargo handling. Fremantle Ports' standard operating procedures for the cleanup of any spillage will be applied.

<u>*Transport*</u>
Assuming all employees individually drive to and from the site there will be an additional 64 vehicle movements per day for each Plant. The estimated number of truck movements associated with the operation of the Plant for Stage 1 are 73 per day and 146 per day for Stages 1 and 2. The increase in road traffic due to the Project is not expected to have a significant impact on the roads servicing the site.

There will be a total of 40 train movements per month for Stage 1. If Stage 2 proceeds and the same quantity of ore is sourced from Koolyanobbing and the same length trains are used then there would be an additional 40 train movements per month for the Stage 2 operations. This results in a small percentage increase to the existing rail movements between Koolyanobbing and Kwinana.

There will be an estimated additional 30-50 ship movements in Cockburn Sound for each Stage of the Project. This relates to an increase to the existing shipping movements to the Sound of around 3-4% for Stage 1 and 6-8% when Stage 2 comes into operation.

Social

Social issues are those issues that have the potential to impact on the community. The Proponent considers the social issues to comprise all the issues raised by the community during the extensive consultation programme conducted during the EIA Process. HIsmelt will continue to liaise with the community during the development, construction and operations of the Plant.

<u>Socio-economic</u>
The Project will have regional and local benefits on the social environment by providing direct and indirect employment opportunities and other economic advantages brought to the state and region by establishing a HIsmelt Plant in Kwinana, Western Australia.

The construction workforce for each Plant is expected to peak at 320 with an average of 230 for a two year period.

Stage 1 of the Project will provide up to 65 full time positions, with an additional 60 positions for Stage 2. There will also be maintenance and service providers and many other indirect employment opportunities associated with the Project.

Fishing and aquaculture are recognised as some of the multiple uses of Cockburn Sound. The main requirements of the fisherman are for continued beach access, healthy fish stocks and clean relatively unpolluted and productive waters. The HIsmelt operations will not impact on the current access to the beach or the waters in Cockburn Sound. The management of impacts associated with the shipping operations will be coordinated by Fremantle Ports.

<u>Visual Amenity</u>
The Plants will be located on the HIsmelt site in the Kwinana Industrial Area where the HRDF is constructed, and are unlikely to impact on visual amenity in the area. Screening vegetation will be established around the Plant site to act as a site buffer for visual, dust and noise aspects.

<u>Recreation, Tourism and Aesthetics</u>
The Plant site is located within the KIA and near Cockburn Sound. The KIA is not an area considered high for tourism with the exception of when visitors may wish to inspect industrial plants. HIsmelt's operations will not have an adverse effect on existing recreation, tourism and aesthetics.

The aesthetics of the marine environment will be maintained by ensuring that the unloading of iron ore and coal from the ships is managed so it does not result in spillage contaminating the marine waters.

<u>Risk and Hazards</u>
The design philosophy for the Plant will ensure that all potential hazards are identified and appropriately addressed at an early stage of Project development. This will result in the development of a Plant that is safe to operate, environmentally acceptable and commercially viable.

HAZOP studies will be undertaken as part of the design, construction and operation of the Plant. The Proponent will also prepare Site Safety Management Plans and Emergency Response Procedures.

A qualitative risk assessment of the Project was undertaken. The results showed that the analysis of the consequences for the credible hazardous events determined that the level of harm is limited to the immediate area of the Plant, with the worst scenario being a process gas release with harmful effects for a distance of approximately 50m. The distance from the Plant to the nearest site boundary is 130m therefore it is concluded that minimal, if any, harmful effects will be incurred at the site boundaries. Therefore the risk level at the site boundary due to these hazardous events (both individual and combined) is determined to be below the EPA criteria for industrial facilities of fifty in a million per year.

The distance from the HIsmelt Plant to the nearest residential area at Hope Valley is approximately 1,500m. The analysis determined that the risk level in the nearest residential area will be below the EPA criteria of one in a million per year.

Accidents such as ship collisions may cause substantial ecological damage, put workers and the community' health at risk and incur massive clean up costs. The risk of such accidents is minimised by strictly adhering to international and Commonwealth marine guidelines. Fremantle Ports maintains a Marine Safety Plan, which sets out the procedures for ensuring safe operations within the Port of Fremantle.

The percentage increase in traffic on the roads and rail due to the Project is relatively small and will be easily accommodated on the existing networks without issue.

Decommissioning and Closure
Effective decommissioning and closure of operations is an integral part of delivering a consistent environmental and commercial performance. Rio Tinto requires all its subsidiaries to prepare and maintain a Closure Plan.

Prior to decommissioning a detailed Decommissioning Plan will be prepared. The Decommissioning Plan will contain specific details of how closure will be achieved, and will be based on the Closure Strategy.

Commitments and Predicted Outcome
To ensure that all of the environmental issues associated with the Project are managed, resulting in an environmentally sound Project, the Proponent has made 68 management commitments in the PER.

The environmental factors, potential impacts, proposed management and predicted outcome of the Project are summarised in Table ES2.

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Table ES2
Environmental Factors and Management

Factor	Issue	EPA and Proponent's Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
BIOPHYSICAL						
Terrestrial flora	Vegetation communities.	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.	Proposed plant site is within an area already cleared. There are no areas of remnant vegetation remaining on site.	Disturbance to vegetation communities.	No clearing of vegetation required.	No impact.
Terrestrial fauna	Terrestrial fauna including Specially Protected (Threatened) Fauna.	Maintain the abundance, diversity and geographical distribution of fauna. Protect Specially Protected (Threatened) Fauna and their habitats, consistent with the provisions of the Wildlife Conservation Act 1950 and the Environment Protection and Biodiversity Act 1999.	No faunal habitats for native species other than those areas established as greening areas around the site.	Disturbance to native fauna.	No disturbance to native fauna	No impact.
Marine environment	Marine flora and fauna	Maintain the ecological function, abundance, species diversity and geographic distribution of marine flora and fauna.	The local marine environment is Cockburn Sound, which is the most intensively used marine embayment in WA. Extensive shipping movements are already undertaken in the Sound. Loading and unloading operations are already undertaken at the jetties in the Sound. The Sound provides a fish nursery and feeding habitat. Two marine pests have been recorded in the Sound's benthic fauna. Monitoring studies of the Sound have identified many contaminants from industrial discharge entering the Sound. High levels of TBT have been found in the Sound.	Impact on the marine environment from shipping operations such as from, TBT anti-fouling agents, ballast water discharge, oil spills and spills of raw materials during ship unloading from the ships.	Management will include: • the selection of reputable shipping contractors; • management by Fremantle Ports; and • compliance with the Draft Cockburn Sound EPP and EMP. Fremantle Ports will be responsible for the management of shipping in Cockburn Sound. A Fact Sheet on the Management of TBT Anti-Foulants in Western Australia has been produced by Fremantle Ports. The management measures include the: • banning or restrictions of its use; and • banning of in-water hull cleaning within Port waters. A Fact Sheet on Ballast Water Management has been produced by Fremantle Ports. The Australian Quarantine Inspection Service (AQIS) has issued Mandatory Ballast Water Requirements to reduce the risk of introducing exotic marine organisms into Australian waters. No ballast water can be discharged in Australian waters without written permission from AQIS. A Fact Sheet on Oil Spill Response has been produced by Fremantle Ports. Fremantle Ports are well equipped and prepared to respond to any spills that may occur within the vicinity of Fremantle Ports' water. Fremantle Ports has experience in the management of bulk cargoes and in minimising or eliminating spillage from cargo handling. Fremantle Ports will upgrade the existing transfer equipment at the KBB2 to minimise the risk of material spillage on to land or water, with a target of zero spill.	No significant impact on the marine environment.
Decommissioning	Decommissioning Plan.	Ensure that the areas affected by the Project are properly decommissioned.	Location of the Plant is on the site occupied by the existing HRDF. Site has been used by industry for decades.	Leaving the site in a condition that is unsafe and environmentally unacceptable.	A Closure Plan will be prepared which will include a Closure Study, Closure Strategy and a Closure Statement. Prior to decommissioning, a Decommissioning Plan will be prepared based on the Closure Strategy and will contain specific details on how closure will be achieved.	Site will be left in a safe, stable and acceptable manner for the required land use.

Table ES2 (cont'd.)

Factor	*Issue*	*EPA and Proponent's Objective*	*Existing Environment*	*Potential Impact*	*Environmental Management*	*Predicted Outcome*
BIOPHYSICAL						
POLLUTION MANAGEMENT						
Atmospheric emissions	*Air emissions and air quality criteria.*	*Ensure that gaseous and particulate emissions from the proposed Plant in isolation, and in combination with the emissions from neighbouring sources and background concentrations, do not cause ambient ground level concentrations to exceed appropriate criteria, including the NEPM standard for Air Quality. Advice to be sought from the DEP on specific pollutants as necessary, or cause an environmental or human health/amenity problem.* *Use all reasonable and practicable measures to minimise the discharge of significant atmospheric wastes such as SO_2, NO_X, particulates, and greenhouse gases*	*The Kwinana region is covered by an EPP, which defines limits and standards for SO_2 and TSP. Other air pollutants are to meet the NEPM standards for air quality.* *There are numerous industries in the KIA emitting gaseous and particulate emissions.*	*Releasing emissions of air pollutants, which result in ground level concentrations that exceed the relevant criteria for air quality. The concentrations may impact on the health and amenity of the community.*	*An air modelling study was undertaken to predict the potential ground level concentrations that will result from the expected atmospheric emissions from the HIsmelt Plants.*	*Air emissions from the Plants will result in compliance with the EPP and NEPM criteria.* *No significant impact.*
	SO_2 emissions.	*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. *Use all reasonable and practicable measures to minimise SO_2 discharges and ensure that they do not cause an environmental or human health/amenity problem.*	*SO_2 concentrations recorded at monitoring sites in the Kwinana region have shown to be well below the EPP criteria since 1995.* *HIsmelt has a maximum permissible quantity emission limit, of 35g/sec, which was allocated in 1992. The 35g/sec was used in the DEP modelling undertaken in 1992 to predict cumulative ground level concentrations and to ensure that they were below the EPP criteria.*	*The emission of SO_2 at concentrations that exceed the maximum permissible emission rate, which results in the ground level concentrations exceeding the EPP criteria. The concentrations may impact on the health of the community.*	*An air modelling study was undertaken to predict the potential ground level concentrations of SO_2 that will result from the expected SO_2 emissions from the HIsmelt Plants.* *Emissions of SO_2 will be minimised by the use of coal with a low sulphur content, and a FGD system, which will remove a minimum of 95% of the sulphur from the offgas.* *A continuous monitoring instrument will be installed to measure SO_2 emissions in the gas stream exiting the main stack.*	*Predicted ground level concentrations of SO_2 resulting from the emissions from the Plants will be below the EPP criteria.* *No increase in resulting ground level concentrations of SO_2 than resulted from the HRDF.* *No additional impact to SO_2 levels in Kwinana.*
	Particulate emissions.	*Protect the surrounding land users such that particulate emissions will not adversely impact upon their welfare and amenity or cause health problems by meeting the NEPM for Ambient Air Quality relating to PM10, and the Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1992 for Total Suspended Particulates (TSP).* *Use all reasonable and practicable measures to minimise the discharge of particulates.*	*PM_{10} levels recorded in the area have shown to be within the NEPM criteria.* *TSP concentrations recorded in 1990-1991 showed an annual average of $40\mu g/m^3$, with maximum 24 hour concentrations of up to $100\mu g/m^3$. These concentrations are below the EPP limits.*	*Emissions of particulates result in the EPP and NEPM criteria being exceeded and impact on the health and amenity of the community.*	*An air modelling study was undertaken to predict the potential ground level concentrations of particulates that will result from the expected emissions of particulates from the Plants' stacks.* *The emissions will be managed by the:* • *use of wet scrubbers to clean the offgas;* • *covering of launders; and* • *capturing of fumes in bag filtering cleaning systems.* *Particulate emissions from the Plant Stacks will be measured on a six monthly basis.*	*Predicted ground level concentrations of particulates resulting from the emissions from the Plants will be well below the EPP criteria and NEPM criteria.* *No significant impact.*
	NO_X emissions.	*Ensure that NO_X emissions meet acceptable standards including the NEPM for Ambient Air Quality, and the requirements of Section 51 of the* Environmental Protection Act 1986. *Use all reasonable and practicable measures to minimise NO_X discharges.*	*Maximum 1-hour concentrations of NO_2 recorded at monitoring sites in the Kwinana region are around 42% of the NEPM standard.*	*NOx is emitted at concentrations, which may cause photochemical smog.*	*An air modelling study was undertaken to predict the potential concentrations of NO_x that will result from the expected NO_x emissions from the HIsmelt Plants.* *Emissions of NO_x will be minimised by using burners that are designed to keep emissions as low as reasonably practicable where process gas will be used as a fuel, and low NO_x burners will be installed where natural gas will be used as the fuel.* *The NO_x concentrations in the gas stream exiting the main stack will be measured on a six monthly basis.*	*Predicted ground level concentrations of NO_x resulting from the emissions from the Plants will be below the NEPM criteria.* *No significant impact.*

Table ES2 (cont'd.)

Factor	Issue	EPA and Proponent's Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
POLLUTION MANAGEMENT						
Atmospheric Emissions	Photochemical smog.	*Use all reasonable and practicable measures to minimise discharges of NO_X and VOCs so as to limit their contribution to the formation of photochemical smog.*	*Ozone levels are used as a measure of smog levels. Since 1997 the recorded ozone levels in the Perth region have been in compliance with the NEPM Criteria.*	*Increase in photochemical smog due to the release of NO_x emissions and NMVOCs.*	*Management of NO_x emissions is discussed above.* *Negligible, if any, NMVOCs will be emitted by the Plants.*	*The Plant will have negligible impact on Perth's ozone levels.*
	CO emissions.	*Ensure that CO emissions meet acceptable standards including the NEPM for Ambient Air Quality and the requirements of Section 51 of the* Environmental Protection Act 1986. *Use all reasonable and practicable measures to minimise the discharge of CO emissions.*	*Motor vehicles contribute around 80% of CO emissions in the Perth region. Recorded yearly 8-hour maximums of CO are around 4 to 5ppm (44% to 55% of the NEPM standard).*	*Exposure to high levels of CO may impact on people's health.*	*The gas combustion systems in the Plant will be designed to minimise CO emissions.* *The gas stream exiting the main stack will be sampled and analysed on a six monthly basis to measure CO emissions.*	*Predicted concentrations of CO at the nearest residential area resulting from the emissions from the HIsmelt Plants are a very small fraction of the NEPM standard.* *No impact.*
	Other gaseous emissions such as Dioxins, Furans, PAHs, and VOCs.	*Ensure that other gaseous emissions such as Dioxins, Furans, PAHs, and VOCs meet acceptable standards.* *Use all reasonable and practicable measures to minimise the discharge of these types of emissions.*	*Current levels of these substances in the Kwinana air shed are unknown.*	*Dioxins, Furans and other persistent organic chemicals have the potential to cause health impacts.*	*The offgas handling system was selected to ensure that no Dioxins, Furans or other persistent organic chemicals would be emitted to the atmosphere.* *Sampling and analysis of the offgas will be undertaken to confirm that there are no Dioxins and Furans or other persistent organic chemicals emitted to the atmosphere.*	*There will be no emissions of Dioxins, Furans or other persistent organic chemicals from the Plant.* *No impact.*
	Heavy Metals	*Ensure that any emissions of heavy metals meet acceptable standards.* *Use all reasonable and practical measures to minimise emissions of heavy metals.*	*Current levels of heavy metals in the Kwinana air shed are unknown.*	*Heavy metals have the potential to accumulate and adversely impact on the environment.*	*Wet scrubbing at a temperature of 900°C to 1000°C will remove the heavy metals such as zinc, lead and cadmium from the offgas stream.* *The offgas will be sampled and analysed to confirm that there are no significant emissions of heavy metals from the Plants.*	*No impact.*
	Odour.	*Odours emanating from the proposed plant should not adversely affect the welfare and amenity of other land users.* *Ensure compliance with acceptable standards and that all reasonable and practicable measures are taken to minimise the discharge and adverse impact of odorous gases.* *Ensure that odour emissions, both individually and cumulatively, meet appropriate criteria and do not cause an environmental or human health problem.*		*The odour associated with hydrogen sulphide, which may be produced during the water cooling of slag, may impact on the community.*	*Water in the process water tank that will be used for the cooling of slag will have been treated with lime, which will reduce the potential for hydrogen sulphide to form.*	*No offsite impact of odour from hydrogen sulphide.*

Table ES2 (cont'd.)

Factor	*Issue*	*EPA and Proponent's Objective*	*Existing Environment*	*Potential Impact*	*Environmental Management*	*Predicted Outcome*
POLLUTION MANAGEMENT						
Atmospheric Emissions	*Greenhouse gases.*	*To minimise greenhouse gas emissions in absolute terms and reduce emissions per unit product to as low as reasonably practicable.* *To mitigate greenhouse gases emissions in accordance with the Framework Convention on Climate Change 1992, and in accordance with established Commonwealth and State policies including Environmental Protection Authority Interim Guidance No. 12 'Minimising Greenhouse Gases'.* *Proponents are required to:* • *take all "no regrets" measures in construction and operation;* • *take "beyond no regrets" measures which are reasonable and practicable; and* • *commit to a programme of investigation, research and reporting of and progressive implementation of "no regrets" and "beyond no regrets" measures.*	*Greenhouse gas emissions are a global concern related to climatic change.*	*Greenhouse gases contribute to global warming.*	*CO_2 emissions will be minimised by employing optimum energy efficiency in Plant design and operations.* *The Process, due to its ability to utilise raw coal and un-agglomerated iron ore fines, has the potential to achieve the lowest greenhouse emissions per unit of production for a coal-based smelting process. The commercialisation of the Process will provide the global iron and steel industry with an alternative ironmaking route that is capable of lowering global greenhouse emissions.* *The Proponent, as part of the Rio Tinto Group, will continue to participate in the Australian Greenhouse Challenge Programme, and will support the research and development of new technologies that will result in a reduction in greenhouse emissions.*	*HIsmelt Process will result in lower emissions of greenhouse gas per unit of iron product compared to other iron making processes.*
Dust	*HIsmelt site.*	*Protect the surrounding land users such that dust emissions will not adversely impact upon their welfare and amenity or cause health problems by meeting the Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1992 for Total Suspended Particulates (TSP).* *Use all reasonable and practicable measures to minimise the generation of dust, including the construction phase.*	*TSP concentrations recorded in the Kwinana area in 1990-1991 showed an annual average of 40µg/m³, with maximum 24 hour concentrations of up to 100µg/m³. These concentrations are below the EPP limits.* *Ambient baseline dust concentrations recorded on the site show average dust levels of 50µg/m³ and a maximum level of 143µg/m³.*	*Emissions of dust from the site result in the EPP and NEPM criteria being exceeded and therefore impact on the health and amenity of the community.*	*A Dust Management Plan will be prepared and implemented and will include measures for:* • *raw material unloading and transfer;* • *use of water sprays on stockpiles and disturbed areas;* • *covering of conveyors and transfer points, where practicable;* • *regular cleaning and control of dust; and* • *monitoring both visually and by high volume sampling.* *The dust monitoring programme initially established for the HRDF will continue and be expanded.*	*Concentrations of dust generated on the site will comply with the Kwinana EPP and NEPM criteria.*
	Rail Transport of Ore	*To ensure that dust emissions from the rail transport of ore do not adversely impact on the environment or residences along the rail route.*		*Dust blowing from the ore in the rail wagons impacts on residences and vegetation along the rail route.*	*The rail wagons will only be half filled to allow for the bulk density and tare capacity of the wagons. This will minimise the potential for ore dust to be blown from the wagons. The ore will have a moisture content of 3% to 5%, which will also prevent dust generation.*	*No significant impact.*

Table ES2 (cont'd.)

Factor	*Issue*	*EPA and Proponent's Objective*	*Existing Environment*	*Potential Impact*	*Environmental Management*	*Predicted Outcome*
POLLUTION MANAGEMENT						
Noise	*Plant Site.*	*Ensure that noise levels from the Project operations comply with the Environmental Protection (Noise) Regulations 1997.*	*Baseline noise levels at the boundary of the HRDF plant site have been regularly monitored and were found to be within the Noise Regulations.*	*Noise from the Project operations exceeds the Noise Regulations and impact on people's lives, particularly at night.*	*Environmental Noise is governed by the Environmental Protection (Noise) Regulations, 1997.* *Acoustical modelling was undertaken to predict the resulting noise levels at residences from the expected noise emissions from Plant operations.* *Noise specification upper limits will be applied when sourcing items of equipment.* *Noise attenuation measures will be incorporated in Plant design such as enclosures around equipment with high noise levels.* *Noise monitoring will be undertaken to establish that noise levels are within those predicted.*	*Noise levels from the Plant will comply with the Noise Regulations, 1997 and will therefore have no significant impact.*
	Road and Rail Transport	*Ensure that noise from the road and rail transport does not have an adverse impact on the amenity of residences along the transport routes.*	*The existing road traffic on the main road where there are residences is in excess of 20,000 per day.* *The current weekly train movements along the rail route range from 115 to 252 along the various sections of rail line from Koolyanobbing to Kwinana.*	*Noise from the trains impacts on the amenity of residences along the rail route.*	*Modelling was undertaken to estimate the change in noise levels from the proposed train operations. The increase in noise levels along the rail route is predicted to be a maximum of 0.2dB(A).* *The freight service provider will minimise pass by noise by using appropriate throttle settings, braking and fuel saving techniques.*	*No significant impact.*
Vibration	*Vibration.*	*Ensure that vibration levels meet statutory requirements and acceptable standards.*	*HRDF previously operated on site.* *Existing rail movements 20 fold those proposed for the Project.*	*Vibration from Plant operations and rail movements may cause instability and damage to structures.*	*Large items of rotating machinery will be placed on concrete footings to dampen any vibrations.*	*No significant vibration impact from Plant operations or rail movements.*
Surface Water	*Surface water quality.*	*Maintain the quality of surface water so that existing and potential uses, including ecosystem maintenance, are protected.*	*There are no natural surface water features in the vicinity of the site. Infrastructure for surface water management already exists around the site with surface drainage and diversion measures implemented.*	*Disturbance to natural surface drainage and the contamination of surface water from contaminated runoff.*	*A Surface Water Management Plan will be prepared and implemented and will include the management for both clean stormwater runoff and potentially contaminated runoff and washwaters.* *Clean runoff will be directed to soaks. Potentially contaminated water will be directed to the process water tank for use as cooling water.*	*No impact on surface water.*
Groundwater	*Groundwater quality.*	*Maintain the quality of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.*	*The depth to groundwater over the site ranges from around 3.5m to 4.5m. Monitoring of groundwater quality has shown that the parameters measured have generally been within the criteria.*	*Contamination of groundwater under the site.*	*Surface water management is discussed above.* *Management of materials which contain potential contaminants are discussed under those factors.* *The groundwater monitoring programme established for the HRDF will continue and be expanded.*	*No impact on groundwater quality.*
Slag	*Management and disposal of slag.*	*Slag is to be managed, used or disposed of in an environmentally acceptable manner.*	*Slag from the HRDF operations has been stockpiled on the site.*	*Leachates from the slag contaminating the environment.*	*Discussions are being held with the potential customers for the slag. Any stockpiling of slag on site will be kept to a minimum.*	*No impact.*

Table ES2 (cont'd.)

Factor	Issue	EPA and Proponent's Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
POLLUTION MANAGEMENT						
Hazardous Materials	Transport, storage and use of hazardous materials.	Ensure that any hazardous materials to be used on site are transported, stored and used in a safe and environmentally acceptable manner.		The risk of transporting, storing ad using the hazardous materials to both people and the environment. Spillage of hazardous materials on the environment.	A Hazardous Materials Management Plan will be prepared and implemented. The transport, storage and use of hazardous materials on the site will be in compliance with the relevant standards, Codes and Regulations. The site's Safety and Environmental Management Systems will also have specific standards for hazardous material control, storage, use and disposal.	No significant impact.
Waste Management	Solid waste disposal.	Where possible, waste should be minimised, reused or recycled to the ALARP level. Solid wastes should be treated on-site or disposed of off-site at an appropriate landfill facility. Where this is not feasible, contaminated material should be managed on-site to prevent groundwater and surface water contamination or risk to public health.		Solid wastes impact on the environment due to inappropriate disposal methods, or from the leaching of contaminants contained on the waste.	Waste requiring disposal will be disposed at an appropriate and approved facility. A Waste Management Plan will be prepared and implemented, which will be based on the principles of Reduce, Recycle and Reuse and will define the waste practices on –site.	No impact.
	Process Wastewaters	Where possible, waste should be minimised, reused or recycled to the ALARP level. Process wastewaters should be treated on-site or disposed of off-site at an appropriate facility. Where this is not feasible, contaminated material should be managed on-site to prevent groundwater and surface water contamination or risk to public health.		Contaminants in process wastewaters impact on the surface water, groundwater or marine environment.	Process wastewater will be treated and stored in a tank prior to reuse for the cooling of slag and pig iron. Water in the process water tank will be sampled and analysed on monthly basis.	No impact.
	Sewage	Ensure that sewage does not impact on the surrounding environment.	Two septic systems are currently installed at the site.	Nutrients and other constituents of the sewage contaminate the surface water, groundwater and marine environment.	The two existing septic systems on site will be replaced with Nutrient Retentive Sewerage Systems.	No impact.
Site contamination	Soil and groundwater contamination.	Ensure that any existing soil and groundwater contamination on-site is carefully managed during construction and operation of the plant so that there is minimal or no disturbance of the contamination, and further contamination is avoided.	Soil and groundwater contamination investigations undertaken on the site found that the site has generally low concentrations of industrial contamination.	Existing contamination is disturbed by the Project resulting in further contamination. Contamination of the site form Project operations.	A Stage II assessment for on site contamination will be undertaken prior to the commencement of construction. Should any contaminated areas have the potential to be disturbed during construction and/or require remediation, a Remediation Plan will be prepared in conjunction with Landcorp. The process wastewater tank is constructed of concrete and is designed to ensure that there is no seepage. Sumps will be installed in the pig iron and slag pit areas to collect any water remaining after the products have been spray cooled. Stockpiles will be designed to minimise the potential for leachate and runoff to impact on the groundwater. The stockpile area will have a base layer of a low permeability material, and will have a drainage system, which collects runoff and directs it to the process water tank. Hazardous material management is discussed above.	No significant impact.

Table ES2 (cont'd.)

Factor	Issue	EPA and Proponent's Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
SOCIAL SURROUNDS						
Community	*Impacts on the community*	*Ensure the community is informed of the Project and is not adversely impacted by the Project.*	*Plant site is located within the Town of Kwinana, with the neighbouring shires being the Cities of Rockingham and Cockburn.*	*The Project results in adverse impacts on the local communities*	*Extensive community consultation programme has been implemented and will continue through the development, construction and operation of the Plant.*	*Open two way dialogue with the community.*
Socio -Economic	*Economic impacts on the social environment.*	*Ensure that positive socio-economic impacts are maximised.*	*Plant site is located within the KIA in Town of Kwinana, in Western Australia.*	*Benefits locally, regionally and nationally.*	*Project will offer many local, regional and national benefits by providing direct and indirect employment opportunities and other economic advantages.*	*Positive socio-economic impact.*
Visual Amenity	*Viewscape of the Plant*	*The visual amenity of the area around the proposed Plant should not be unduly affected.*	*The HRDF exists on the site, and the site is surrounded by industry.*	*The Plant is obtrusive and affects the visual amenity of the area.*	*The proposed Plant has been superimposed on photographs taken from public vantage points show little change in the viewscape.*	*No impact*
Recreation, Tourism and Aesthetics	*Recreational activities, tourists and aesthetics*	*The Project should not have an adverse impact on the recreation and tourism and aesthetic values of the area.*	*The KIA is not an area considered high for tourism.* *Cockburn Sound provides opportunities for recreational and tourism opportunities, and aesthetic qualities.*	*The Project operations restrict recreational activities, impacts on tourism in the area, and reduce the aesthetics qualities of the area.*	*The operations will not have an adverse impact on the existing recreation, tourism and aesthetics in the area.* *The number of visitors to the Plant and therefore Kwinana is expected to increase significantly.* *The operations will not impact on the current access to the beach or waters in Cockburn Sound.*	*No adverse impact.*
Culture and heritage	*Aboriginal culture and heritage.*	*Ensure that the project complies with the requirements of the* Aboriginal Heritage Act 1972.	*No Aboriginal site are listed on the IAD database*	*Disturbance to Aboriginal sites.*	*Search of the IAD register found that there are no recorded Aboriginal sites.* *If Aboriginal artifacts or skeletal remains are uncovered during construction activities the Department of Indigenous Affairs will be notified in accordance with* the Aboriginal Heritage Act, 1972.	*No impact.*
Public safety	*Risk and hazards.*	*Ensure that risk is managed to meet the EPA's criteria for individual fatality risk off-site and the Department of Mineral and Petroleum Resources (MPR) requirements in relation to worker and public safety.*	*Site is located within the Kwinana Industrial Area surrounded by industry with the nearest residential areas being 1500m from the site.*	*The Plant poses an unacceptable risk to other industries in the area and the local communities.*	*All potential hazards will be identified and appropriately addressed at an early stage of Project development. HAZOP studies will be undertaken as part of the design, construction and operation of the Plant. The Proponent will also prepare Site Safety Management Plans and Emergency Response Procedures.* *A qualitative risk assessment of the Project was undertaken. The risk level at the site boundary due to hazardous events was determined to be below the EPA criteria for industrial facilities of fifty in a million per year. The analysis determined that the risk level in the nearest residential area will be below the EPA criteria of one in a million per year.* *The risk of shipping accidents is minimised by strictly adhering to international and Commonwealth marine guidelines. Fremantle Ports maintains a Marine Safety Plan, which sets out the procedures for ensuring safe operations within the Port of Fremantle.*	*No impact.*
	Transport and traffic.	*Ensure that the increase in road and rail transportation movements resulting from the Project does not adversely impact on the safety of the public.*	*Rail transport of materials already occurs along the railway proposed to transport the iron ore for the Project.* *Light and heavy vehicle traffic frequent the roods to be used for the transport of materials.*	*The increase in the road and rail traffic due to the Project has a significant impact on the existing road and rail networks and the safety of the Public*	*The percentage increase to road and rail traffic from the Project will be relatively small and will easily be accommodated on the existing networks without issue.* *Any hazardous materials trucked to site will be transported in accordance with the Dangerous Goods (Transport) (General) Regulations, 1999 and the Dangerous Goods (Road and Rail Regulations), 1999.*	*No significant impact.*

TABLE OF CONTENTS

Page No.

List of Tables

List of Figures

List of Plates

List of Appendices

List of Supporting Documents
(Available Upon Request)

Det Norske Veritas (2001) HIsmelt PER Risk Assessment. Prepared for HIsmelt Corporation Pty Ltd.

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PUBLIC ENVIRONMENTAL REVIEW

COMMERCIAL HISMELT® PLANT
KWINANA WESTERN AUSTRALIA
HISMELT (OPERATIONS) PTY LIMITED

1. INTRODUCTION

1.1 BACKGROUND

HIsmelt (Operations) Pty Limited (ABN 73 008 751 317) (the Proponent), acting as the manager on behalf of an unincorporated Joint Venture with a number of other companies, proposes to construct and operate a commercial scale HIsmelt® Process Plant (the Plant) at Kwinana in Western Australia. The Plant will be located at the site occupied by the existing HIsmelt Research and Development Facility (HRDF) within the northern portion of the Kwinana Industrial Area (KIA), 40km south of Perth (Latitude 32° 15' S and Longitude 115° 45'E (Figures 1.1, 1.2 and 1.3).

The Plant will initially produce around 820,000 tonnes per annum (tpa) of pig iron, referred to as Stage 1 of the Project. If the Stage 1 Plant is found to be technically and commercially viable, it is proposed to install an additional iron-making Plant (Stage 2) to double production to around 1.6 Mtpa of pig iron.

The HIsmelt® Process (the Process) is a direct smelting technology for the production of liquid iron (hot metal) using iron ore fines or any other appropriate ferrous feed material. The smelting will be undertaken in a molten iron bath using coal as the reductant and energy source. The process gas evolved from the molten iron bath will be combusted using an oxygen enriched Hot Air Blast (HAB) to optimise the energy balance.

The principal raw materials required for the Process are iron ore fines, coal and fluxes (lime and dolomite). Iron ore will be shipped to Kwinana from Dampier and railed from Koolyanobbing in Western Australia (see Figure 1.1). Coal will be shipped from the east coast of Australia to Kwinana. Iron ore and dolomite will be heated in a Preheater prior to being injected into a molten bath contained in a Smelt Reduction Vessel (SRV).

An on-site power generation facility will be established that will utilise the offgas from the Process to generate electricity. Air Separation Units (ASU) to supply oxygen and nitrogen will be an integral part of the Plants and is considered a component of this Project. It is currently envisaged that the ASUs will be built and operated by Air Liquide WA on the HIsmelt site. The ASUs will be designed to each supply 880 tonnes per day (tpd) of gaseous oxygen (95% purity) and 800 tpd of gaseous nitrogen to the Plant.

Pig iron produced in the Plant will be shipped for use in steel mills either within Australia or overseas. The unloading and loading of raw materials and product will be undertaken at the Fremantle Port Authority's (trading as Fremantle Ports) Kwinana Bulk Terminal Berth No. 2 (see Figure 1.3).

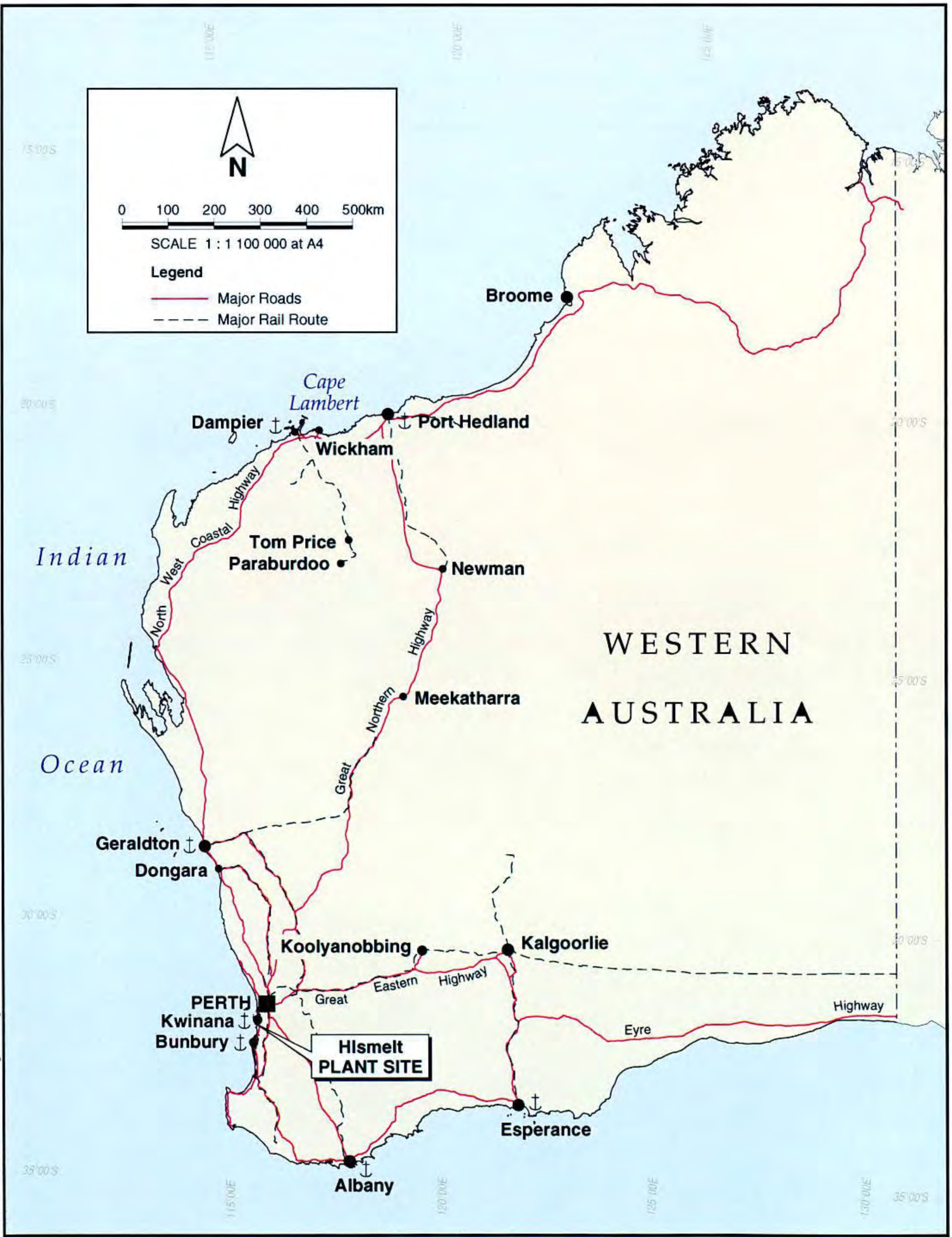
The Stage 1 and 2 Plants, associated facilities and activities, referred to hereafter as the Project, are the subject of this Public Environmental Review (PER).

The major components of the Project comprise:

- Process plants.
- Transport of materials and products.
- Power generation.
- Water supply and treatment.
- Air separation (oxygen and nitrogen) units.
- Waste disposal.

The Project was referred to the Western Australian Environmental Protection Authority (EPA) in October 2001, who determined that the Project was to be assessed under Part IV of the *Environmental Protection Act,1986*. The EPA set the level of assessment at PER with a four week public review period. This document has been prepared in compliance with the *Environmental Protection Act, 1986* and in accordance with the EPA guidelines provided as Appendix A.

The key characteristics of the HIsmelt Project are presented in Table 1.1.

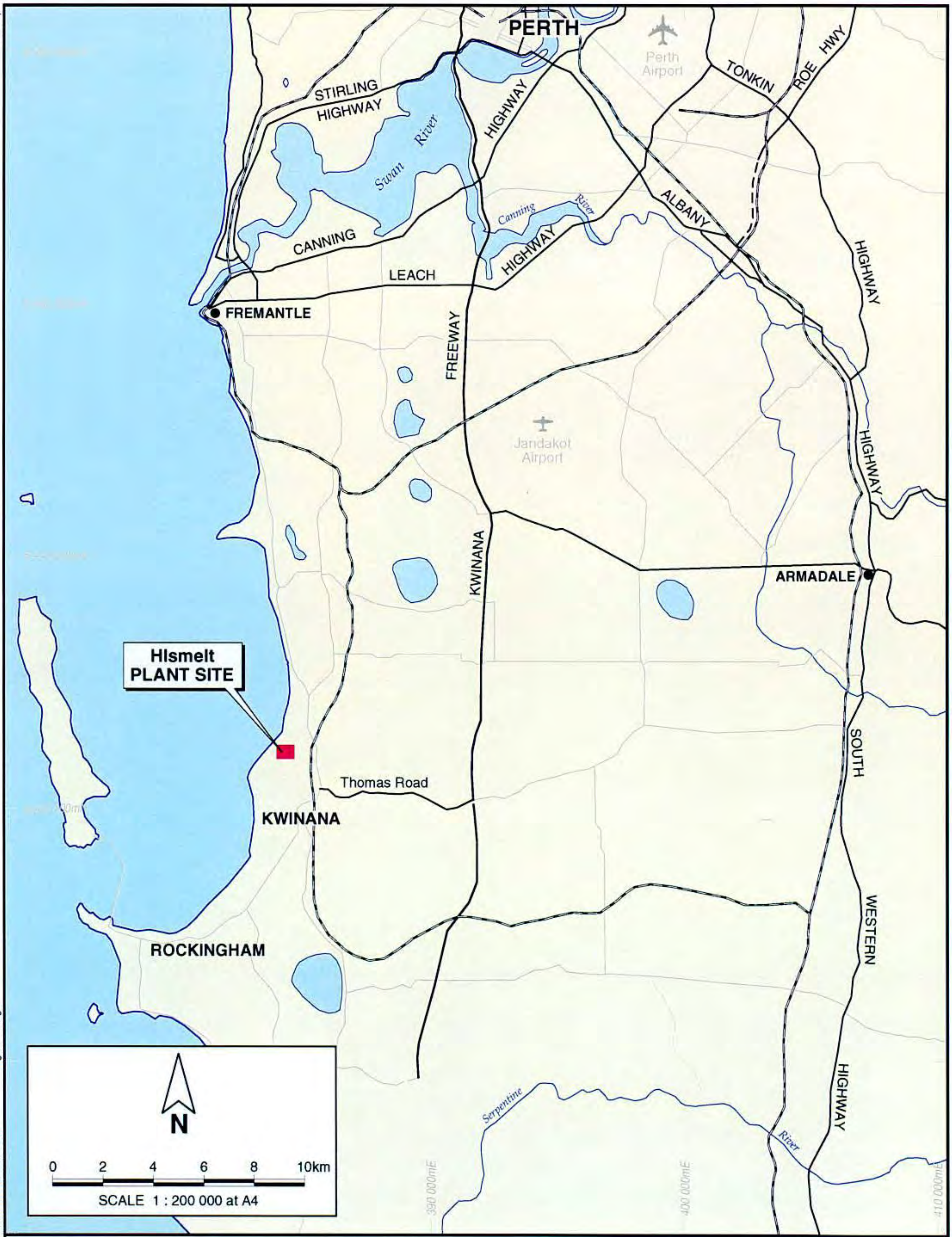


HIsmelt®

Kwinana HIsmelt Process Plant
PUBLIC ENVIRONMENTAL REVIEW

REGIONAL LOCATION

Figure 1.1



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HIsmelt®

Kwinana HIsmelt Process Plant
PUBLIC ENVIRONMENTAL REVIEW

LOCATION PLAN

Figure 1.2

HIsmelt®

Kwinana HIsmelt Process Plant
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AERIAL VIEW OF EXISTING PLANT

Figure 1.3

Table 1.1

Commercial HIsmelt Plant Key Characteristics (Estimated at the Time of Preparation of the PER)

Element	Stage 1	Stages 1 and 2
Project Purpose	To construct and operate a HIsmelt Process Plant in Kwinana to produce pig iron.	
Project Location	Leath Road, Kwinana Industrial Area, Western Australia.	
Life of Project (yrs)	20	20
Project Components	• Process Plants. • Transport of Materials and Product. • Water Supply. • External Electrical Supply. • Natural Gas Supply.	
Plant Components	• Raw Material Delivery and Storage. • Raw Material Reclamation and Preparation. • Ore Preheater. • Smelt Reduction Vessel. • Offgas System. • Flue Gas Desulphurisation System. • Pig Iron and Slag Production. • Power Generation Facility. • Air Separation Unit (Oxygen and Nitrogen Plant). • Water Supply Facilities and Circuits. • Effluent Treatment Facility. • Stormwater and Wastewater Collection Facilities. • Electrical Power Supply Facilities. • Natural Gas Supply Facilities. • Administration Facilities. • Plant Access Roads and Car Parking.	
Plant Operating Hours (per day)	24	
Operating Hours (per year)	7660 - 8760	
Pig Iron Production (ktpa)	820	1640
Slag Production (ktpa)	225	450
Gypsum Production (ktpa)	11.1	22.2
Iron Ore Fines (ktpa, by ship)	650	1300
Iron Ore Fines (ktpa, by Rail)	650	1300
Imported Coal (ktpa wet)	560	1120
Lime (ktpa)	70	140
Dolomite (ktpa)	70	140
Lime Kiln Dust (ktpa)	6	12
Natural Gas (TJ/a)	1480	2960
Ore Stockpiles (kt)	56 and 10	56 and 10
Coal Stockpile (kt)	57	57
ASU - Oxygen Production (tpd) - Nitrogen Production (tpd)	880 800	1760 1600

Table 1.1 (Cont'd)

Element	Stage 1	Stages 1 and 2
Greenhouse Gas Emissions (tonnes of CO_2/tonne of hot metal)	1.86	1.86
Greenhouse Gas Emissions (Mtpa CO_2 gross)	1.5	3
S0x Emissions - normal operations g/sec (tpa)	9 (250)	18 (500)
N0x Emissions g/sec (tpa)	21.8 (603)	43.6 (1206)
Particulate Emissions g/sec (tpa),	2.3 (64)	4.6 (128)
Water Usage kL/hr (GL/a)	405 (3.2)	810 (6.4)
Water Source (Kwinana Wastewater Recycling Plant is at the proposal stage).	Scheme - Assumed Kwinana Wastewater Recycling Plant - Preferred	
Construction Period months	20 – 24	20-24
Power Generation - No of Turbines	1	1
Power Generation (MW)	20	20
Emergency Power Supply (Standby from the grid) (MW)	10	10
Plant Area (ha)	21.1	36
Solid Waste (tpa)	6-10	12-20
Process Effluent (Plant expected to be in water balance).	0	0
No of Truck Movements (per day)	73	146
No of Ore Train Movements (per week)	10	20
Ship Movements (per year)	30 - 50	60 - 100
Workforce Numbers	65	125
Construction Noise	Comply with Environmental Protection Noise Regulations, 1997.	
Operational Noise at Residential Areas.	At least 5dB(A) below the assigned noise levels at residential areas.	
Operational Noise – Boundary dB(A)	65	65
Road Noise Increase in L_{Aeq} dB(A)	0.0	0.0
Rail Noise Increase in L_{Aeq} dB(A)	0.1	0.2
Noise – Shipping Operations	At least 5dB(A) below the assigned noise levels at residential areas.	
Risk at Plant Boundary	Less than fifty in one million per year.	
Risk at Residential Area	Less than one in one million per year.	

1.2 HISTORY OF THE HISMELT® PROCESS

HIsmelt Corporation, a wholly owned subsidiary of Rio Tinto, has been developing the HIsmelt® Process for the direct smelting of iron ore since 1981. The key drivers to develop this technology are as follows:

- The requirement for an alternative iron making process that can be economically implemented at a smaller scale compared to the blast furnace, whilst eliminating the environmentally harmful sinter plants and coke ovens that are associated with the blast furnace processing route.
- The ability to utilise cheaper and more abundant raw materials such as non-coking coals, non-agglomerated fine iron ores and iron bearing steel plant wastes.
- The need for new sources of iron metallics as feedstock for the rapidly growing electric arc furnace (EAF) industry, particularly in the Asian region.

The successful testing of the smelt reduction concept using a 60t steelmaking converter during the period 1982 to 1984 led to the construction of a small-scale pilot plant (SSPP) located in southern Germany. The SSPP operated from 1984 to 1990 and this phase of the project proved the viability of the technology. There remained however the question of scale-up of the process. The next phase of the Process development was the HIsmelt Research and Development Facility (HRDF), constructed at Kwinana, Western Australia. The HRDF was subject to a Public Environmental Review in 1989 (Dames and Moore, 1989) with environmental and works approval granted in 1991. The HRDF was constructed as a research and development facility to test the Process in a semi-continuous mode under a wide range of operating conditions. The original smelting vessel configuration was based on a horizontally shaped vessel capable of rotation through 90°. Whilst the Process was successfully demonstrated with this direct scale-up of the SSPP smelt reduction vessel the complexity of engineering a horizontal vessel limited its commercial viability. The horizontal vessel was operated over a number of campaigns between 1993 and 1996.

To overcome the deficiencies of the horizontal vessel a design was developed for a water-cooled vertical vessel. The vessel, which allowed the top injection of solids and the introduction of water-cooled panels to overcome the refractory wear problems encountered in the horizontal vessel, was commissioned in 1997 and operated to mid 1999. A wide range of ferrous feed materials and coal types were successfully tested with the essential features of the HIsmelt® Process and engineering viability of the vertical vessel demonstrated. The HRDF was placed on care and maintenance in May 1999.

The HIsmelt® Process has moved from pilot plant status to a position where it is ready for commercial application. The Process has addressed all of the key requirements of the industry for a successful alternative iron making technology, combining a high level of technical achievement with simple engineering concepts and plant technology.

The Plant will be the first commercial application of the HIsmelt® Process and when proved successful is expected to be the forerunner of a new generation of iron making plants around the world using this technology.

1.3 OBJECTIVE, SCOPE AND TIMING OF THE PROJECT

The objective of the Project is to establish a commercial scale HIsmelt® Process Plant in Western Australia for the direct smelting of iron ore to produce pig iron to be used in the production of steel. The Plant will initially produce around 820,000tpa of pig iron and if found to be technically and commercially viable, an additional iron-making Plant will be installed to double production to 1.6 Mtpa of pig iron. The Project considered in this PER is for both the Stage 1 and 2 Plants.

The Proponent proposes to commence construction as soon as the appropriate Project approvals have been obtained. Construction of the Stage 1 Plant is planned to commence in late 2002 and expected to take around 24 months with commissioning scheduled for 2004. Construction of the Stage 2 Plant will be contingent upon successful demonstration of the technical and commercial viability of the technology during Stage 1 and is expected to commence in 2006 at the earliest.

1.4 THE PROPONENT

The Proponent for the Project is HIsmelt (Operations) Pty Ltd acting as manager on behalf of an unincorporated Joint Venture between the following parties:

- HIsmelt Corporation Pty Ltd (ABN 12 022 183 552) a wholly owned subsidiary of Rio Tinto Limited;
- Nucor Australia, LLC, a wholly owned subsidiary of Nucor Corporation (USA);
- M C Iron and Steel Pty Ltd (ABN 66 064 296 243) a wholly owned subsidiary of Mitsubishi Corporation (Japan); and
- China Shougang International Trade and Engineering Corporation, a wholly owned subsidiary of Shougang Corporation (of China).

The Plant will be managed and operated on behalf of the Joint Venture by HIsmelt (Operations) Pty Ltd. The contact details for HIsmelt are provided below.

HIsmelt (Operations) Pty Ltd
c/o HIsmelt Corporation Pty Ltd
PO Box 455
KWINANA
WESTERN AUSTRALIA 6966

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Facsimile:	08 9437 0601
e-mail	enviro@hismelt.riotinto.com.au
web site	www.hismelt.com

1.5 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The Environmental Impact Assessment (EIA) Process is designed to ensure the environment is protected if, and when, new development proceed. During the EIA Process information is provided to the EPA, Department of Environment and Water Catchment Protection (DEWCP) (formerly the Department of Environmental Protection (DEP)), other regulatory authorities and the public on the proposed development, particularly those aspects with potential environmental and social impacts. The process is run in parallel with project development so environmental protection measures can be incorporated and the proponent can commit to responsible environmental management.

The Western Australian EPA states in its Guide to Environmental Impact Assessment in Western Australia "The process is designed to:

- ensure that Governments gets timely and sound environmental advice before they make decisions;
- encourage and provide opportunities for public involvement in the environmental aspects of proposals before decisions are made;
- ensure that proponents take primary responsibility for protecting the environment affected by their proposals;
- encourage environmentally sound proposals which minimise adverse environmental impacts and maximise environmental benefits;
- provide for continuing environmental management; and
- promote environmental awareness and education."

This Project will be assessed under the Western Australian *Environmental Protection Act, 1986.* Administrative procedures associated with the Act formalise the review process and enforce the Proponent's management commitments. An outline of the PER process is shown on Figure 1.4.

Following the referral of the HIsmelt Project to the EPA in October 2001, the EPA advised the Proponent that a PER would be required to be prepared and released to the public for a four week review period. Guidelines were issued by the EPA to assist the Proponent in identifying the issues to be addressed in the PER. A copy of the guidelines is provided as Appendix A.

1.6 AIM OF THE PUBLIC ENVIRONMENTAL REVIEW

The PER aims to provide relevant details of the Project, the potential environmental impacts and the proposed management techniques to enable the environmental acceptability of the Project to be assessed.

The main text of the PER is structured into the following five major components:

- Introduction, benefits and the alternatives (Sections 1, 2 and 3).
- Project description (Section 4).
- Description of the existing biophysical and social environment (Section 5).
- Consultation programme (Section 6).
- Issues and management (Sections 7, 8, 9 and 10)

The PER also contains the following appendices to support the main text:

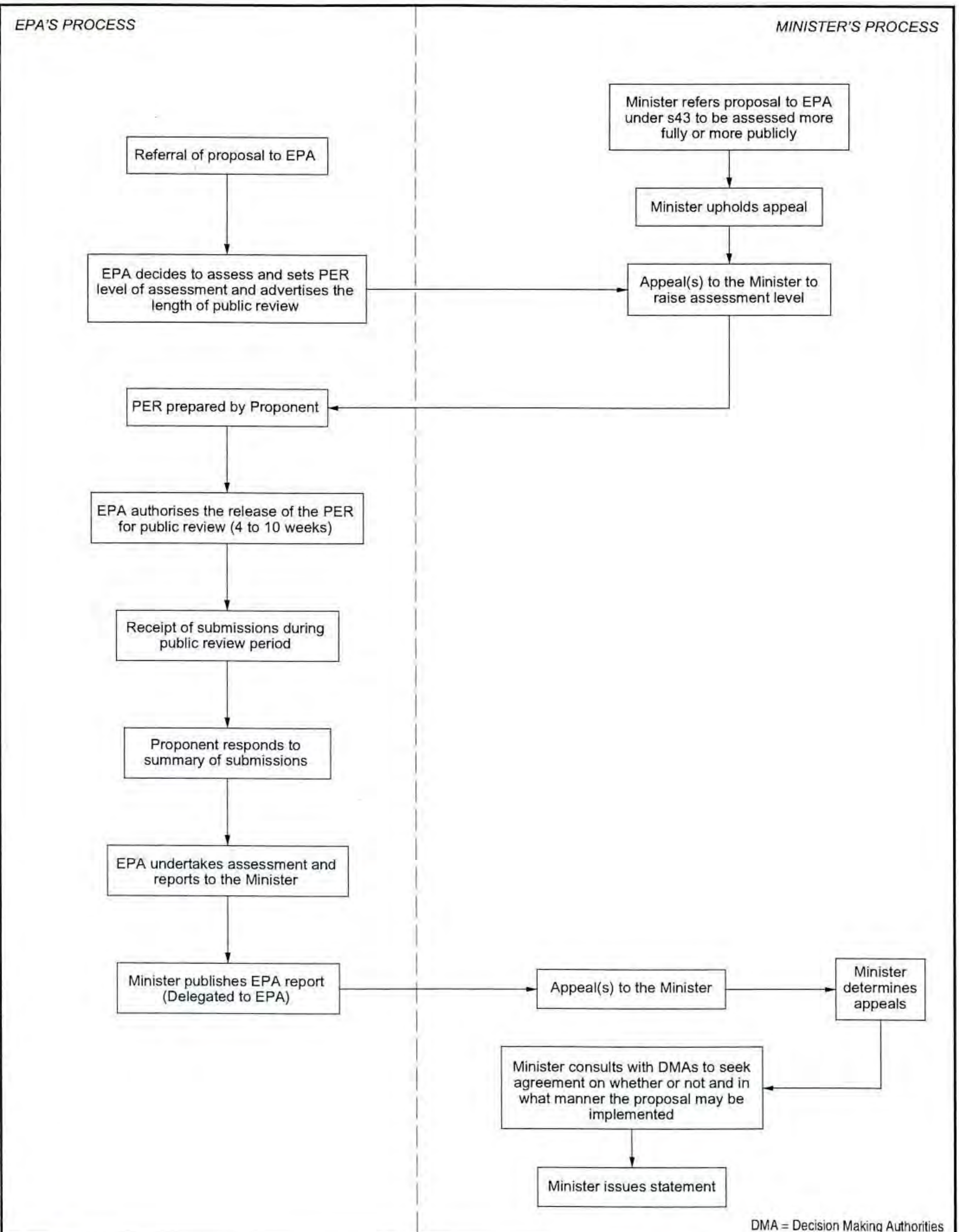
- Environmental Protection Authority Guidelines for the PER (Appendix A)
- A description of the Flue Gas Desulphurisation System (Appendix B)
- Air Quality Assessment (Appendix C)
- Summary of the groundwater quality for the site (Appendix D).
- Register search for Aboriginal sites (Appendix E).
- Summary of the consultation programme (Appendix F)
- Discussion on the chemistry of Dioxins and Furans (Appendix G)
- Acoustic Assessment for the Plant (Appendix H)
- Fremantle Ports Environmental Fact Sheets on TBT, ballast water and oil spills (Appendix I)

1.7 RELEVANT LEGISLATION AND POLICIES

In addition to obtaining approval from the State Minister for the Environment, the Proponent will comply with legislation and regulations administered by a number of State and Federal Government bodies. The Plant site is a designated mine site and will comply with the *Mines, Safety and Inspection Act, 1994*. Other legislation relevant to the Project includes the following:

State

- *Environmental Protection Act, 1986* (amended 1994).
- *Mines, Safety and Inspection Act, 1994.*
- Mines, Safety and Inspection Regulations, 1995.
- Dangerous Goods (Transport) (General) Regulations, 1999.
- Dangerous Goods (Road and Rail) Regulations, 1999.
- Dangerous Goods Regulations, 1992
- *Explosives and Dangerous Goods Act, 1961.*
- *Local Government Act, 1995.*
- *Industrial Lands (Kwinana) Agreement Act, 1964.*
- *Industrial Lands (Kwinana) Railway Act, 1966.*



PUBLIC ENVIRONMENTAL REVIEW PROCESS

HIsmelt®

Kwinana HIsmelt Process Plant
PUBLIC ENVIRONMENTAL REVIEW

Figure 1.4

- *Town Planning and Development Act, 1928 – 1983.*
- *Metropolitan Region Town Planing Scheme, 1959.*
- *Water Corporation Act, 1995.*
- *Water and Rivers Commission Act, 1995.*
- *Conservation and Land Management Act ,1984.*
- *Aboriginal Heritage Act, 1972.*
- *Bush Fires Act, 1954.*
- Environmental Protection Regulations, 1987.
- Environmental Protection (Kwinana) (Atmospheric Wastes) Policy, 1992.
- Environmental Protection (Liquid Waste) Regulations, 1996.
- Environmental Protection (Noise) Regulations, 1997.
- *National Environment Protection Council (Western Australia) Act, 1996.*
- Environmental Protection (NEPM- NPI) Regulations, 1998.
- *Heritage of Western Australia Act, 1990.*
- *Health Act, 1911.*
- *Wildlife Conservation Act, 1950.*
- *Marine and Harbours Act, 1981.*
- *Western Australian Marine Act, 1982.*
- *Western Australian Planning Commission Act, 1985.*

Federal

- *Environmental Protection Biodiversity and Conservation Act, 1999*
- *Australian Heritage Commission Act, 1975*
- *Protection of the Sea (Prevention of Pollution from Ships) Act, 1983*
- *Navigation Act, 1912*
- *National Environment Protection Council Act, 1994*

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2. BENEFITS OF THE PROJECT

The Project will provide significant direct and indirect benefits to the nation, state and local community as presented in this section.

2.1 NATIONAL BENEFITS

Benefits to Australia from establishing a commercial HIsmelt® Process Plant in Australia are as follows:

- Proving the viability of the HIsmelt® Process at a commercial scale will provide the global iron and steel industry with an alternative to the conventional blast furnace iron-making route.
- The Process has significant environmental advantages over blast furnace technology. Blast furnaces have associated coke ovens and sinter plants, which cause significant environmental impacts.
- Greenhouse gas emissions per tonne of pig iron will be significantly lower in the HIsmelt® Process than from conventional, currently installed iron making technology.
- Dioxins, produced in other iron smelting processes, will not be generated in the high intensity HIsmelt® Process.
- The product will be a high quality pig iron that can be used in Electric Arc Furnace (EAF) steel mills enabling them to produce high grade steels from a predominantly scrap feedstock and cold pig iron.
- The Project would allow Australia's raw material producers to be more competitive in supplying material to EAF plants.
- Owning the HIsmelt® Process technology that produces iron for use in overseas EAFs will result in additional Australian iron ore and coal sales.
- The Project's Joint Venture partners, Nucor and Shougang, would be investing in an Australian project for the first time. This may develop into further trade and foreign investment opportunities.
- An annual production of 820,000 tonnes of pig iron is currently valued at A$200 million per annum.
- It is estimated that Australia's Gross Domestic Product (GDP) will increase by $176 million dollars[1].
- Revenue to the Commonwealth Government would increase by $144 million[1].
- This Australian developed technology has the potential to revolutionise the global steel industry. The Process is the most efficient iron ore processing technology in the world and shows Australian engineering excellence, which is likely to have spin offs for other Australian activities.

[1] based on benefits to the year 2020 in 2001 prices for the Stage 1 Plant (Adams, 2001)

2.2 BENEFITS TO WESTERN AUSTRALIA

Western Australia would be seen to be in the forefront of world class iron making technology, with the potential of being the location of a new globally competitive steel industry. In addition the following benefits would be achieved for each Stage of the Project:

- A significant proportion of an estimated $400 million capital expenditure will be to industries within Western Australia.
- Considerable value will be added to the State's reserves of lower value iron ore fines, particularly those that are not suitable as blast furnace feed due to their high phosphorus content. This would extend the life and significantly add to the value of the iron ore resources providing benefits to iron ore producers and the community in general.
- The Process will result in a more sustainable use of the State's iron ore resource.
- The establishment of a new value added industry to the State.
- Western Australia's Gross State Product will be increased by $128 million[2].
- The generation of around 800 jobs in the State[2].
- Net international exports from the State will be an additional $160 million[2].
- The State's revenue will increase by $19 million[2].

2.3 LOCAL BENEFITS

Local benefits relate to those specific advantages that the Project will provide to the communities in the vicinity of the Plant site. The national and state benefits listed above would also be of benefit to the local communities. Local benefits would include the following:

- Kwinana would be recognised as the location of a world's first Commercial HIsmelt® Process Plant.
- Direct employment for an average of 230 people (peak of around 320) during the 24-month construction period for each of the Stage 1 and Stage 2 Plants.
- Provision of an estimated 65 permanent positions for the operation of the Stage 1 Plant and around 60 positions for the operation of the Stage 2 Plant.
- Provision of indirect employment opportunities through local maintenance and service contractors.
- Increased numbers of visitors inspecting the Plant in operation and as a result of the anticipated interest in the Process by iron and steelmakers, with spin off benefits to local hospitality providers.

[2] based on benefits to the year 2020 in 2001 prices for the Stage 1 Plant (Adams, 2001)

2.4 THE HISMELT PROJECT AND SUSTAINABILITY

There is currently a global move to adopt the principles of sustainable development, which is defined as meeting the requirements of the current generation without jeopardising the needs of future generations. Sustainable development requires corporations to consider the "triple bottom line" effects of their business activities, which is to consider the environmental, social and economic aspects.

Rio Tinto has taken a leadership role within the minerals sector on sustainable development, its chairman Sir Robert Wilson being one of the driving forces behind the Global Mining Initiative.

The HIsmelt® Process meets the principles of sustainable development, as discussed in the following sections, and will assist the iron and steel industry to become more sustainable. The Project also exhibits many benefits with regards to sustainability on a state and regional level.

2.4.1 Environmental

2.4.1.1 Resource Stewardship

Industry acceptance of the HIsmelt® Process will contribute to sustainability due to the ability to utilise lower grade, high phosphorus iron ore fines, which are currently unsaleable. This will:

- result in more efficient utilisation of iron ore resources;
- effectively double Australia's iron ore resources; and
- lead to increased longevity of mining operations, and hence delay the requirement to open new mines thereby addressing the issue of intergenerational equity.

2.4.1.2 Pollution Prevention

The HIsmelt® Process contributes to reducing the environmental impacts associated with ironmaking technology due to the following:

- The higher ore/waste ratio results in a better specific energy utilisation, and hence reduced greenhouse emissions, by mining operations since less energy is used in processing and transporting waste per tonne of ore mined.
- Lower specific energy utilisation per tonne of hot metal due to the elimination of feed preparation modules such as coke, sinter and pellet plants that are currently associated with integrated steel mills, and therefore lower greenhouse emissions.
- The elimination of coke, sinter and pellet plants will result in a reduction in the emissions of gaseous pollutants, and the quantities of solid waste and liquid effluent.
- The ability to accept steel plant waste oxide materials as feed will assist the steel industry to reduce its solid waste.

The Project may also reduce the environmental impacts of the existing industries in Kwinana through the identification of synergies with other industries such as the exchange of waste streams for use as Process input, which are actively being explored. When the Plant is operational further synergistic opportunities will be explored. The use of iron rich wastes from other Kwinana industries as input to the Plant may be feasible and if this were achieved it would help Kwinana Industry move closer to one of its sustainability targets of zero net wastes.

2.4.1.3 Product Stewardship

Pig iron production at the Plant will have used less energy and resulted in lower emissions per tonne than if produced by the conventional (blast furnace) route. The product is inert and its transportation or use does not pose a risk to the environment or the health and safety of those involved.

The product will be used as feed to EAF steel mills where it will facilitate the recycling of steel scrap to produce higher quality steel than would otherwise be possible.

2.4.2 Economic

The HIsmelt® Process will result in a greater sustainability of the iron and steel industry by:

- Providing an alternative iron making process that has lower capital and operating costs than conventional processes and therefore represents a cost effective replacement for existing plants that require capital expenditure for maintenance and rebuilding.
- Enabling the scrap based minimill sector to move into the production of higher grades of steel by supplying high quality virgin iron units to the EAF to supplement the scrap charge.
- Providing a process with flowsheet flexibility that enables plant design to be tailored to a customer's requirements. For instance the Plant can:
    - be configured to supply hot metal to an EAF, thereby realising power savings in the EAF;
    - fit into an integrated plant as a blast furnace replacement; and
    - be configured for stand-alone pig iron production.

2.4.3 Social

The Project will add to the sustainability of the local communities through:

- building capacity (or utilisation of currently under-utilised capacity) in fabrication and maintenance activities. An estimated 70% of plant modules will be fabricated locally, and the major maintenance activities for the site will be outsourced locally; and
- helping to expand local businesses and services.

Proliferation of the HIsmelt® Process will contribute to the greater sustainability of Western Australian Iron Ore Mining communities through the effective increase in resource tonnage and mine life. Service companies and government institutions are more likely to set up and continue operations within the local communities.

3. EVALUATION OF ALTERNATIVES

The Proponent considered many options during the development of the Project such as selection of technologies, plant location, raw materials, transport of materials, water supply and waste disposal. An overview of the alternatives considered, with a focus on the environmental aspects, is presented in the following section.

3.1 PROCESSING TECHNOLOGY

The Process has been developed by HIsmelt Corporation as an improved method of producing liquid pig iron. The only alternative technologies currently available for the production of pig iron at a commercial scale are considered to be:

- Blast Furnace
- Mini Blast Furnace
- Corex[3]® Process

While not strictly a substitute for pig iron, Direct Reduced Iron (DRI) and Hot Briquetted Iron (HBI) can also be used as a source of iron units for EAF steel mills. Therefore these process technologies are also discussed as alternatives to the HIsmelt® Process.

3.1.1 Blast Furnace Technology

Blast furnaces have been used to process ore for over 100 years. The modern blast furnace has evolved as a highly efficient unit capable of producing large tonnages of molten iron, most of which is processed in the molten state in basic oxygen furnaces (BOFs) to form steel. However, some of the molten iron is cast as pig iron and sold as a scrap substitute to EAF based minimills.

Blast furnaces require either lump iron ore or iron ore fines that have been agglomerated, either by pelletising or sintering, as inputs. The iron ore must have a low level of phosphorus as the strongly reducing conditions in the blast furnace cause the phosphorus to be retained within the iron, which if carried through has a deleterious effect on the properties of the steel. The reductant and energy source used in blast furnaces is primarily coke, which is produced from metallurgical grade coal.

Coke is produced by heating coking or bituminous coals to 900 to 1100°C in an oxygen free environment for 15 to 21 hours. Volatiles such as coke oven gas (essentially methane and hydrogen) and tars are driven off the coal, collected and transported to a by-product recovery plant. The coke is removed from the oven by an operation called pushing, and then quenched with water. Emissions from a coking plant include sulphur dioxide (SO_2), nitrogen oxides (NOx), particulates, carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbons, poly-aromatic hydrocarbons (PAHs), benzene, hydrogen sulphide (H_2S) and methane (CH_4). Wastewater from quenching coke and the by-products plant must be treated in a biological effluent treatment

[3] Registered Trade mark of VAI

plant to remove cyanides, phenols, thiocyanates, nitrogen containing compounds and solids prior to discharge. In many countries environmental constraints restrict the construction of new coke ovens, which will in the future lead to a potential shortage of coke on the global market.

Sintering involves the heating of iron ore fines and other iron bearing materials with flux and coke breeze to produce a semi-fused agglomerate. This sinter after cooling and crushing provides a porous and sized material with strength characteristics suitable as a blast furnace feed. Steel plant waste oxides, such as mill scale and flue dusts are often recycled through Sinter Plants. Emissions from the sintering process include SO_2, NO_x, particulates, CO, CO_2, Dioxins, lead (Pb), cadmium (Cd), volatile organic compounds (VOCs), hydrogen chloride (HCl) and hydrogen fluoride (HF).

Pelletising involves rolling a mixture of finely ground iron ore, fluxes, water and binder to form 12mm diameter spheres. The 'green pellets' are hardened by drying and heating to 1300 °C in a kiln or on a grate. Emissions from the pelletising process are dependent on the raw materials used and include most of those listed for sinter plants. Particulate emissions are generally at lower levels than those from the sinter plant.

The blast furnace is a counter-current, packed-bed reactor. Coke, lump iron bearing materials and flux are alternatively layered and charged into the stack from the furnace top. Preheated air (between 1000 and 1200°C) is blasted through tuyeres at the bottom of the furnace. Pulverised coal, hydrocarbons and oxygen may also be injected through the tuyeres. The hot air blast burns the coke in front of the tuyeres to provide heat for the reduction reactions and heating and smelting of the feed materials and products.

The HIsmelt® Process, through its direct use of iron ore fines and ground coal, does not require coke ovens, sinter plants or pellet plants. This results in a significant improvement in environmental performance and energy efficiency compared to the blast furnace iron making process.

3.1.2 Mini Blast Furnace

Blast furnace technology has generally evolved in the direction of larger units, replacing older and smaller sized blast furnaces. However the mini blast furnace, with lower capital investment and greater flexibility in operation due to its simplicity, continues to be of interest in specific locations, such as Brazil, India and China. The use of heat exchangers (rather than hot blast stoves) reduces the capital cost of the plant but results in lower hot blast temperatures (around 800°C). The process is essentially the same as the blast furnace except lower grade feed materials are used, specifically lower quality coke or charcoal can be charged. Technological development however has lagged behind the medium and large size blast furnace and as a result the mini blast furnace is generally less efficient resulting in higher greenhouse gas emissions.

The HIsmelt® Process; has a lower capital investment, can directly use a range of coal types, has the flexibility of operation to match the mini blast furnace, offers an alternative to the mini blast furnace with improved environmental performance.

3.1.3 The Corex® Process

The Corex® Process uses two separate reactors, a reduction shaft furnace and a melter gasifier. Lump ore or pellets are charged into the reduction shaft where reduction is performed by the offgas from the melter gasifier to produce DRI. In the melter gasifier coal is charged directly and mixed with DRI from the reduction shaft. Combustion with oxygen injected into the melter gasifier results in the melting of the DRI and the production of a highly reducing gas that is then used in the reduction shaft. The quantity of reducing gas produced is far in excess of that required for reduction and a large quantity is available for electricity generation or additional DRI production.

Corex® Plants require lump ore or pellets, therefore, a pellet plant would be necessary if iron ore fines are to be used. As for blast furnaces, highly reducing conditions in the process preclude the use of ore with high phosphorus content as the phosphorus remains in the iron rather than the slag. While non-metallurgical coal is predominantly used in the process, a minimum of 5% coke is required for production at design capacity. The Corex® Process results in significant benefits compared to blast furnace technology, however it does not entirely eliminate the environmental impacts of coke ovens and pellet plants associated with blast furnaces.

The Corex® Process is unlikely to be economically viable without a market for the surplus electricity generated by combustion of the offgas or the use of Process offgas for additional DRI production.

The HIsmelt® Process is considered to be more flexible to customers requirements than the Corex® Process as it may be configured to be either in energy balance or to produce surplus electricity. Phosphorus in the Process is removed in the slag due to the lower temperature and higher oxygen potential at the slag - metal interface, thus allowing the use of ores with higher phosphorus content.

3.1.4 Direct Reduced Iron/Hot Briquetted Iron

Iron ore may be processed to produce DRI or HBI, either of which can be used as feed for the electric arc furnace steelmaking process. A number of commercial technologies for the production of DRI or HBI exist. Most of these processes are based on natural gas as the reductant with the methane firstly being reformed to form CO and Hydrogen (H_2). The CO and H_2 then react with the iron ore, which removes the oxygen and forms an iron product. A few coal-based processes are also available. Most of the DRI/HBI processes require the iron ore to be in the form of high grade lump or to be in an agglomerated state such as pellets.

The abundance of both natural gas and iron ore would suggest that a number of these value-adding plants should have been already established in the Pilbara Region of Western Australia. However, the application of these technologies to the processing of Western Australian iron ore is not straightforward due to a number of factors. Only one plant has been established, the BHP-Billiton HBI plant at Port Hedland, which has not proven to be a commercial success to date.

The main factor preventing the widespread application of DRI/HBI technology in WA is the gangue content of most Western Australian iron ores. The reduction of iron ores with natural gas to form either DRI or HBI takes place in the solid phase with no separation of impurities (gangue). Thus to produce a DRI or HBI product of acceptable quality requires that :

- high quality iron ores are used as feed to the process, which are the premium product of the Western Australia iron ore mines that comprise the bulk of the current exports; or
- the ores undergo a beneficiation step prior to being fed to the process, resulting in a tailings stream that contains a high proportion of the iron that was input to the beneficiation step; and in addition
- high phosphorus ores cannot be fed to these processes as the phosphorus stays in the DRI or HBI and would end up in the steel product requiring a costly de-phosphorisation step to be undertaken prior to casting of the steel.

The combination of the above factors has contributed to Rio Tinto Iron Ore making the decision to use the Hismelt® Process for adding value to its considerable reserves of lower grade and high phosphorus iron ore fines.

3.2 PLANT LOCATION

In investigating the feasibility to proceed with the commercialisation of the Process in Australia, the secondary processing obligations associated with Rio Tinto Iron Ores' Pilbara Operations led to Western Australia being focussed on as a location for the Plant. A number of potential locations within Western Australia were investigated based on their suitability and an economic perspective.

The selection criteria included:

- logistics for raw materials supply of ore, coal, fluxes and water;
- proximity to port and rail infrastructure for the delivery of raw materials and the export of product;
- proximity to major regional centres;
- social and environmental aspects;
- supply of utilities; and
- availability of suitable land.

The sites selected for further evaluation based on the above criteria were:

- Pilbara
  - Cape Lambert
  - Dampier
  - Quarry Flats
  - Maitland Estate
- Midwest
  - Oakajee

- Perth
  - Kwinana
- Southern
  - Bunbury (old Western Power Plant Site)
  - Esperance

The Pilbara locations were in relatively close proximity to iron ore mines and had access to deepwater ports. Coal and fluxes would be transported by ship. However, the capital cost for a plant of the size proposed for the Project would be increased significantly if located in the Pilbara due to higher labour costs, the cost of construction camps, the requirement for a desalination plant to produce cooling water and the necessity to construct wharf facilities for the receival of coal shipments. The Pilbara remains a potential location for a larger scale HIsmelt Plant in the future.

The Midwest region was included as it has the potential to be a major regional industrial area. However, the current lack of port infrastructure is a major barrier to development of the area at this time.

The Kwinana site met the selection criteria. Infrastructure exists for the iron ore to be delivered to the site by either ship or rail. Coal would be shipped to Kwinana from Queensland using standard shipping routes. If the process is modified in the future to allow Collie coal to be input then the coal can be railed to Kwinana. Lime (used as flux) is locally available and would be delivered by road tanker. Dolomite would be shipped from South Australia.

The old power station site in the Bunbury Harbour area was also considered. For Stage 1, all of the ore and coal would be shipped through the Bunbury Port. There is the potential in the future to use Collie coal if alternative pre-reduction systems are considered. The site is in relatively close proximity to residential areas, and thus has only a limited buffer zone. Pumps are available at the site for the intake of seawater for cooling, which would be a preferred alternative to using fresh water.

Infrastructure exists at Esperance for ore to be railed from Koolyanobbing. Coal would be shipped from Queensland. The shipping route is not considered to be a normal trading route and would therefore attract a premium in freight rates.

From the initial list of potential sites further evaluation was carried out to assess the suitability of each of the sites. The following criteria were used to rank the sites:

- Infrastructure capital expenditure.
- Plant capital expenditure.
- Labour cost (construction).
- Operating cost.
- Remoteness of location.
- Manageable environmental impact.
- Perceived social acceptance.

Table 3.1 presents a matrix of the locations compared to the above criteria ranked from very high to low where low is preferred.

Table 3.1

HIsmelt Site Selection Criteria and Ranking

Location	Infrastructure Requirement	Capital Expenditure	Labour Cost	Operating Cost	Proximity to Major Population Centre	Social and Environmental Constraints*	Overall Ranking
Cape Lambert	H	M	H	L	H	L-M	3
Dampier	H	H	H	L	H	L	5
Quarry Flats	H	H	H	L	H	L	6
Maitland Estate	VH	M	H	L	H	M	7
Oakajee	VH	VH	M	H	M	L	8
Kwinana	L	L	L	L	L	M-H	1
Bunbury	L	M	L	L	L	M	2
Esperance	H	M	M	M	L	L-M	4

Notes: VH very high (least preferred)
H high
M Medium
L Low (most preferred)
* Subjective assessment undertaken by HIsmelt based on the social and environmental issues identified for each site.

Using the analysis in Table 3.1 the Kwinana site was found to be the preferred site for the Plant.

One of the significant advantages of locating the Plant at Kwinana is the ability to utilise much of the existing HRDF plant. The neighbouring bulk material handling infrastructure for the import and export of materials is also an advantage. The site for the Plant, which is already cleared, is within the KIA and has been used for similar industry since 1954. Construction labour will be sourced from the Metropolitan Area, therefore, an on-site construction camp will not be required.

3.3 RAW MATERIALS

3.3.1 Iron Ore

Iron ore provides the iron units required for hot metal production. The Process utilises low cost iron ore fines and can smelt ores containing higher levels of phosphorus than other iron and steel making processes.

The major suppliers of iron ore in Western Australia are Rio Tinto (Hamersley Iron and Robe River), BHP Billiton and Portman Mining Limited. Other internationally traded ores have not been considered due to higher transport costs and the benefits to the State generated by processing Western Australian ores.

Hamersley Iron has large quantities of low value or unsaleable fines and will supply HIsmelt with a special high phosphorus blend of ore referred to as HIsmelt Special Fines.

Portman Mining also produces high phosphorus fines at its Koolyanobbing mine, which are currently stockpiled. Portman Mining has identified a resource in the existing mine areas, sufficient for at least the first five years of Plant operation. Supply beyond the initial five years may be available if the proposed Northern Tenement development at Koolyanobbing proceeds.

Both the Portman and Hamersley Iron fines contain approximately 62.5% iron on a dry weight basis. It is currently envisaged that the ore will be initially sourced equally from both Portman and Hamersley Iron and blended for input into the Process.

3.3.2 Coal

The three major functions of coal used in the Process are:

- for the removal of oxygen from the iron bearing feeds (reduction);
- to provide energy to the Process; and
- to carburise (add carbon to) the molten iron product.

Coal composition varies widely and the major parameters of importance for the Process are:

- Volatile Matter - the lower the volatile content the more efficient the coal is as a fuel and reductant.
- Calorific Value - determines how much energy the coal will supply to the Process.
- Ash - low ash coals are preferred, as the ash requires the addition of flux to facilitate its removal as slag.
- Moisture Content - coals with high inherent moisture content result in a higher energy consumption to remove the moisture.
- Sulphur Content - it is desirable to minimise the sulphur input to the Process as:
  - a portion of the sulphur remains in the pig iron and must be removed to meet the current product specifications;
  - the offgas must be scrubbed to remove sulphur dioxide; and
  - sulphur adversely influences Process performance.

Other coal properties that may influence coal performance and/or selection include:

- oxygen content;
- phosphorus content;
- ash chemistry;
- alkali content; and
- Hardgrove Grindability Index (HGI).

In order to minimise the technical risk in scaling up the process, similar low volatile coals to those predominantly used at the HRDF will be sourced for the Project. HRDF successfully operated with a range of coal types. The low volatile coals were found to offer lower operating costs. The possible sources for low volatile coals included:

- Queensland
- China
- Vietnam
- South Africa

Charred Collie coal was also considered.

Queensland

Queensland has significant reserves of semi-anthracite and low volatile bituminous coals with five mines currently producing semi-anthracite.

China

The Chinese coal industry is growing rapidly and there has been a large amount of capital spent on export-related infrastructure. China is the word's largest producer of (semi-) anthracite and has massive reserves of these coals. The most promising sources of supply in China, due to their resource base and supply logistics, are from Shanxi and Henan provinces and coalfields in the Beijing region, all of which are planning to increase exports. Chinese exporters are in a strong position to meet additional demand and compete with Australian producers.

Vietnam

Total coal production in Vietnam has increased significantly in the last decade with the vast bulk of this material being anthracite. The coastal location of the coalfields makes exports very attractive to the producers. Much of the supply from Vietnam is high quality although the coal can be difficult to grind. There is a high sovereign risk for foreign companies doing business in Vietnam, which is delaying further expansion of anthracite resources.

South Africa

South Africa has been a long-term exporter of anthracite coals. However in recent years exports have dwindled due to competition from China and Vietnam into the Asian market. The South African mines also tend to have high cash costs. However, they will increase market presence when prices from other sources are high.

Charred Collie Coal

The Collie coalfield, located 200 km south of Perth, is the only current site of commercial coal production in Western Australia. The coal has a high volatile and moisture content, which makes it unsuitable for direct use in the current Process proposed for the Project. However, charring of Collie coal produces a product that may be suitable for use in the Process. A preliminary analysis of the viability of charring Collie coal, which was performed in conjunction with the Collie producers, indicated that it might be economically viable. No commitment to the use of charred Collie coal will be made by the Proponent until the commercial Process is proven and long-term demand can be demonstrated.

Coal Selection

A blend of Queensland coals has been selected for input into the initial operation of the Plant due to coal characteristics, reliability of supply, operating experience, lead-time and economics. While competitive prices have been obtained for Chinese and Vietnamese coals these sources are not considered suitable as base suppliers for initial Plant start-up.

3.3.3 Fluxes

Gangue in the ores and ash in the coals primarily consist of silica and alumina. Fluxes containing lime and magnesia are used to remove the gangue and ash materials as a slag. The chemistry of the slag must be controlled to minimise refractory wear, maintain slag fluidity and enhance the capture of sulphur and phosphorus in the slag.

Fluxes can either be supplied in the calcined or uncalcined states (calcining is the process whereby a raw material, such as limestone, is subjected to high temperatures (>900 °C) with the result that carbon dioxide and moisture being driven off to form a simple oxide such as lime). Calcined fluxes can be directly injected to the SRV. Uncalcined fluxes, injected into the SRV, would significantly lower production due to the highly endothermic nature of calcination. The Process economics can be improved if the uncalcined fluxes are added to the preheat stage and the SRV offgas is used to achieve calcination. Experience has shown that 70% of any calcium carbonate ($CaCO_3$) will calcine to CaO and 100% of any magnesium carbonate ($MgCO_3$) will calcine to MgO under the conditions prevailing in the Preheater.

Flux materials that can be utilised in the Process include:

- Lime, both calcined and uncalcined;
- Dolomite, both calcined and uncalcined;
- Magnesite, both calcined and uncalcined; and
- BOF slag.

If calcined fluxes are to be used, it is preferable that they are sourced locally as:

- calcined materials tend to be reactive to moisture requiring that they are transported and stored in sealed containers which is both difficult and costly when large tonnages are involved;
- calcined materials generally have a high proportion of fine particles which would cause difficulty in handling bulk quantities of the materials at the jetty (since the main dust control technique, water sprays, cannot be employed due to the reactivity of the material to moisture); and
- calcined materials are relatively expensive and therefore transport costs should be as low as possible to minimise the overall flux costs.

Based on an assessment of process performance and quoted delivered costs the most suitable combination of flux supply is calcined lime, (most likely to be sourced from Cockburn Cement, located 6 km north of the site), and uncalcined Ardrossan dolomite from South Australia. BOF slag to be sourced from either Whyalla in South Australia or Port Kembla in New South Wales may be a useful alternative if the use of calcined lime becomes uneconomic.

3.4 WATER SUPPLY

The Plant will require water for cooling and gas cleaning. Water will be recycled wherever possible. Make up water will be required to replace the water evaporated through the cooling towers and that removed as blowdown. The Proponent considered both the use of seawater and freshwater as cooling water.

3.4.1 Seawater

Seawater is used for cooling by a number of plants in the vicinity of the site including the BP Refinery, the Kwinana Power Station and has been approved for the Global Olivine WA project on a nearby site. Seawater was considered for cooling use in the HIsmelt Plant. However, this option has not been pursued due to the following factors:

- The temperature of the cooling water returned from the Plant and discharged through the outfall would be constrained, therefore high flow rates would be required to minimise the differential between discharge and ambient temperatures. This would result in the requirement for large pumps and an associated higher capital cost.
- The cumulative effect of the outfall plumes in Cockburn Sound discharged by other users could impact on the temperature of the intake water.
- Dispersion of the outfall plume may be affected if the proposed James Point Port is developed.

3.4.2 Freshwater

Fresh water supply options for the Kwinana site are currently limited to groundwater or scheme water. Groundwater is used by a number of industrial sites in the KIA under licences from DEWCP, which was previously Water and Rivers Commission (WRC). The volume of water available under such licences is limited and it is understood that the water resources are close to fully committed in this area, therefore, groundwater is not available for use in the Project (WRC, *pers. comm.* 2001).

The Water Corporation currently supplies scheme water for the site from the Lake Thompson reservoir, which comprises a blend of hills dam water and groundwater from the Jandakot borefield. The water Corporation currently indicate that additional scheme water will be available for use in the Project, subject to some upgrade to the supply system (Water Corporation, *pers. comm.* 2002a).

At the time of the preparation of the PER the only guaranteed supply of fresh water is scheme water and is therefore the basis for Plant design.

3.4.3 Recycled Water

There is a probability that an additional source of water will be available prior to the commissioning of the Plant. The Water Corporation together with Kwinana industries is proposing to establish a Waste Water Recycling Plant in Kwinana. The proposed Treatment Plant would treat wastewater using reverse osmosis (RO) to produce high quality industrial grade water from secondary treated municipal effluent drawn from the pipeline to Point Peron outlet. The water would have a Total Dissolved Solids (TDS) concentration of around 50 milligrams per litre (mg/L) for industrial use.

Reject water from the Treatment Plant would be reintroduced back into the Point Peron line together with treated waste water of suitable quality from the industries for disposal offshore (4.2km) into the Sepia Depression.

Using water from the Waste Water Recycling Plant and returning the waste water into the line would eliminate the need for industrial effluent from Kwinana industries to be discharged to Cockburn Sound, and it would also reduce the requirements for industry to draw on scheme water or groundwater resources.

There is also a proposal by Global Olivine Western Australia for a Waste to Water and Energy Plant to be established in Kwinana. The Global Olivine Plant will produce large quantities of high quality water from seawater which would be suitable for industrial use.

3.5 EFFLUENT TREATMENT AND DISPOSAL

3.5.1 Process Effluent

The Plant will use water for cooling and gas cleaning. The TDS levels in the water will concentrate due to evaporation and, in the case of the gas cleaning the dissolution of gaseous species. When the TDS reaches certain concentrations, which varies for the different circuits, a portion of the water must be removed and be replaced with fresh water. The water removed is termed blowdown. The alternative methods for treatment and disposal of the two types of blowdown are discussed in the following sections.

3.5.1.1 Cooling Tower Blowdown

Water in the cooling tower circuits does not become contaminated as it does not come into contact with any process materials. The blowdown contains only concentrated levels of those constituents present in fresh water plus residual levels of corrosion inhibitor and scale dispersant. Cooling towers are generally operated with an upper TDS limit of around 2000mg/L. The options for cooling tower blowdown disposal considered were:

- Disposal of the blowdown into soaks. The water will seep into the shallow groundwater aquifer and ultimately enter Cockburn Sound. The constituents of the blowdown would not have an adverse effect on groundwater or Cockburn Sound (D.A. Lord, 2000).
- Recycling of the blowdown through the wet scrubber circuits. The wet scrubber circuit for gas cleaning can tolerate higher TDS concentrations therefore the potential exists to use cooling tower blowdown for gas cleaning and cooling.

The recycling option reduces the overall water consumption and has a lower potential environmental impact therefore this is the preferred alternative. All cooling tower blowdown will be directed to the gas cleaning (wet scrubber) circuit, which will reduce water consumption and eliminate a potential effluent stream.

3.5.1.2 Potentially Contaminated Wastewater

Potentially contaminated wastewater will include water from the gas cleaning circuits that has come into contact with process gas containing soluble species and particulates and other wastewater streams that may contain both dissolved and suspended solids. These may include waters from:

- the regeneration of the ion-exchange circuits in the demineralised water plants;
- the offgas hood;
- the Waste Heat Recovery (WHR) system;
- the Flue Gas Desulphurisation (FGD) system; and
- stormwater runoff from stockpile areas.

The wastewaters are to be initially directed to a pond for settling. The alternative treatment and disposal methods considered for the wastewaters entering the settling pond were as follows:

- Overflow from the settling pond would be directed to soaks. This option is not preferred as the lack of pH control allows potential contaminants to enter the groundwater.

- Lime would be added to the wastewater in the settling pond, which would raise the pH and cause the metal contaminants to precipitate as hydroxides. The solids would collect in the pond and then be periodically removed. The overflow, without the metals, could then be either:
  - directed to soaks;
  - directly discharged to the marine environment; or
  - disposed of through the Water Corporation's outfall at Point Peron.

  The option of disposing directly into the marine environment is not preferred by the Proponent due to the ongoing contamination issues associated with Cockburn Sound.

- The addition of lime to cause metal contaminants to precipitate as hydroxides. The overflow would be recycled for cooling of pig iron and slag.

The selected option is for the potentially contaminated wastewater to be directed to a process water tank for settling. Lime will be added to raise the pH of the wastewater, causing the dissolved metal salts to precipitate. The water will be recycled to the Plant for use in the cooling of pig iron and slag. During the wet winter months the stormwater runoff plus blowdown may exceed the capacity of the process water tank. The surplus runoff water from the process water tank will be directed either to the Water Corporation's Point Peron line or to an additional on-site water storage facility that would be installed if the Point Peron option is not feasible.

3.6 POWER SUPPLY

The estimated electrical supply requirement will be 40 Megawatts (MW) for each of the Stage Plants. The alternative sources of power supply considered by the Proponent are outlined below.

3.6.1 Total Requirement from the Western Power Grid

Obtaining the electricity supply from the Western Power supply grid would result in a significant saving in capital expenditure as it would eliminate the requirement for an on-site power generation facility. However, there are a number of adverse factors associated with this option including the following:

- An emergency power supply would be required to provide power for an orderly shutdown of the Plant should the grid supply become unavailable. There is the potential for a hazardous situation to develop if the power to the cooling water pumps fail while there is hot metal in the SRV.
- A large volume of offgas containing CO, H_2 and H_2S from the Plant would need to be combusted and scrubbed prior to discharge to the atmosphere.

- A large quantity of saturated steam would be generated by the cooling of the process offgas in the offgas hood. The steam would require condensing prior to being recycled to the hood.

Unless a use could be found for the large volume of offgas (which has a significant chemical energy content and is suitable for use as a fuel) and for the steam produced in the offgas hood, this option would result in a waste of an energy source. This would result in a higher greenhouse emissions per tonne of product than can be achieved using the offgas for power generation.

3.6.2 On-Site Generation

The combined offgas from various stages of the Process has a calorific value of 2.1 Mega Joules per normal cubic metre (MJ/Nm^3), which makes it suitable for use as a low-grade fuel. WHR systems can be designed to combust the offgas and use the heat produced to generate steam. Saturated steam from the offgas hood can be added to the steam from the WHR system prior to the superheater thereby resulting in a single stream of superheated steam. This steam can be used to generate electrical power via a steam turbine-generator set.

The total steam produced in the WHR would be the equivalent of approximately 40MW of electrical power, which is sufficient to supply the Stage 1 Plant's requirements. Therefore the incorporation of a power generation facility with an output of approximately 40 MW in the Stage 1 Plant design would result in the Plant being in energy balance. A duplicate power generation facility would be required for the Stage 2 Plant.

However there is one disadvantage to this option. If all the steam energy is used for electricity generation and there is a problem with the turbine-generator, a large back up power supply would be required to run essential equipment during an orderly process shutdown and to restart the Plant. This back up power could only be supplied from the Western Power grid. To reserve the required quantity of power for emergency and infrequent use would attract very high standby and reservation fees.

To minimise the quantity of reserved emergency power an analysis of the optimum use of the waste heat energy available was undertaken. The analysis found that the most energy efficient, and lowest cost, scenario was:

- A WHR Unit providing:
  - 20MW equivalent in steam for use in steam drives for the ASU compressor and the Hot Air Blast (HAB) blower; and
  - steam to the turbine generator to produce 20MW of electricity.
- Power reservation of 10MW from the Western Power grid requiring:
  - refurbishment of the existing 20MW switchyard; and
  - diesel powered pumps as back up on important plant cooling water circuits to protect equipment during loss of power and to help remain under the 10MW reserve power cap.

This scenario results in the site being energy self sufficient, neither importing nor exporting electricity from the Western Power grid and represents an almost optimum use of the process energy.

4. PROJECT DESCRIPTION

4.1 PROJECT OVERVIEW

The Stage 1 Plant will be designed to process around 1.3Mtpa of iron ore and 560,000 tpa of coal to produce around 820,000 tpa of pig iron using the HIsmelt® Process. The Stage 2 Plant will be effectively a duplication of the Stage 1 Plant. The Process is a reduction process that produces liquid iron hot metal by the smelting of iron ore or any other appropriate ferrous feed material. The smelting is undertaken in a molten iron bath using coal as the reductant and energy source. A process flow diagram is presented as Figure 4.1 and a detailed process flow sheet has been provided separately and confidentially to the EPA due to the commercial sensitivity of the Process.

Iron ore will be shipped to Kwinana from Dampier, and railed from Koolyanobbing in Western Australia. Coal will be shipped from the east coast of Australia to Kwinana.

The core element of the HIsmelt® Process is the SRV, which contains a molten iron bath into which ferrous feed material, coal and fluxes will be injected. The ore will be smelted in the SRV to produce molten iron and a slag that will contain the gangue. The use of a HAB will result in hot gas (offgas) exiting the furnace. A Preheater module will use the thermal and chemical energy of a portion of the offgas to heat and partially reduce the iron ore fines prior to their injection into the SRV. This will improve the energy efficiency and productivity of the Plant and reduce the greenhouse gas emission rate per tonne of product.

The pig iron product will be shipped for use in steel mills either within Australia or overseas. The unloading and loading of raw materials and product will be undertaken at the Fremantle Ports' Kwinana Bulk Berth No.2 (KBB2) (Figure 1.3).

The Project will include power generation facilities that will utilise the offgas from the Process to generate electricity. ASUs will also be constructed at the site to supply oxygen and nitrogen to the Plants. The proposed layout of the facilities on the site is presented on Figure 4.2.

4.2 CONSTRUCTION

Construction of the Stage 1 Plant is expected to commence in late 2002 and would extend for a period of 24 months. Construction of the Stage 2 Plant will be dependant upon the success of the Stage 1 Plant and is expected to commence in 2006 at the earliest. No clearing or major earth works would be required as the majority of the site is already levelled and compacted.

Construction activities will include the following:

- Ground consolidation.
- Installation of foundations.
- On-site construction.

Some of the buildings and equipment from the HRDF that are no longer required will be removed, following approval from the DEWCP, in readiness for the site preparation for the construction of the Plant. The buildings and material removed will be either stored on-site for possible sale or re-use, or sold for scrap.

The initial phase of site preparation will involve ground consolidation to increase bearing capacity in the areas under the Plant that are likely to be subjected to high loads. Ground consolidation includes:

- levelling.
- piling;
- the installation of limestone columns to a depth of approximately 10m; and
- compacting.

Once ground consolidation is completed, concrete foundations will be installed. Cranes will be used for the erection of the buildings on site.

The average construction work force will be around 230 with a peak workforce of around 320.

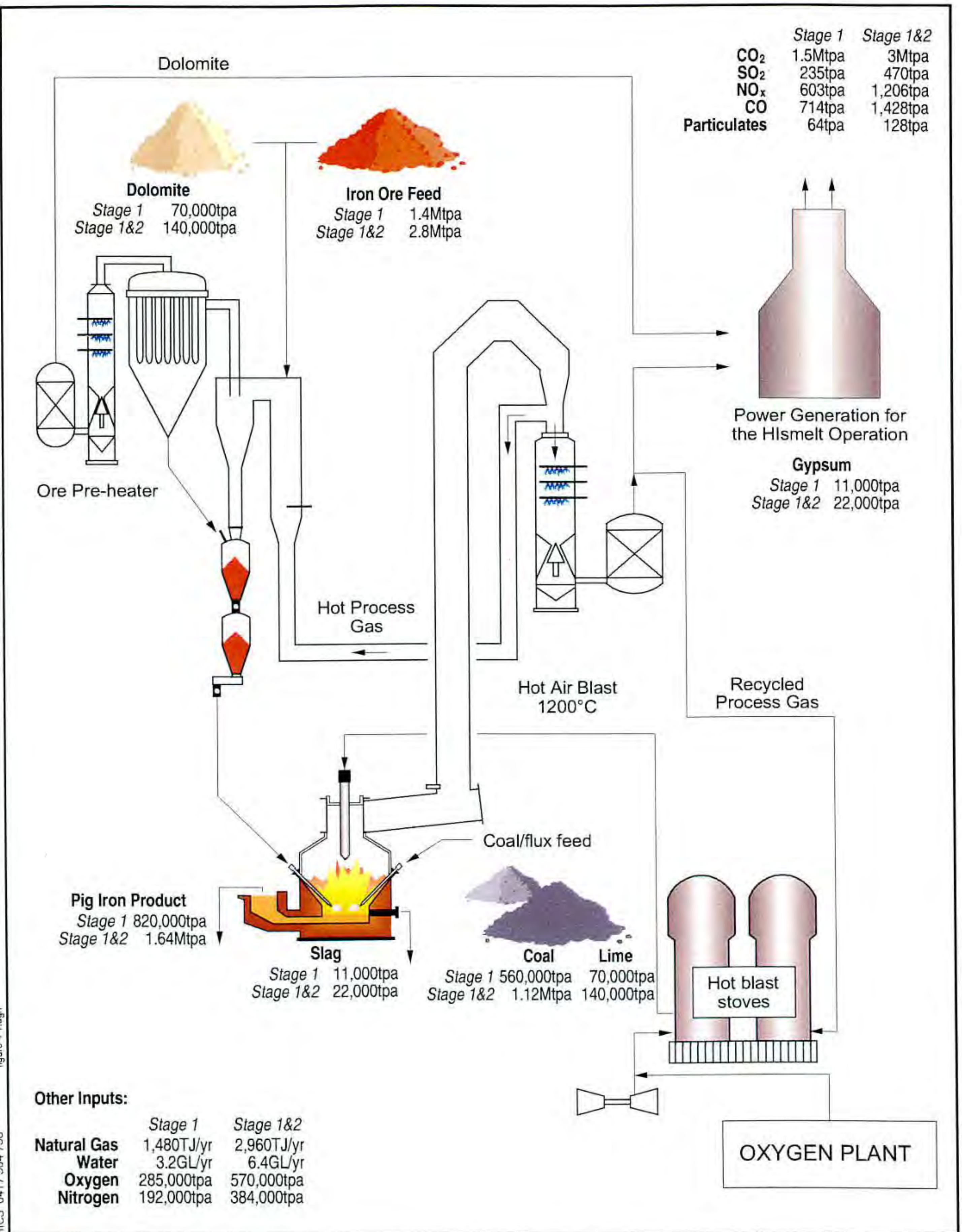
4.3 COMMISSIONING

Commissioning and ramp up of the Stage 1 Plant to full production will occur over a two year period. During the first year of production the estimated output will be 60% of the nominal annual production rate. In the second year the output rises to 90% of nominal production with full production being achieved in the third year. It is expected that the ramp up period for the Stage 2 Plant may be shorter than for the Stage 1 Plant due to the experience gained from the operation of the Stage 1 Plant.

The Plants will be operated in five modes during the first two years of their operation. These modes are as follows:

1. Normal operational mode at the design rate flowsheet operating conditions and consumptions.
2. Reduced hot metal production rate with a 5% increase in coal consumption due to maintaining low SRV heat losses and a full slag inventory.
3. Ramp up at higher than design coal rate when it is necessary to re-establish steady state thermal balance following periods of no production with the Plant on-line, or after start up following an end tap. An end tap is when the SRV has been completely drained of metal and slag such as when repair or maintenance is required either on the SRV or a critical item of ancillary equipment.
4. No production with the Plant on-line when an item of ancillary equipment is undergoing maintenance.
5. No production with the Plant off-line following an end tap.

It has been estimated that up to four end taps may be required in the first year of operation and two in the second year to allow for Plant maintenance, process equipment checks and Plant modifications. An end tap could result in no production for a period of around four weeks to allow for cool down, refractory inspection, SRV reheat and the re-start of the Process. The ramp up period following an end tap will be around 24 hours.



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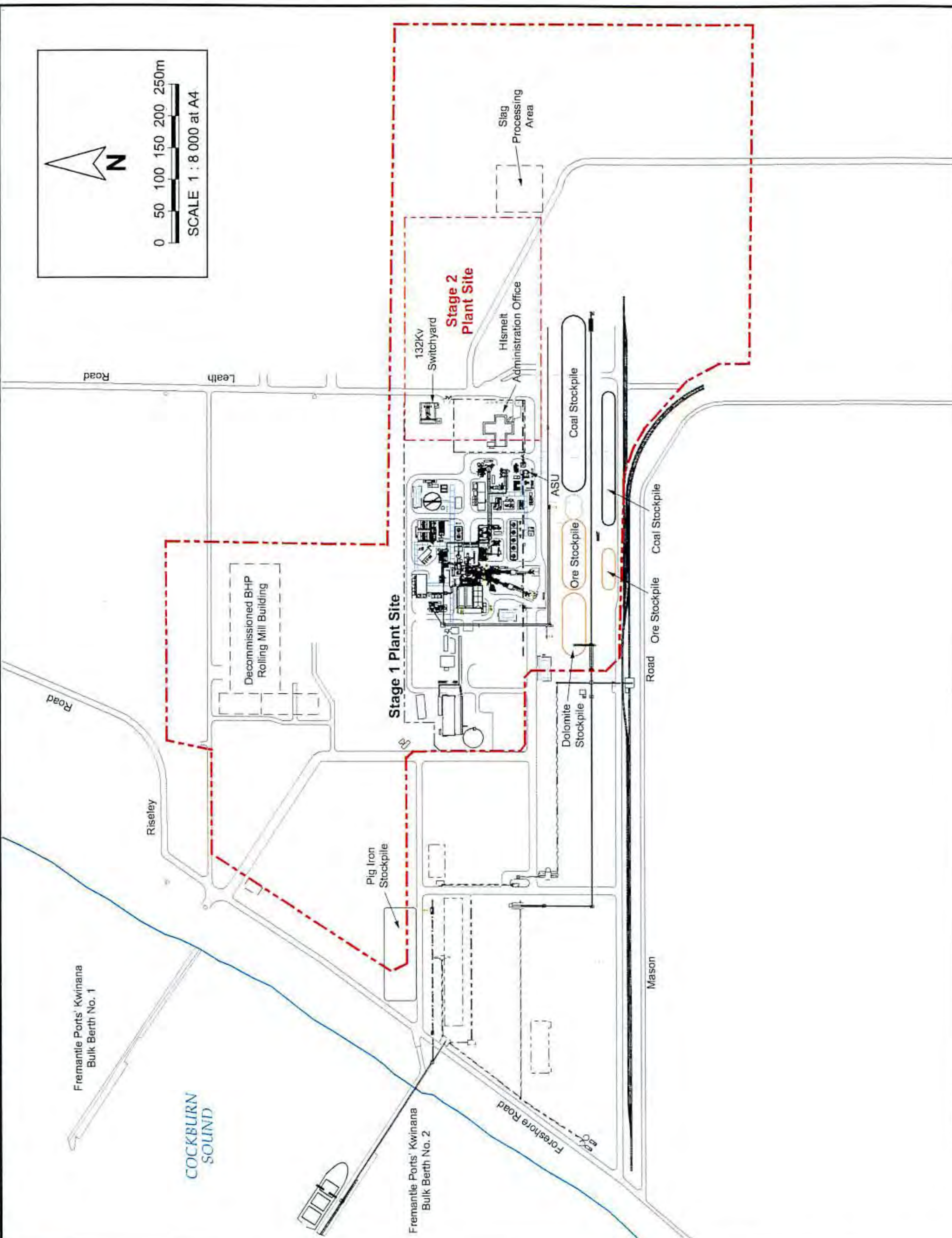
PROCESS FLOW DIAGRAM - STAGE 1

Figure 4.1



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CONCEPTUAL SITE LAYOUT

Figure 4.2

It is estimated that up to 40 on-line interrupts for up to a maximum of 4 hours each for Plant maintenance and/or feeder system checks will occur in the first year. The ramp up period following an on-line interruption is estimated to be 12 hours.

The estimated number of hours and percentage of the time in each operating mode is summarised in Table 4.1.

Table 4.1

Estimated Operating Time in Ramp Up Mode

		Operating Rate	**% of Operating Time**		**Hours at Operating Rate**	
Mode		(% of design capacity)	Year 1	Year 2	Year 1	Year 2
1	Operating rate (design)	100	0%	61.5%	0	5387
2	Reduced production.	90	48%	5%	4205	438
3	Ramp up	80	20%	15%	1752	1314
4	No production - on line	0	5%	6.5%	438	569
5	No production - end tap	0	27%	12%	2365	1052
				Total hours	8760	8760

For example for a 6 metre SRV

	Year 1	Year 2	Year 3
Design rate (Ktpa)	824	824	824
Total Production (Ktpa)	495	738	824
% Production Capacity (%)	60	90	100

4.3.1 Preheater Commissioning

The Preheater will be an integral part of the core process. During commissioning, the Preheater will be de-coupled from the SRV in order to simplify the commissioning process. The Preheater module will be operated as a stand-alone unit for up to six months during which time it will be fired with natural gas rather than with the SRV offgas. The Preheater offgas during the commissioning period will have no value as a fuel and will be cleaned in the wet scrubber prior to being discharged to the atmosphere.

4.4 PLANT DESIGN

The detailed design of Stage 1 will be performed as a Joint Venture between Kvaerner and Clough Engineering. The Project objectives outlined to the engineers include the following:

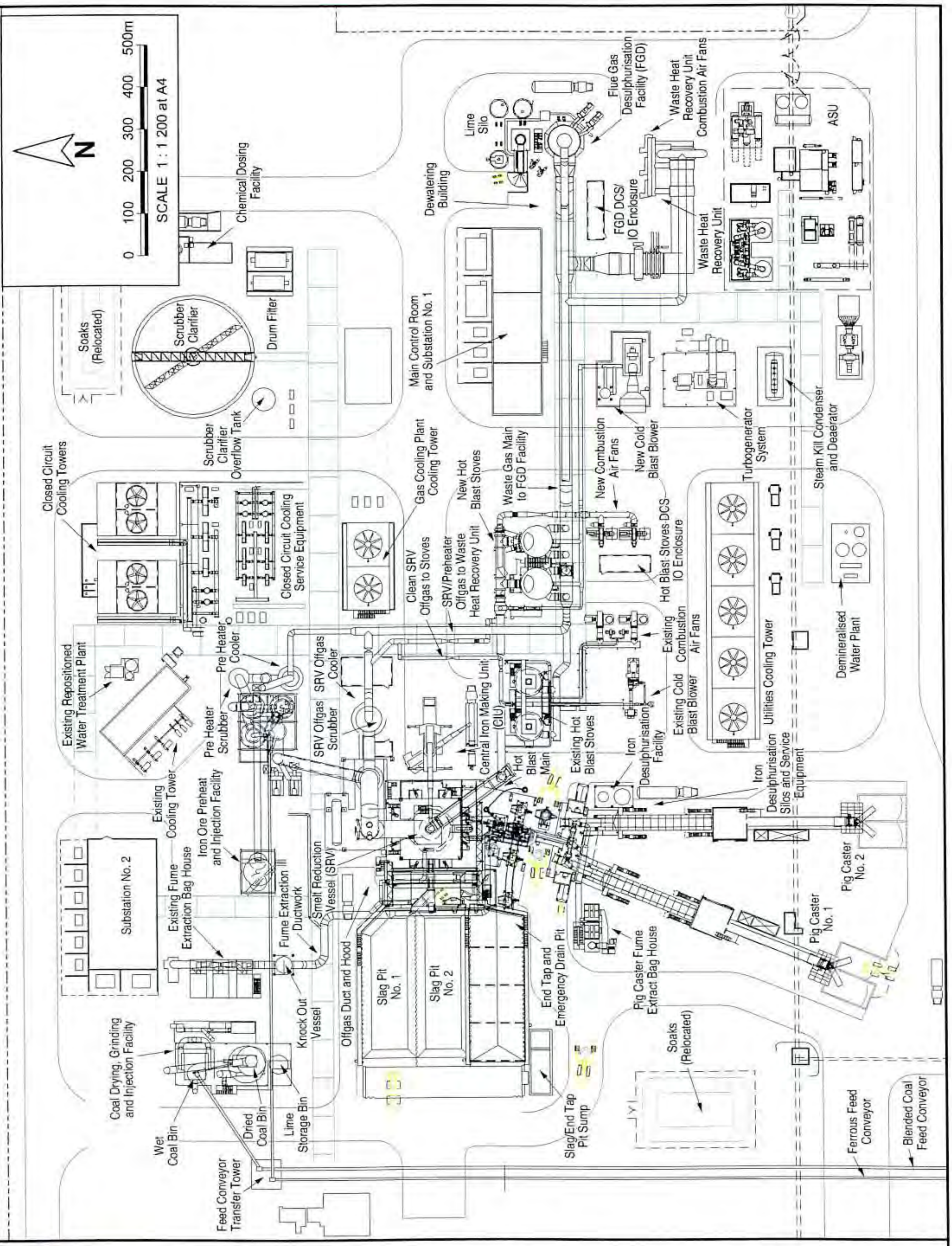
- The Plant shall be safe, operable and maintainable.
- The Plant shall be designed for a 20-year operational life.
- The Project Team shall maximise the use of existing HRDF equipment and infrastructure.
- The Project Team shall maximise Australian content.
- The Plant will come under the jurisdiction of the Mines Inspectorate and will therefore be required to comply with the *Mines Safety and Inspection Act, 1994.*
- The Plant must comply with relevant Western Australian and Commonwealth environmental legislation.
- The Plant shall comply with Rio Tinto Health, Safety and Environment guidelines.
- The Plant design shall comply with all relevant Australian Standards.
- The Plant will operate continuously with a major shutdown approximately every two years; regular 8-hour maintenance stoppages are envisaged to occur once per month.
- Annualised operation is estimated to be 7660 hours.

The major components of the Plants will comprise:

- Raw Material Delivery and Storage.
- Raw Material Reclamation and Preparation.
- Ore Preheater.
- Smelt Reduction Vessel.
- Offgas System.
- Pig Iron and Slag Production.
- Power Generation Facility.
- Air Separation Unit (Oxygen and Nitrogen Plant).
- Water Circuits and Effluent Treatment Facility.

The proposed Stage 1 Plant layout is presented on Figure 4.3 and a conceptual 3-D view of the Plant is presented as Figure 4.4.

The design for the Stage 2 Plant will be finalised once the Stage 1 Plant has proven to be successful. The Stage 2 Plant design is likely to incorporate improvements and changes based on the experience gained in the commissioning, ramp up and operation of Stage 1. However, for the purpose of the PER it is assumed that the Stage 2 Plant will be a duplication of Stage 1. The Proponent will notify the EPA of any significant changes to design for the Stage 2 Plant.



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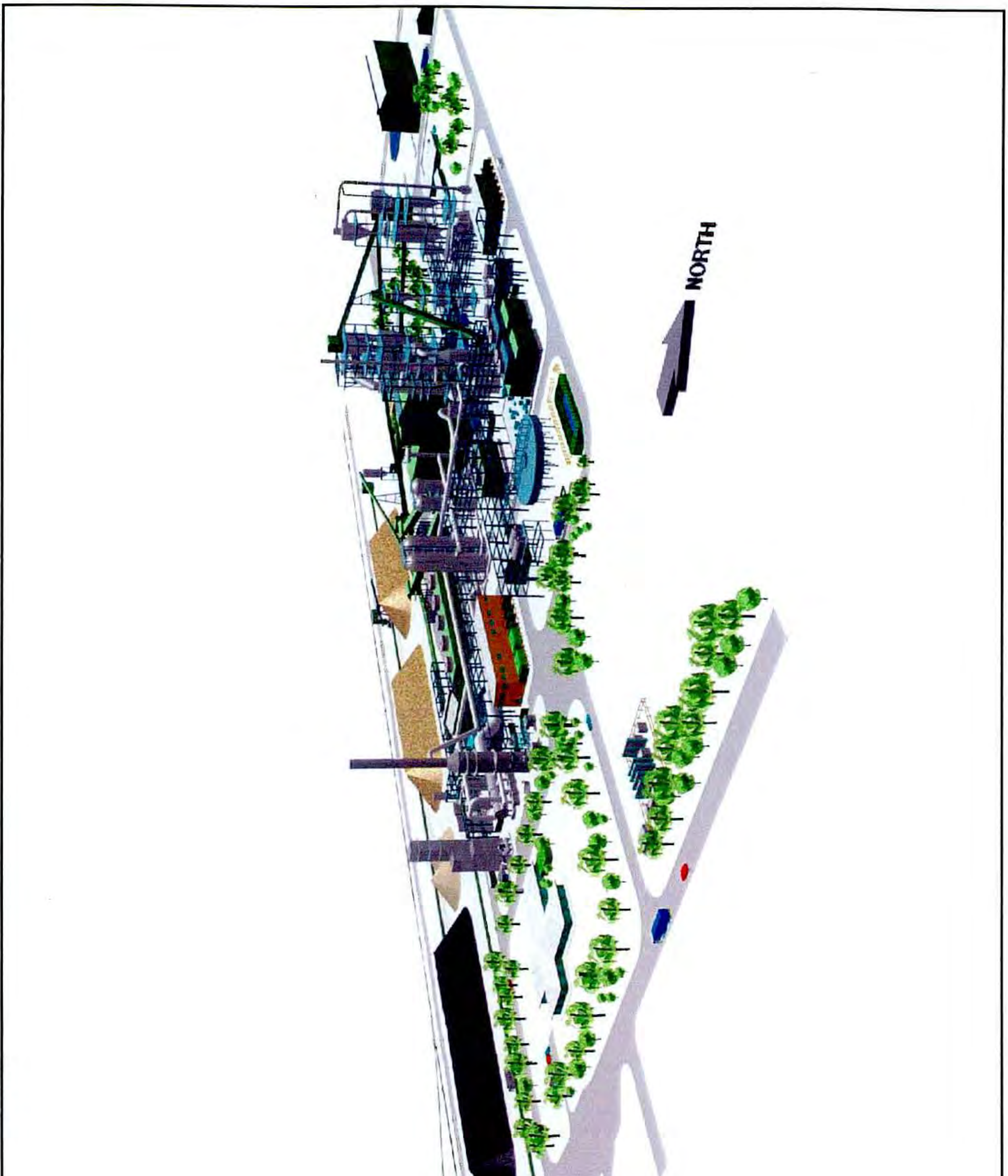
CONCEPTUAL STAGE 1 PLANT LAYOUT

Figure 4.3



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CONCEPTUAL 3-D VIEW OF THE STAGE 1 PLANT

Figure 4.4

4.5 RAW MATERIAL DELIVERY AND STORAGE

4.5.1 Iron Ore

Two potential sources of iron ore fines to be used in the Process will be:

- Fine ore from the Portman Limited mine at Koolyanobbing, located approximately 400km east of Kwinana.
- A special blend (HIsmelt Special Fines) of Fines from Rio Tinto Iron Ore's Pilbara operations.

Approximately 1.3 Mtpa of iron ore fines will be required as feed for the Stage 1 Plant. It is anticipated at this stage that half of the ore requirements would be provided by each supplier. If Stage 2 of the Project proceeds then an additional 1.3 Mtpa of ore would be required and this may be sourced from the same suppliers, although the percentage from each source may differ from Stage 1.

Ore from the Pilbara will be shipped from the Port of Dampier and delivered to Kwinana, in shipments of approximately 45,000t capacity Handymax vessels. Approximately 16 ships per year will transport the ore from the Pilbara for the Stage 1 Plant, with an additional 16 ships required for the Stage 2 Plant.

The existing facilities at the Fremantle Ports' Kwinana Bulk Terminal (formerly BHP Transport and Logistics) will be used for the unloading and transfer of ore to the HIsmelt site. Stage 1 will utilise the currently operational jetty, which is the Kwinana Bulk Berth No.2 (KBB2). It is anticipated that if Stage 2 proceeds then Kwinana Bulk Berth No.1 (KBB1) will require recommissioning. KBB1 and KBB2 were formerly referred to as the Steelworks Jetty No.1 and No.2, respectively.

The ore will be unloaded from the ship's hold using a Grab Bucket Ship Unloader and transferred through a feed hopper to a series of conveyors. An additional length of conveyor will be installed to connect the Fremantle Ports' conveyor system to a stacker conveyor on the HIsmelt site.

Portman Mining iron ore fines will be transported by rail to site from Koolyanobbing utilising bottom dumping rail wagons. Approximately five trains per week, comprised of a single locomotive pulling approximately 2,500t of ore in a total of 39 wagons, will be required for the transport of ore for the Stage 1 Plant. The number of trains may possibly double if Stage 2 proceeds and an equivalent amount of ore is sourced from Koolyanobbing. The trains will be approximately 600m long. The ore will be discharged into a dump hopper using the existing bottom dump wagon system at the Fremantle Ports' site.

Ore will be transferred from the Fremantle Ports' conveyors and the dump hopper via a series of conveyors, and then delivered to the HIsmelt stacker conveyor prior to being directed to the following ore stockpiles located as shown on Figure 4.2:

- 56,000t Pilbara fines ore stockpile
- 10,000t Koolyanobbing ore stockpile

The base of the stockpiles will comprise a compacted layer of a very low permeability material such as clay, crushed slag or a synthetic liner. A decision as to the most suitable material will be made during the detailed design phase of the Project in liaison with the authorities. The stockpile area will be graded to ensure that all stormwater run off is captured and drained to a sump from where it will be pumped to the process water pond for treatment and re-use.

The iron ore fines from Koolyanobbing will be sourced from the high phosphorus reserves that are currently being mined or from those proposed to be mined. The high phosphorus fines are currently not considered saleable to other iron making processes. The iron ore fines will be a mixture of specular hematite, hematite-goethite and goethite-limonite.

The ore from both sources will typically contain approximately 60 to 65% Fe, between 0.07 and 0.2% P and 3 to 5% gangue. The moisture content of the ore will be around 3 to 4%. The top size of the ore will be 6mm with 30% less than 1mm.

4.5.2 Coal

Approximately 560,000 tpa of coal will be required as feed for each of the Stage Plants. Coal will be sourced from Queensland and delivered to Kwinana in 45,000t capacity ships. The coal will be pre-blended in Queensland prior to shipment. Approximately 13 ships per year will be required to transport the coal from Queensland to the existing Fremantle Ports' KBB2 for the Stage 1 Plant. If the Queensland coal is also used for the Stage 2 Plant there would be an additional 13 ships per year. Coal will be unloaded from the ship's hold using a crane grab and transferred through a feed hopper and a series of conveyors to a nominal 51,000t capacity stockpile located as shown on Figure 4.2.

Coal will be reclaimed from the stockpile on a continuous basis using front-end loaders and placed into reclaim hoppers. Coal feed from the reclaim hoppers will be conveyed to small surge bins at the drying plant.

The key chemical and physical properties of the Queensland coal are presented in Table 4.2. The coal will have a top size of 50mm with 50% being less than 2mm.

Table 4.2

Key Chemical and Physical Properties of the Coal

Constituent	% (Dry Weight Basis)
Carbon (total)	78 - 81
Hydrogen	3 - 4
Nitrogen	1.5 - 2
Oxygen	2.5 - 3
Sulphur	0.5 - 1.0
Ash	10 - 13
Volatile Matter	10 - 20

4.5.3 Fluxes

Fluxes such as lime and dolomite will also be required in the Process. Approximately 240tpd of lime will be delivered to the site by 40t capacity sealed tanker trucks. Approximately 40 trucks per week will be required to transport lime to the site for each Plant. The lime will be dry and fine (less than 3mm) and will be pneumatically conveyed directly into storage bins. Dolomite will be shipped to site from Whyalla, South Australia in 45,000t capacity vessels, approximately two vessels per year will be required. The dolomite will be unloaded at the KBB2 using the same system used for ore and coal shipments and transferred to a stockpile alongside the ore fines stockpiles (see Figure 4.2).

The key chemical and physical properties of the lime proposed for use in the Plant are presented in Tables 4.3 and 4.4.

Table 4.3

Chemical and Physical Properties of Lime

Parameter	Analysis % by Dry Weight	
	Typical	Range
Fe_2O_3	0.2	0.18 - 0.22
CaO	85	82 - 88
SiO_2	7	4 - 10
Al_2O_3	0.4	0.2 - 0.6
MgO	5.0	4.8 - 5.2
SO_3	0.9	0.88 - 0.92
LOI	1.0	0.2 - 1.8

Note LOI – Loss on Ignition

Table 4.4

Particle Size Distribution of Lime

Particle Size	Cumulative % Retained	
	Typical	Range
>2.36mm	0.2	0.1 - 0.3
>0.60mm	3.2	1.2 - 5.2
>0.30mm	19	12 - 25
>0.15mm	58	48 - 69
>0.045 mm	79	64 - 93
Bulk Density t/m^3	0.86	0.6 - 1.1

4.5.4 Other Materials

4.5.4.1 Feed Materials

Iron ore fines will be the principal base iron feed material for the Plant. However, other iron bearing materials may also be processed during the life of the Project. These may include:

- Iron bearing ores or materials from potential users of the HIsmelt® Process wishing to trial the Process on their materials, prior to committing to the implementation of the technology.
- Iron bearing materials generated in other processes that are currently considered as waste streams, such as waste from Synthetic Rutile plants, DRI/HBI fines that do not comply with marketing specifications, and steelplant waste oxides.

The use of such alternative ferrous feed materials will be subject to certain criteria being met, such as :

- The material shall not result in emissions that cause non-compliance with the Plant's operating licence.
- The materials shall not have an adverse impact on production (unless the Joint Venture partners agree to the loss of production).

As discussed in Section 4.5.2 the main source of carbon for the Process will be coal. However, there are other potential sources of carbon that may be used in the Plant such as coke breeze (fine coke), petroleum coke or coal char. These other feed materials will be handled and stored in the same manner as the iron ore fines and coal. The first two criteria listed above for alternative ferrous feed materials will also apply to any alternative sources of carbonaceous materials. In particular the sulphur content will be monitored to ensure compliance with the Plant's operating licence conditions for SO_2 emissions.

4.5.4.2 De-Sulphurisation Reagents

De-sulphurisation reagents such as burned lime (CaO) and magnesium metal (Mg) will be used in the Plant to reduce the sulphur content of the pig iron product to levels acceptable for steel makers. The lime will be delivered as bulk material in silo trucks and pneumatically unloaded into storage silos. Packaged magnesium will be delivered to site and stored in a silo.

Lime kiln dust will be used in the FGD system. The lime will be delivered by road tanker and pneumatically conveyed into the lime storage silo.

4.5.4.3 Process Chemicals

The main process chemicals to be used in the Plant will be as additives to cooling water circuits. These include the following:

- **Corrosion inhibitors** will be used on site to suit the following different types of cooling circuits:
  - Open Circuits – where a Cooling Tower performs the heat rejection;
  - Closed Circuits – softened water systems where heat rejection is via heat exchange to open circuits;
  - Steam Circuits – require an additive that is carried through with the steam to prevent the condensate from causing corrosion.
- **Scale dispersants** may be required to prevent deposition of a calcium carbonate type scale in cooling towers.
- **Biocides** will be used to control microbiological problems associated with cooling tower circuits. It is envisaged that the biocides mainly used will be a sodium hypochlorite (bleach) based chemical. Periodic dosing with other types of biocides will be undertaken to ensure that the microbes do not develop a tolerance to the bleach biocide.
- **Flocculants** will be added to aid settling of solids in the slurry. The flocculant will typically be a high molecular weight polymer and will be selected during the commissioning of the Plant as flocculant is material specific.
- **Caustic soda (sodium hydroxide)** solution will be used to raise the pH of water going from the scrubbers to the clarifier in order to compensate for the fact that the pH is lowered in the scrubber by acidic species dissolved out of the offgas.
- **Sulphuric acid** may be used in the FGD system to aid in the oxidation of gypsum, and in the cooling towers for pH control.

It is anticipated that the supply and dosing of the above chemicals will be contracted out to a single water treatment chemical company. Until the contract is in place the actual chemicals that will be used in some applications have not been determined. However, the Proponent will ensure that the potential environmental impacts of the chemicals are considered during the vendor selection process. The Proponent will consult with DEWCP to ensure that the chemicals proposed for use by the successful tenderer are considered environmentally acceptable.

4.6 RAW MATERIAL PREPARATION

4.6.1 Iron Ore Fines

The Koolyanobbing and HIsmelt Special Fines ores will be reclaimed using front-end loaders from their respective stockpiles in equal proportions to facilitate blending. The ore will be dumped into a fixed reception hopper.

The reception hopper will feed ore onto a reclaim conveyor from where it will be conveyed to the ore surge bin. Ore will be recovered from the surge bin via a vibrating feeder, which will transfer the ore through a scalping vibrating screen onto a conveyor where dolomite will be fed onto the ore burden. The blended ore and dolomite will then flow via a series of conveyors to the Preheater. The feed rate of the ore into the Preheater will be monitored and controlled.

4.6.2 Coal

Coal will be reclaimed from the surge bins and will pass over a vibrating scalping screen where the material greater than 50mm will be removed for crushing. The undersize coal will be conveyed to a wet coal receival bin at the coal grinding and drying facility. A volumetric feeder will extract the coal from the bin and direct it into a fully automated impact type coal mill for grinding to less than 3mm.

The coal will also be dried in the mill to approximately 2% free moisture. An integrated, natural gas-fired, hot gas generator will provide the hot gas required for drying. The heated gas will be introduced at a rate that is determined by pressure and temperature sensors located in the system and will be adjusted automatically.

Ground coal suspended in oxygen depleted air will pass through an adjustable spinner separator where an accurate size classification will be made. The dried milled coal will be discharged together with the offgas stream and then recovered by means of a cyclone. The collected coal will be screened with the oversize coal being returned to the coal mill and the undersize being directed to the coal bin for storage.

Air flow will be maintained by the main fan. The oxygen content will be controlled to below 10%(v/v) by means of recycling flue gas, for safety reasons. An exhaust fan will discharge clean gases and evaporated moisture from the system. A portion of the exhaust gas will be recycled back through the heater where the oxygen will be consumed in the combustion process.

A high-efficiency fabric dust collector will be used to remove airborne fines that remain entrained in the exhaust gas from the cyclone collector. A screw conveyor will transport the fine coal dust from the dust collector to the dry ground coal storage bin.

4.7 ORE PREHEATER

The Ore Preheater is a circulating fluidised bed (CFB) process whereby a portion of the offgas from the smelting process, containing both thermal and chemical energy, will be used to:

- remove both free and chemically bound moisture from the ore;
- pre-reduce the ore (remove some of the oxygen) prior to injection to the smelting furnace; and
- preheat the ore prior to its injection into the smelting process to increase energy efficiency.

During commissioning preheating of the ore will be a stand-alone operation that will use natural gas as the energy source.

The Preheater will consist of the following:

- CFB reactor.
- Recycle cyclone.
- Two-stage venturi Preheater with the necessary gas/solids separation cyclones.

By the use of counter current heat exchange of the hot SRV gas and cold iron ore fines feed the energy usage for drying and heating the ore is optimised.

Ore, from the wet ore bin, will be fed at a controlled rate through a lock hopper system via a screw conveyor into the first stage of the Preheater. Dolomite will be added to the ore stream prior to the lock hopper. The fresh fine ore feed will be mixed with offgas from the second cyclone to preheat the ore and to achieve evaporation of surface moisture. The ore, separated from the gas in the first cyclone, will be gravity fed into the second cyclone, from where it will be further heated and about 70% of the combined moisture and Loss on Ignition (LOI) component will be removed. After separating the gas and solids in the second cyclone the preheated ore will be gravity fed into the CFB reactor where, by introduction and partial combustion of hot SRV gas, the final ore preheating temperature of approximately 850°C will be attained and the dolomite will be calcined.

The Preheater offgas will pass through a multiclone where the majority of dust particles will be removed from the gas. The collected dust will be fed via a lock hopper system to the hot ore injection feed bin. Preheated ore will be discharged from the lower part of the CFB into the hot ore injection feed bin. The offgas stream from the Preheater will be passed through a wet venturi scrubber to remove the residual dust particles prior to being piped to the process gas line.

4.8 PROCESS DESCRIPTION

4.8.1 Smelt Reduction Vessel

The Process will be undertaken in a molten iron bath using coal as the reductant and energy source. The core element of the Process is the SRV. A conceptual diagram of the SRV is shown on Figure 4.5.

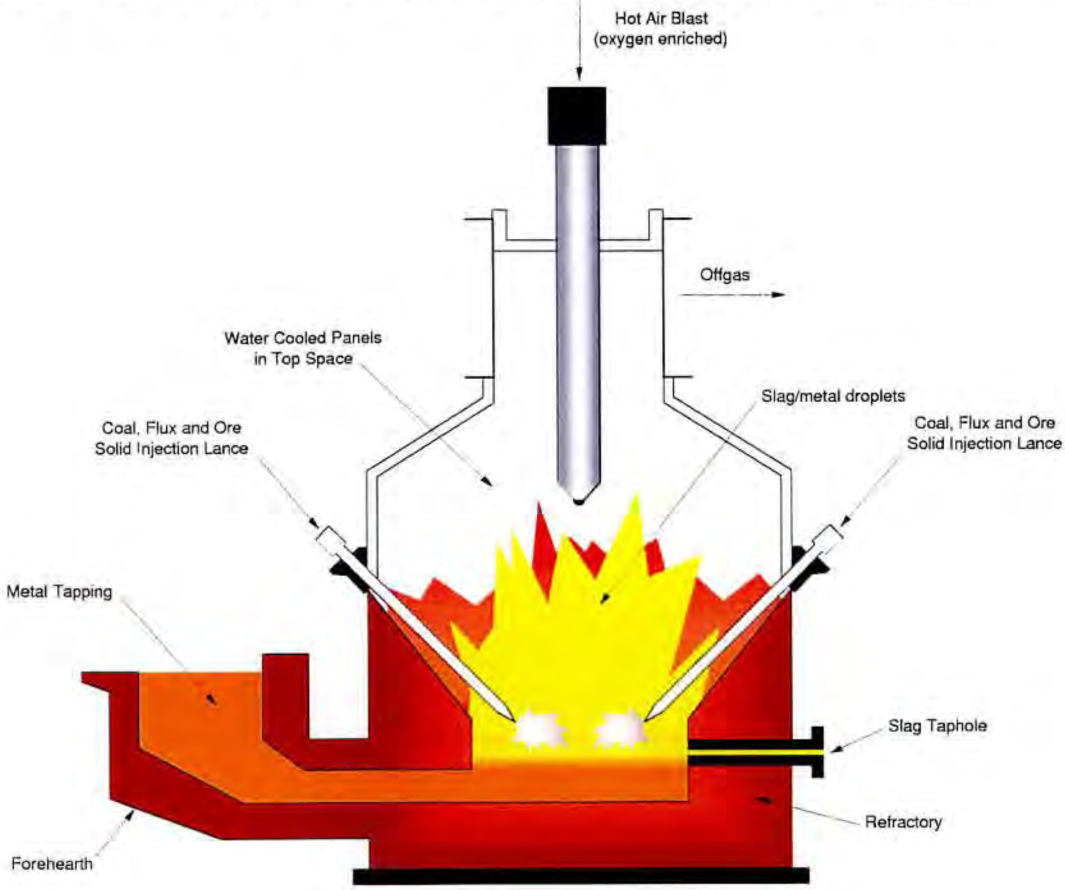


Figure 4.5 Conceptual Diagram of the HIsmelt Vertical Smelt Reduction Vessel

The SRV will contain a molten iron bath into which ferrous feed (such as iron ore fines, iron-bearing steel plant wastes or DRI fines), coal and fluxes (lime and dolime) will be directly injected via eight specially designed water-cooled injection lances (see Section 4.8.2)

Coal will be injected into the molten iron bath where it will be de-volatilised, liberating H_2 and CO resulting in the reduction of the iron oxides to produce metallic iron. The carbon will be rapidly dissolved and will react with the oxygen combined with the iron units in the feed material, generating CO.

The typical reduction reactions that will occur in the iron bath are:

(1) $$Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO$$

(2) $$FeO + C \longrightarrow Fe + CO$$

As reactions (1) and (2) are endothermic the energy required to sustain the process and maintain a steady temperature will be provided by reacting the CO and H_2 released from the bath with oxygen from a 1200 °C HAB in the top space of the SRV. The typical reactions that will occur in the top space are:

(3) $$CO + \frac{1}{2}O_2 \longrightarrow CO_2$$

(4) $$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$$

Reaction (3) will be the dominant reaction for heat production with reaction (4) only occurring if volatile hydrocarbons are present in the coal. Energy released from the post combustion reactions in the SRV top space will be transferred to the molten iron bath via the "transition zone", which will be a highly turbulent region above the bath that will contain liquid droplets of slag and some iron. The droplets will be heated in the transition zone by the heat generated from post combustion reactions and will then return to the slag/iron bath thereby transferring energy to the iron bath.

Reacted hot gases will exit the vessel and can then be used to pre-heat and partially pre-reduce iron ore feed. The Process, as trialled in the HRDF, has consistently demonstrated very high levels of energy efficiency.

An overview of the processes that will occur within the molten iron bath is as follows:

- Carbon from the coal will be dissolved into the metal bath.
- The iron-bearing materials will be rapidly reduced to form molten iron.
- Post combustion of the gaseous reaction products by the HAB will produce the thermal energy to sustain the process.
- Gangue and ash will be separated from the ore and coal to form slag.
- Manganese and phosphorus will be contained in the slag allowing very clean metal to be produced.

A water cooled lance will be used to introduce the HAB into the SRV. The HAB lance will be positioned at a suitable height above the molten bath to allow optimisation of the post-combustion reaction occurring within the SRV.

The SRV shell will consist of a water-cooled upper barrel and a brick-lined lower barrel. The refractory bricks will be made from magnesia-chromite spinel and will have a life expectancy of approximately two years. However, a portion of the lining in the high wear zones may need to be replaced after one year of operation. At the water cooled panels slag will solidify and protect the panels and shell.

A water sheath system will be installed on the SRV outer shell in order to prevent mechanical stresses that may arise from temperature differences on the shell itself. The bottom of the SRV will be cooled with ambient air provided by two fans.

4.8.2 Solids Injection System

Raw materials will be pneumatically fed to the SRV through solids injection lances (see Figure 4.5). Four lances will be used for the injection of hot, pre-reduced iron ore and four will be used for the input of coal and fluxes. The lances will be water-cooled, to protect them from the high temperature inside the SRV, and ceramic lined, to protect them from abrasion by the gas/solids mixture being injected at high velocity. The raw materials will be conveyed from the storage silos to the lances by means of injection systems. The coal injection system will comprise four dispensers.

There will be two dispensers for the hot ore, each of which feeds two injection lances. The lime injection system will comprise two dispensers that feed into two of the coal and flux injection lines. The dispensers will have fluidised cones to ensure that the material is free flowing. The flow rate for each injector will be controlled with a rotary type valve, which in turn will be controlled by load cells on the dispenser. The mass flow rate will be able to be adjusted over a wide range. Plant nitrogen with a pressure of approximately 10 bar will be used as conveying gas.

4.8.3 Hot Air Blast System

The SRV will be designed to operate with an oxygen enriched HAB at 1200°C. The HAB will be generated by passing an oxygen enriched air stream (nominally containing 30 to 35% O_2) through hot blast stoves. The hot blast stoves will be heated by the combustion of cleaned offgas enriched, if necessary, with natural gas to ensure that there is an adequate specific heating value. When offgas is unavailable, such as on start-up, the stoves will be fired with natural gas. Oxygen will be mixed with cold air generated by a blower prior to being heated in the stoves. Offgas from the stoves will be passed through heat exchangers for preheating of fuel gas and combustion air with an exit temperature of around 180° C.

As the scrubbed fuel gas from the SRV offgas cleaning system will contain some sulphur in the form of hydrogen sulphide (H_2S) and sulphur dioxide (SO_2), exhaust gases from the stove will be cleaned in the Flue Gas Desulphurisation system (see Section 4.15).

4.8.4 Cooling Circuit

High internal temperatures will be experienced in the SRV. In order to protect the integrity of the vessel shell the region from the slag zone up through the top space to the offgas duct in the SRV will be water-cooled. Refractory lining of these regions is not considered an option as wear resulting from contact with gas and slag would result in an adverse impact on refractory life and therefore production. A mix of steel and copper panels will be cooled by treated softened water in a closed circuit that will include Wet Surface Air Coolers (WSAC) for heat rejection.

The evaporation of the secondary cooling water in the WSAC will result in an increase in concentration of soluble salts. When the concentration reaches a level that may affect the performance of the WSAC it will be necessary to remove a portion of the water as blowdown in order to maintain an acceptable water quality.

4.9 DESULPHURISATION OF MOLTEN IRON

Hot metal produced by the SRV will contain levels of sulphur that would not be suitable for steelmaking. Prior to casting the molten iron the sulphur content of the metal will be reduced in a desulphurisation facility. Reagents such as burned lime and magnesium powder will be injected into the hot metal to reduce the sulphur level from 0.12-0.15 % to less than 0.04 %.

The desulphurisation slag containing the sulphur will be removed and placed in a slag pit. The metal overflowing from the desulphurisation facility will flow down a refractory lined launder to the pig casters located at the end of the desulphurisation building.

4.10 OFFGAS HANDLING

Offgas from the SRV will be cooled in a radiation cooler, which is termed the offgas hood, resulting in the generation of steam. The gas stream leaving the offgas hood, at a temperature of approximately 1000°C, will then be split into two streams. Approximately half of the hot gas stream will be directed to the Preheater where it will be used to remove moisture and to pre-reduce the iron ore fines. The remainder will be passed into a wet cone scrubber where particulate material and soluble gaseous species will be removed.

The cleaned gas from the scrubber will then be passed through the offgas cooler to further cool the gas and remove water vapour. The resulting gas will be suitable for use as a fuel.

4.10.1 SRV Offgas Scrubber

The offgas will be cleaned in a conventional wet venturi scrubber, which is recognised as the best available scrubbing technology in iron making plants (European Commission, 2000). Figure 4.6 presents a schematic diagram of the type of scrubber that will be used in the Plant.

Water sprays, fed with the water recirculated from the cone scrubber section of the scrubber unit, will be used to quench the offgas in the upper section of the offgas scrubber. The upper sprays will be fed with the water recirculated from the cone scrubber section of the scrubber unit. Water returned from the gas cleaning circuit clarifier to the scrubber will be used for the other sprays. The gas stream will be saturated by the evaporation of water within the conditioning section. Excess water within the conditioning tower will collect the majority of dust from the gas stream. The dirty water collected in the conditioning section sump will exit through a seal leg, which will include a level control valve to ensure a gas seal at the conditioning tower discharge.

Acidic gaseous species such as HCl, HF, SO_2 and, to a limited extent, H_2S and CO_2, present in the offgas will react with water to form acidic solutions. This will lead to low pH and corrosive conditions particularly at the inlet section of the conditioning tower. The low pH in the quench zone is expected to result in the dissolution of gaseous metallic elements, such as zinc, lead and cadmium, which volatilise in the SRV. Alkali species such as potassium oxide (K_2O) and sodium oxide (Na_2O) will also dissolve in this region of the scrubber. The upper section of the conditioning tower will be constructed from duplex stainless steel to resist corrosion whilst the remainder of the vessel will be epoxy coated. Internal fittings will also be manufactured from corrosion resistant materials.

Gases from the conditioning section will pass through a variable-cone scrubbing element in the lower section of the scrubber vessel. The scrubber element will consist of a moveable cone, operating within a fixed conical section. Tangential and radial sprays will spray scrubber feed water directly onto the cone inlet. The gas velocity created by the moveable cone pressure drop will atomise the spray water, providing efficient gas scrubbing. The additional gas cooling which will take place in the scrubbing section will also condense some of the contained water in the gas stream.

The cone element will be operated by a hydraulic actuator and will be used to control the operating pressure within the SRV.

Offgas leaving the scrubber vessel will pass through an internal demister section to prevent any carryover of dirty water to the clean offgas cooling circuit.

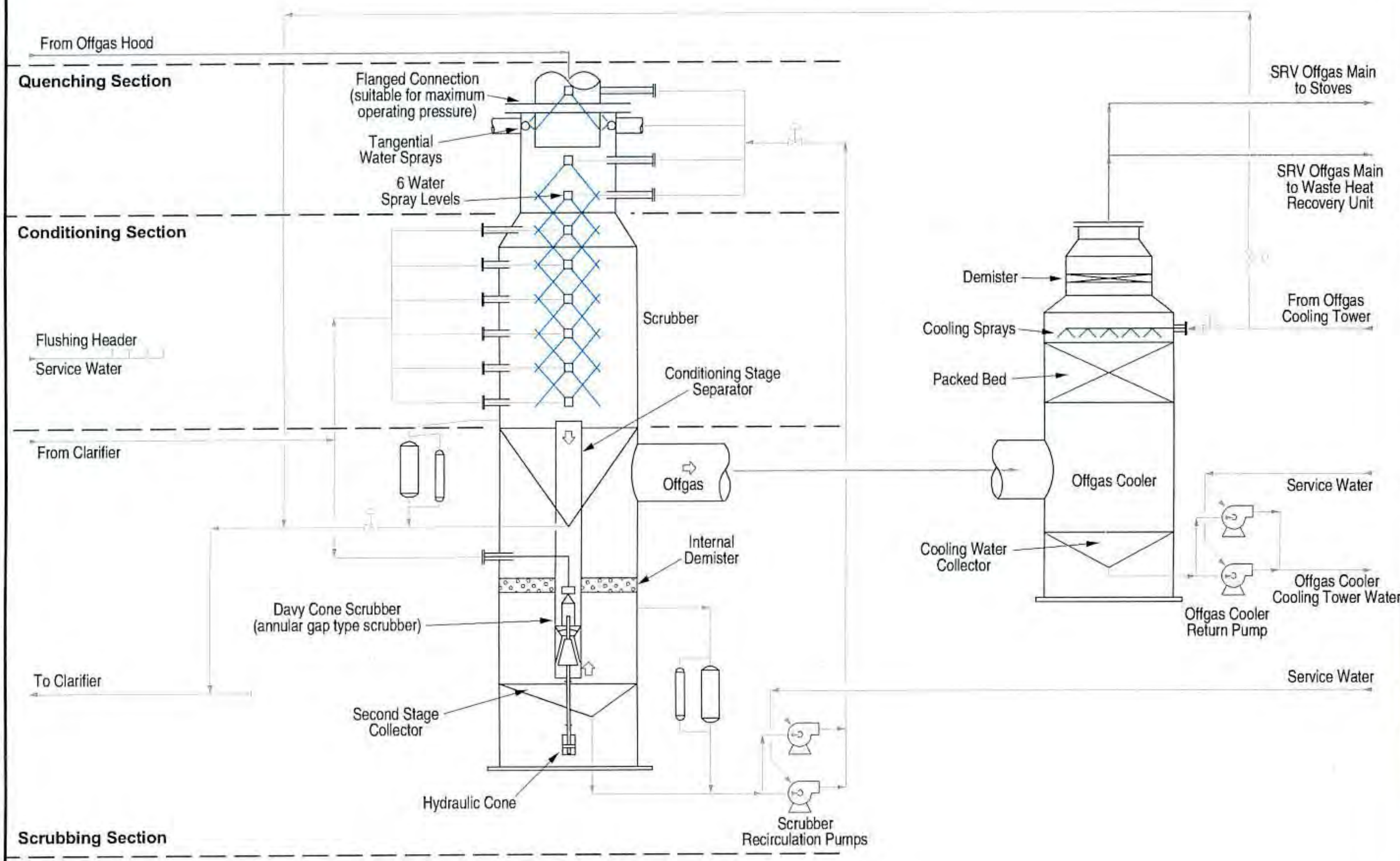
4.10.2 Scrubber Water Circuit

Water collected in the scrubber section sump will be recirculated to upper sprays in the conditioning section by two recirculating pumps, one operating and one on standby. A level control valve in this line will maintain sufficient water level in the scrubber section sump to provide a gas seal.

Water discharged from the conditioning tower will be fed to a clarifier where the dust from the SRV will be removed. In order to reduce the temperature of the conditioning section discharge water, the water will be mixed with cold make-up water from the offgas cooler circuit.

The clarifier will provide sufficient residence time for the solids to settle out. A rake mechanism will draw the settled solids to the centre of the clarifier basin from where they will be discharged. Flocculant will be added to the incoming dirty water stream to promote effective solids settling. Caustic solution will be added to adjust the pH to between 5 and 6. The higher pH will result in some of the metals precipitating out of solution as insoluble hydroxides at this point. Some metallic elements will also react with the dissolved H_2S to form insoluble sulphides and will also settle out in the clarifier. Scaling inhibitors will also be added periodically to control the scrubber recirculating water quality.

A scraper arm mounted on the clarifier rake mechanism will collect any scum floating on the clarifier water surface. The scum will be scraped to a discharge point and then collected in a bin.



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SCHEMATIC DIAGRAM OF OFFGAS SCRUBBER AND COOLING TOWER

Figure 4.6

Clarifier overflow will be collected in a clarified water tank from where it will be pumped back to the scrubber sprays. A set of clarifier underflow pumps will pump the settled solids slurry into a vacuum drum filter where the solids will be recovered and recycled back to the Process as part of the ferrous materials blend. Filtrate from the drum filter will be returned to the clarified water tank.

In order to control water quality, a portion of the clean clarifier overflow will be removed from the discharge of the scrubber feed pumps on a continuous basis. The overflow will be directed to the wastewater tank for treatment where the pH will be raised and any remaining dissolved metals will be precipitated as hydroxides.

4.10.3 Offgas Cooler and Water Circuit

The offgas cooler will contain a packed tower section with a large surface area to promote good water and gas interaction and maximise cooling efficiency. The offgas will enter the cooler below the packing and pass through a gas distributor to promote flow distribution across the full packing cross section. Cooling water will be fed through a spray distribution arrangement above the packed column section. The gas leaving the packed cooling section will pass through a packed bed demister section before exiting the cooler vessel.

Cooling water, together with the water condensed from the gas stream, will be collected in the offgas cooler sump from where it will be pumped directly to the offgas cooler cooling tower. The cooling tower will be a forced draught evaporative tower capable of taking relatively high inlet water temperatures.

4.11 PLANT CONTROL

4.11.1 Plant Control System

A Control System will be implemented in the Plant and will provide for:

- safe and stable operation;
- optimisation of Plant performance; and
- the collection of operating and environmental data for monitoring of the Process.

The System will be modern and robust utilising state of the art technology already extensively proven in similar industries. There will essentially be the following two main components:

- Automation system for process control and monitoring.
- Supervisory Control and Data Acquisition system for higher levels of process control, data management and supervisory functions.

The Plant Control System and Supervisory Control and Data Acquisition System will be linked by standard network connection with the information from both systems available to operators in the Central Control Room as shown on Figure 4.7.

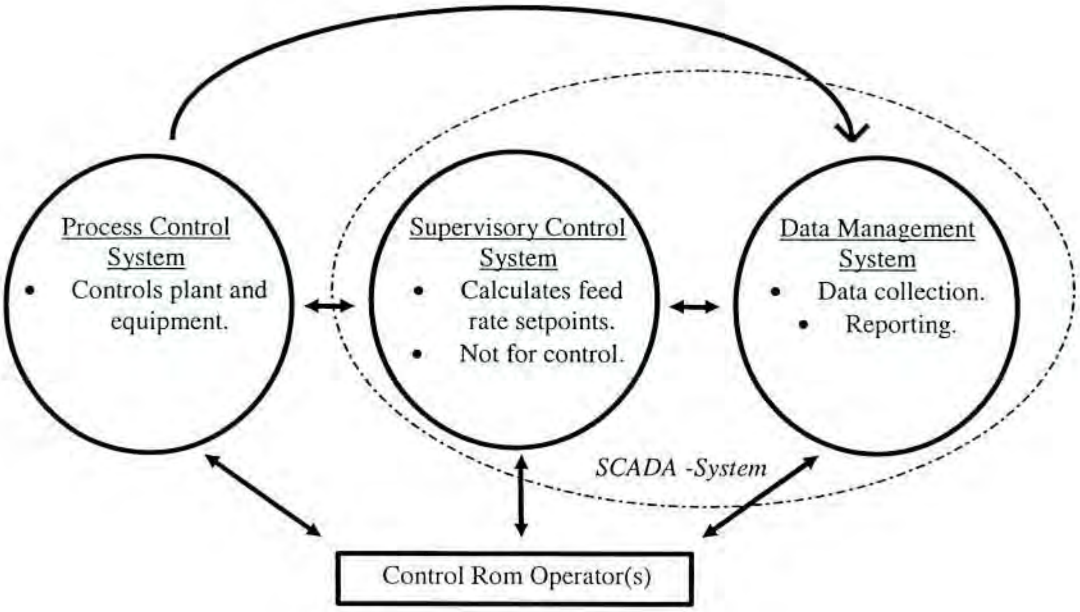


Figure 4.7 Plant Control Components

The Plant Control System will be based on an integrated distributed control system. It will provide control, monitoring, alarming, historical trending and reporting throughout the Plant. The Plant will for the most part be controlled through operator stations located in the Central Control Room.

The System will be divided into a number of distributed control nodes with redundant processors used to provide reliable, uninterrupted control. The redundancy will involve automatic switch over if a primary processor fails. A dual communication system will link the Plant instrumentation to the Central Control Room. The automation system will be connected to an uninterruptible power supply to provide the operator with uninterrupted plant information during a failure situation or major power outage. This will provide 100% availability for Plant safety.

The Plant Control System will provide for continuous, sequential and interlocking control of the Plant and equipment. Plant operation requires the operator to control both the core iron making unit and ancillary equipment such as injection systems, hot blast system and co-generation facilities. The control will be organised to allow ease of operation and maximise Plant safety. It will be configured to provide sequencing for start-up and shut-down of the Plant equipment to ensure the correct conditions are met before the equipment is started or stopped, or before solids flow can be initiated. Safety interlocks within the Control System will prevent the plant being operated beyond specified control limits. Alarms will alert the operator to any aspect of the process or equipment outside normal operating criteria. The Plant Control System will also be configured to respond to various conditions if an emergency occurs. If an emergency action is taken the Plant Control System will continue to monitor and record all Plant data and perform the necessary sequenced operation for safe shut down or continued operation of Plant equipment.

4.11.2 Supervisory Control And Data Acquisition System

The two main components of the Plant Control System will be:

- Supervisory Process Control; and
- Data Management.

The Supervisory Control System will consist of a series of metallurgical model applications specifically designed for controlling and optimising the Process. The primary function of the Supervisory Control System will be to control the conditions in the SRV.

The Process models will be linked to the Plant Control System for access to real time Plant data such as offgas analysis, water-cooling heat loads and HAB rate. The data will be used to carry out heat and mass balance calculations that will define injection conditions. The key process measurements used in the heat and mass balance calculations are shown on Figure 4.8.

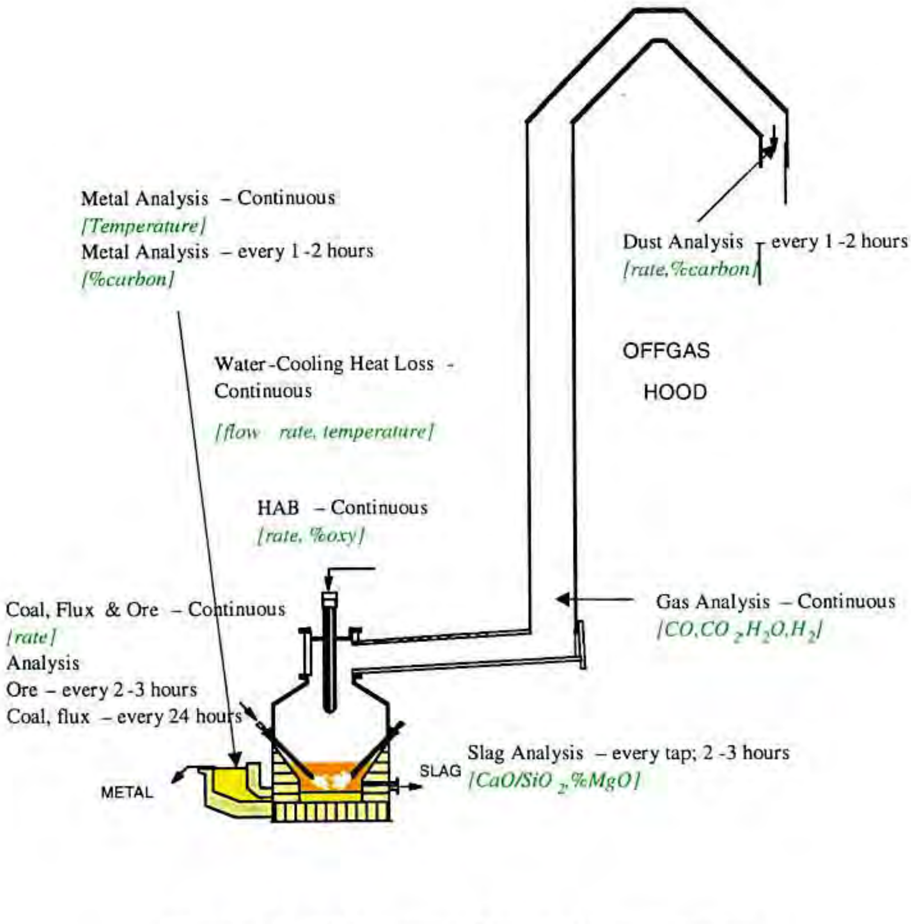


Figure 4.8 Key Process Control Measurements

The Data Management System will collect and provide long-term data storage for information from the Plant Control System, Supervisory Control System and Laboratory. The key parameters to monitor Plant and process performance will be logged on a continuous basis. This will include environmental monitoring data.

4.11.3 Environmental Monitoring

The Plant Control System will monitor and collect measurements of SO_2, concentrations in the stack emissions from the stack on a continuous basis. It will generate, and log, an alarm if the monitoring indicates the emissions are not within specified limits of the licence approvals. Procedures will be in place to take the appropriate action to lower the emission levels.

The data will be logged by the Data Management System for preparation of environmental reports for the DEWCP, NPI and Rio Tinto, and will be stored for an extended period of time to provide an accurate history of Plant emissions. This will be an important aspect not only in terms of meeting environmental requirements but also in marketing of the HIsmelt technology.

4.12 PRODUCT AND BY-PRODUCTS

4.12.1 Pig Iron Product

The pig iron will comprise predominantly metallic iron with a carbon content of around 4% and low levels of other constituents. Pig iron will be cast into five kilogram (kg) "pigs" and then shipped to overseas or Australian customers in 40,000t shipments approximately twice per month for each of the Stage Plants.

Two pig casting machines will be installed, one for normal operation and the other on standby. The casting machines will consist of a chain and mould assembly mounted on a heavy structural steel framework. The assembly will consist of overlapping open-top pig moulds, suspended between two matched strands of roller chain. As the empty moulds pass beneath the metal stream, they will be filled with hot metal, with any excess overflowing to the next mould (see Plate 4.1).

Plate 4.1 Pig Caster at the HRDF

After the top surface of the pigs has air-cooled and solidified the pigs will pass under a series of water sprays, which will cool the pigs and the moulds as they travel up the slope towards the discharge end. As the moulds pass around the head end sprockets they will be struck by an automatic mould rapper to aid in freeing the pigs from the moulds. As the moulds continue around the head sprockets they will invert and allow the pigs to fall by gravity onto the discharge chute. A sticker ejector will help to remove any pigs that fail to drop. Water sprays of recycled process water blowdown will be used to cool the pile of pigs forming below the discharge chute.

The empty moulds will return on the underside of the machine to the pouring point. As they travel they will be sprayed with a mould coating solution, which both insulates the mould and also acts as a non- sticking agent. The mould coating solution will be dried upon contact with the hot moulds, any excess will be drained back to the mould coating solution tank for re-use.

The pile of cooled pigs will be removed using a front-end loader and delivered by truck to the nominal 66,000t pig iron stockpile located as shown on Figure 4.2.

Front-end loaders will retrieve pigs from the stockpile and place them into a 250t capacity hopper. A variable speed heavy duty apron feeder will feed the pigs onto conveyors that will transport them to the ship loading arm and then load them into the ship's hold.

4.12.2 Slag By-Product

Slag will be produced in the Process due to the reaction between the flux and gangue in the ore, and the ash in the coal. Depending on the source of the raw materials and process efficiency approximately 250 to 300kg of slag will be generated per tonne of hot metal. This results in annual slag production of 225,000tpa for the Stage 1 Plant. This will be doubled when the Stage 2 Plant is operational.

Slag will be tapped from the SRV through a taphole and will flow down a refractory lined runner to a pit. Water sprays will cool the slag so that it can be broken up and removed. Two slag pits will be established so one pit will be available, whilst the cooled solidified slag is being removed from the other.

4.12.2.1 Properties of Slag

The slag will have properties similar to those of blast furnace slag, which traditionally has been used as an aggregate for concrete or road base applications. To produce slag suitable for use as an aggregate, it is necessary to slowly cool the slag to allow the mineral phases to crystallise. Slow-cooled slag has similar properties to rock, therefore it can replace material currently being supplied by hard rock quarries, which is a benefit to the environment and sustainability.

Mineralogical analysis of slag produced by the HRDF indicated that the major mineral is Merwinite ($MgO.3CaO.2SiO_2$). When the alumina content of the slag increased, Gehlenite ($2CaO.Al_2O_3.SiO_2$, sometimes with TiO_2 substitution) was found to be the dominant mineral. These findings are consistent with the constituents found in slag produced in a blast furnace. A typical analysis of slag produced at the HRDF is shown in Table 4.5.

Table 4.5

Typical Components of Slag Produced at the HRDF (% by Dry Weight)

Component	Minimum	Typical	Maximum
FeO	2.0%	4.0%	7.5%
Fe_2O_3	0.5%	1.0%	2.0%
CaO	30.0%	35.0%	38.0%
SiO_2	25.0%	28.0%	30.0%
MgO	8.0%	10.0%	12.0%
Al_2O_3	13.0%	16.0%	20.0%
MnO	0.2%	1.5%	3.5%
P_2O_5	0.1%	1.4%	2.0%
CaS	0.1%	0.3%	0.5%
Others	-	2.8%	-

Source: HRDF Data

Rapidly quenching the slag with water results in a granulated slag with vitreous (glassy) properties. Granulated slag has good hydraulic properties and can be used as a substitute for clinker in the production of Portland cement. The Proponent is currently investigating the value-adding potential of rapidly quenching the slag as the use of this type of slag in the manufacture of cement would have an additional benefit of reducing the Cement Industry's greenhouse gas emissions. However, the limited market for cement in Western Australia and the cost of transporting the slag to interstate or overseas customers will result in only a small amount of slag being granulated. At this stage, it is envisaged that both processing methods may be applied to the slag. However, until the results of the value-adding investigations are available it is assumed that the slag will be sold as an aggregate.

Research is currently being undertaken on the development of new value-adding uses for slag, such as mineral fibre products or as inorganic polymers. While limited success has been achieved to date it is believed that further research may lead to successful outcomes. Any processes that enhance the value and demand for the slag by-product will be applied at the Plant if economically feasible.

4.12.2.2 Slag Processing and Transport

A contractor with expertise in slag processing will process the slag once it has been tapped from the furnace, which is standard practice in the iron and steel industry. The contractor's involvement will encompass the operation of a slag granulation facility should further investigations show that this to be is a viable processing option.

The contractor may install an on-site facility for the processing of slag for use as aggregate or road base. Alternatively the slag may be taken to an off site processing facility. The slag will be crushed and screened and any entrained metallic iron particles will be magnetically removed and returned to the Plant. The slag will be loaded onto trucks for delivery to customers. If established on-site the slag processing facility would be located to the east of Leath Road on land that was historically the slag storage area for the Australian Iron and Steel (AIS) blast furnace and the HRDF (see Figure 4.2).

Approximately 20 to 30 trucks per day (average of 24) will be required for the transport of the slag from the Stage 1 Plant with that number doubling when both the Stage 1 and Stage 2 Plants are operating.

4.12.3 Gypsum

The FGD System will produce a high quality gypsum product that may be used either as an additive by the cement industry or by the wallboard manufacturing industry. It is expected that local cement manufacturers will consume the small tonnage that will be produced by the Plant.

Gypsum is a hydrated Calcium Sulphate ($CaSO_4.2H_2O$) that occurs naturally and is commonly used as a soil conditioner. It is an inert compound with a very limited solubility.

The FGD will be operated in a manner that is conducive to the production of large crystals of gypsum that are easily de-watered, resulting in a product that has high purity and a moisture content of less than 10%. Production levels will depend on the sulphur content of the raw materials but is expected to be around 1.5 tph. The gypsum will be stored in a concrete bin prior to being loaded onto trucks by front-end loader for delivery to customers. Approximately two trucks per day per Plant will transport the gypsum from site.

4.13 POWER SUPPLY

Power supply to the Plant will be from the following two sources:

- The existing Western Power 132kV feeder from the Leath Road Switchyard, which is in turn fed from Mason Road.
- Two 20MW steam turbine generators to be incorporated in the Plants.

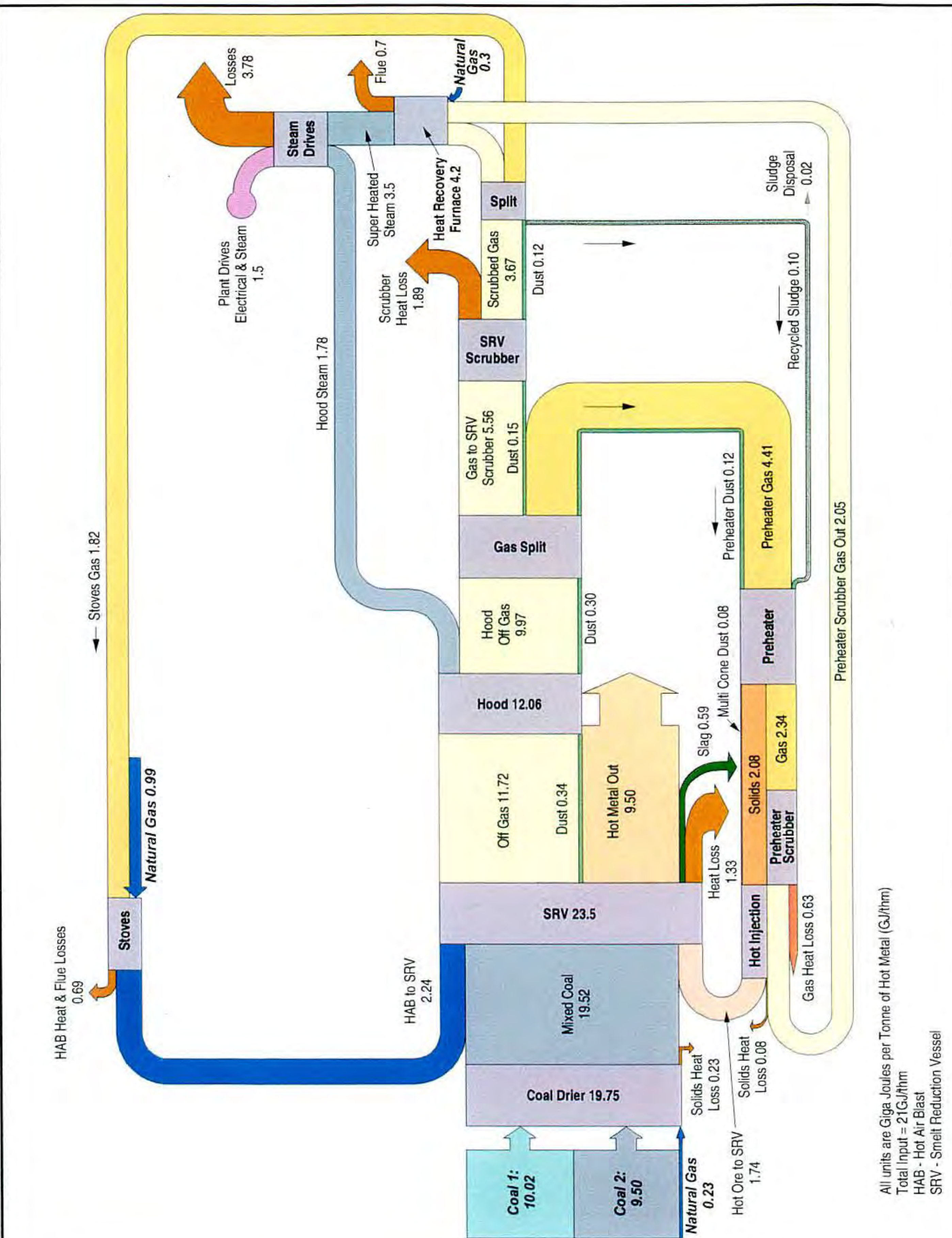
The equipment in the existing 132kV switchyard will be retained and re-used with only minor modifications made to the control and protection systems. Power will be distributed from the existing 132kV switchyard to substations located as shown on Figures 4.2 and 4.3, respectively. Start up power will be from the Western Power system.

Super heated steam from the WHR system will be delivered to the steam turbine generator. The generator will be connected to the main 11kV switchyard located in the Substation and will provide the primary power supply for the Plant once it is in full production.

4.14 POWER GENERATION

The combined offgas from the ore Preheater and the proportion of SRV gas not used in the Preheater or stoves will have a calorific value of approximately 2 MJ/Nm^3, which will make it suitable for combustion as a fuel when supplemented by natural gas. The gas will be combusted in a WHR system designed for use with a low calorific value, mildly sour, fuel gas. The energy balance for the site operations is shown on Figure 4.9.

The WHR system will be designed to receive and combust the combined cleaned and cooled offgas streams from the Process to produce superheated steam for use in steam turbines. The offgas will be combusted within the WHR system in a manner that maximises the CO destruction, while minimising NO_x formation. The gas exiting the WHR system will be combined with the flue gas exiting the stoves, and will then pass to a FGD system where SO_2 will be removed prior to the exhaust gas being released to the atmosphere via a stack.



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ENERGY BALANCE FOR EACH PLANT

Figure 4.9

The WHR system will include:

- thermal oxidiser;
- WHR unit;
- steam drum; and
- necessary heat exchange equipment such as superheat coils and a demineralised water economiser.

The WHR package will produce saturated steam, which will be combined with the hood saturated steam supply to generate superheated steam. Natural gas fuel will be used only for start-up and fuel gas enriching, as required. Demineralised water will be produced on site and stored in a tank prior to being used in the offgas hood and WHR system.

Wastewater generated in the demineralisation plant, which will contain most of the dissolved and suspended solids present in the input water, will be directed to the process water tank for recycling to the slag or pig iron cooling water sumps.

4.14.1 Thermal Oxidiser

The WHR thermal oxidiser will be a cylindrical carbon steel shell, with internal refractory and insulation. The thermal oxidiser will be arranged horizontally with a 90-degree turn prior to entering the downstream heat recovery equipment.

The WHR thermal oxidiser will be operated with varying SRV offgas flow rates and qualities. Under normal operating conditions, the system will require no auxiliary support fuel for flame stabilisation. The thermal oxidiser will comprise:

- a cyclonic combustor;
- an auxiliary burner with fuel train and Burner Management System;
- combustion air fans;
- instruments; and
- controls.

Offgas will be introduced tangentially to the cyclonic combustor and will impart a cyclonic swirl pattern within the cylindrical shell of the incinerator chamber. This flow pattern will ensure quick and efficient oxidation of the combustibles in the offgas. A refractory choke ring within the shell will help to recirculate the products of combustion and facilitate mixing with the fresh combustible gases.

Combustion air will be injected via high-velocity radial jets to penetrate and mix with the offgas stream. This will result in staged combustion that will assist in minimising NO_x generation. The combustion air flow to the thermal oxidiser will be set by maintaining a constant oxygen level (1 to 2%) in the exhaust gas. Combustion airflow will be supplied by a set of three motor driven fans.

An auxiliary low NO_x forced draught register natural gas burner will be installed at the offgas inlet end of the combustion chamber to maintain suitable combustion of the hydrocarbons and to allow steam production when SRV offgas is not available. To ensure adequate destruction of the CO in the offgas, a minimum combustion temperature of 850°C will be maintained.

The WHR unit will generate superheated steam from the imported hood steam and internally generated steam. In producing this steam, the WHR unit will absorb heat from the thermal oxidiser combustion products. The steam raising equipment will consist of the following sections:

- A radiant screen to protect the downstream coils.
- A two-stage superheater section with desuperheater controls (where the quantity of superheat is controlled by injecting demineralised water as required to maintain the superheated steam at a temperature of 420°C).
- A main evaporator section, consisting of three modules of convective coils.
- An economiser section.
- A steam drum with three element demineralised water control.

The steam raised in the WHR system and the offgas hood will be used to drive the HAB blower and the ASU main air compressor with the remainder being passed through a turbo-alternator that will generate the 20MW of electrical power required to operate the Plant.

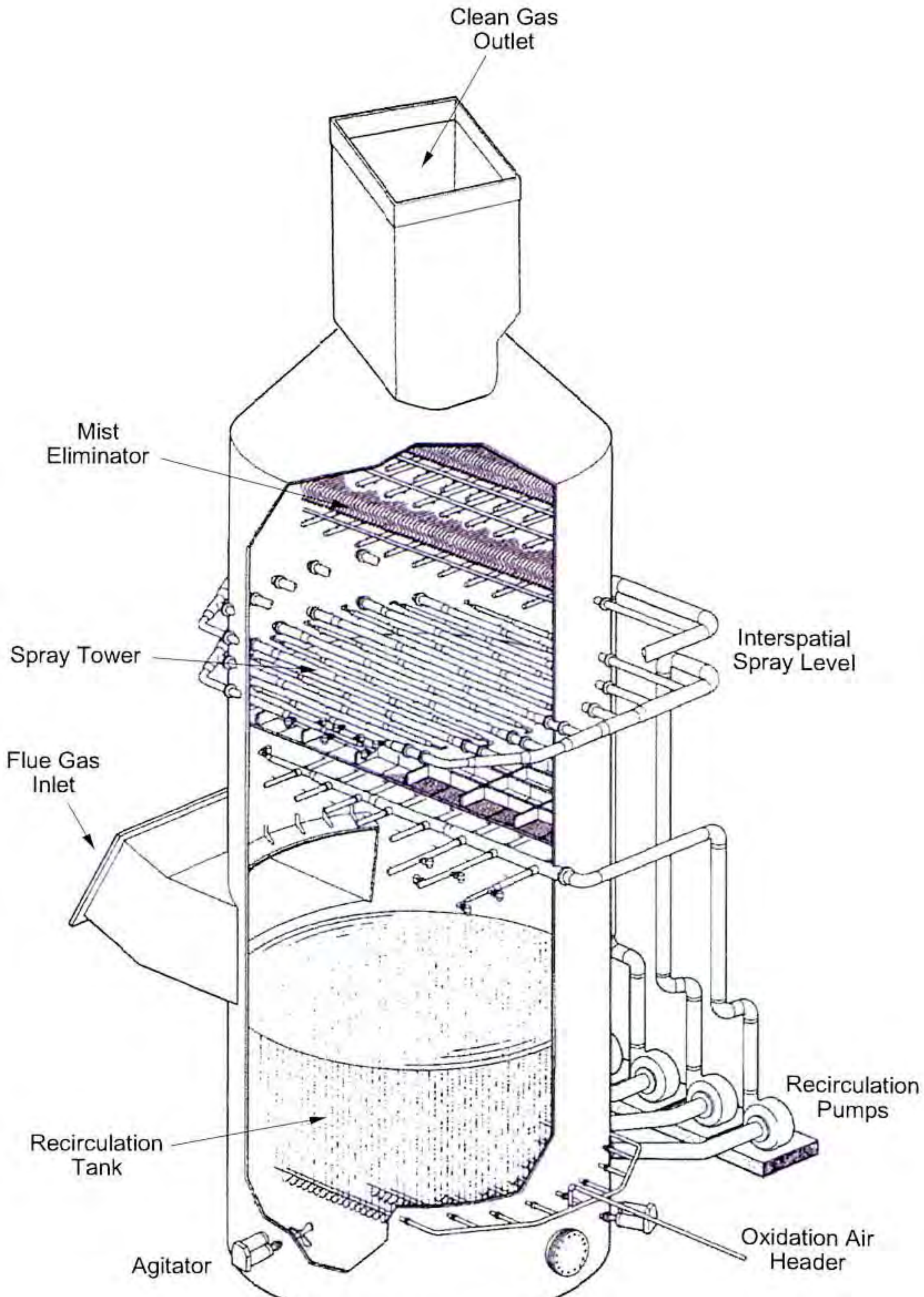
The turbo-generator system will include a condensing turbine designed to receive superheated steam. The discharge from the turbine will pass through a surface condenser operating at vacuum with the resultant condensate being pumped to the de-aerator via condensate pumps.

The use of the offgas as a fuel from one Plant will offset approximately 40MW of electrical power that would otherwise need to be obtained from the grid, which makes the Plant self sufficient in terms of electrical power.

4.15 FLUE GAS DESULPHURISATION

The WHR and stove waste gases will contain SO_2 due to the combustion of the H_2S in the Process offgas. A FGD system will be incorporated in the Plant design to remove SO_2 from the waste gases. FGD systems are recognised as the best available technology for SO_2 removal and are commonly used in large combustion plants (European Commission, 2001).

A schematic diagram of a FGD Unit is presented as Figure 4.10. The system will utilise wet lime/limestone slurry for scrubbing the gas and will have an *in-situ* oxidation process to produce a commercial grade gypsum product. The waste gas streams will flow via a common flue gas header into the absorber tower of the FGD system and be scrubbed by slurry sprays prior to exiting through the stack. The system will have a SO_2 removal efficiency of at least 95%. The processes undertaken in the FGD are described in Appendix B.



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SCHEMATIC CROSS SECTION OF A FLUE GAS DESULPHURISATION UNIT

Figure 4.10

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4.16 WATER SUPPLY

A water balance for the Process is shown on Figure 4.11. The major use of water will be in the cooling towers for cooling process equipment, the process offgas or the condensation of steam. Blowdown from the cooling towers will be directed to the scrubber circuits as a source of make-up since those circuits are able to tolerate higher levels of TDS than the cooling towers. The blowdown from the scrubbers will be evaporated in the cooling of the slag and pig iron products.

Currently scheme water sourced from the Water Corporation is the only viable supply of fresh water for use in the Plant. Approximately 405KL/hr (3.2GL/pa) of water will be required for each Stage of the Project as shown on Figure 4.11. A typical analysis of Perth scheme water is shown in Table 4.6. The Water Corporation currently indicate that this quantity of scheme water will be available subject to some upgrade to their supply system (Water Corporation, *pers. comm.*, 2002).

The Water Corporation, together with Kwinana industries, is proposing to construct a Waste Water Recycling Plant to produce high quality industrial grade water from secondary municipal effluent drawn from the Point Peron outlet line as discussed in Section 3.4.3. The Proponent will preferably use water from the Recycling Plant if it is feasible. Table 4.6 also contains the expected analysis of the treated recycled water from the proposed Water Corporation Plant.

Table 4.6

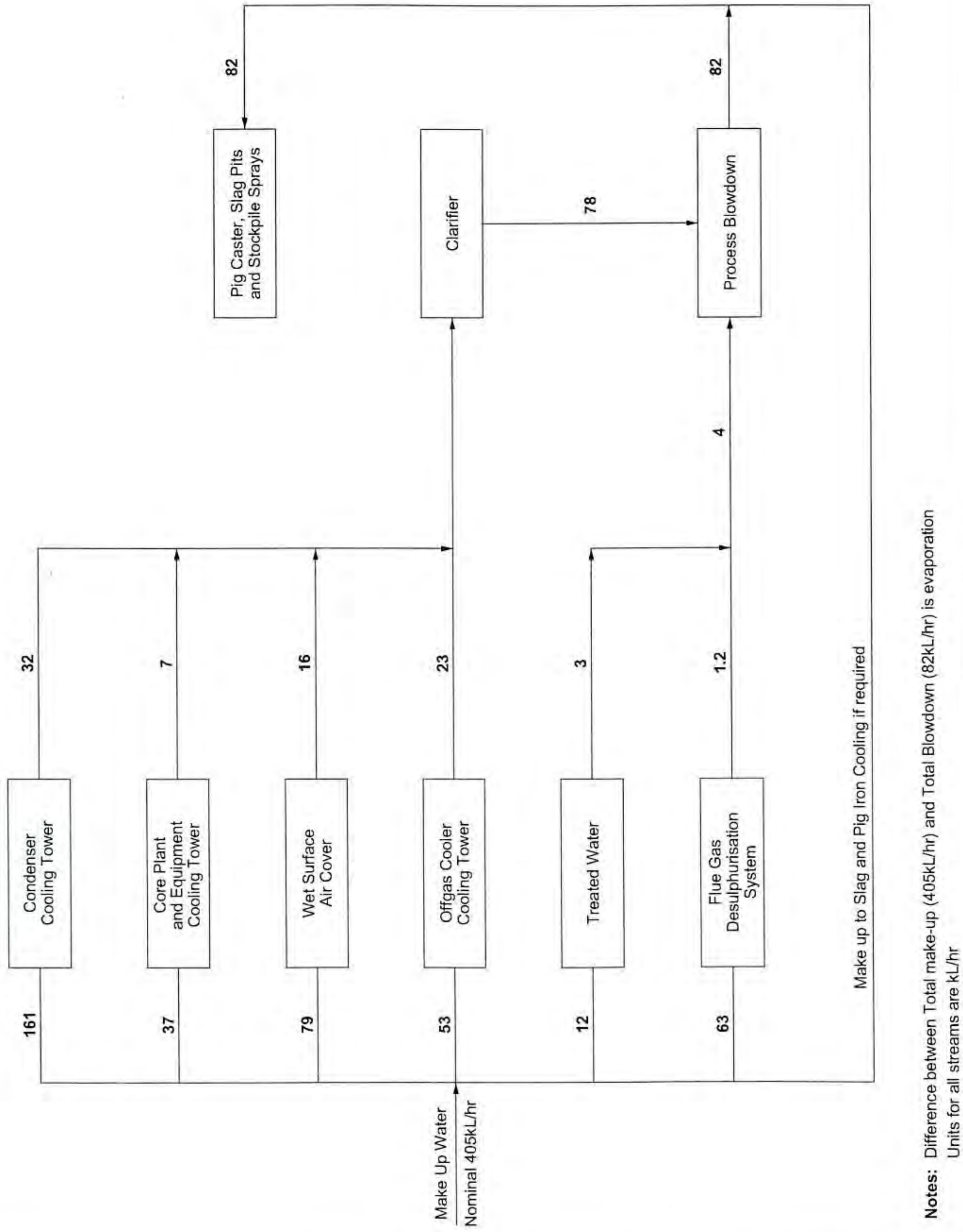
Water Supply Quality

Parameter	Concentration (mg/L)	
	Scheme[1]	Waste Water Recycling Plant[2]
Na	79	12
K	3.6	2.5
Cl	146	10
F	0.84	0
S(SO4)	28	0.8
Zn	<0.02	
Pb	<0.002	
Cd	<0.0002	
Fe	0.024	
Ca	22	0.4
Mn	0.005	
Ni	<0.02	
B	0.045	
P	<0.01	
Cr	<0.002	
Mg	8.6	0.1
Al	0.1	
Si (SiO2)	10.7	(0.5)
Cu	0.01	
Mo	<0.01	
Ba	0.044	
pH	6.9	5.9
Alkalinity (as CaCO3)	36	
Conductivity (μS/cm)	560	
TDS		50

Source: 1 From HRDF experience
2 Water Corporation, *pers. comm.* 2001

Scheme water can be concentrated around five times without adversely affecting the cooling circuit performance. The recycled water could be concentrated more than ten times without having an adverse impact on cooling circuit performance.

The main types of water that will be required for the Project are discussed below.



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HIsmelt PLANT STAGE 1 - WATER BALANCE

Figure 4.11

Process Water

Approximately 400 kL/hr (3.2 GLpa) of process water will be required for:

- cooling the SRV and associated equipment either by removing heat from the closed circuit systems via heat exchangers or direct cooling of the external shell of the SRV;
- cleaning the offgas from the SRV and pre-heater; and
- condensing the steam used in the Plant so that the condensate can be recirculated to the WHR system.

Water for the process water will be from scheme water supplied by the Water Corporation. However, should the proposed Water Corporation's Kwinana Wastewater Recycling Plant be approved and operational then the process water may be sourced from that Plant.

High Quality Water

The closed circuit cooling systems, the offgas hood and the waste heat recovery require a higher quality of water. The make up to these systems will be produced in treatment plants located on site.

Pig Iron and Slag Cooling Water

Water for cooling the pig iron and slag will be obtained from blowdown from the gas cleaning scrubber circuits and stockpile storm water run off. This recycling of water will reduce the water usage and result in minimal (if any) effluent for disposal.

Fire Water

Fire water will be supplied via the existing underground pipes and routed in order to provide a fire water loop around the HIsmelt facility. Fire hydrants will be positioned around the loop, spaced so that all plant areas (including the stockpiles) are within 90m of a hydrant. Fire hose connections will be provided at the hot metal handling areas and along elevated conveyors. Sprinkler systems will be supplied at conveyor transfer towers, the main control building and the cooling towers.

4.17 NATURAL GAS

Natural gas will be obtained from an existing supply main which feeds the HRDF site. The gas will be supplied through a 150mm nominal diameter pipeline at a nominal pressure of 1500 Kilopascals Gauge (kPag). A metering station will be provided at the facility boundary to monitor natural gas usage. The major natural gas requirements in the Plant are for the:

- hot blast stoves;
- waste heat recovery system;
- coal drying facility; and
- preheating hot metal handling systems.

The ore Preheater and SRV will also be heated with natural gas during commissioning and start-up.

4.18 AIR SEPARATION UNIT

Air Separation Units (ASUs) will be required to provide oxygen and nitrogen to the Plants. It is currently envisaged that the ASUs will be constructed and operated by Air Liquide WA Pty Ltd and will be located on the HIsmelt site as shown on Figure 4.3.

4.18.1 Construction of the ASU

Construction of the ASUs will comprise:

- Civil works where the site will be prepared, the ground excavated, foundations formed and concrete poured.
- Erection of equipment by lifting and setting on foundations.
- Installation and pressure testing of process and utilities piping between the ASUs and the HIsmelt Plant.
- Connection of the electrical equipment and motors to the HIsmelt power feeders.

4.18.2 Design of the ASU

The layout of an ASU is presented on Figure 4.12.

The ASU will have a nominal production capacity of 880 tpd of oxygen and up to 800 tpd of nitrogen.

4.18.3 ASU Process Description

The air separation process is carried out in two main steps:

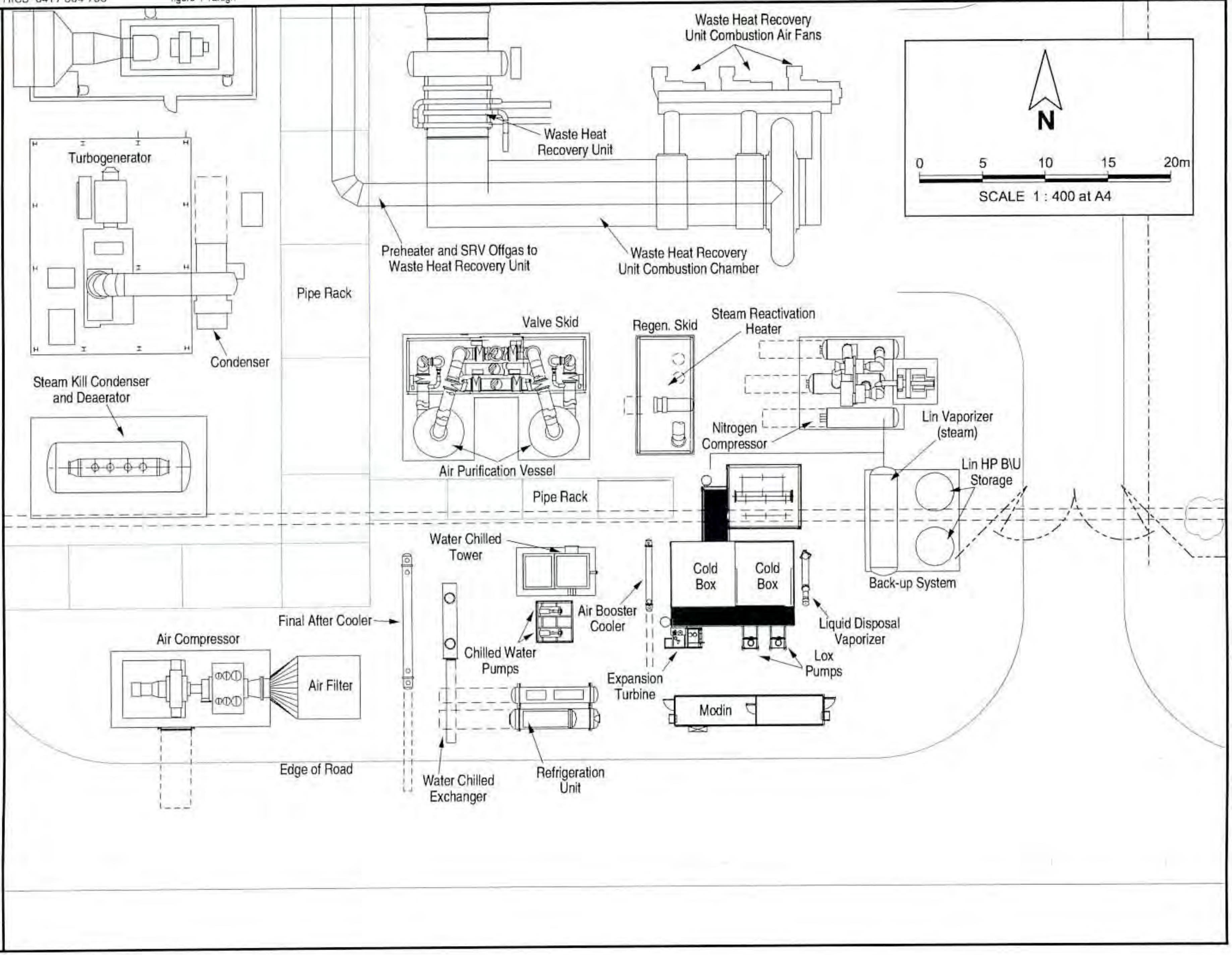
- Air Compression and Purification
- Cryogenic Processing

A process flow diagram for an ASU is presented as Figure 4.13.

4.18.3.1 Air Compression and Purification

Atmospheric air will be drawn through an inlet filter to remove dust and other particulates. It will then be directed into a compressor where it will be compressed to approximately 620kPa. The compressors will be equipped with water-cooled intercoolers.

Upon exiting the compressor, the air will be cooled in two stages using chilled water, namely the aftercooler and the chilled water cooler. The chilled water for both of these stages will be supplied from the nitrogen chiller tower, which will use cold nitrogen and mechanical refrigeration to cool the water.



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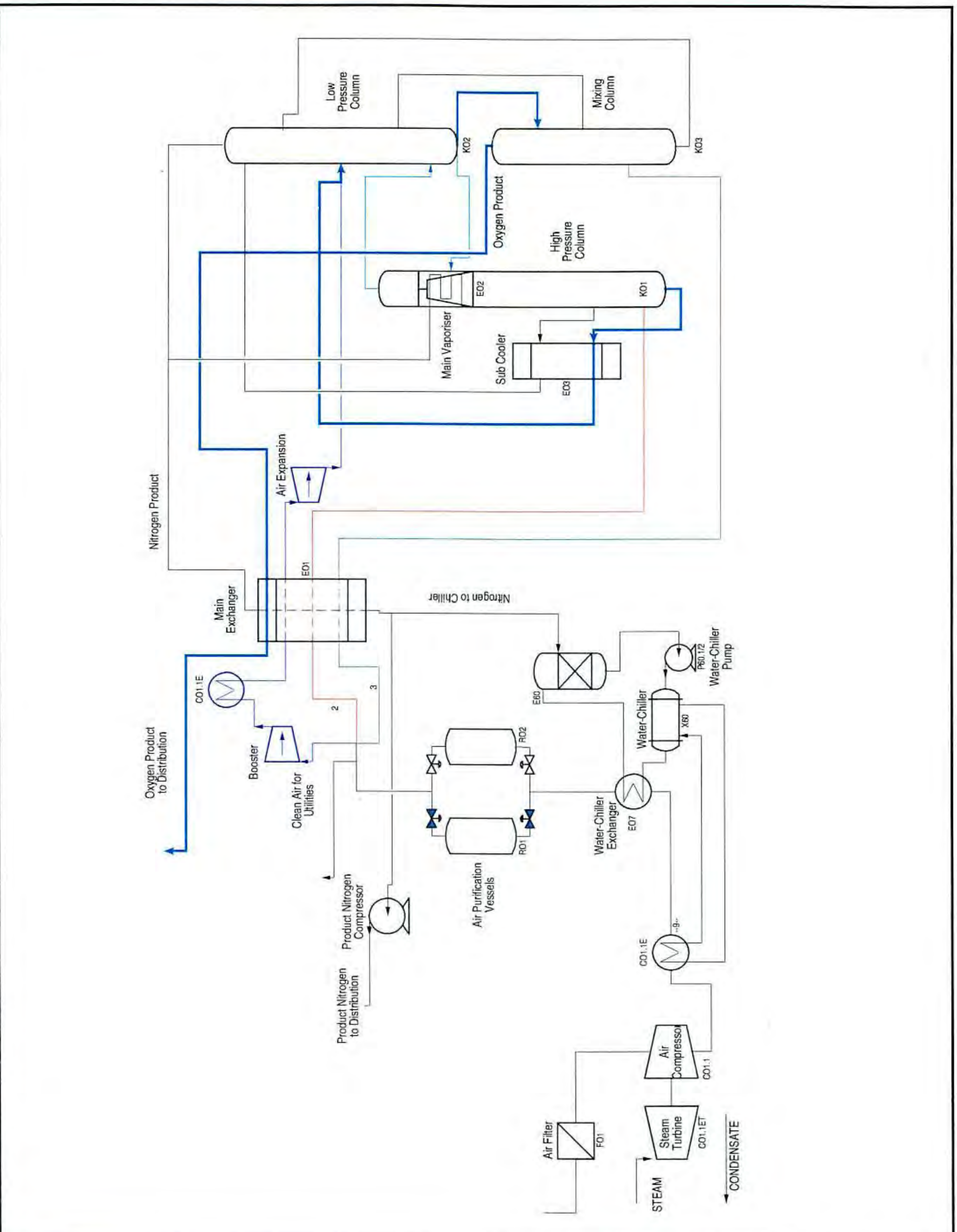
AIR SEPARATION UNIT LAYOUT

Figure 4.12



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AIR SEPERATION UNIT
PROCESS FLOW DIAGRAM

Figure 4.13

The chilled and compressed air from the chilled water cooler will enter an adsorption system. This system will remove the CO_2 and water in the air using a dual bed of alumina and molecular sieve (sodium silicoaluminate). For continuous processing, two dual bed adsorbers will be used in parallel to purify the air. While one adsorber is accumulating CO_2 and water from the air the other adsorber is being regenerated. The time that each adsorber is operating or being regenerated will be controlled.

A waste nitrogen gas stream from the cold box (see Figure 4.12) will be used to remove CO_2 and water during the regeneration of the adsorber bed. The purified compressed air from the adsorbers will be suitable for cryogenic processing.

4.18.3.2 Cryogenic Processing

The main cryogenic processing will occur in the cold box in three columns, being the high-pressure column, the low-pressure column and the mixing column. The air stream from the adsorbers will be split into three streams. This spilt will represent a separate cold air supply to each of the three columns.

The first stream will be compressed and aftercooled in the booster before being directed to the main heat exchanger where further cooling will occur through indirect contact with nitrogen and oxygen product. This air will then be expanded producing a cold low-pressure air, which is fed near the middle of the low-pressure column.

The second and largest of the three air streams is cooled further in the main heat exchanger and then sent directly to the lower part of the high-pressure column. The third stream will also be cooled in the main heat exchanger and will be fed into the lower section of the mixing column.

The high-pressure column will be used to separate the air into oxygen-rich liquid at the bottom and impure nitrogen liquid at the top, using staged distillation. The impure nitrogen will be vaporised in the main vaporiser via indirect contact with a small part of the flow of oxygen-rich liquid from the bottom of the low-pressure column. This vaporised nitrogen will be part of the nitrogen product from the ASU while the vaporised oxygen will be recycled to the low-pressure column.

The rest of the nitrogen product will be drawn as gaseous nitrogen from the top of the low-pressure column.

The two nitrogen product streams will be mixed and then sent to the nitrogen compressor via the main heat exchanger where the cold nitrogen will be used to cool the incoming air streams.

The liquid oxygen from the low-pressure column that is not used to vaporise nitrogen in the main vaporiser will be fed to the mixing column. The oxygen product from the ASU will be drawn as the gas in the top of the mixing column and is approximately 95% pure. The oxygen product will be discharged to distribution via the main heat exchanger.

4.18.4 Materials

A small capacity refrigeration unit will be used to produce chilled water for the cooling of the incoming process air.

As described in Section 4.18.3 alumina and molecular sieve (sodium silicoaluminate) will be used to remove the CO_2, water and most of the hydrocarbons from the process air. Approximately 40t of alumina and 46t of molecular sieve will be used in each of the ASUs. It is not expected that the alumina and the molecular sieve will need to be replaced in the ASUs.

Perlite (a natural occurring mineral comprised of sodium, potassium, alumina, and silicate) will be used as the insulation media in the cold box. It is not expected that the perlite will need to be removed and replaced in the ASUs.

4.18.5 Water and Power Supply

A recirculating water flow of approximately 4,000kL/hr will be required for operating each of the ASUs. The water will be sourced from a HIsmelt cooling tower (see Section 4.16).

Power for the ASUs will be sourced from the HIsmelt's Power Generating Facility (see Section 4.14). The ASUs' main air compressor will be driven by steam supplied by the WHR system at the HIsmelt Plant.

4.18.6 Commissioning of the ASU

Commissioning of the ASUs will commence once the utilities become available. The adsorption vessels will be reactivated and the CO_2 and moisture trapped inside the cryogenic equipment and piping will be removed. The ASU processes will then commence to separate the air into oxygen and nitrogen.

4.19 OXYGEN AND NITROGEN

Oxygen will be required for the enrichment of the cold blast. Approximately 880tpd of oxygen will be supplied from each ASU (see Section 4.18).

Nitrogen will also be supplied at a rate of up to 800tpd from each ASU and used:

- as a conveying gas;
- for bag filter cleaning;
- to maintain inert atmospheres; and
- for purging purposes.

4.20 ATMOSPHERIC EMISSIONS

4.20.1 Source of Emissions

Atmospheric emissions for both the Stage 1 and Stage 2 Plants will occur from five stacks under a number of operating modes. The point source emissions are presented in Table 4.7.

Table 4.7

Point Source of Atmospheric Emissions

Stack	Source	Operating Modes
Main Stack	Off gases from SRV that have been cleaned through scrubbing systems	Up to five operating modes (including normal operations) that are dependent on the coal feed rate to the SRV
Coal Mill	Dust extraction from coal handling	Normal Operation Only
Cast House Extraction #1	Dust extraction after being passed through dust collection systems	Normal Operation Only
Pig Caster Fume Extraction #2	Fume extraction after being passed through dust collection systems	Normal Operation Only
Preheater Stack	Gas fired burner with small amounts of sulphur dioxide liberated from the iron ore	Emissions for the first six months of commissioning only

4.20.2 Operating Modes

The various operating modes during commissioning and ramp up discussed in Section 4.3 will impact on Plant emissions. The main source of sulphur input to the Process will be from the coal (83%) with minor amounts from the iron ore (10.8%) and fluxes (6.2%), therefore, any variation in coal usage rate and sulphur content will potentially affect SO_2 emissions. The anticipated emission rates from each Plant for the five modes of operation are summarised in the Table 4.8.

Table 4.8

SO_2 Emission Profile from Each Plant

Mode Of Operation	Description	Coal Rate (% of Nominal)	SO_2 Emission (g/s)	% of Time		
				Year 1	Year 2	Year 3 onwards
1	Design Rate	100	9	0	61.9	87.5
2	Reduced production with greater coal consumption	105	10	42.3	5.0	0
3	Ramp up with higher coal rate	112	11	20.4	14.7	6.0
4a	No Production whilst Plant on-line – Initial 30 minutes	30	24	1.1	0.85	1.0
4b	No Production whilst Plant on-line – Following initial 30 minutes	30	3	7.4	5.95	1.5
5	No Production with Plant offline due to end tap.	0	0	28.8	11.6	4.0
				Annual Average SO_2 (g/s)		
				6.7	**7.9**	**8.8**

4.20.3 Normal Mode – Design Conditions

Emissions under normal operations and the associated stack parameters for the Stage 1 and Stage 2 Plants are presented in Table 4.9. It should be noted that the Stage 2 Plant is expected to be a duplication of the Stage 1 Plant, therefore, there will be two of each type of stacks listed in Table 4.9 when Stage 2 becomes operational. The total stack emissions from the Stage 1 Plant operations and both the Stage 1 and Stage 2 Plants operating are presented in Table 4.9.

Table 4.9

Stack Parameters Under "Normal" Operations for both the Stage 1 and Stage 2 Plants

Parameter	Units	Main Stack	Coal Mill	Cast House Extraction No. 1	Pig Caster Fume Extraction No. 2	Pre-Heater Stack	Total Emissions Stage 1[1]	Total Emissions Stage 1 and Stage 2
Stack Height	(m)	60	55	15	25	62	-	
Stack Tip Diameter	(m)	3.45	0.815	2.00	1.65	1.62	-	
Stack Volume	(Am^3/s)	166	12.4	48.2	25	44.4	-	
Stack Temperature	(deg C)	63	82	80	80	80	-	
Exit Velocity	(m/s)	17.8	30.9	20	15.8	28	-	
SO_2 Emissions	(g/s)	9	0	0	0	1.5	9 (10.5)	18
CO Emissions	(g/s)	23.4	0	0	0	Negl	23.4 (23.4)	46.8
NO_X Emissions	(g/s)	20.7	0.38	0	0	2.0	21.1 (23.1)	42.2
Particulate Emissions	(g/s)	0.17	0.19	1.45	0.5	1.54	2.31 (4.59)	4.62
SO_2 Concentration	(mg/Nm^3),dry	96	0	0	0	45	-	
CO Concentration	(mg/Nm^3),dry	250				Negl.	-	
NO_X Concentration[2]	(mg/Nm^3),dry	157	48	0	0	71	-	
Particulate Concentration	(mg/Nm^3),dry	1.8	15	30	20	50	-	
Operation		Normal	Normal	Normal	Normal	First 6 months		

Notes: 1 Values in brackets are for the first 6 months of commissioning.
2 NOx concentration relate to dry and 7% O_2 content.

The data indicate that under normal operations SO_2 emissions will be 9 g/s from the main stack of each Plant, with a small amount (1.5 g/s) from the Preheater stack during the first six months of commissioning of the Plant (see Section 4.3.1).

During the period when the Preheater is operating in a stand-alone mode the Preheater offgas will not pass through the FGD system. However, it must be noted that at such times the only source of sulphur input will be from the ore. This small amount of sulphur will react with the calcined dolomite in the Circulating Fluidised Bed, which is a demonstrated technology for SO_2 removal. The resulting emission rate from the Preheater stack is estimated to be around 1.5g/s. Adding this to the 9g/s that will be emitted from the main stack results in a total of 10.5g/s emitted for a period of six months for Stage 1. The emissions for the first six months of Stage 2 operating together with Stage 1 operating normally will be 19.5g/s.

Emissions of NO_X will occur primarily from the main stack with minor amounts from the Preheater stack and coal mill totalling 21.1g/s for each Plant.

Particulate emissions from the main stacks of the Plants are estimated to be 1.8mg/Nm^3 and 0.17g/s. Particulate emissions from other stacks within each Plant will total 2.1g/s.

Emissions of Dioxins, other volatile organic compounds and heavy metals will be negligible due to the scrubbing process and subsequent combustion (see Section 7.3.8).

4.20.4 Other Operating Modes

The initial phase of a period of operation in the no production on-line mode (Mode 4) will result in a shift in the equilibrium distribution of sulphur within the SRV. Under normal operating conditions the metal, slag and gas phase will reach equilibrium. 80% of the input sulphur will be liberated to the gas phase and the remaining 20% will be distributed between the slag (5 to 8%) and metal (12 to 15%). However, a period of operation with no ore feed and a low coal rate, which is termed a heating run as it is designed to keep the bath in a molten state whilst maintenance is performed, will result in high post combustion. This will shift the sulphur equilibrium state so that sulphur will be removed from the slag and directed to the gas phase, resulting in a higher emission rate of 24g/s for a period of 15 to 30 minutes. For the remaining period of Mode 4 emissions are estimated to be to be a maximum of 3g/s.

If it is assumed that the slag inventory will be 250t with a sulphur content of 0.18% and that this will be decreased to 0.075% during the heating run (based on experience at the HRDF), then 292kg of additional sulphur will be removed and directed to the gas. Assuming the SO_2 removal efficiency of the FGD system will be maintained at 95% (see Section 4.15) then it is estimated that additional SO_2 emission rates will be an average of 15g/s above those for normal operating conditions for a 30 minute period. Resulting in a total rate of 24g/s for the 30 minute period. The frequency of such events is estimated to be 37 per Plant per year, which relates to a total of 18.5 hours per Plant or 0.2% of the time for each Plant. However, in the first year during ramp up there may be up to 111 events, representing 0.63% of the time for each Plant.

If the events coincided with the Stage 2 Plant on a ramp up mode at a higher coal rate (Mode 3) then the total SO_2 emission from the two Plants would be 35g/s. Anticipated emissions with the addition of the Stage 2 Plant are presented in Table 4.9 and Appendix C. The frequency of such events is difficult to estimate, if a value of 2.5% of the time per Plant is used for production estimation then the frequency would be around 5% for the two Plants operating together.

If the Stage 2 Plant proceeds then the Plant Control System will be designed to ensure that maintenance of the two Plants does not occur at the same time, so that the maximum SO_2 emissions of 24 g/s for each Plant does not occur concurrently. Therefore the maximum SO_2 emission rate will be 35 g/s from the main stacks when both the Stage 1 and 2 Plants are operating. That is 11 g/s from one Plant when operating in Mode 3 (ramp up mode) and 24 g/s from the other Plant for the maintenance mode (Mode 4). Average SO_2 emission rate for the two Plants in operation, including down time, are estimated to be 17 g/s.

Anticipated emission rates from each Plant for Year 1, Year 2 and Year 3 onwards of operation are presented in Table 4.8 and in Appendix C. These rates indicate that the SO_2 emissions will typically be 9 to 11 g/s with small infrequent emissions up to 24 g/s. Average SO_2 emissions from each Plant will range between 6.7 to 8.8 g/s.

4.21 PROCESS WASTES

4.21.1 Wastewater

The wastewater treatment system for the Plant will be designed to separate the waste streams into the following two categories:

- Non-Contact Cooling Water Blowdown; and
- Scrubbing Circuit Blowdown.

The system has been designed to meet the Effluent Guidelines for the Iron and Steel Industry set out by the US EPA (40 CFR 420, BAT-1) for iron making plants.

4.21.1.1 Non–Contact Blowdown

Non-contact blowdown will be a mixture of process water blowdown from:

- Wet Surface Air Coolers;
- Core Plant and Equipment Circuit Cooling Tower; and
- Utility Cooling Tower.

The non-contact blowdown streams will flow into a central collection sump from where the water will be pumped to the offgas cooling tower as make-up water for the scrubber circuits.

4.21.1.2 Scrubbing Circuit Blowdown

Water in the wet scrubbing circuit will come into contact with the hot, dirty gas stream exiting the offgas hood. The solids will be primarily removed in the first stage of the scrubber using a combination of spray water contact and a drop in velocity. The solids will drop out of the gas stream and will be collected in the sump at the base of the scrubber first stage. The solids will be removed from the scrubber in a dilute slurry (<1% solids) that will flow through a degassing tower and into the clarifier. Prior to entering the clarifier caustic soda (sodium hydroxide solution) will be added to adjust the pH from around 4 to between 6 and 7.

Flocculant (a high molecular weight polymer) will also be added to aid in the settling of solids. If carbonaceous particles prove difficult to settle a wetting agent will also be added. The actual flocculant and wetting agents used will depend on the Chemical Contractor chosen to service the site (as the different companies have proprietary brands of chemicals) and on the results of trials to determine the most suitable chemical. Environmental performance will be an important criterion when choosing a chemical for use in any application on site.

The underflow from the clarifier will be pumped to a vacuum filter where the solids will be separated from the liquid. The filtrate will be pumped back to join the clarifier overflow stream and then directed back to the scrubber.

The soluble species from the hot offgas will dissolve in the scrubber water increasing the TDS concentration. A portion of the water will be removed as blowdown to maintain the water quality at a level that does not cause problems through corrosion or deposition in the scrubbing circuit. The offgas, at 1000°C, in addition to alkali and acid gaseous components will contain low levels of volatile metals such as Zn, Pb and Cd. These metals will dissolve in the scrubber water at the gas inlet. The pH of the water around the gas inlet is expected to be low due to the rapid dissolution of the acidic gases. As some of the H_2S in the offgas will also dissolve, a high proportion of the metals will precipitate out as metallic sulphides, as shown in Figure 4.14 (Roberts Alley & McGraw-Hill, 2000). However, it is likely that some of the metals will remain in solution and be removed from the scrubber in the blowdown stream.

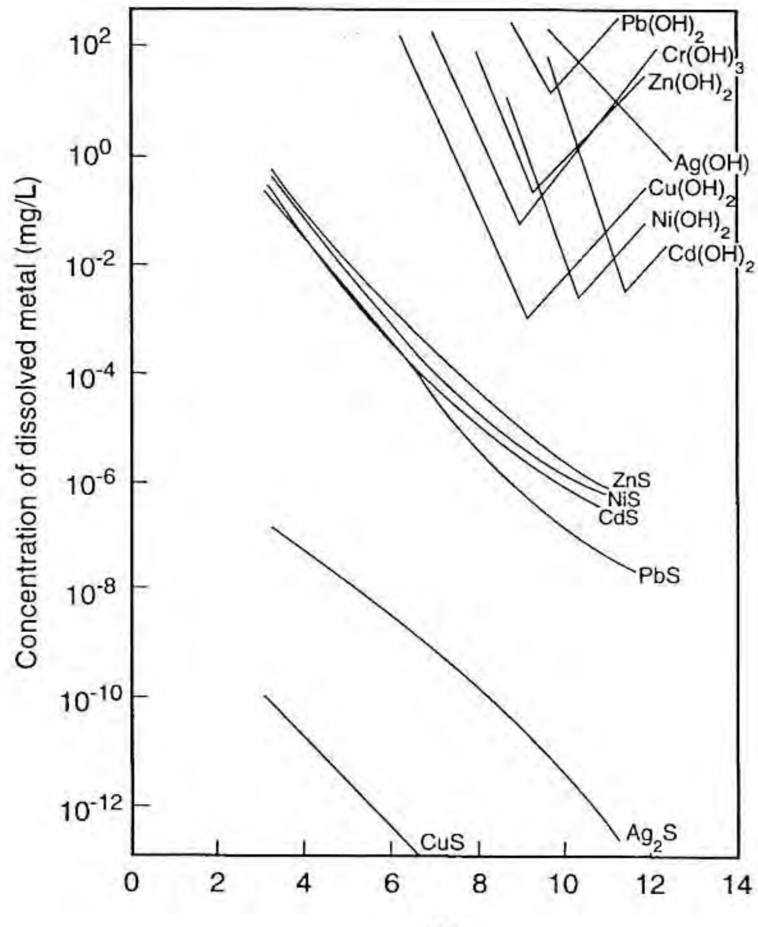

Figure 4.14 Metal Hydroxide and Sulphide Solubility Curves as a function of pH (Roberts Alley and Mc Graw- Hill, 2000)

Lime will be added to the scrubbing circuit blowdown in a mixing tank to raise the pH to above 8 which will cause the metals to precipitate as hydroxides (Figure 4.14). The water will then be directed to the process water tank. The presence of iron in solution and its subsequent removal as iron hydroxide will aid in the settling of the other metallic residues. If the metals are found not to settle then a suitable flocculant will be added to aid settling. Solids will be allowed to settle in the process water tank and the clear liquor from the tank will be used for the cooling of the pig iron and slag.

Blowdown will also be produced in the FGD (see Section 4.15 and Appendix B). The FGD system will treat the combined exhaust gas stream from the combustion processes. The gas will be contacted with ground limestone slurry in the spray tower. No halides or alkalis will be present in the gas as the gas will have been wet scrubbed prior to use as a fuel. However, the makeup water will contain halides, which can affect the quality of gypsum. Evaporation of the water vapour as the gas is cooled will increase the TDS levels in the FGD system. For these two reasons it will be necessary to periodically remove blowdown from this circuit.

The blowdown stream from the FGD may have a pH below 7 due to the dissolution of SO_2. If pumped directly to the settling basin at the process water tank this stream may result in the precipitated metals being re-dissolved. Therefore the blowdown will be first directed to the mixing tank where the pH will be raised to between 8 and 9.

4.21.2 Solid Waste

The Process will generate only a relatively small quantity of solid wastes. The solid waste will comprise a mixture of iron oxide, carbon, dust and slag and will be disposed off-site in a suitable and approved disposal facility. Approximately 6 to 10ktpa of solid waste material will require disposal. Potential uses for the solid waste are currently being investigated (see Section 7.11.1).

The solids discharged at the underflow will be de-watered using a filter press. The majority of the solids will be recycled to the SRV with approximately 5% being removed to prevent the build up of elements such as Zn, Pb and Cd in the recycled stream. The discharged filter cakes will be transported to the raw material handling area or prior to disposal at an approved landfill.

4.22 WORKFORCE

4.22.1 Summary of Workforce Requirement

Table 4.10 presents a breakdown of the workforce required for Stage 1 of the Project. A total of four shift crews will be required, each on a 12 hour shift roster, for continuous operation. It is anticipated that the workforce for the Stage 2 Plant will be similar to that required for Stage 1.

Table 4.10

Summary of Anticipated HIsmelt Operations Workforce

Stage 1 Plant

Area	Numbers
Plant Operators	20
Maintenance	6
Process Control	8
Management/ Administration	15
Permanent Contractors	16

5. EXISTING ENVIRONMENT

5.1 LOCATION AND LAND USE

The proposed location for the Plant is at the site occupied by the existing HRDF within the northern portion of the KIA. Due to the size of the Commercial Plant an additional area of land will be required to the south and east of the current HRDF site (see Figure 1.3). The site has been subject to significant development both for the construction of the HRDF and also for its previous use as the site of the AIS Blast Furnace Iron Making Plant and facilities.

The site is bounded by the Cockburn/Swan Cement Plant to the north, a petroleum refinery owned and operated by British Petroleum to the south west, a LPG Plant owned by Wesfarmers Kleenheat to the southeast and a Bulk Materials Handling operation to the south and west (Figure 5.1).

The KIA is part of the South-West corridor, as defined by the Perth Metropolitan Region Scheme. Under the scheme, land use zonings include industrial, urban, parks and recreation and rural. Kwinana is a heavy industrial area with the following major industries established in the area.

- Western Power Power Station.
- Alcoa Alumina Refinery.
- BP Petroleum Refinery.
- WMC Nickel Refinery.
- Tiwest Pigment Plant.
- CSBP Fertiliser Plant.
- Wesfarmers LPG Plant.
- Australian Gold Reagents Sodium Cyanide Plant.
- Cockburn/Swan Cement Lime and Cement Plant.
- Air Liquide Air Separation Plant.
- Australian Fused Materials.
- CIBA Specialty Chemicals.
- TYCO Water.
- Coogee Chemicals
- BOC Plant

The Kwinana region has been subject to several planning studies over the years. A recent study was undertaken by the Western Australian Planning Commission (WAPC) on strategic land use planning directions for the Fremantle - Rockingham region for the next 20 to 25 years. The study is referred to as the Fremantle – Rockingham Industrial Area Regional Strategy (FRIARS) and was the subject of a final report released in April 2000 (WAPC, 2000).

The FRIARS report recognised that the "KIA is the State's premier industrial site and has many advantages of agglomeration and infrastructure. It is vital to the State's economy and must be protected through the planning process which should maximise the potential for the development of the area." (WAPC, 2000).

Therefore the FRIARS is premised on the need to protect and optimise the KIA as the area represents a significant State investment and the optimisation of the area is important to the State economy.

Due to the presence of heavy industry, air quality in the Kwinana area was recognised by the EPA as becoming degraded, with the most significant issues considered to be SO_2 and particulates. The EPA established the Environmental Protection (Kwinana) (Atmospheric) Wastes Policy (EPP) in 1992 (EPA, 1992b) as a means of addressing the air quality issues in Kwinana. The EPP was revised in 1999 (EPA, 1999c). The Policy Area is divided into the following three regions as shown on Figure 5.2:

- Area A (Industrial) - the area of land on which heavy industry is located.
- Area B (Buffer Zone) - an area surrounding industry, plus other outlying land zoned for industrial use.
- Area C (Rural/Residential) - land beyond Areas A and B used predominantly for rural and residential purposes.

Major residential areas occur at Kwinana (Medina, Calista, Parmelia, Orelia, Leda) and Rockingham. The residential areas of Wattleup and Hope Valley are north east of the Project site and within the Kwinana Environmental Protection Policy (EPP) Buffer Area (Area B) (Figure 5.2). It is estimated that there are 2200 residents living inside the EPP Buffer Area (WAPC, 2000). The FRIARS study considered in its findings the need to ensure that any person living in or near the KIA has standards of air quality that comply with the specifications of the Kwinana EPP and in the future State Air EPP (WAPC, 2000).

The preferred land use strategy outlined in the FRIARS report promotes long term land use change at the Hope Valley and Wattleup townsites. The strategy depicts heavy industrial uses in the Hope Valley Area and general industrial uses in Wattleup. It is imperative that the Government implements the Strategy in a manner that minimises the negative impacts on residents and landowners and maximises the benefits to the State. The recommendations for implementation are presented in the FRIARS report (WAPC, 2000).

5.2 METEOROLOGY

5.2.1 Climate

The Kwinana area is described as having a Mediterranean climate, characterised by hot dry summers and mild wet winters. Climate data have been sourced from the Bureau of Meteorology averages for BP's Kwinana Refinery for the period 1955 to 2001, and summarised in Table 5.1.

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HIsmelt SITE AND ADJACENT INDUSTRIES

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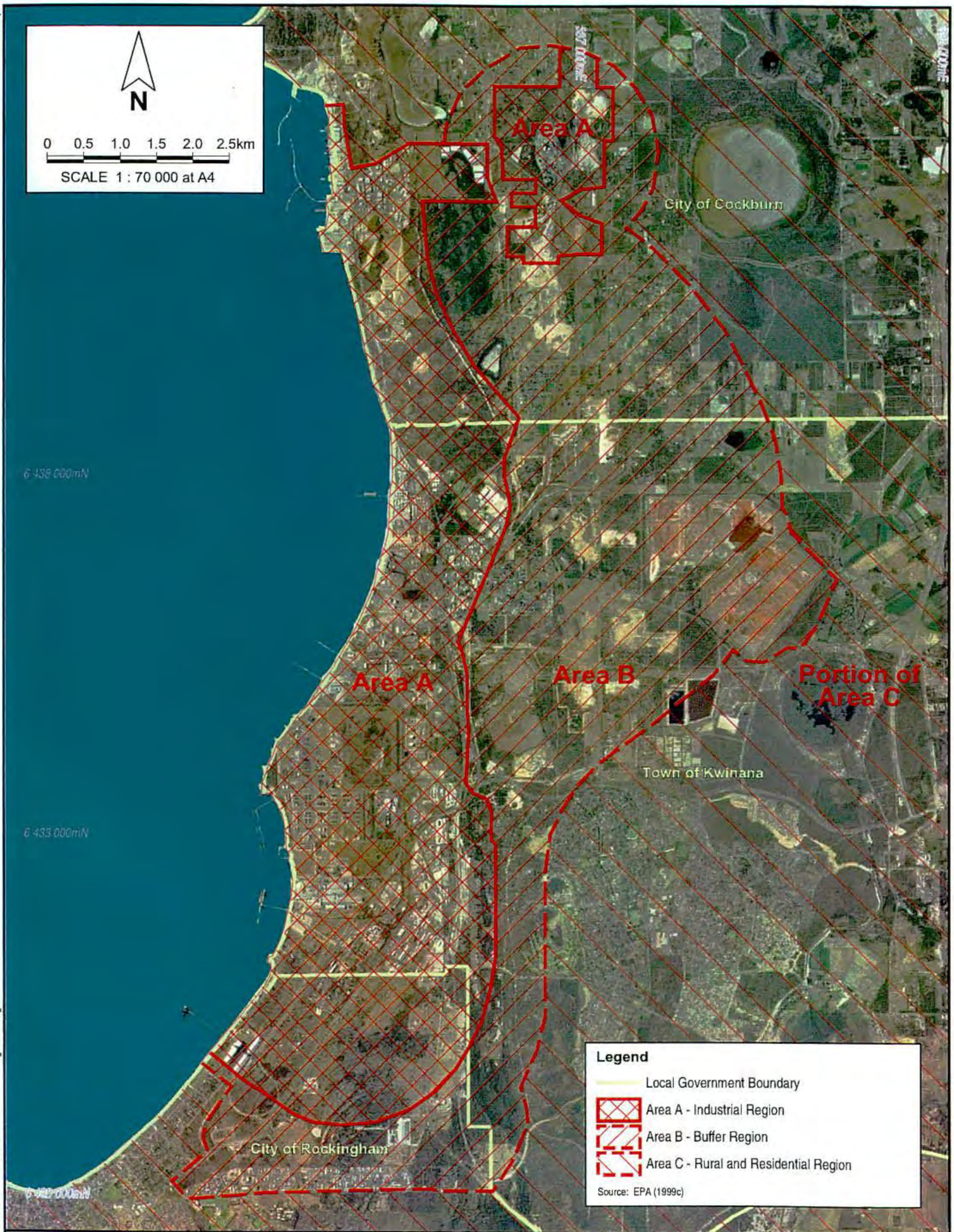
Figure 5.1



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ENVIRONMENTAL PROTECTION POLICY (EPP) AREAS

Figure 5.2

Table 5.1

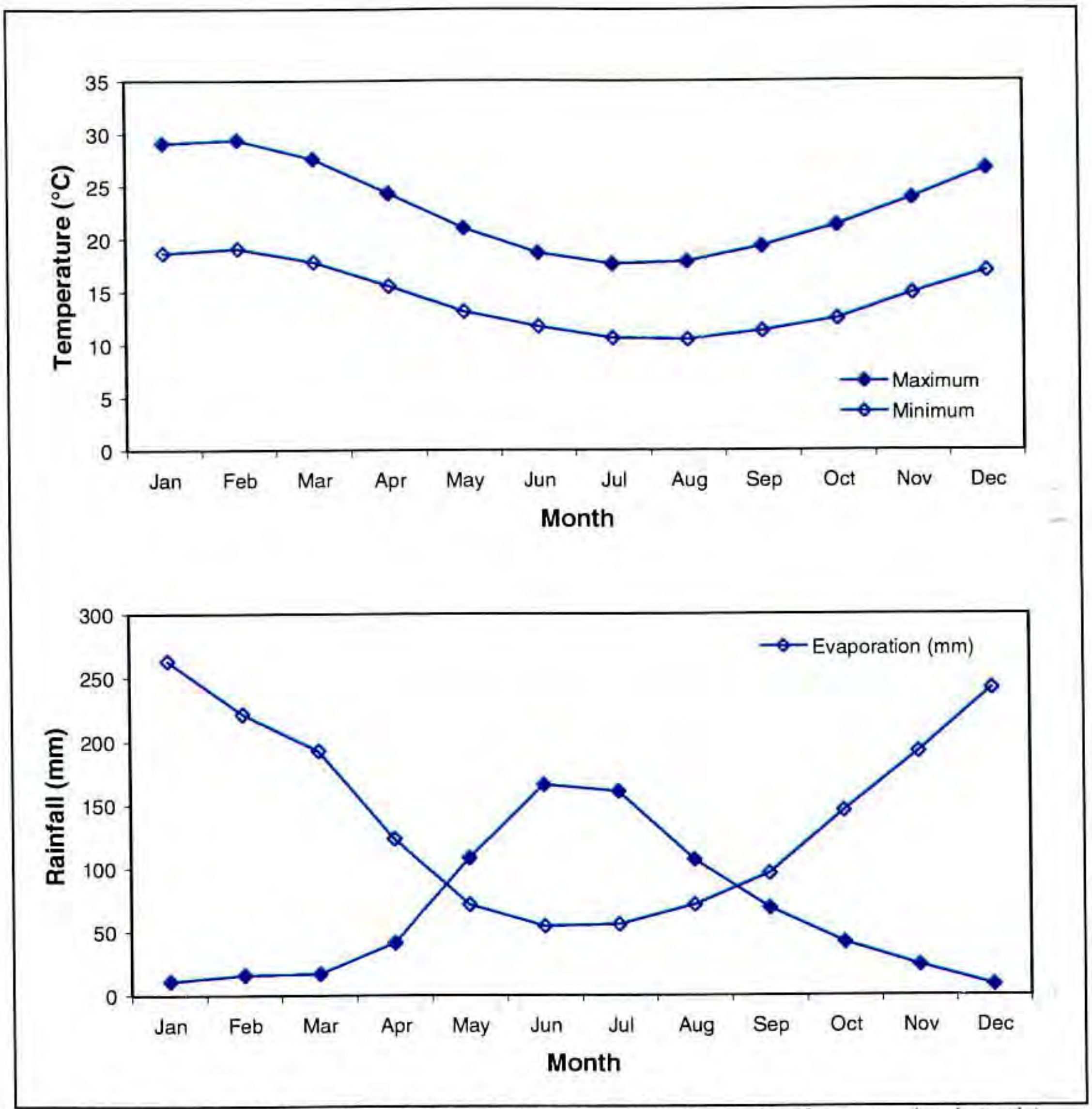
Summary of Climatic Data for BP's Kwinana Refinery from 1955 to 2001

Month	Temperature (°C)		Relative Humidity (%)		Evaporation* (mm)	Rainfall (mm)	
	Mean Daily Maximum	Mean Daily Minimum	9 am Mean	3 pm Mean	Mean Daily	Mean	Mean No. of Rain Days
January	29.1	18.7	52	55	8.5	10.9	2
February	29.4	19.1	53	54	8.2	16.0	2
March	27.6	17.8	56	54	6.2	16.9	4
April	24.3	15.5	63	58	4.1	41.2	8
May	21.0	13.1	69	62	2.3	107.9	13
June	18.7	11.7	74	65	1.8	165.8	18
July	17.6	10.6	74	66	1.8	160.5	19
August	17.9	10.5	72	65	2.3	106.6	16
September	19.3	11.3	68	63	3.2	68.6	13
October	21.3	12.5	61	60	4.7	41.7	9
November	23.9	14.9	56	58	6.4	24.0	6
December	26.7	17.0	53	56	7.8	8.4	3
Annual Mean	23.0	14.4	63	60	4.8		
Annual Total					1750	768.6	113

Notes: * Evaporation data is from Bureau of Meteorology's Medina research station, for the period 1983 to 2001

5.2.1.1 Temperature and Humidity

The mean annual maximum and minimum temperatures for Kwinana are 23°C and 14.4°C, respectively. The highest temperatures are usually experienced in February, when the mean daily maximum temperature is 29.4°C and the mean daily minimum temperature is 19.1°C. Minimum temperatures occur in July, when the mean daily maximum and minimum temperatures are 17.6°C and 10.6°C, respectively. Figure 5.3 presents the mean maximum and minimum temperatures recorded at BP's Kwinana Refinery each month.



Source: Bureau of Meteorology, Kwinana BP Refinery and Medina Station (for evaporation data only)

Figure 5.3 Mean Monthly Temperature, Rainfall and Evaporation

The mean annual relative humidity at BP's Kwinana Refinery is 63% at 9 am and decreases to 60% at 3 pm. Relative humidity is generally higher in winter, with a July mean of 74% at 9 am and 66% at 3 pm. During February, mean relative humidity at 9 am is 53% and rises slightly to 54% by 3 pm.

5.2.1.2 Rainfall and Evaporation

Rainfall in the Kwinana region is seasonal and the majority is confined to the winter months (June to August) (Figure 5.3). Mean monthly rainfall is highest in June at 165.8 mm, with an average of 18 rain days. Rainfall in July is similar with a monthly mean of 160.5 mm over an average of 19 rain days. The lowest mean monthly rainfall is 8.4 mm in December, with an average of three rain days. The average annual rainfall is 768.6 mm, with an average of 113 rain days per year.

The closest station where evaporation is recorded is at the Bureau of Meteorology's Medina Research Station, which is located immediately north of the Kwinana townsite. Data for the period 1983 to 2001 shows that mean daily evaporation ranges from a minimum of 1.8 mm in June and July to a maximum of 8.5 mm in January (Figure 5.3). The total annual evaporation is approximately 1750 mm, which exceeds annual rainfall by approximately 980 mm.

5.2.1.3 Winds

Winds in the Kwinana region result from both large-scale (synoptic) winds associated with low and high pressure systems, and local thermally-influenced winds. Typically, strong offshore breezes occur during the daytime followed by corresponding onshore breezes as the land cools during the evening. This sea breeze/land breeze cycle is typical of coastal environments.

Synoptic winds in the Kwinana region are generally from the east. During spring and summer, the easterly winds are disrupted by the sea breeze from the south-west and south-south-west, which is generally an afternoon weather phenomenon.

Annual wind roses showing the predominant easterly and south westerly winds are presented in Figure 5.4.

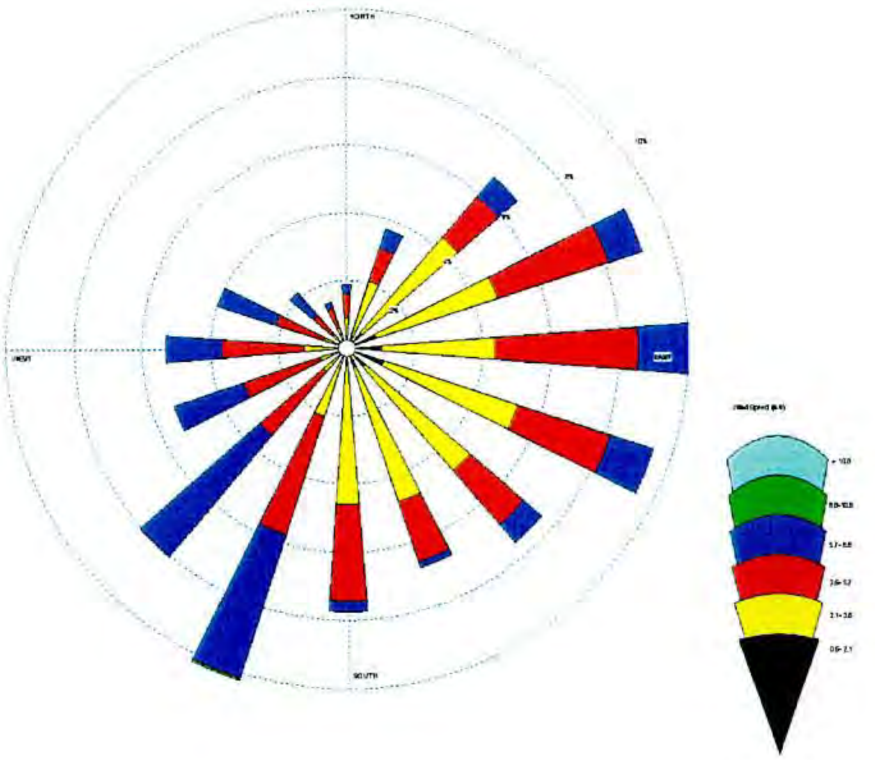


Figure 5.4 Annual Wind Roses from Kwinana
(Source: DEPs Hope Valley Meteorological Station - 1980 data)

5.2.2 Air Pollution Meteorology

Local meteorological conditions strongly influence the dispersion of atmospheric emissions. At Kwinana the main determining factors are wind speed, and the intensity and depth of atmospheric turbulence. The flow of wind over rough surfaces and convection over heated land, both generate atmospheric turbulence. The layer of the atmosphere in which turbulence occurs is termed the "boundary layer". Over land during the day time, this depth grows to be large, typically in the range of a kilometre or more. At night and over water, the mixing depth may remain within a few hundred metres or less.

The wind climate is determined by both the large scale (synoptic) winds due to high and low pressure systems and the local winds induced by topographic features or thermal influences. The Perth summer season is characterised by prevailing offshore winds, with long periods of fine warm weather. The resulting temperature difference between sea and land regions creates an onshore pressure difference, which leads to regular south-westerly sea breezes.

The influence of the sea breeze also arises through its effect on inland mixing depths. It brings cool air onshore, which replaces a layer of air already warmed by convection. Due to the temperature difference the sea breeze is denser than the inland air mass, so that the sea breeze inflow cannot mix with the air above. This means that mixing depths when the sea breeze occurs are commonly reduced to only a few hundred metres.

5.3 AIR QUALITY

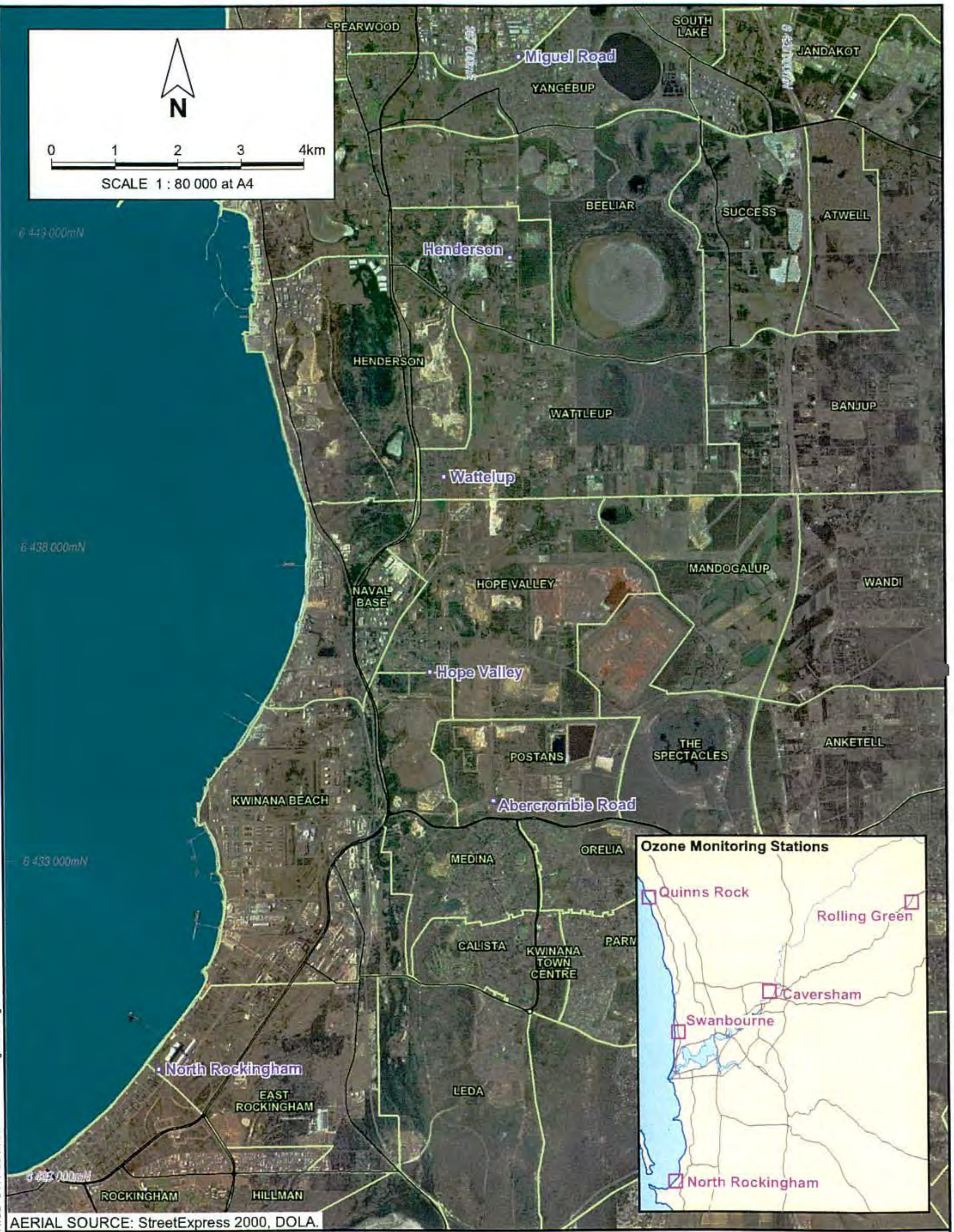
The atmospheric emissions from the Plant of potential concern will be SO_2, NOx, particulates, CO and CO_2. SO_2, particulates and CO are of local concern in that they can potentially lead to adverse impacts in the immediate region. NO_x, as well as potentially leading to local impacts, are also important in the formation of photochemical smog which is a regional air quality issue for the Perth region. The main concern with CO_2 is as a greenhouse gas and is not relevant to existing local ambient air quality.

The Proponent engaged a consultant to undertake an air quality assessment for the Project (SKM, 2002). A component of the study was to describe the existing air quality in the Kwinana region from which the following description has been drawn. A copy of the assessment report is provided as Appendix C.

5.3.1 Sulphur Dioxide

Sulphur Dioxide is measured at the following six sites (see Figure 5.5) within the Kwinana area:

- North Rockingham
- Abercrombie Road
- Hope Valley
- Wattleup
- Henderson
- Miguel Road



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LOCATION OF AIR QUALITY MONITORING STATIONS

Figure 5.5

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Concentrations recorded at the Hope Valley and North Rockingham stations are presented on Figures 5.6 and Figure 5.7, respectively. The figures show that SO_2 concentrations were higher in the early 1990s. However, with the general change to the use of low suphur fuels and better operating practices and the subsequent introduction of the Kwinana EPP (EPA, 1992) the groundlevel concentrations of SO_2 have been well below the criteria at all stations since 1995.

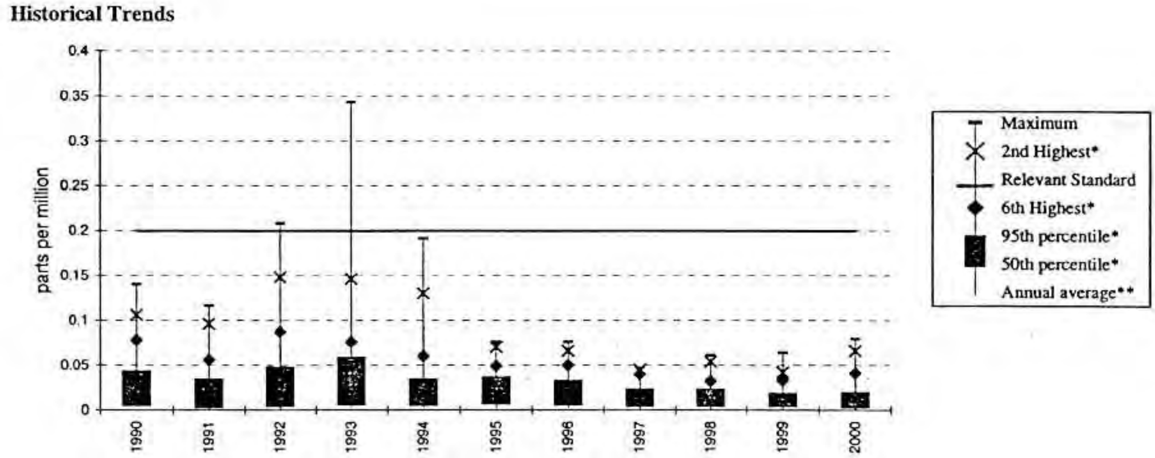


Figure 5.6 Monitored 1-hour Sulphur Dioxide Levels at Hope Valley (1990 to 2000)

Source: DEP 2002a. Note relevant standard on graph relates to the NEPM standrd for residential areas (NEPC, 1998) and not the Kwinana EPP.

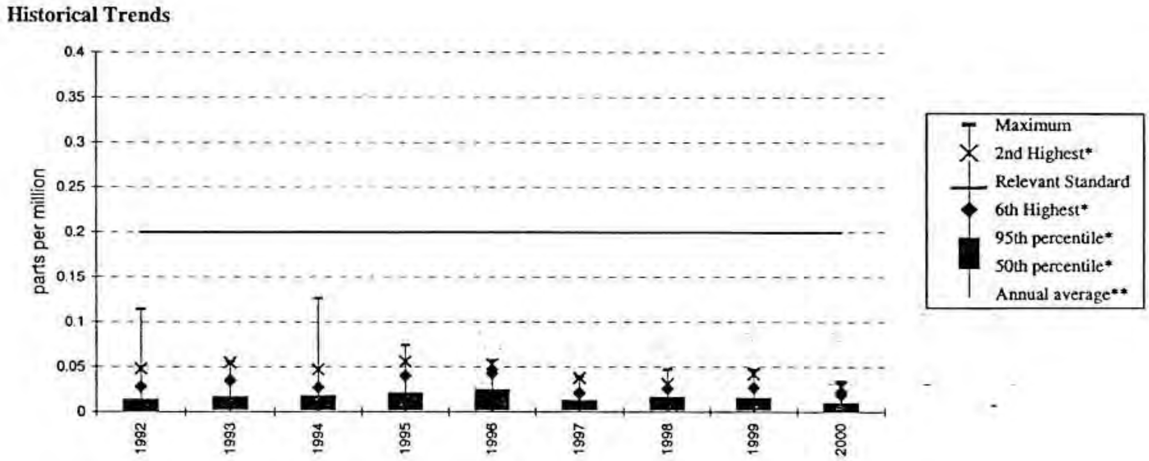


Figure 5.7 Monitored 1-hour Sulphur Dioxide Levels at North Rockingham (1990 to 2000)

Source: DEP 2002a. Note relevant standard on graph relates to the NEPM standrd for residential areas (NEPC, 1998) and not the Kwinana EPP.

5.3.2 Nitrogen Dioxide

Nitrogen oxides (NO_x) are produced through the combustion at high temperature where the nitrogen in the air is oxidised to NO and then to NO_2. Additionally, for fuels with nitrogen present, the nitrogen in the fuel can be oxidised to NO_x. From gas-fired burners, typically around 90% of the NO_X is emitted in the form of NO, with the remainder as NO_2. Following release the NO is oxidised to the more reactive NO_2.

NO_x along with hydrocarbons are the basis for the formation of photochemical smog. This is discussed in more detail in Section 5.3.3.

Within the Kwinana region, the DEWCP operates two air quality monitoring stations that record NO and NO_2, one at Hope Valley and the other at North Rockingham. The location of these is shown on Figure 5.5. Data from these stations are readily available in the DEP data monitoring reports and is summarised on Figures 5.8 and 5.9. The most recent report at the time of undertaking the study (DEP, 2002) indicates that at Hope Valley and North Rockingham, the maximum 1-hour NO_2 concentrations over an eleven year period from 1990 to 2000 have been around 0.05parts per million (ppm) (103µg/m^3) which is around 42% of the National Environmental Protection Measure (NEPM) standard. Typical second highest concentrations per year are around 0.035ppm (72µg/m^3) which is around 29% of the NEPM standard.

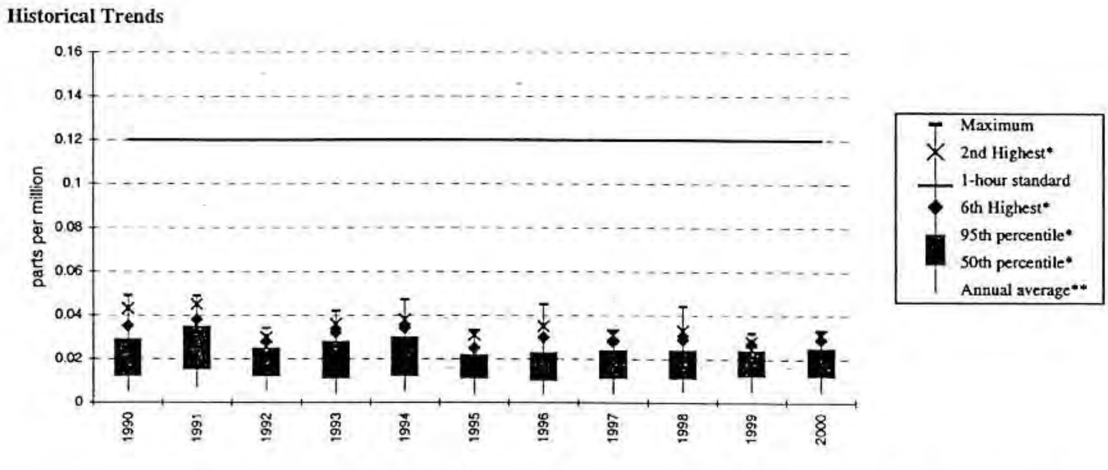


Figure 5.8 Monitored 1-Hour Nitrogen Dioxide Levels at Hope Valley (1990 to 2000)
Source: DEP 2002a.

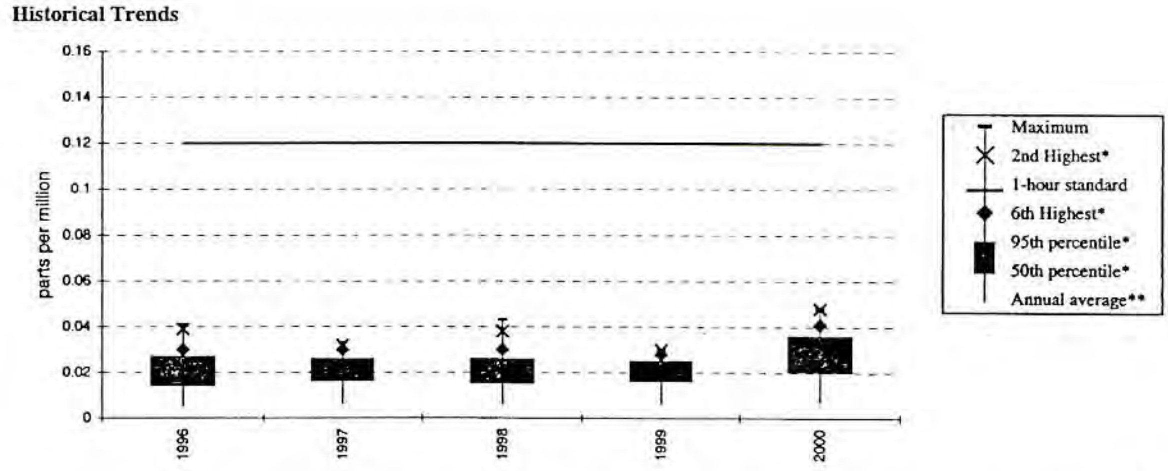


Figure 5.9 Monitored 1-hour Nitrogen Dioxide Levels at North Rockingham (1996 to 2000)
Source: DEP 2002a.

Given that local concentrations of NO_2 at these monitors are well below the NEPM standard, the existing local levels of NO_2 are not considered to be a significant air quality issue in their own right.

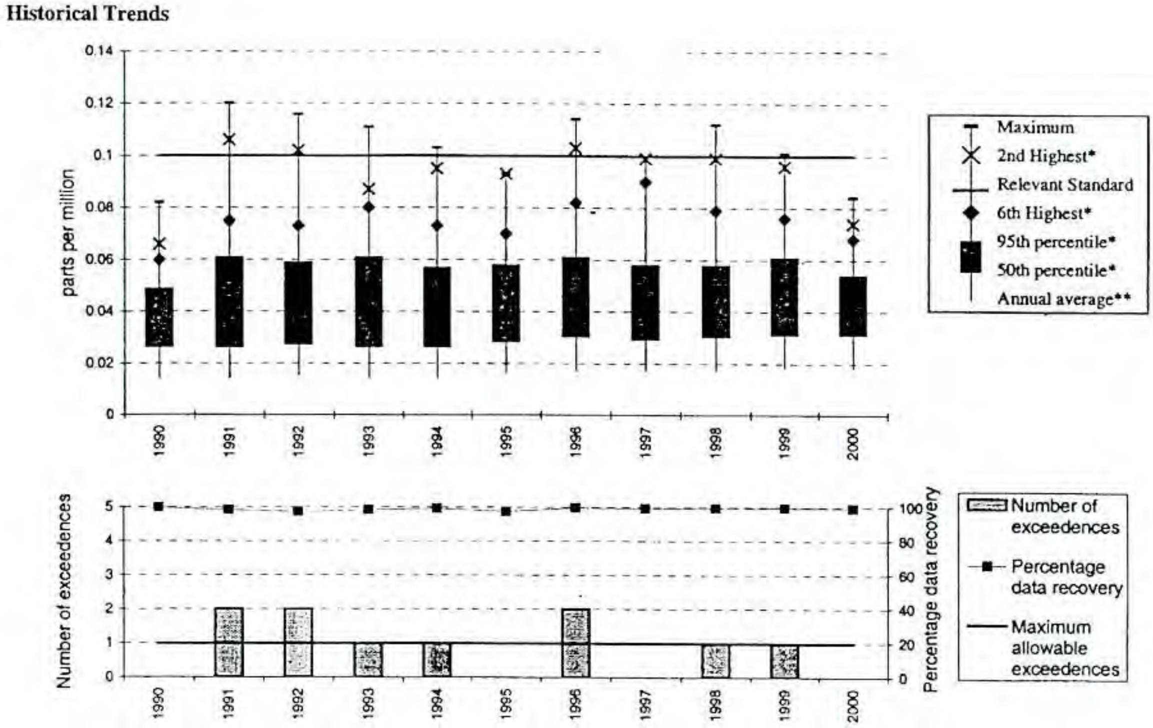
5.3.3 Photochemical Smog

Photochemical smog forms when pollutants such as NOx and reactive organic compounds react together under the influence of sunlight and high temperature. The principal product in photochemical smog is ozone and consequently it is used to define smog levels. Ozone near the ground , as distinct from the "ozone layer" that occurs tens of kilometres up in the atmosphere, occurs typically in the range of 15 to 35 parts per billion (ppb) and at such concentrations is a colourless gas.

Ozone measurements in Perth are recorded at five monitoring locations shown on Figure 5.5 at:

- Caversham
- Rolling Green
- Quinns Rock
- North Rockingham
- Swanbourne

The highest concentrations are generally recorded at Caversham and Rolling Green. Data from these two sites are presented on Figures 5.10 and Figure 5.11, respectively.



* - Ranked values determined from the daily maxima
** - Concentration calculated from all recorded data

Figure 5.10 Monitored 1-Hour Ozone Levels at Caversham (1991 to 2000)
Source: DEP, 2002a

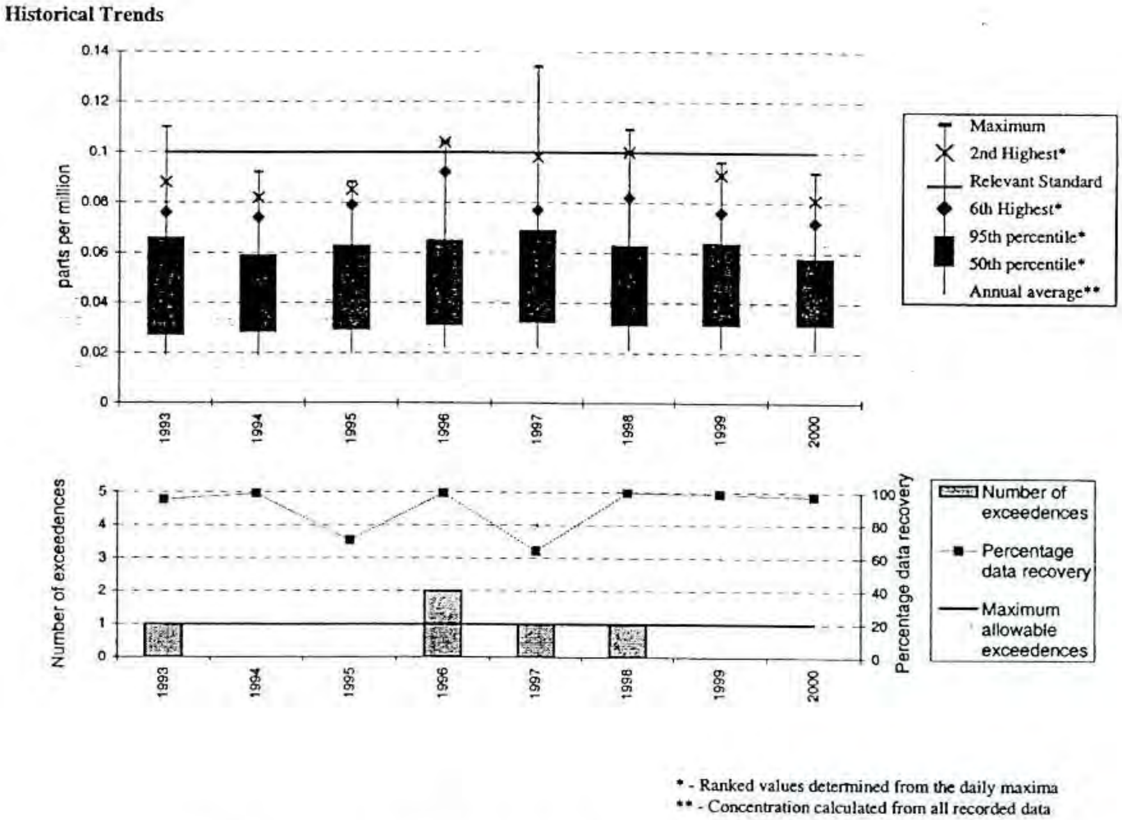


Figure 5.11 Monitored 1-Hour Ozone levels at Rolling Green (1993 to 2000)
Source: DEP, 2002a

Data from Figures 5.10 and 5.11 show concentrations have on occasional years exceeded the NEPM criteria of no more than one exceedance although these sites have been in compliance since 1997.

5.3.4 Carbon Monoxide

Carbon monoxide (CO) is a colourless and odourless gas produced by the incomplete combustion of any carbon based fuel such as petrol, gas, diesel, wood and coal). In urban areas motor vehicles are the principal source of CO and are estimated to account for 80% of emissions in the Perth region.

CO is measured at four sites within the Metropolitan area at:

- Caversham
- Queens Building (Perth)
- Duncraig
- Leeming

The outer metropolitan site at Caversham recorded maximum values of up to 2.5ppm, which is 28% of the NEPM standard. At the other three more central areas where motor vehicle and wood fire emissions are greater, yearly 8–hour maximums of 4 to 5ppm (44 to 55 % of the NEPM standard) were recorded with occasional concentrations of up to 7 ppm (78% of the NEPM standard).

5.3.5 Particulates and Dust

5.3.5.1 Regional

Total Suspended Particulates (TSP) were monitored at regional monitoring sites at Hope Valley and Wattelup between 1990 and 1991. The data indicated that for TSP concentrations the annual average was around 40 μg/m^3 with maximum 24-hour concentrations, in a given year, of up to 100 μg/m^3. As these levels were considered relatively low, the DEP decommissioned these monitoring sites in the early 1990s. PM_{10} (particulates with a diameter less than 10μm) monitoring was conducted at the Abercrombie Road site from January 1997 to March 1998 and at the Miguel Road site from April 1998 to June 2001. PM_{10} levels as reported in the DEP's latest report (DEP, 2002a) for Miguel Road are shown on Figure 5.12. These show up to one exceedance of the standard per year at this site, which is well below the NEPM goal of 5 exceedances in any year.

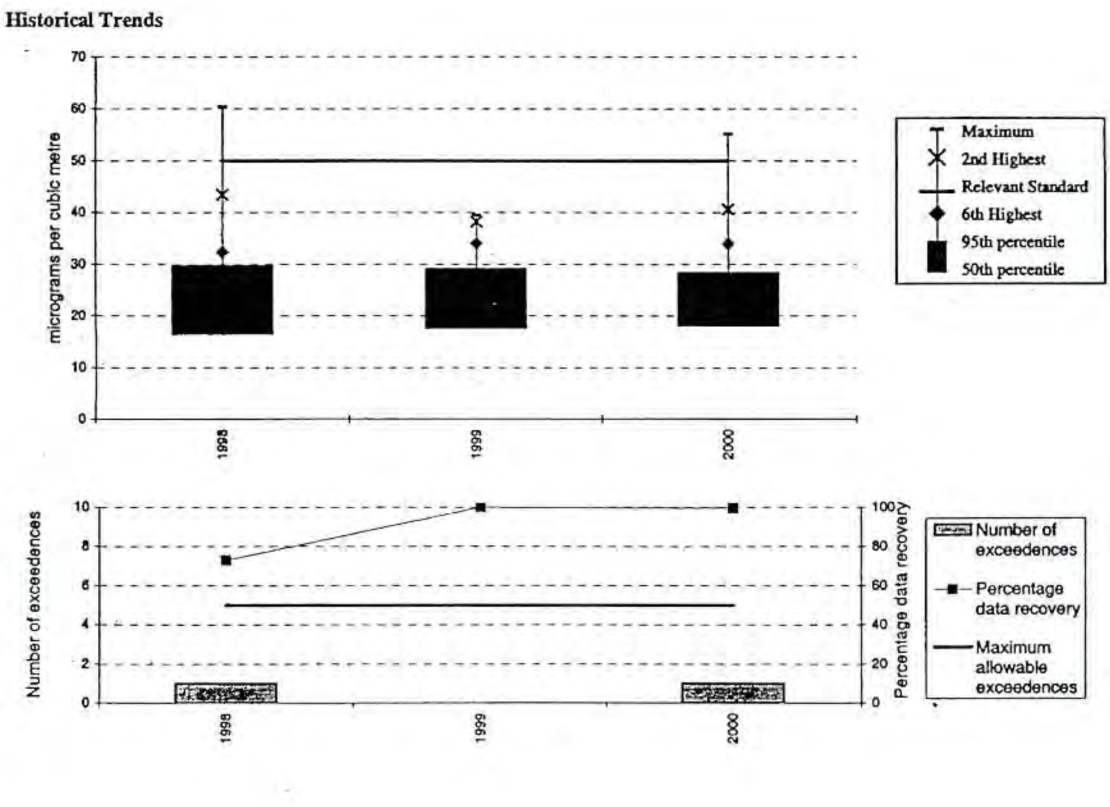


Figure 5.12 Monitored 24-hour PM_{10} levels at Miguel Road from 1998 to 2000 (DEP, 2002)
Source DEP, 2002a

Apart from regional dust levels (those not immediately adjacent to potential dust sources) there are a number of locations, most notably the area immediately surrounding Alcoa's residue drying areas, where localised higher dust levels may occur. As reported by Alcoa (Alcoa, 2001) TSP dust levels at their boundary monitors have decreased substantially from around 60 exceedances of the 90 μg/m^3 Kwinana standard in 1993/1994 to only five exceedances during the 1999/2000 year. Dust levels in the Kwinana region are generally below the applicable standards.

5.3.5.2 Site

Monitoring of ambient dust levels has been undertaken at the HRDF site since the early 1990s. Monitoring data from May 1999 when the HRDF was placed on a care and maintenance is provided in Table 5.2 and Figure 5.13. These are considered current baseline data as no activities that could give rise to fugitive dust emissions were performed on the HRDF site during this period. Sampling was performed over a 24-hour period every six days, on the same cycle as used by the DEP, using a high volume dust sampler.

Table 5.2

Ambient Dust Concentrations (July 1999 to December 2000)
(24hr Average)

	Ambient Dust Concentration (μg/Nm^3)
Average	50
Standard Deviation	26
Maximum	143
Minimum	9

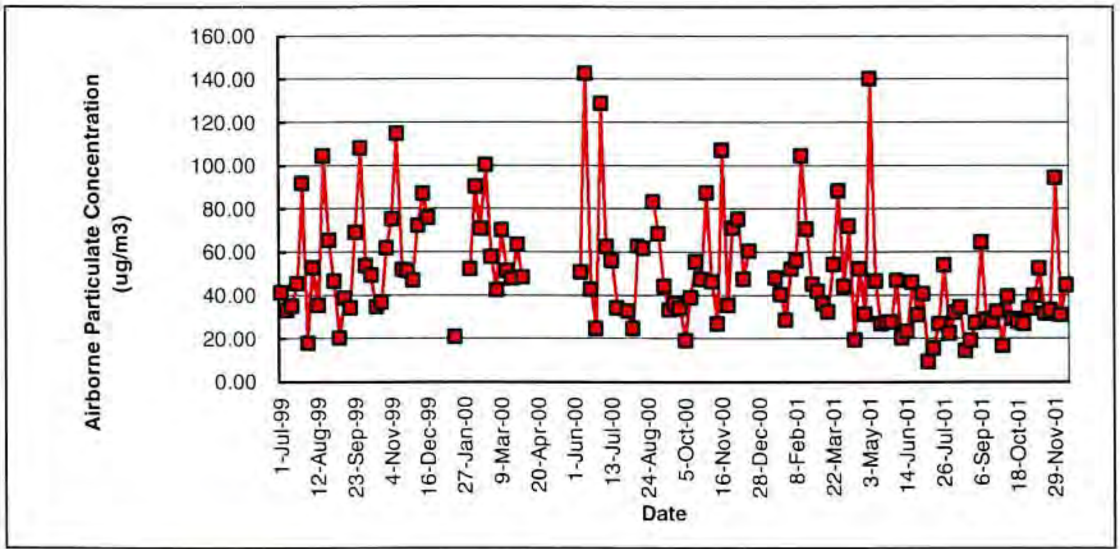


Figure 5.13 Ambient Dust Monitoring Results (July 1999 to December 2001)

5.4 NOISE

5.4.1 Regional Noise Study

Following the gazettal of the Environmental Protection (Noise) Regulations 1997, a number of industries on the Kwinana industrial strip carried out noise surveys and monitoring campaigns aimed at better defining their current noise outputs and impacts on neighbours. It became clear that noise emissions from different sources are cumulative at their point of impact.

The Kwinana Industries Council (KIC), through its noise task force, decided to undertake a modelling study of the cumulative impact of the noise emitted from the various industries in the area. HIsmelt consulted KIC as to the status of the study and were notified that the study had been undertaken and that KIC expect the findings to be reported in April 2002. Therefore the report was not available during the preparation of the PER. As the report has not yet been finalised the information contained in this section has been provided by KIC (KIC, *pers. comm.*, 2002).

The KIC study is being undertaken in three phases. Phase 1 was a gap analysis and involved the collection of available noise data, to assess the suitability of the data for input into the acoustic model, and to identify any areas where the lack of data would prevent the completion of the model.

Phase 2 of the study was to model the cumulative noise for the KIA. The scope of work for Phase 2 provided by KIC was as follows:

- Development of the cumulative noise model.
- Prediction of noise levels at selected receiving positions for a broad range of meteorological conditions.
- Ranking of noise sources at each receiving position and for each meteorological condition.
- Generation of noise contours for the Kwinana area for a broad range of meteorological conditions.
- Analysis of historical meteorological data.
- Risk analysis – estimation of the probabilities of noise levels exceeding threshold levels based on the correlation of predicted noise levels with historical meteorological day.
- Noise source ranking based on the findings of the risk analysis.

Phase 3 entails the verification of the noise model by simultaneously monitoring noise levels and meteorological conditions at representative locations throughout the study area.

5.4.2 Site

Baseline noise monitoring surveys were undertaken in 1991 prior to the commissioning of the HRDF. Noise monitoring surveys were also undertaken annually from 1993 to 1997 inclusive. The results of the survey found that the background noise was relatively high and that noise emissions from the plant complied with the noise regulations (Dames & Moore, 1991; Herrring Storer Acoustics, 1993; 1994;1995;1996;1997).

The Proponent engaged a noise consultant to take ambient noise measurements to establish the current baseline noise levels at the site (Herring Storer Acoustics, 2001). Two automatic noise loggers were established on site between 10 July and 23 July 2001. One logger was located near the existing HIsmelt office and the other logger was located on the southern site boundary fence line south of the HRDF. A summary of the averages of the ambient noise levels are presented in Table 5.3.

Table 5.3

Average Ambient Noise Levels at Monitored Locations (July 2001) (dB(A))

	Site Location 1 (Administration Office)				Site Location 2 (Southern Boundary)			
	L_{A90}	L_{A10}	L_{A1}	L_{Amax}	L_{A90}	L_{A10}	L_{A1}	L_{Amax}
Day Time Average	47	52	59	67	50	55	60	68
Evening Average	50	52	54	60	51	54	56	61
Night Time Average	50	53	57	62	53	56	58	62
Total Average	49	52	57	63	51	55	58	63

Source: Herring Storer Acoustics, 2001

5.5 GEOMORPHOLOGY AND GEOLOGY

The Kwinana site is located in the Coastal Belt subdivision of the Swan Coastal Plain in the Quindalup Dunes, which is a relic foredune plain of the Holocene period (Davidson, 1995; Gozzard, 1983). The geological profile of the site is typical of the coastal deposits found in the area. It consists of Safety Bay Sand (recent) unconformably overlying Tamala Limestone, and the Leederville Formation (Pinjar Member) (Davidson, 1995).

The Safety Bay Sand comprises a thick layer (around 20m) of calcareous sand over a basal layer of up to 2m of Silty Clay and Clayey Sand (Dames & Moore, 1990a). The calcareous sand is white medium–grained, rounded quartz and shell debris, well sorted and of eolian (wind transported) origin (Gozzard, 1983). The clay basal layer is discontinuous and is known to pinch out towards the west.

The Tamala Limestone comprises various proportions of quartz sand, fine to medium grained shell fragments and minor clayey lenses (Davidson, 1995). The Tamala Limestone comprises an upper layer of pale yellow medium to coarse grained sand that has decomposed from the deeper limestone, which in turn is pale yellow/brown variably cemented fine to coarse grained limesand with shell debris (calcarenite) (D.A. Lord, 2001). The Limestone unit has been well cemented due to the dissolution of shell fragments. It is heterogenous and vuggy in parts and has a relatively high transmissivity. Geotechnical investigations at the site indicate the Tamala Limestone is approximately 12m thick and comprises a series of variably cemented limestones, sandstones, calcarenites and carbonate sands (Dames & Moore, 1990a). These materials represent cemented calcareous and siliceous sands of beach and dune origin.

The Leederville Formation consists predominantly of discontinuous, interbedded sandstones, siltstones and shales with individual sandstone beds (Davidson, 1995). The sandstones are weakly consolidated, grey , fine to very coarse grained, poorly sorted, subangular to subrounded, and commonly silty. The siltstones and shakes are dark grey to black , typically micaceous, thinly laminated with fine-grained sandstone.

5.6 TOPOGRAPHY AND SOILS

The site is relatively flat with an average elevation of around 5m Australian Height Datum (AHD). Parts of the site have been covered with compacted fill.

Soils in the area of the Becher/Rockingham Plain are typically of the Quindalup Association and are mostly immature with little profile development. In some of the older profiles organic material tends to accumulate and may extend up to 1m in some of the larger swales. Carbonates tend to leach in some of the older profiles (Dames & Moore, 1993).

The Safety Bay Sand comprises predominantly medium dense, fine to medium grained, poorly graded sand and is occasionally slightly silty near the top of the layer. The sand is composed predominantly of carbonate skeletal or shell grit and may have a carbonate content of more than 50% by weight. Generally the sand is uncemented but in some places it is cemented with calcium carbonate to form weak to moderately strong limestone (Dames & Moore, 1993).

The sediments in the clay layer underlying the Safety Bay Sand are generally dark grey to greenish grey and contain variable amounts of sea shells and shell fragments. The top of the formation is generally sandy to gravelly and consists of shell grit and shell fragments. The bottom half of the formation to the Tamala Limestone is shelly firm clay (Dames & Moore, 1993).

In addition to the natural soils the site also contains fill materials (as detailed in Golders, 2000) which include the following:

- **Clean Fill** which is mainly shallow fill comprising reworked safety bay sand mixed with minor amounts of gravel or imported soil and construction debris.
- **Dredge Spoil** (from offshore dredging for the ship loading facilities) comprising poorly sorted fine-grained sand or silty sand with some shell debris.
- **Blast Furnace Slag** which was a by product of pig iron production and has a similar metal composition to clean fill.
- **HIsmelt Slag** has been stockpiled on the Plant site.
- **Industrial Fill** occurs widely across the site and was generally found in layers less than 0.5 m thick.

5.7 HYDROGEOLOGY

5.7.1 Description

The Safety Bay Sand and the Tamala Limestone Formations contain unconfined aquifers (Dames and Moore, 1990b). At a regional level the aquifers in the Sand and Limestone are considered to form a single aquifer system. The aquifer is referred to as the Superficial Aquifer and the site is located within the Jandakot Mound division of the Aquifer. However, detailed investigations indicate that the flow paths within the KIA are more complex and that the aquifers can be separated on the basis of hydrostatic head and natural groundwater quality (Barnes & Whincup, 1981).

The direction of groundwater flow is generally to the north west under a hydraulic gradient of approximately 1 in 2500 (Dames & Moore, 1990b). Fresh groundwater overlies the saline marine water in the aquifer. As groundwater flowing from the Jandakot Mound approaches the coast at Cockburn Sound it is forced over the dense saline wedge and then discharges into the shallow near shore zone (D.A.Lord, 2001). Some of the fresh groundwater mixes with the salt water at the interface and tends to remain in the sediments beneath Cockburn Sound. However, most of the groundwater rises up the interface and discharges into Cockburn Sound (Barnes & Whincup, 1981). Regional groundwater contours are presented on Figure 5.14.

Groundwater flow through the Tamala Limestone is highly variable and ranges between 200 and 2000m per year (Davidson, 1995). Groundwater flow through the Safety Bay Sand is significantly slower at around 20m per year (D.A.Lord, 2001).

The Tamala Limestone is the most productive and widely used aquifer in the Kwinana area with permeabilities in the order of 500 to 1500m/day. The Safety Bay Sands are unconsolidated and well compacted with a permeability in the order of 10 to 20m/day (Barnes & Whincup, 1981).

5.7.2 Groundwater Monitoring at the HRDF Site

Six groundwater monitoring bores (BH1 to BH6) were installed around the HRDF site in 1990 to provide baseline data on the groundwater which would have been impacted by previous industrial activities in the area. The locations of the bores are shown on Figure 5.15.

BH4 was lost due to construction works in late 1990. Two additional monitoring bores were established (BH7 and BH8) in 1991 and another two bores (BH9 and BH10) established in 1993. Bores BH5, BH6 and BH7 are background bores located to the east of the site. All other bores monitor the groundwater under the site.

Groundwater monitoring of these bores was undertaken on a bi-annual basis between 1990 and 1993 prior to the commissioning of the HRDF. The frequency of monitoring was increased to quarterly once the HRDF was operational. Monitoring continued on a quarterly basis even after the HRDF was placed on care and maintenance.

5.7.3 Groundwater Levels

Estimated groundwater contours based on the monitoring data are shown on Figure 5.15. The depth to groundwater over the site is between 3.5m and 4.5m below surface. The reduced groundwater elevation is around 0.57 to 1.14m AHD from west to east indicating that flow is to the west (URS, 2001). However, the direction of groundwater flow upgradient of the site is more variable and may reflect a change in subsurface conditions due to historical landfilling operations in the area.

5.7.4 Groundwater Quality

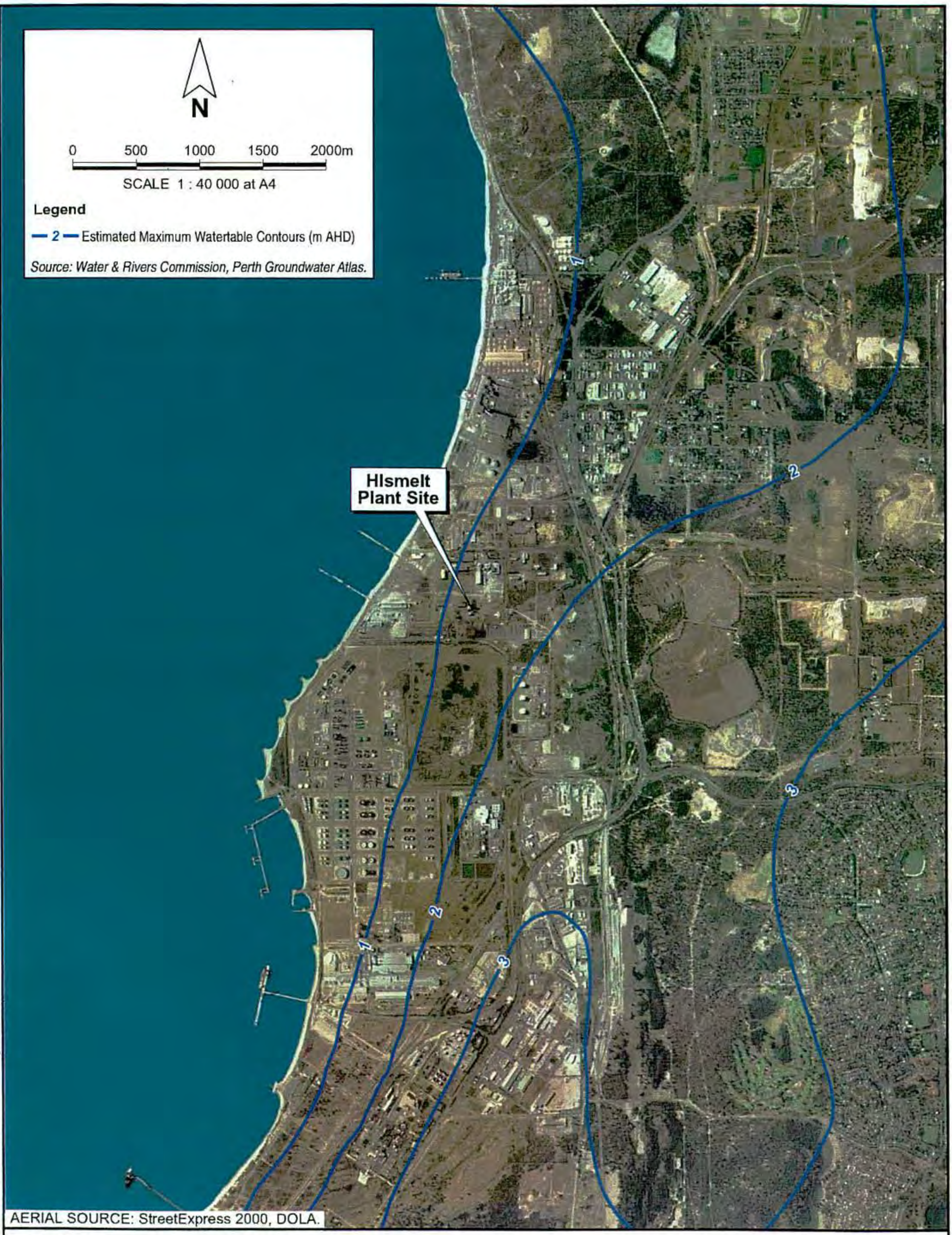
Groundwater samples are analysed for the following parameters in accordance with the requirements of the DEP operating licence:

- BH1 to BH3, BH5 to BH10: pH, electrical conductivity (EC), TDS, Sodium (Na), Calcium (Ca), Magnesium (Mg), Chloride (Cl), Sulphate (SO_4), Bicarbonate (HCO_3), Nitrate (NO_3), CO_2, dissolved and unfiltered Total Iron (Fe).
- BH1, BH6, BH7, BH8: Chemical Oxygen Demand (COD) and Total Organic Carbon (TOC).
- BH5 and BH6: Total Chromium (Cr) dissolved.
- BH6, BH7 and BH8: Selenium (Se) dissolved.
- BH5, BH6 and BH7: Non- Sulphate Sulphur.
- BH1 and BH3: Total Oil and Grease.

Results of the historical analyses are provided in Appendix D and show that the parameters measured have been at relatively constant levels and have generally been within the adopted criteria. One exception is chloride which has shown levels above the irrigation criteria level of 30mg/L, which is applied to crop tolerance and not applicable at the site. Levels of iron have also been above the adopted guideline. However, the guideline is for a filtered sample and the DEP licence requires analysis of an unfiltered sample.

The DEP has indicated that the use of individual criteria values should be based on the beneficial use and management objectives of the water resource. The HIsmelt site is within an industrial area with no planned abstraction for human or livestock consumption, or agricultural use. Groundwater discharge is expected to be to the marine environment of Cockburn Sound to the west. Therefore, the guidelines referenced for assessment of groundwater quality at the site in order of application are:

- Aquatic Ecosystems – Marine Waters.
- Aquatic Ecosystems – Fresh Waters.
- Agricultural - Irrigation Waters.



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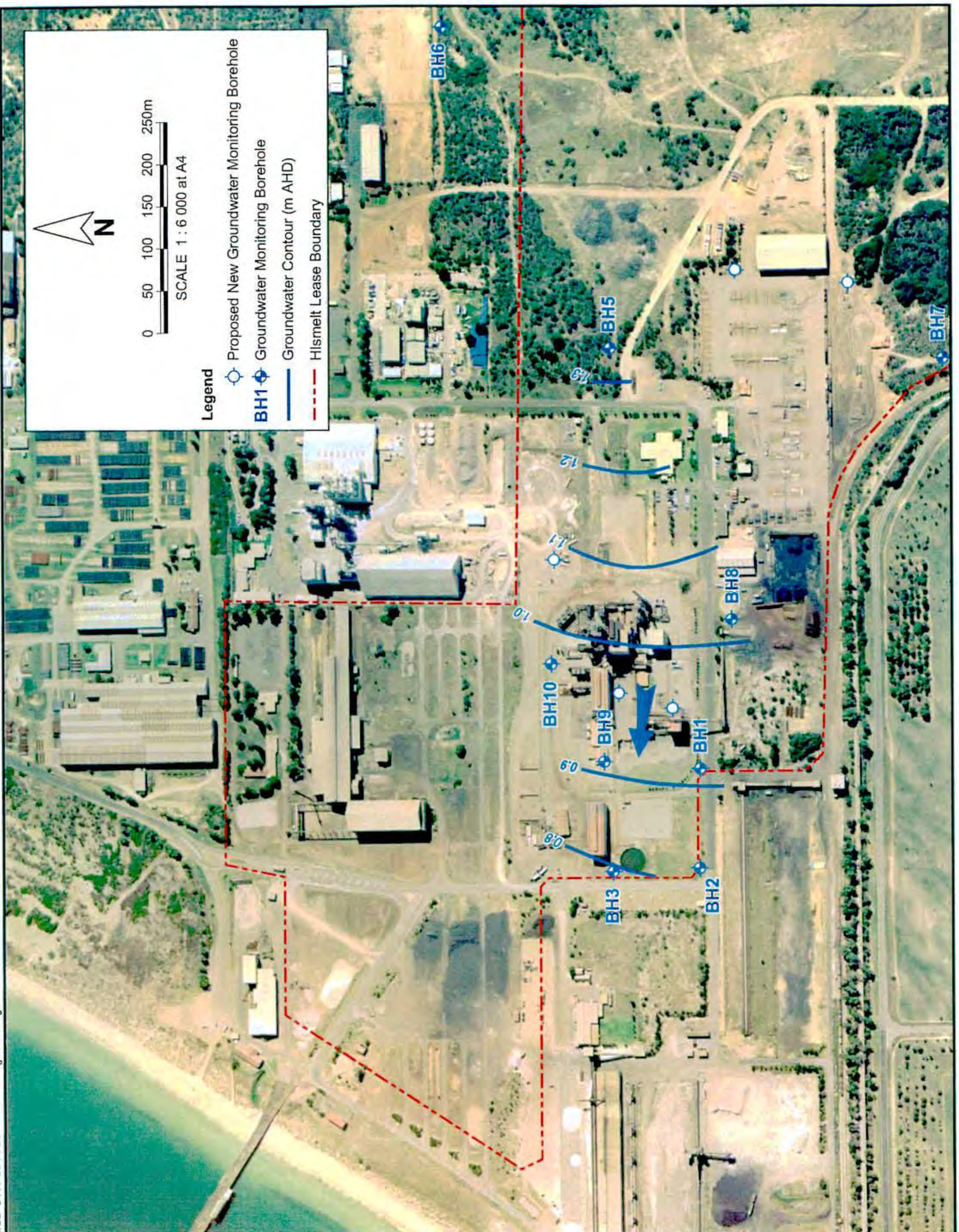
REGIONAL GROUNDWATER CONTOURS

Figure 5.14



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LOCATION OF EXISTING GROUNDWATER MONITORING BORES AND GROUNDWATER CONTOURS AT THE HIsmelt PLANT SITE

Figure 5.15

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5.8 CONTAMINATION ON SITE

5.8.1 Investigations

The HIsmelt site and the surrounding area has been extensively investigated for soil and groundwater contamination (Golder, 2000; Golder 2001a and b). The investigation in 2000 (Golder, 2000) involved:

- a review of the available information;
- inspections of historic aerial photography;
- sampling of soil at 133 locations;
- installation of nine groundwater monitoring wells; and
- chemical analysis of over 275 soil and groundwater samples for a range of organic and inorganic chemical constituents.

The 2000 investigation found that the site has generally low concentrations of industrial contamination and the contamination should not constrain continued use of the site for industrial purposes.

Additional investigations were carried out in 2001 and involved:

- a detailed review of historic aerial photography;
- further sampling and analysis of soils, groundwater and fill materials; and
- the leachability tests on some fill materials found on the site (Golder, 2001a and b).

5.8.2 Groundwater

Groundwater contamination in the Cockburn Sound catchment area is mainly due to spills and leakage from industrial sites and from seepage from waste disposal ponds. Contaminant plumes exist within the KIA due to past waste disposal practices, with the main contaminants being ammonium sulphate, sodium hydroxide, hydrocarbons, nitrogen and herbicides (CSMC, 2001).

HIsmelt has conducted a groundwater monitoring programme as discussed in Section 5.7. The water quality found in these bores is discussed in Section 5.7.4 and a summary of the analyses is presented in Appendix D. In addition a number of bores were installed by BHP on its site and monitored for contamination over a period of years. The results of the monitoring indicated that there was no evidence of significant contamination by hydrocarbons or pesticides, and there was only minor contamination by sulphate, nitrate and zinc but with levels within the ranges commonly found in groundwater in the KIA.

The quality of groundwater on the site satisfies the guideline values for use of water for irrigation of lawns, landscape areas and industrial cooling purposes. With the exception of zinc (and possibly nitrate as no specific limit is provided) the levels of contaminants in the groundwater under the site are below the ANZECC water quality guidelines for marine ecosystems.

Elevated nitrate levels were detected in some bores (Golder, 2000) but the distribution of contamination did not seem to follow a pattern with the exception that the bores near the southern boundary of the site reported higher levels. The concentration levels peaked in the mid 1990s and appear to have since declined. Regional concentrations vary within a wide range and values of 50 to 100 mg/L are not uncommon. Golder's (2001b) concluded that the source of the elevated nitrates could not be identified but that an offsite source in the area to the south of the site could be contributing to these levels.

5.8.3 Soil

The various materials on the Plant site (as listed in Section 5.6) were sampled and analysed for a range of metals. The 95^{th} percentile or typical levels of the metals in these materials are presented in Table 5.4.

Table 5.4

95^{th} Percentile or Typical Concentration Levels for Metals in Fill Materials on the Site (mg/kg)

Fill	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Natural soil	9	<1	29	<15	<0.1	<10	<10	16
Clean fill	9	<1	60	30	<0.1	13	16	71
Dredge spoil	11	<0.5	46	<10	<0.1	<10	<10	86
Blast furnace slag	13	<1	54	37	<0.1	23	40	23
HIsmelt slag[1]	<50	<<5	<140	<70	<0.1	<65	<250	<300
Industrial fill	15	<2	194	77	<0.1	358	58	1340
EIL[2]	**20**	**3**	**50**	**60**	**1**	**60**	**300**	**200**
HIL[3]	**500**	**100**	**500**	**5000**	**75**	**3000**	**1500**	**35000**

Notes: 95^{th} percentages were not calculated where a very large proportion of the samples were below detection limits. These concentrations are indicated as "<"

1 95^{th} percentile not calculated in HIsmelt slag because of the small number of samples (Golder, 2000). More extensive sampling and analysis of HIsmelt slag was undertaken in 2001 and showed arsenic concentrations between 1.7 to 5.6mg/kg, no cadmium or mercury detected, copper 11 to 17mg/kg, chromium ranging from 56 to 120mg/kg and zinc 43 to 54mg/kg (Golder, 2001a).

2 Ecological Investigation Level (DEP, 2000c).

3 Health Investigation Level (DEP, 2000c).

The results presented in Table 5.4 show that all samples of fill materials had metal concentrations well below the Health Investigation Level (HIL) and some samples of industrial fill and HIsmelt slag material contained metal concentrations that exceeded Ecological Investigation Levels (EILs) for some metals.

Column leach and Toxic Characteristics Leaching Procedures (TCLP) tests were conducted on blast furnace slag in 1993 (Golder, 2000). The tests found that there were no exceedences of the DEWCP (DEP, 2000c) or Australian Standard Leaching Procedures (ASLP) (AS4439) leachability criteria for either pH 4.9 or pH 7.0 leachates.

The ecotoxicity of a range of column leachates from the blast furnace slag was tested under laboratory conditions in 1999 (Julli, 1999). This study showed that under very severe environmental conditions (for example highly acidic or potentially anaerobic conditions) blast furnace slag could produce acutely toxic leachates which may warrant consideration if fresh unconsolidated slag is close to a slow flowing watercourse. However, the unbound rock slag produced at the Kwinana site has been in place for 15 years and has been spread on a generally flat surface which leads to infiltration rather than runoff. Rainwater will have a neutral pH and column tests showed that leachates under these conditions are below ASLP1 criteria (Golder, 2001a).

Leachability tests, using water, were undertaken on samples of the HIsmelt sites with the results indicating that all parameters were below laboratory detection limits (Golders, 2001a).

Millscale metal debris and other wastes may have caused some elevation of metals such as chromium, copper and lead in the soils relative to those levels found in clean fill or natural soil. Elevated, but below the HIL, mercury concentrations were detected in two samples (5.6 mg/kg and 9.3 mg/kg) on the southern boundary of the HIsmelt Plant site. Chromium and zinc levels exceeded EILs in a small number of samples (Cr <86 mg/kg and Zn <8200 mg/kg) but were well within HILs, within the proposed Stage 1 and Stage 2 Plant areas.

5.9 SURFACE DRAINAGE AND RUNOFF

Surface drainage on the site was installed by BHP for its steel mill, sinter plant, blast furnace and power station. A network of drains services the north western portion of the lease around the old rolling mill and workshops, and the south western portion of the lease, which includes the area previously leased by HIsmelt for the HRDF.

The BHP drainage systems ultimately discharged into Cockburn Sound via a concrete drainage channel (Southern Drain) at the south-western portion of the Fremantle Ports' Kwinana Bulk Terminal area, or a drain at the north-western portion of the site (Northern Drain) near the Fremantle Ports' Kwinana Bulk Berth No.1 (KBB1). The drain outlets are both located on Fremantle Ports' Kwinana Bulk Terminal site.

During the construction of the HRDF the drainage system on HIsmelt's lease for the HRDF was modified to prevent site runoff from entering the BHP drainage system. The bulk of the HRDF site runoff was directed to two settling ponds. Soak wells were also installed at the boundary of the HRDF lease to capture runoff and allow the water to seep into the superficial aquifer.

The drainage system in the area occupied by the coal, ore and dolomite stockpiles for the HRDF was modified to capture all stormwater runoff and direct it to a concrete-lined sump. Water was pumped from the sump to the clarifier, which acted as a process water tank, on the western end of the HRDF site for retention and use for the cooling of the slag.

Washwaters from the areas around the HRDF Core Plant building, which had the potential to be contaminated through contact with raw materials or cooling water chemicals, were captured in a sump and pumped to the clarifier.

The north-western portion of the expanded HIsmelt lease area has a drainage network that captures stormwater runoff from the roads and around the rolling mill buildings. The drainage system contains a number of drainage sumps and silt traps that capture any suspended solids prior to the water being discharged through the Northern Drain.

The area between the rolling mill building and the HRDF site, which was used as a laydown area for the steel mill does not have a drainage system, surface water in this area would simply flow to a low point and seep through the soil.

The undeveloped area to the east of Leath Road is not currently served by a drainage network. Surface water in this area would be absorbed by or seep through the porous soil.

5.10 FLORA AND VEGETATION

The site is within an area that has been extensively cleared and used for industry over several decades. There are no areas of remnant vegetation remaining on the site that will be cleared for the Project.

5.11 FAUNA

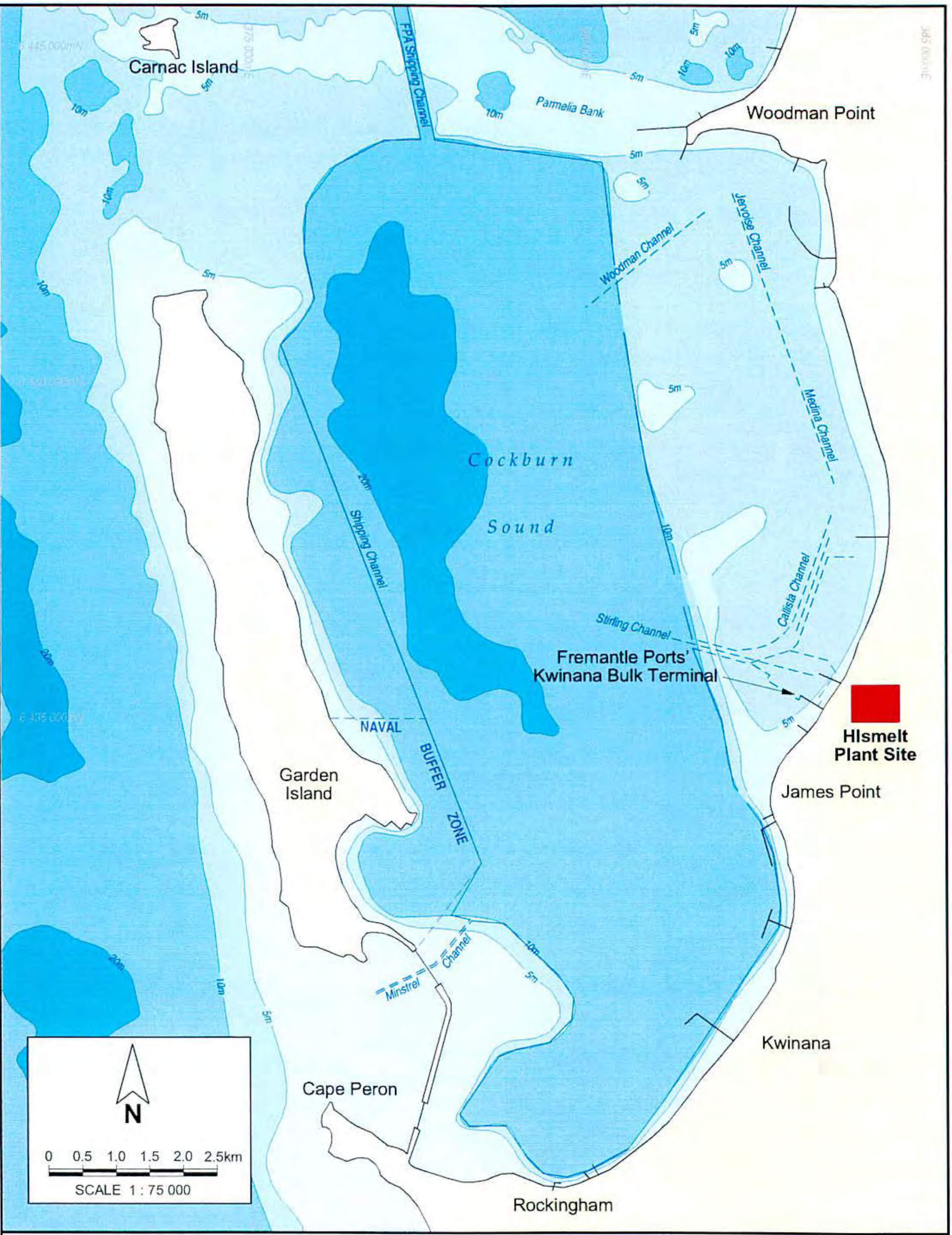
Due to the clearing of vegetation on the site for previous developments, there are no faunal habitats for native species other than those areas that have been established as greening areas around the site.

No fauna surveys were conducted at the site as the degraded nature of the area suggests that the presence of native non-mobile species is unlikely.

5.12 MARINE ENVIRONMENT

Projects in the Kwinana area have the potential to impact on the marine environment of Cockburn Sound. Materials for the Project will be imported and exported through the Fremantle Ports' KBB2 located as shown on Figure 5.16.

Cockburn Sound comprises the main part of the Outer Harbour of the Port of Fremantle and the channel dredged through Parmelia and Success banks is the only means of access to Cockburn Sound for larger cargo and naval vessels.



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COCKBURN SOUND

Figure 5.16

Many studies have been conducted on Cockburn Sound over the last three decades due to the widespread contamination of sediments and biota, poor water quality and widespread loss of sea grass on the eastern margin of the Sound. A recent study was a Pressure-State-Response Report prepared by the Cockburn Sound Management Council (D.A. Lord, 2001) from which the following description of the Cockburn Sound environment has been drawn.

5.12.1 Cockburn Sound Description

Cockburn Sound has two features that are unique along the Perth's metropolitan coast, it is sheltered and has deep water which results in the Sound being the most intensively used marine embayment in Western Australia. Cockburn Sound is separated from Warnbro Sound by Rockingham Bank, and from Owen anchorage by the Parmelia Bank. The coastal waters of the region are strongly influenced by the Leeuwin current, which flows from the equator southwards along the coast of Western Australia.

Cockburn Sound is 16km long and 9km wide and has a 17 to 22m deep central basin. Garden Island to the west shelters the Sound from ocean swells, which makes it an attractive location for fishing, aquaculture and marine recreational activities. Dolphins visit the Sound which provides an opportunity for tourism through conducting dolphin tours. The sheltered deep waters are suitable as an outer harbour for the Perth/Fremantle area and for the shipping requirements of local industries. It is also the location of a strategic naval base. The Sound therefore has multiple uses and must be managed to allow for existing and future pressures.

5.12.2 Water Movement

Modelling of water movement in Cockburn Sound has been the subject of a number of studies. The hydrodynamics of the Cockburn Sound region have been reviewed in some detail by Hearn, (Hearn, 1991), D'Adamo (D'Adamo, 1992) and the DEP (DEP, 1996).

Very little offshore wave energy reaches Cockburn Sound due to the shelter provided by Garden Island along the Western shore, the causeway at the southern end of the Sound, and the Parmelia Bank at the northern end of the Sound. Three main processes that control the hydrodynamics are:

- wind;
- horizontal pressure gradients due to wind, tides, waves, atmospheric pressure and continental shelf waves; and
- horizontal pressure gradients due to buoyancy effect

Wind

Waves and current in Cockburn Sound are primarily due to wind forcing. The predominant wind direction during summer is south to southwest, and westerly in winter as discussed in Section 5.2.1.3. Along the coastal margins of Cockburn Sound and in the surface waters during summer the net current is northward due to the prevailing south to south-westerly winds. Current velocities are up to 0.2m/s in summer and drop to 0.1m/s in winter (D.A.Lord, 2001).

Horizontal Pressure Gradients

Horizontal pressure gradients result from the difference in water pressure between two areas, which may be caused by differences in water level (due to wind, tides, waves, seiches and atmospheric pressure) and differences in water density (buoyancy effect).

Changes in water level due to wind are the result of the interaction of the wind and the complex topography of the coastline. During periods of strong winds, such as northwest or westerly storms, water is pushed up against the coast, particularly in the enclosed basins of Cockburn Sound. Current speeds are generally between 1 to 2cm/s due to changes in water level from tidal movement and seiching. The tidal range in Cockburn Sound is typically around 0.5m. Seiching can cause variations in the sea level of 0.1m although effects on current speeds are generally small or negligible. Low frequency oscillations such as continental shelf waves are able to penetrate Cockburn Sound and can contribute approximately 10cm/s to ambient current speeds (D.A.Lord, 2001).

Buoyancy effects arise when waters of differing densities are adjacent to one another with the less dense water flowing over the denser water. In Cockburn Sound horizontal density differences can be caused by:

- groundwater discharge;
- differences in evaporation and cooling between Cockburn Sound and adjacent waters;
- cooling water discharge; and
- differences in cooling between near shore waters and deeper basin waters.

These density differences can influence circulation in localised areas such as the nearshore region or over the entire Sound. The horizontal pressure gradients due to density differences between Cockburn Sound and adjacent waters determine the flushing of Cockburn Sound during the autumn and winter–spring seasons. Density gradients act to transport water into and out of Cockburn Sound during calm conditions, thereby flushing the surface waters in autumn and the bottom waters in winter.

5.12.3 Water Quality

Water quality in Cockburn Sound has been monitored since 1977. The average water temperature in the Sound varies from about 16°C in winter to 24°C in summer. Water salinity ranges from 34 parts per thousand (ppt) in winter and 36 ppt in autumn (D.A. Lord, 2001)

Water in the Sound is generally well oxygenated, although deep waters at the southern end of the Sound may become low in oxygen if calm weather persists for more than one week. Water quality monitoring in the Sound has focused on nutrient-related effects as nutrients have historically been the main contaminants of the Sound (D.A. Lord, 2001).

Studies conducted in the 1970s identified contaminants in the industrial discharges entering the Sound. Industry responded by reducing contaminant and nutrient discharges and by the early 1980s water quality had improved. Studies conducted in the early 1990s showed that nutrient levels in the water had once again increased due to contaminated groundwater from the southern part of the KIA entering the Sound.

Subsequent studies indicated that nutrient related water quality has improved since the early 1990s. Nutrient inputs from human activities have declined from an estimated 2000tpa in 1978 to about 300tpa in 2000 (CSMC, 2001).

5.12.4 Marine Sediments

Water movement plays a major role in determining sediment type within Cockburn Sound. In deeper areas the sediments tend to be fine and silty, while shallower areas experience more wave and current action and tend to have sandy sediments. Contaminants discharged to marine environments typically accumulate in the sediments. Widespread contamination of the sediments in Cockburn Sound was found in the studies undertaken in the late 1970s. A sediment study was undertaken in 1994, which showed that contaminant levels had decreased since the 1970s. High levels of tributylin (TBT), which is a toxic ingredient found in antifoulant paints used on large commercial shipping vessels, were found throughout the Sound particularly near shipping facilities (see Section 7.15.4).

The quality of the sediments was also monitored in 1999. The results indicated that there is an apparent decline in arsenic and TBT levels since the 1994 study. The 1999 study also showed that there was lead contamination near areas of shipping activity, and widespread zinc contamination throughout the Sound. However, the levels of lead and zinc were below national guidelines (D.A.Lord, 2001).

5.12.5 Marine Flora and Fauna

Cockburn Sound marine flora includes:

- seagrasses;
- seagrass epiphytes;
- phytoplankton;
- microphytobenthos;
- seaweed; and
- drift algae.

Zooplankton in Cockburn Sound were studied in the early 1990s and were found to be typical of temperate coastal regions. The benthic invertebrate fauna of the deep basin were studied in the 1970s and 1993. The 1993 survey found that more species were present and in greater numbers in the northern half of the Sound compared to the southern half (D.A.Lord, 2001)

The deep basin of Cockburn Sound was found to contain fine organic rich silts due to the accumulation of detritus from surrounding areas. It also contained species that have not been found anywhere else on the central west coast of Western Australia, as reported in the Cockburn Sound EMP (CSMC, 2001) (Wilson *et.al*, 1978).

Cockburn Sound provides a very important fish nursery and feeding habitat. Over 130 species of fish and 14 large crustaceans and mollusc species have been recorded in the Sound (Dybadahl, 1979 in CSMC, 2001). A resident population of Bottlenose Dolphins *(Tursiops truncates)* lives in Cockburn Sound. Australian Sea lions *(Neophoca cinerea)* occasionally visit Cockburn Sound.

At least 12 species of seabirds are found in the Sound area but as the eastern shores of Cockburn Sound are heavily developed they are not considered as important as nesting, feeding and roosting areas as the nearby islands.

5.12.6 Marine Pests

Two acknowledged marine pests have been found in the benthic fauna of Cockburn Sound. These are:

- European Fan Worm (*Sabella* cf. *Spallanzanii);* and
- Asian Date Mussel (*Musculista senhousia).*

These species are prolific growers and can compete with native species, which may affect biodiversity.

Other introduced species, or species of unknown origin, recorded in Cockburn Sound but which are not considered significant environmental threats include:

- *Tridentiger trigonocephalus;*
- *Bugula neritina;*
- *Bugula flabellate;*
- *Tricellaria occidentalis;*
- *Cryptosula pallasiana;*
- *Watersiproa subtorquata (?);*
- *Tubularia raphi;*
- *Asidiella aspersa; and*
- *Cionqa intestinalis.*

5.13 ETHNOGRAPHY AND ARCHAEOLOGY

A search was undertaken on the databases maintained by the Department of Indigenous Affairs in January 2002. The search was aimed at identifying:

- previously recorded sites within or adjacent to the Plant site; and
- other potential Aboriginal heritage constraints that may require specific management.

The review of the Department of Indigenous Affairs Register of Aboriginal sites revealed that there are no previously recorded Aboriginal sites located within the Plant site area. A copy of the search results is provided in Appendix E.

5.14 SOCIAL ENVIRONMENT

5.14.1 Historical Overview of Kwinana

The Kwinana District derives its name from the steamship Kwinana (an Aboriginal word for Pretty Maiden), which was damaged by fire in Carnarvon in 1920 and towed to Garden Island for mooring. In 1922 the ship broke its moorings and drifted across Cockburn Sound and sank. The ship became an attraction and people commenced visiting the beach resulting in the settlement of the Kwinana beach site.

The town of Kwinana was planned in the 1950s by the State Government to accommodate the development of industry in the area. This related to British Petroleum (BP) establishing an oil refinery on a Cockburn Sound site offered by the State. In addition, BHP established a fence post plant adjacent to BP's Refinery. Both plants were commissioned in 1954. BHP then selected the Kwinana area for establishing a steel rolling mill to fulfill the obligations under the State Government's Steel Industry Agreement Act. Construction of the rolling mill commenced in 1954 and was commissioned in 1956. The steel rolling mill was closed in the mid-1990's.

In 1960, BHP undertook to provide a blast furnace to produce not less than 450,000tpa of pig iron or equivalent foundry iron by December 1968. At the same time the State undertook to construct, operate and maintain a standard gauge railway line connecting Koolyanobbing (the source of the iron ore) with Kwinana. The administration of the blast furnace was passed to Australian Iron and Steel, a wholly owned subsidiary of BHP, and the plant was completed in 1968. The blast furnace was shutdown and demolished in the 1980's.

The first suburb to be established in the Kwinana area was Medina located as shown on Figure 5.5, which was opened up as a state housing area which attracted predominantly newly arrived Anglo Celtic migrants. Three new suburbs Calista, Orelia and Parmelia were also established around the town centre in the late 1970s with the suburb of Leda opened in the early 1990's. Other suburbs in the Kwinana Town include Kwinana Beach, Naval Base, Hope Valley, Wandi, Anketell, Casuarina and Wellard.

The Kwinana Town Council began in 1961 with the election of seven board members, an additional two were elected in 1970 once the Kwinana Road District became a Municipality. In 1977, Kwinana achieved Town status and currently (Kwinana Town Council Website, 2001) has a population of approximately 21,000.

The KIA is recognised as Western Australia's major heavy industrial area.

5.14.2 Demographic Profile

The Plant site is located within the industrial area of the Town of Kwinana. For the purpose of the PER demographic data are also provided for the adjoining Cities of Rockingham and Cockburn. These areas are collectively referred to as the Study Region and are shown on Figure 5.17.

The Town of Kwinana covers an area of 120.1 km^2 with a population density of 179.5 persons/ km^2 based on the Australian Bureau of Statistics (ABS) census data and ABS resident population estimates for 30 June 2000.

The City of Rockingham covers an area of approximately 257.1km^2 (ABS database estimates for June 2000). Based on the ABS resident population estimates for 30 June 2000, the population density for Rockingham was 275.2 persons/ km^2.

The City of Cockburn to the north of the site, which includes the nearby suburb of Wattleup, covers an area of 167.5km^2 with a population density of 407.1 persons/km^2 based on the ABS estimates for 30 June 2000.

5.14.2.1 Population Levels

The population of Perth is projected to grow from 1.3 Million in 1996 to 1.5 Million in 2006, and then 2.1 Million in 2031 (Ministry for Planning, 2000). Therefore the growth rate for Perth is estimated to decline from around 1.7% to around 1% by 2031.

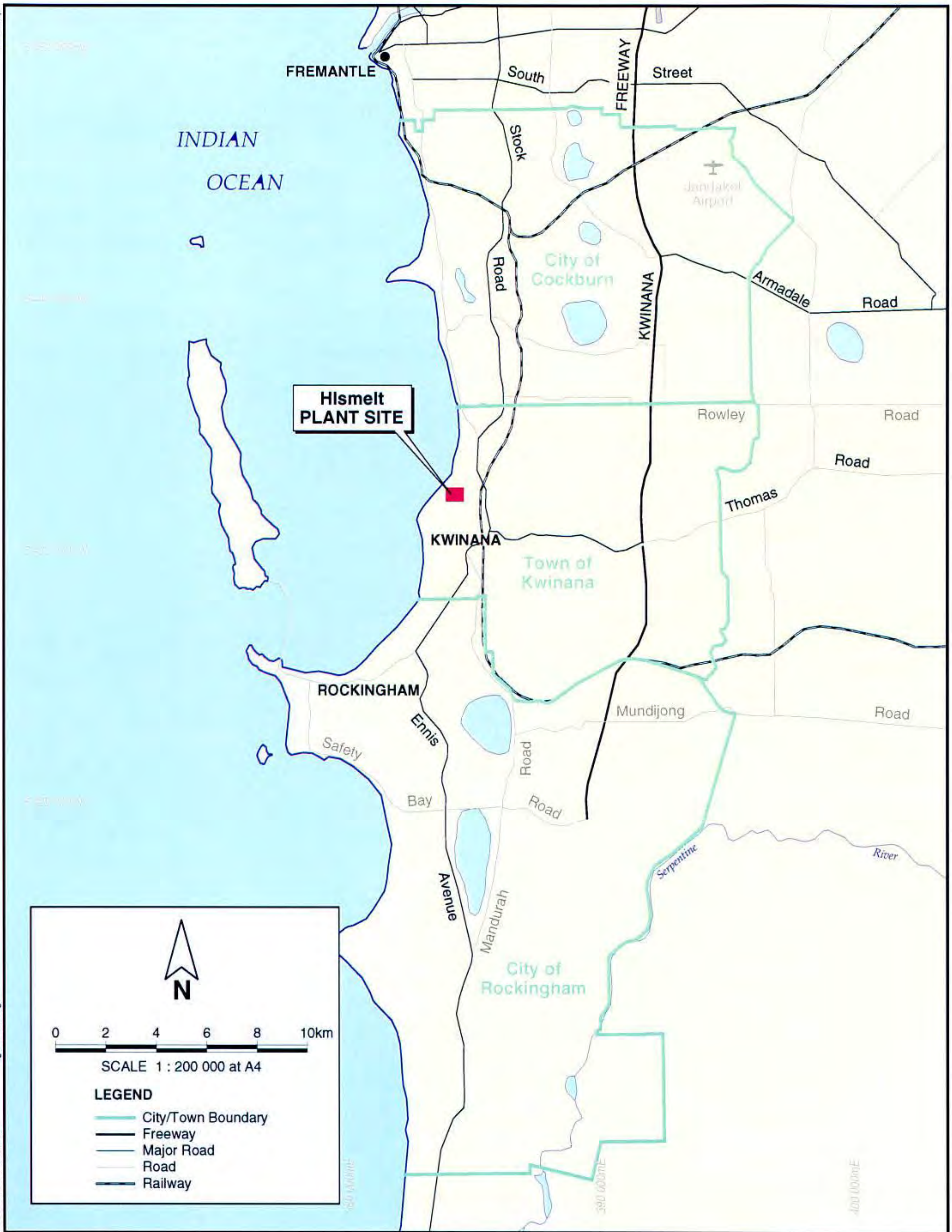
Existing and projected population levels for the Study Region are provided in Table 5.5. The data have been obtained from the ABS databases and from the Ministry of Planning documentation.

Table 5.5

Population Levels and Projections

	1991[1]	1996[2]	% Growth Rate p/a (1991-1996)	2000[3]	2006[4]	2016[4]	2031[5]
Town of Kwinana							
Males	8,609	9,815	2.8	11,186	13,802	19,572	
Females	8,698	9,371	1.5	10,367	11,840	15,714	
Total	17,307	19,186	2.2	21,553	25,642	35,286	42,600
City of Rockingham							
Males	20,744	28,484	7.5	35,022	42,578	56,123	
Females	21,124	29,683	8.1	35,730	43,045	57,039	
Total	41,868	58,167	7.8	70,752	85,623	113,162	158,600
City of Cockburn							
Males	25,019	28,667	2.9	34,642	42,124	50,035	
Females	25,347	28,668	2.6	33,531	40,651	47,730	
Total	50,366	57,335	2.8	68,173	82,775	97,765	100,400
South West Metropolitan Region							
Males	109,762	124,123	2.6	144,144			
Females	114,901	130,324	2.7	146,347			
Total	224,663	254,447	2.6	290,491	nd	nd	nd

Notes: 1. ABS 1991 Census Data
2. ABS 1996 Census Data
3. ABS Estimated Resident Population for 30 June 2000 (based on 1996 census data)
4. Ministry of Planning Projection (medium series) (Ministry of Planning, 2000)
5. Ministry of Planning Indicative Projection (Ministry of Planning, 2000)
nd- no data



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LOCAL COUNCIL BOUNDARIES

Figure 5.17

The population growth rate between 1991 and 1996 was greatest in Rockingham with 7.8% per annum. Cockburn and Kwinana had growth rates of around 2.8% and 2.2% per annum, respectively. This compares with an annual growth rate of around 2.6% between 1991 and 1996 for the South West Metropolitan Division.

5.14.2.2 Age Distribution

The age profile of the three localities in the Study Region and the South West Metropolitan Region estimated by the ABS for 30 June 2000 is presented in Table 5.6.

Table 5.6

Population by Age and Sex Estimated for 30 June 2000#

Age Group	Kwinana			Rockingham			Cockburn			South West Metropolitan Region		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-4	900	814	1714	2763	2709	5472	2774	2567	5341	9788	9185	18973
5-9	927	941	1868	3094	2908	6002	2684	2467	5151	10269	9880	20149
10-14	845	809	1654	3034	2911	5945	2609	2409	5018	10498	10220	20718
15-19	710	655	1365	2624	2461	5085	2662	2321	4983	10750	10229	20979
20-24	779	749	1528	2289	2089	4378	2799	2459	5258	11050	10620	21670
25-29	1015	1024	2039	2424	2538	4962	2821	2755	5576	10894	10927	21821
30-34	1053	845	1898	2588	2799	5387	2760	2680	5440	10547	10577	21124
35-39	941	818	1759	3818	3008	5826	2929	2833	5762	11224	11565	22789
40-44	826	717	1543	2575	2695	5270	2592	2658	5250	10988	11413	22401
45-49	647	550	1197	2093	2118	4211	2384	2534	4918	10197	10797	20994
50-54	663	527	1190	1879	1968	3847	2156	2108	4264	9558	9316	18874
55-59	543	495	1038	1590	1642	3232	1626	1520	3146	7452	7019	14471
60-64	448	429	877	1431	1525	2956	1317	1245	2562	5911	5946	11857
65-69	329	313	642	1326	1385	2711	1018	969	1987	5018	5233	10251
70-74	235	241	476	1172	1170	2342	746	787	1533	4373	4863	9236
75-79	195	220	415	743	883	1626	453	568	1021	3106	3902	7008
80-84	80	140	220	357	514	871	197	321	518	1518	2417	3935
85+	50	80	130	222	407	629	115	330	445	1003	2238	3241
Total	11186	10367	21553	35022	35730	70752	34642	33531	68173	144144	146347	290491

Note # ABS data estimated for 30 June 2000.

Table 5.7 presents the percentages of age distribution, and the ratio of males to females.

Table 5.7

Summary of Age Distribution and Sex Ratio (30 June 2000)

	Kwinana	Rockingham	Cockburn	South West Metropolitan Region
0-14 (%)	24.3	24.6	22.8	20.6
15-64 (%)	67.0	63.8	69.2	67.8
65+ (%)	8.7	11.6	8.1	11.6
Males/100 Females	107.9	98.0	103.3	98.5

Source: ABS Estimates for 30 June 2000

The data show that Cockburn has the highest resident population within the 15-64 age group (69.2%) with Kwinana having 67% and Rockingham with a much lower percentage of 63.8%. This can be compared with 67.8% for the Total South West Metropolitan Region (ABS, 30 June 2000 estimated data). Rockingham has the greatest percentage of 65 years and over, which is due to many people choosing to retire to the Rockingham area.

The Ministry for Planning has made population projections by age and sex for the localities in the Study Region (Ministry for Planning, 2000). Those predicted for a medium scenario projections are provided in Table 5.8.

Table 5.8

Population Projections by Age and Sex

Age Group	Kwinana						Rockingham						Cockburn					
	2006			2016			2006			2016			2006			2016		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-4	957	873	1830	1234	1125	2359	3201	3064	6265	4057	3881	7938	2900	2716	5616	3028	2835	5863
5-9	1006	913	1919	1216	1103	2319	3352	3193	6545	4139	3938	8077	2863	2695	5558	3010	2829	5839
10-14	1026	993	2019	1157	1065	2222	3667	3452	7119	4151	3908	8059	2969	2747	5716	3050	2865	5915
15-19	920	892	1812	1140	998	2138	3269	3079	6348	3880	3640	7520	3051	2931	5982	3174	2985	6159
20-24	892	818	1710	1270	1200	2470	3032	2978	6010	4275	4070	8345	3256	2930	6186	3553	3300	6853
25-29	974	839	1813	1429	1351	2780	2992	3121	6113	4382	4523	8905	3401	3082	6483	3936	3720	7656
30-34	1280	977	2257	1485	1162	2647	2986	3301	6287	4250	4559	8809	3490	3125	6615	4096	3483	7579
35-39	1374	989	2363	1483	1060	2543	3292	3280	6572	4069	4104	8173	3289	3171	6460	3952	3434	7386
40-44	1239	905	2144	1825	1166	2991	3208	3242	6450	3638	3856	7494	3361	3221	6582	3874	3419	7293
45-49	989	736	1725	1871	1173	3044	2844	2840	5684	3564	3676	7240	3048	3078	6126	3459	3392	6851
50-54	799	608	1407	1576	1006	2582	2422	2586	5008	3473	3714	7187	2674	2788	5462	3554	3366	6920
55-59	709	601	1310	1221	817	2038	2235	2273	4508	3259	3443	6702	2462	2279	4741	3211	3065	6276
60-64	516	477	993	887	684	1571	1848	1839	3687	2854	3086	5940	1747	1675	3422	2630	2709	5339
65-59	417	411	828	669	572	1241	1488	1481	2969	2481	2387	4868	1314	1273	2587	2162	2102	4264
70-74	309	291	600	483	404	887	1087	1179	2266	1626	1672	3298	1005	1047	2052	1401	1488	2889
75+	395	517	912	626	828	1454	1655	2137	3792	2025	2582	4607	1294	1893	3187	1945	2738	4683
Total	13802	11840	25642	19572	15714	35286	42578	43045	85623	56123	57039	113162	42124	40651	82775	50035	47730	97765

Source: Ministry for Planning (2000) – Medium Scenario Projections

Table 5.9 presents the grouped age distribution and sex ratio.

Table 5.9

Population Projection Summary of Age Distribution and Sex Ratio

Age Group	Kwinana		Rockingham		Cockburn	
	2006	2016	2006	2016	2006	2016
0-14 (%)	22.5	19.6	23.3	21.3	20.4	18.0
15-64 (%)	68.4	70.3	66.2	67.4	70.1	69.9
65+ (%)	9.1	10.2	10.5	11.3	9.5	12.1
Males/100 Females	116.6	124.6	98.9	98.4	103.6	104.8

It is estimated that the working age population (15 to 64 age group) will increase from 67% in 2000 to 70.3% in 2016 in Kwinana, from 63.8% in 2000 to 67.4% in 2016 at Rockingham, and from 69.2% in 2000 to 69.9% in 2016 at Cockburn.

The percentage of the 0 to 14 year age bracket is estimated to decrease in all areas by 2016 from the 2000 estimates. Kwinana from 24.3% to 22.5%, Rockingham from 24.6% to 21.3%, and Cockburn from 22.8% to 18%, which is consistent with the national trend towards an ageing population.

5.14.2.3 Employment

Employment levels in the Study Region based on the 1996 census data for persons over 15 years of age are shown in Table 5.10.

Table 5.10

Employment Levels from 1996 Census Data

	Kwinana	Rockingham	Cockburn	South West Metropolitan Region
Employment Status				
Employed – Full Time	4432	14414	16724	69914
Employed – Part Time	2081	7154	7942	35503
Employed – Total	6705	22081	25225	107687
Unemployed	1021	2595	2257	10215
Not in Labour Force	5497	17259	14835	74461
Unemployment Rates				
15-24 (%)	19.9	16.8	13.1	14.5
15 + (%)	13.2	8.2	10.5	8.7

Source: ABS based on 1996 census data.

Data in Table 5.10 indicate that in 1996 Kwinana has the highest unemployment rates with 13.2%. Rockingham had the lowest unemployment rate of 8.2 % for the total population over 15 years of age. These can be compared with the South West Metropolitan Region of 8.7% of the total population over 15 being unemployed.

In 1996 Kwinana had the highest youth unemployment rate with 19.9% of the 15 to 24 age group being unemployed. Cockburn had the lowest youth unemployment rate with 13.1 % of those within the 15 to 24 age group being unemployed. Data for the Total South West Metropolitan Region showed that in 1996 the youth unemployment rate was 14.5%.

Unemployment rates obtained from the Department of Employment and Workplace Relations are presented in Table 5.11.

Table 5.11

Unemployment Rate Estimates

	June 1997	June 1998	June 1999	June 2000	June 2001
Kwinana	12.1	12.0	11.0	12.1	12.6
Rockingham	9.1	8.7	7.9	8.7	9.1
Cockburn	8.1	7.4	6.5	6.9	7.1
South West Metropolitan Region	6.8	7.6	6.5	7.8	7.2

Source: Department of Employment and Workplace Relations pers. comm. 2001

Data in Table 5.11 show that unemployment levels in Kwinana have increased from 12.1% in June 1997 to 12.6% in June 2001. These rates are much higher than those for Rockingham, Cockburn or the South West Metropolitan Region.

The key occupations for those employed in the Study Region and the South West Metropolitan Region are presented in Table 5.12 based on the ABS 1996 census data.

Table 5.12

Occupation of Employed Persons (15 years and over)

Occupation	Kwinana		Rockingham		Cockburn		South West Metropolitan Region	
	No.	%	No.	%	No	%	No	%
Professionals	468	7.0	2098	9.5	2753	10.9	18744	17.4
Intermediate clerical, sales and service	1036	15.4	3532	16.0	4492	17.8	17836	16.6
Tradespersons and Related Workers	1256	18.7	4480	20.3	4449	17.6	15490	14.4
Associate Professional	591	8.8	2519	11.4	2473	9.8	12430	11.5
Other	3354	50	9452	42.8	11058	4308	43187	40.1
Total	6705	100	22081	100	25225	100	107687	100

Source: ABS based on 1996 census data

The highest percentage grouped occupation in Kwinana and Rockingham is for tradespersons and related workers with 18.7% and 20.3%, respectively. Cockburn has a slightly greater percentage of workers in the intermediate clerical, sales and service areas (17.8%) than the tradespersons and related workers. These figures can be compared with the South West Metropolitan Region of 14.4% for tradespersons and 16.6% for intermediate clerical, sales and service workers.

All localities in the Study Region have a lower number of professionals when compared to the South West Metropolitan Region. Kwinana has the lowest number with only 7% of the total workforce being classed as professionals.

Table 5.13 presents a breakdown of the key industries in which the local workforce are employed.

Table 5.13

Industry of Workforce

	Kwinana		Rockingham		Cockburn		South West Metropolitan Region	
	No.	%	No.	%	No.	%	No.	%
Retail Trade	958	14.3	3425	15.5	3810	15.1	15319	14.2
Manufacturing	1288	19.2	3768	17.1	3944	15.6	14015	13.0
Property and Business Services	506	7.5	1672	7.6	2177	8.6	11464	10.6
Health and Community Services	486	7.2	1736	7.9	2170	8.6	10325	9.6
Other	3467	51.7	11480	52.0	13124	52.0	56564	52.5
Total	6705	100	22081	100	25225	100	107687	100

Source: ABS 1996 Census Data

In 1996, manufacturing accounted for 19.2% of the employed persons in Kwinana, 17.1% in Cockburn and 15.6% in Rockingham compared with 13% of the Total South West Metropolitan Region workforce. This can be attributed to the proximity to the Kwinana Industrial area.

There was a greater percentage of workers in the retail trade in Rockingham with 15.5% followed by Cockburn with 15.9% and Kwinana with 14.3%.

5.15 EXISTING SERVICES AND FACILITIES

One advantage of siting the Plant in Kwinana is that there are industrial services and utilities such as electricity, water and natural gas already in place. There are established road, rail and shipping transport facilities available. Power, natural gas and water are currently available on the site.

5.15.1 Roads

The major service roads for the site are Rockingham Road, Beard Street and Leath Road (Figures 5.18 and 5.19). Rockingham Road comprises a dual carriageway with two lanes in each direction, with turn pockets at some intersections. Surfacing width in each carriageway varies between 7.0m and 10.9m. Beard Street and Leath Road are 10m and 7.4m wide, respectively (Kwinana Town Council, *pers. comm.* 2002).

Traffic numbers for the major roads are provided in Table 5.14. The heavy vehicle component available for the Main Roads roads for a section of Rockingham Road, south of Russell Road, indicated around 12 % of the traffic was heavy vehicles (Main Roads *pers. comm.*, 2002). Kwinana Town Council advised that the heavy vehicle component of Beard Street is around 25% (Kwinana Town Council, *pers.comm.* 2002).

Table 5.14

Traffic Counts

Road	Location	Vehicle Count	Year
Rockingham Road (AWT)[1]	South of Stock Road	27312	2001
	South of Russel Road	23193	2001
	North of Hope Valley Road	26943	2001
	North of Cockburn Road	24469	2001
	Rail Bridge South of Beard	38067	2001
	Rail Bridge South of Thomas	45087	2001
Beard Street (AADT)[2]	West of Rockingham Road	2247	2000
Leath Road (AADT)[2]	South of Beard Street	1657	1995

Notes: 1 Data provided by Main Roads, 2001. AWT – Average Weekday Traffic
2 Data of total movements on the road provided by Kwinana Town Council, 2002. AADT – Annual Average Daily Traffic

5.15.2 Rail

A railway line is already established between Koolyanobbing and Kwinana. The railway line is standard gauge and follows the route as shown on Figure 5.18. The closest spur to the Plant site is located immediately to the south of the site which services the Fremantle Ports' Bulk Terminal (see Figure 5.19). The railway will be used for the transport of iron ore from Koolyanobbing, which will be unloaded using the existing facilities to the south west of the site.

Data obtained from the Australian Rail Group on weekly train movements are presented in Table 5.15.

Table 5.15

Weekly Train Movements

Rail Section	Movements per Week
Koolyanobbing to Merredin	115
Merredin to Northam	135
Northam to Forrestfield	252
Forrestfield to Kwinana	230

Source: Australian Rail Group, *pers.comm.* 2002

5.15.3 Shipping

The facilities at the KBB2 (located as shown on Figure 1.3) will be used for the import and export of the materials required for the Stage 1 HIsmelt operations. KBB1 would need to be recommissioned to accommodate the additional ships required for Stage 2 of the Project.

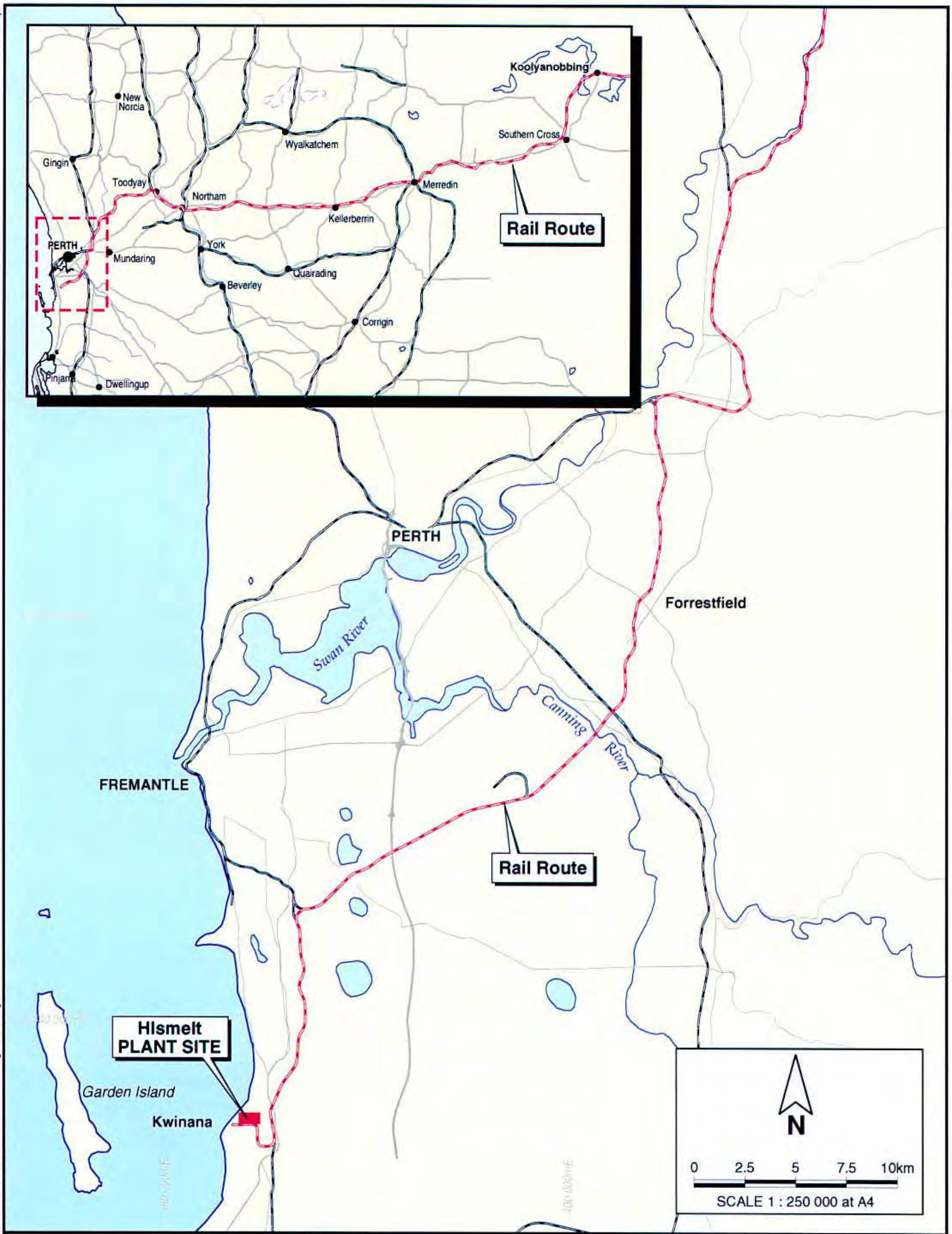
There were 967 ship arrivals in Cockburn Sound in 2000 (232 were naval vessels) (D.A.Lord, 2001). Seventy nine ships visited the KBB2 in 2000 (Fremantle Ports, *pers. comm.*, 2001). Table 5.15 presents the commodities handled at the KBB2 for the year 2000.

Table 5.16

Commodities Handled at the Kwinana Bulk Berth No.2 in 2000

Commodity	Quantity (kt)
Cement Clinker	320
Fertiliser	140
LPG	170
Mineral Sands	540
Total	**1170**

Source: Fremantle Ports, *pers.comm.* 2001



HIsmelt®

Kwinana HIsmelt Process Plant
PUBLIC ENVIRONMENTAL REVIEW

REGIONAL ROAD AND RAIL INFRASTRUCTURE

Figure 5.18

PINPOINT CARTOGRAPHICS (08) 9277 7763 figure 5-19.dgn

HIsmelt®

Kwinana HIsmelt Process Plant
PUBLIC ENVIRONMENTAL REVIEW

LOCAL ROAD AND RAIL INFRASTRUCTURE

Figure 5.19

6. CONSULTATION

6.1 CONSULTATION PROGRAMME

HIsmelt has given a high priority to consultation during the planning and environmental assessment phases of the Project. It was recognised that a comprehensive consultation programme is essential to reliably inform the government authorities, other groups and the public of the Project and to obtain input relevant to the development of the Project and the PER. An extensive consultation programme was implemented during the preparation of the PER and will continue during the public review period, with follow on activities to be conducted during the construction and life of the Project.

The consultation programme commenced early in the process to:

- provide the government, interest groups and the community with early information on the Project;
- establish a genuine two way consultative process;
- allow government representatives and the community access to HIsmelt personnel; and
- enable the stakeholder views to be included in Project planning and the PER.

The forms of consultation undertaken included:

- Media releases;
- Letters and faxes;
- Telephone contact;
- Briefings and meetings;
- Workshops;
- Project presentation material;
- Advertisements;
- Displays;
- Site tours; and
- Web site.

The key groups included in the consultation programme are:

- Politicians
- Government Authorities
- Local Councils
- Industrial Groups
- Non Government Organisations and Community Groups
- General Community.

A summary of those contacted during the consultation programme and the key issues raised is provided in Appendix F.

6.2 GOVERNMENT AUTHORITIES

The Government authorities consulted during the preparation of the PER included the following:

- EPA, to provide an overview of the Project and to discuss the environmental issues.
- EPA Service Unit, to discuss the environmental aspects of the Project and the PER.
- Officers from the DEWCP responsible for the Kwinana site, air quality, noise, groundwater, surface water, and Cockburn Sound.
- MPR Minerals Division, to discuss the safety and risk aspects of the Plant, and the development of a Project Management Plan for the Plant.
- MPR's Office of Major Projects, to assist in the project approval process.
- Main Roads WA, to discuss the traffic and road transport of materials.
- Water Corporation, to discuss water supply and disposal options.
- Landcorp, to negotiate the lease of land.
- Fremantle Ports, regular contact on agreement for material and product handling, and the proposed management of the operations.

Environment Australia and the Australian Greenhouse Office were also consulted on issues relating to greenhouse emissions from the Plant.

6.3 SPECIFIC INTEREST GROUPS

The Proponent identified specific interest groups to consult, which included:

- Kwinana community.
- Rockingham community.
- Cockburn community.
- Industrial, environmental and community consultative groups.

6.3.1 Kwinana Community

The Project is located in the Town of Kwinana. The Kwinana community consulted comprised local Members of Parliament, council executives, councillors, council employees and local residents. The programme for consultation included provision of project information, briefings, meetings, a community workshop and static displays.

The key issues discussed during the briefings were:

- Employment and workforce (Sections 4.22 and 8.2).
- SO_2 emissions and the FGD (Sections 4.15, 7.3.3 and Appendix B)
- Waste recycling and disposal (Section 7.11)
- Stockpiles (Sections 4.5, 7.5.3 and 7.8)
- Greenhouse (Section 7.4)
- Noise (Section 7.6)
- Slag (Section 7.9)
- Stakeholder consultation (Section 6)
- Shipping (Sections 7.1.3, 7.5.5, 7.6.7 and 7.15)
- TBT and ballast water (Sections 7.15.4 and 7.15.5)
- Kwinana air shed (Section 7.3)
- Truck movements (Sections 7.2.5, 7.6.8 and 7.16.1)
- Dust (Section 7.5)
- Visual aspects of the Plant (Section 8.3)
- Wastewater discharge (Section 7.11.2)
- Surface water management (Section 7.8)
- Rail movements (Sections 7.5.4, 7.6.8 and 7.16.2)
- Sewage (Section 7.11.3)
- Site contamination (Section 7.12)
- Risk (Section 9)

The specific issues and questions raised during the Kwinana Community Workshop are provided in Appendix F and are summarised in Section 6.3.6.1.

6.3.2 Rockingham Community

The City of Rockingham is to the southern border of the Town of Kwinana. The Rockingham community may be impacted by the Project in relation to impacts on Cockburn Sound, and noise and dust related to the Project. The Rockingham community consulted comprised local Members of Parliament, council executives, councillors, and local residents. The programme for consultation included provision of Project information, briefings, meetings, a community workshop and static displays.

The key issues discussed during the briefings were:

- Railing of ore (Sections 7.5.4, 7.6.8 and 7.16.2)
- Dust from the unloading of ore (Sections 7.5.4 and 7.5.5)
- Source of ore (Section 4.5.1)
- Wastewater discharge (Section 7.11.2)
- Transport noise (Section 7.6.7 and 7.6.8)
- Visual amenity (Section 8.3)
- Timing of the Project (Section 1.3)

- Employment (Section 4.22 and 8.2)
- Dust (Section 7.5)
- Consultation (Section 6)
- Landscaping (Section 8.3)

The specific issues and questions raised during the Rockingham community workshop are provided in Appendix F and are summarised in Section 6.3.6.2.

6.3.3 Cockburn Community

The City of Cockburn is to the north of the Town of Kwinana. The trains transporting the ore from Koolyanobbing will travel along the existing railway line which traverses through Cockburn. The Cockburn City Council was briefed on the Project at which the following key issues were raised:

- Railing of ore (Sections 7.5.4, 7.6.8 and 7.16.2)
- Water consumption (Section 3.4)
- CO_2 emissions (Section 7.4)
- SO_2 emissions (Section 7.3.3)
- Stockpiling of materials (Sections 4.5, 7.5.3 and 7.8)
- Economic value of the Project (Section 2)
- Wastewater disposal (Section 7.11.2)
- Solid waste disposal (Section 7.11.1)
- Dust from the site, unloading of ore and trains (Section 7.5)
- Conveyor system (Sections 4.5 and 4.6)

6.3.4 Industrial, Environmental and Consultative Groups

Industrial, environmental and consultative groups in the Kwinana, Rockingham and Cockburn areas were identified and consulted by the Proponent on the Project. The groups contacted included:

- Kwinana Industries Council
- Chamber of Commerce and Industry
- Chamber of Minerals and Energy
- Kwinana Communities and Industries Forum
- Kwinana Progress Association
- Kwinana Watchdog Group
- COMNET
- IP14 Community Advisory Committee
- Hope Valley Progress Association
- Rockingham Inner Wheel Inc.
- Casuarina Wellard Progress Association
- Homestead Ridge Progress Association
- Leda Progress Association

- Wandi Progress Association
- Parmelia Progress Association

Issues raised by the groups met included:

- Selection of Kwinana for the Plant location (Section 3.2)
- Water supply (Section 4.16)
- Dust (Section 7.5)
- Noise (Section 7.6)
- Train movements (Section 7.16.2)
- Stockpiles (Section 4.5, 7.5.3 and 7.8)
- Consultation (Section 6)
- Dioxins and Furans (Section 7.3.8 and Appendix G)
- Wastewater discharge (Section 7.11.2)
- Atmospheric emissions (Section 7.3)
- FGD (Section 4.15 and Appendix B)
- Consultation (Section 6)
- CO_2 emissions (Section 7.4)
- Raw material handling (Section 4.5)
- Workforce (Section 4.22)
- Coal source (Section 4.5.2)
- Lime source (Section 4.5.3)
- Stormwater runoff (Section 7.8)
- Visual impacts (Section 8.3)
- Ship unloading of ore (Sections 4.5.1, 7.5.5 and 7.6.7)
- Use and market for the pig iron product (Section 2)
- Greenhouse benefits (Section 7.4)

The Conservation Council of Western Australia was also consulted on the Project and raised the issues of Greenhouse (Section 7.4) and SO_2 emissions (Section 7.3.3).

6.3.5 Questions Raised During Consultation

From the consultation undertaken with the groups listed in Section 6.1, a list of questions was prepared and is presented in Table 6.1 together with a cross reference to the Section of the PER where the issue is addressed. Where additional information to that presented in the main text of the PER is required, a response to the question is presented in Appendix F.

Table 6.1

Questions Raised During Consultation

Question/Issue	Section
Plant	
Why is the Plant being built in Kwinana? Why not in the Pilbara?	3.2
What is the timing of the two stages?	1.3
Will the plant be used for treating other peoples scrap?	2.4.1
What are the chances of steel making at the site?	Appendix F
Employment	
What will HIsmelt's policy be on employing local people?	Appendix F
How many people will be employed at the Plant?	4.2.2
Will you be importing the workforce?	Appendix F
Will there be a permanent maintenance workforce?	2.4.3 and 4.22
Raw Materials	
Where is the ore coming from?	4.5.1
Where is the coal coming from?	4.5.2
Where is the lime coming from?	4.5.3
Where will the stockpiles be located? Will there be anything underneath the stockpiles?	4.5
Product	
What is the product? What will it be used for? Where is the market?	4.12.1
By-Products	
What happens to the gypsum?	4.12.3
What happens to the slag?	4.12.2
Will there be any stockpiles of slag on site?	4.12.2
Will there be any leaching from the slag stockpiles?	7.9.1
Air Quality	
What will be the air outputs from the Plant?	4.20 and 7.3
How will sulphur be removed from the gas?	4.15 and Appendix B
Is the Flue Gas Desulphurisation Unit a scrubber? How does it work?	4.15 and Appendix B
How much sulphur is to be emitted into the Kwinana air shed?	4.20 and 7.3
Will dioxins or furans be emitted from the Plant?	7.3.8
How much CO_2 will be emitted? How does this compare to other iron making processes?	7.4
Will there be plumes from the Plant?	Appendix F
Will there be any toxic emissions such as VOCs, PAH s and heavy metals?	7.3.9
Dust	
Will the stockpiles be covered?	7.5
Will the ore trains be unloaded in a shed?	7.5.4
How will dust from the ship unloading be controlled?	7.5.5
Noise	
What noise levels are associated with the railing and shipping of materials?	7.6.7 and 7.6.5
What are the expected noise levels from the plant?	7.6.4
Was there a problem with noise when the HRDF was operating?	Appendix F
Will HIsmelt be incorporating noise enclosures around noise equipment?	7.6.5
Water Supply	
Where will HIsmelt get its water from?	4.16
Waste	
Where will the solid waste go?	7.11.1
Will there be recycling of wastes?	7.11.1

Table 6.1 (*cont'd*)

Question/Issue	Section
Wastewater	
What is the quantity of discharge from the cooling towers?	4.21.1
What happens to the waste waters?	7.11.2
What happens to stormwater runoff from the stockpiles and the general site?	7.8
Will there be any discharge to Cockburn Sound?	7.8 and 7.11.2
Road Transport	
How many trucks will there be? Where will they be coming from?	7.16.1
Rail Transport of Ore	
How many trains will be transporting the ore from Kollyanobbing? How long will the trains be?	7.16.2
Will there be red dust coming from the ore trains?	7.5.4
Will the trains come through Cockburn?	7.16.2
Will there be train movements at night?	Appendix F
Will there be any new rail infrastructure required?	Appendix F
Marine/shipping	
How many ships per year will be required for the Project? How many transporting the ore?	4.5.1
Who will have the responsibility for the shipping operations?	7.1.3
What will be the impact of shipping movements?	7.16.3
Will there be a requirement to dredge the shipping channel?	Appendix F
Has the existing contamination around the jetty been identified? Will the shipping operations impact on these contaminants?	Appendix F
Port Infrastructure	
Will another jetty be required for the Stage 2 Plant?	7.15.1
Will additional wharf infrastructure be required?	Appendix F
What type of unloading system would be used?	4.5.2
Will the conveyors be covered?	7.5.3
Viewscape	
Is there a landscaping plan for the site?	8.3
How large will the cooling towers be?	8.3
How tall and big will the Plant be? What will it look like?	8.3
Consultation	
What is HIsmelt doing to consult with the communities?	6
Risk	
Will there be any offsite risk associated with the Plant?	9

6.3.6 Community Workshops

To ensure that the wider community was consulted on the Project, the Proponent organised two community workshops one in Kwinana and one in Rockingham. The workshops were arranged in response to the suggestion by some of the local environmental and consultative groups that workshops would be an appropriate forum for local residents to raise their concerns and issues relating to the Project. The workshops would also provide an opportunity for the Proponent to provide the public with information on the Project.

Letters were sent to the local environmental and consultative groups notifying them of the workshops and inviting them to attend. Invitations to the workshops were also advertised in the community newspapers and advertisement posters were placed in the Kwinana and Rockingham shopping centres.

6.3.6.1 Kwinana Workshop

The Kwinana workshop was held at the Kwinana Arts Centre on 22 January 2002. In addition to HIsmelt and Fremantle Ports' representatives and their technical consultants, 19 people attended the workshop. This comprised 13 from the local community and interest groups, four from government and three from industry. The workshop process is described in Appendix F.

Following a presentation by the Proponent and Fremantle Ports', the participants were invited to seek clarification on any points. A list of the clarification points is presented in Appendix F together with the response provided by the Proponent at the workshop. The participants were then invited to provide specific issues and questions that they would like to be addressed in the PER. These issues and questions have been grouped into areas of concern and are presented in Appendix F together with the Proponent's responses. The specific questions are also presented in Table 6.2 with a cross reference to the corresponding section of the PER in which the issue is addressed.

Table 6.2

Questions and Issues Raised at the Kwinana Community Workshop

Question/Issue	Response
Transport	
How will HIsmelt streamline its transport to minimise noise levels to community?	7.6.8
Greenhouse	
How will HIsmelt help Australia to meet its international obligations?	7.4
Has HIsmelt considered carbon sequestration as a solution to balance its CO_2 emissions?	7.4
Emissions and Waste	
Can HIsmelt please provide a clearer picture of the emissions and waste from the plant.	4.20, 7.3 and 7.11
Noise	
If HIsmelt is to be a 24 hour per day operation, what will the noise be like on a calm night?	7.6.4
Dust and Particulates	
What will the size and amount of dust be?	4.20.3, 7.3.4 and 7.5
What are the predicted dust fall-outs from the stacks and from the loaders?	7.3.4
How far will the dust travel, what volume and what size will it be?	7.3.4
Steel Market	
How will HIsmelt guarantee that the price of its product won't compete unfairly against recycled product?	Appendix F
Technology	
Is HIsmelt a state of the art technology and what is the forecast for the life of the project?	Appendix F
Risk	
Has HIsmelt taken into account potential problems such as shutting down the smelting vessel and relining it? Would that cause any problems?	Appendix F
Has HIsmelt done a risk analysis?	9.0

6.3.6.2 Rockingham Workshop

The Rockingham workshop was held at the City of Rockingham Council Chambers on 23 January 2002. In addition to HIsmelt and Fremantle Ports' representatives and their technical consultants, 25 people attended the workshop. This comprised 15 from the local community and interest groups, two from government and eight from industry. The workshop process is described in Appendix F.

Following a presentation by the Proponent and Fremantle Ports'the participants were invited to seek clarification on any points. A list of the clarification points is presented in Appendix F together with the response provided by the Proponent at the workshop. The participants were then invited to provide specific issues and questions that they would like to be addressed in the PER. These issues and questions have been grouped into areas of concern and are presented in Appendix F together with the Proponents responses. The specific questions are also presented in Table 6.3 with a cross reference to the corresponding section of the PER in which the issue is addressed.

Table 6.3

Questions and Issues Raised at the Rockingham Community Workshop

Question/Issue	Response
Greenhouse	
What will the impact of CO_2 emissions be to the inventory locally, in Western Australia and internationally?	7.4
Dust	
What will happen to the sprayed down dust (which will presumably turn into mud/sludge)?	Appendix F
Currently there is no dust suppression system prior to the material reaching the conveyor at loading and unloading facilities – how will this be addressed?	7.5.5
Community	
What provision is there for ongoing community liaison and monitoring?	6.1
Does HIsmelt have any sense of social responsibility?	Appendix F
Employment	
How many jobs are there currently at HIsmelt and how many will there be in Stage 2 of the HIsmelt development?	4.22
Can commissioning workers be offered permanency?	Appendix F
Will there be indirect and direct traineeships and apprenticeships offered by HIsmelt and if so how many?	Appendix F
What is HIsmelt's commitment to local employment and use of local service providers?	Appendix F
Transport of Materials	
What will be the impact of railing ore from Koolyanobbing on local communities? – particularly residents of Hillman and old Rockingham.	7.16.2
Will there be heavier trains creating more noise and vibration?	7.16.2, 7.6.7 and 7.7
How is the coal being transported and in what form (eg. fines or lump material)?	4.5.2
Marine Environment	
Will there be surface pollution of the sea – from fines ore blowing into it?	7.5.5
How will you protect the marine environment generally (eg ballast water)?	7.15
What will be the impact on Cockburn Sound?	7.15
Water Supply	
Are there alternative sources of water other than scheme water for the HIsmelt process?	3.4
Is HIsmelt using Woodman Point water?	Appendix F

Table 6.3 (*cont'd*)

Question/Issue	Response
Stage 1 and Stage 2 Plants	
If there are to be two plants (Stages 1 and 2) then does this mean double the waste produced and is that addressed in the PER?	7.11
What will be the location of the second plant? Next door? Nearby?	4.1
Waste Management	
Is HIsmelt committed to recycling both in the plant and office?	7.11
What provisions has HIsmelt got for internal office recycling?	7.11
Wastewaters	
What treatment will there be for the gas cleaning water discharge? How is it recycled?	4.10
Selection of Material	
HIsmelt should be more proactive in the use of Collie coal. It should explore opportunities with Collie to produce a suitable product for HIsmelt.	3.3.2
Process Control	
What is the validity of the Quality Assurance systems being used in the plant?	Appendix F
Rehabilitation	
How will the HIsmelt site be rehabilitated after 25 years (or on closure)?	10
Environmental Performance	
What is HIsmelt's track record here?	Appendix F
Gas Cleaning	
How can HIsmelt guarantee that the scrubbing process will remove 100% of toxic gasses (ie chlorine)? Is there such a thing as 100% guarantee?	Appendix F
Project Ownership	
How will overseas control of HIsmelt effect decision making locally? Will decisions be made in the interest of overseas parties rather than locally and Australia?	Appendix F
Shipping	
How responsible is Rio Tinto Shipping (what country's ships do they use)? What are their standards, methods etc?	7.1.3.2
Health Impacts	
HIsmelt testing has confirmed that there will be no health impacts. How do HIsmelt know this? There has not been any so far – but what about the future?	Appendix F
Product	
What are the specifications of pig iron produced such as silica, copper, manganese, phosphorus for export?	Appendix F

7. ENVIRONMENTAL ISSUES AND MANAGEMENT

7.1 GENERAL ENVIRONMENTAL MANAGEMENT

7.1.1 HIsmelt Process Plant

HIsmelt (Operations), as part of the Rio Tinto Group, is committed to responsible environmental management and is currently developing environmental management strategies and procedures that will minimise or ameliorate the potential environmental impacts of the Project.

An Environmental Management Programme was prepared for the operation of the HRDF in 1992 (HIsmelt, 1992) and updated in 1995 (HIsmelt, 1995). An Environmental Management System (EMS) was also prepared for the HRDF and submitted to the EPA in 1998 (HIsmelt, 1998).

An Environmental Management Plan (EMP) will be prepared for the Project. The EMP will propose the management activities to be undertaken to ensure the environmental objectives are met. The EMP will specify management for:

- Construction
- Air Emissions
- Dust
- Noise
- Surface Water
- Groundwater
- Slag
- Hazardous Materials
- Solid Waste
- Wastewaters
- Transport of Materials (road, rail and shipping)
- Decommissioning and Closure
- Contractors
- Public Safety
- Employee Environmental Education
- Environmental Incidents

The construction component of the EMP will be submitted to the DEWCP prior to the commencement of construction, and the complete EMP will be submitted to DEWCP for approval prior to commissioning.

An EMS will also be developed and implemented to ensure that the Plant achieves the highest level of environmental performance. The EMS will be based on the principles outlined in the ISO 14000 series and the Australian Mineral Industry Code for Environmental Management (Minerals Council of Australia, 2000).

The elements of the EMS may include the following components:

- Identification of issues to be managed such as significant environmental and legal issues.
- Defining management measures.
- Training and communication.
- Development of key performance indicators.
- Methods for measuring the effectiveness of the implementation of the system, and to ensure the system is self correcting.
- Methods for maintaining and updating documentation.
- Methods for keeping appropriate records safe and secure.
- Programme of review to assess appropriateness of system.
- Means for continual improvement in environmental performance.
- Policy.
- Emergency preparedness and response.

The components of the EMP will be further defined and integrated into the EMS.

The Plant will be designed to:

- Meet the appropriate Australian Standards.
- Comply with all relevant legislation.
- Meet the requirements of all relevant statutory authorities.
- Meet Rio Tinto Guidelines for operational safety and environmental performance.

Operating procedures for the Plant will be developed using the principles of the ISO 9000 and ISO 14000 series of standards and will be based on experience gained from other iron making plants and from the operation of the HRDF.

Personnel will undergo competency-based training prior to being allocated operational roles. Each standard operating procedure will incorporate specific instructions for environmental protection where applicable.

Commitments

The Proponent will comply with all applicable environmental standards and regulations pertaining to and appropriate for an iron ore processing plant and its operations in Western Australia.

Prior to commissioning, the Proponent will prepare an EMP for the site, which will be submitted to the DEWCP for approval prior to commissioning.

The Proponent will prepare an EMS for the operations of the HIsmelt Plant, prior to commissioning.

The Proponent will implement the EMS during the commissioning and operation of the Plant.

7.1.2 Rail

The Proponent has entered into a Memorandum of Understanding with a rail freight provider for the transport of iron ore fines from Koolyanobbing to the Kwinana site. The rail freight provider selected currently operates under an ISO 14001 compliant EMS, which is applied at all of its operational sites. The provider complies with all environmental legislation applicable to the states in which it operates.

The rail freight provider will be responsible for cargo management while the ore is in its custody during transport from Koolyanobbing to Kwinana.

Commitment

The Proponents will consider environmental performance and standards in the selection process for a rail freight provider.

7.1.3 Shipping

7.1.3.1 Selection of Shipping Contractors

Rio Tinto Shipping, in conjunction with BHP Billiton, has developed a ship vetting system called Rightship to minimise the risk associated with chartering a vessel. The system is based on a database that draws together information from reliable sources around the world such as Lloyds of London, AMSA, Pilots at ports (including Dampier), and other sources. The system rates a vessel on a number of criteria which includes the following:

- Age.
- Maintenance history.
- Flag.
- Owner.
- Incidents (Safety and Environmental).
- Design.
- Competency of crew.

Forty-two known criteria about the ship are analysed to provide a comprehensive picture of the vessel, its management and performance. If the ship has been involved in an environmental incident such as non-compliance with Australian Quarantine and Inspection Services Ballast Water Requirements (see Section 7.15.5), or spills then these factors will be considered in the analysis and will significantly reduce the ship's rating. The analysis is supplemented by physical inspections and management audits of the owner, manager and crew competence. The information is weighted for importance and benchmarked against regulatory standards to derive a risk rating for each ship. The system rates each vessel and assigns a number of stars.

Three to five stars denotes that the ships are acceptable for charter, two stars requires further information whilst one star rates the vessel as unacceptable for charter.

Ships chartered for the delivery of raw materials and the export of pig iron will generally be chartered through the services of Rio Tinto Shipping and will thus have to satisfy the requirements of the Rightship system. The Rightship system will ensure that only well-maintained vessels that are operated by companies with good management principles and competent crews will be chartered by the Proponent.

Commitment

The Rightship vetting system, developed by Rio Tinto Shipping and BHP Billiton, will be applied by the Proponent to ensure that any vessels chartered by the Proponent for the Project are well maintained and are operated by companies with good management principles and competent crews.

7.1.3.2 Management by Fremantle Ports

Fremantle Ports has developed and implemented an EMS that is certified to the International Standard ISO 14001. This complies with the current policies for Cockburn Sound as the CSMC in its EMP (CSMC, 2001) encourages port and harbour operators to have an EMS that is consistent with the ISO 14000 series. The CSMC also suggest that the EMS should prioritise the management to reduce spillage.

In addition to ongoing internal audits to ensure compliance with the International Standard, Fremantle Ports is subjected to six monthly surveillance audits by an external certifying body. The purpose of these audits is to ensure that the EMS continues to function and is resulting in continued improvement in environmental performance.

The development of the Fremantle Ports' management systems commenced with quality management in the early 1990s utilising the Australian Quality Council framework. This extended to safety management with the International Safety Rating System and more recently environmental management with ISO 14001. The approach has been to integrate system elements wherever possible to form a true Integrated Management System (IMS).

Fremantle Ports has also developed a Marine Safety and Environment Plan (Fremantle Port Authority, 2000) with the following objectives:

- to identify the scope, function and activities of Fremantle Ports, and all other activities that occur within or impact on the Port of Fremantle (with a potential safety or environmental impact);
- identify the potential safety and environmental loss exposures and review their likelihood and potential consequences;
- identify the controls that are in place to prevent and/or mitigate the loss exposures; and

- provide justification as to the adequacy of the measures in place to ensure the safe and environmentally sound operation of the Port of Fremantle.

Fremantle Ports has an IMS which has been evolving since 1994. The aim of the IMS is to facilitate continuous improvement in a co-ordinated manner through the integration of quality, safety and environmental systems. As part of the Marine and Safety Management Plan and the IMS Fremantle Ports makes the following commitment to the environment (Fremantle Port Authority, 2000):

> *"The Fremantle Port Authority is an environmentally responsible port manager. It is our policy to maintain a healthy and ecologically sustainable port environment.*
>
> *We are committed to continuous improvement in the prevention of pollution.*
>
> *We have adopted ISO 14001 to ensure that we comply with environmental standards."*

7.2 CONSTRUCTION

7.2.1 General

An EMP will be prepared for the construction phase of the Project and will be submitted to DEWCP prior to construction. The EMP will include the management for:

- Contractors.
- Incident reporting.
- Dust.
- Noise.
- Waste Disposal.
- Stormwater Runoff.
- Erosion.
- Transport.
- Public Safety.

The EMP will be applied at the site by the Proponent and the contractors undertaking the construction operations. All activities will be conducted under the supervision of the Construction Manager.

Commitment

The Proponent will develop an EMP for the construction phase of the Project. The Construction EMP will be submitted to DEWCP for approval prior to the commencement of construction.

The Construction EMP will be implemented at the site during the construction period by the Proponent and the contractors undertaking the construction activities.

7.2.2 Dust

Issue

During the construction period dust may be generated by the site preparation activities, movement of vehicles and from exposed areas.

Management

Dust generated during the construction activities is not expected to have a significant impact on the environment. Water trucks will be used to spray disturbed areas and unsealed roads on site, as necessary, to minimise dust generation. Dust during the construction phase will be visually monitored, particularly when strong winds persist. Additional dust minimisation methods will be implemented if dust is identified as a problem during construction.

Commitment

During construction, the Proponent will implement dust minimisation measures such as the use of water sprays on disturbed areas and unpaved roads on the site.

7.2.3 Noise

Issue

Noise generated during the construction period will be related to:

- pile driving;
- movement of vehicles; and
- the use of construction equipment.

Management

Construction activities will be carried out in accordance with the Environmental Protection (Noise) Regulations, 1997 and the control of noise practices set out in the Australian Standard 2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites."(AS 2436-1981).

Construction activities will generally be undertaken between 7am and 7pm on Monday to Saturdays. If construction activities are to be undertaken outside of these hours then the requirements of the Environmental Protection (Noise) Regulations 1997 for "Construction Out of Hours" will be complied with.

The Proponent will ensure that the equipment used for construction has adequate operational noise control measures fitted.

Commitment

The Proponent will ensure that construction activities comply with the Environmental Protection (Noise) Regulations, 1997.

7.2.4 Construction Wastes

Issue

The site has been subjected to industrial activity since the 1950's and some infrastructure from these activities remains on the site. Prior to the construction of Stage 1, some of the existing concrete footings that are not required for the new Plant will be removed. Soil and fill will also be excavated to enable new foundations to be installed.

Wastes generated during the construction period will include:

- inert waste including excess fill;
- general refuse such as building rubbish and packaging material;
- waste oils; and
- sewage.

Management

The various construction wastes will be separated as far as is practicable. Inert wastes may be used as fill. Some of the construction wastes will be sent to a suitable facility, where they will be processed and separated into a number of recyclable or re-usable materials. Soil from the on-site excavations will be screened to remove oversize material and used as clean fill for use on construction sites. HIsmelt is in preliminary discussions with a local company that offers such a service.

Metallic waste, such as steel offcuts, will be segregated and sent to a scrap metal contractor for recycling. Wherever feasible, packaging waste will be segregated and the recyclable materials delivered to recycling depots. General waste will be disposed of in an approved landfill.

Waste oil will be collected and removed by a licensed contractor for recycling or disposal at an approved waste disposal site.

A Nutrient Retentive Sewerage System will be installed to handle the ablutions from the toilets and washroom facilities.

Commitment

Waste disposal management will be included in the Proponent's Construction EMP, which will be submitted to the DEWCP for approval prior to the commencement of construction.

7.2.5 Traffic and Transport

Issue

Construction traffic will include the haulage of construction materials and the movement of the workforce between their residences and the site. The construction activities will generally be only undertaken between 7am and 7pm on Monday to Saturday inclusive. The construction workforce is estimated to peak at around 320 with an average of around 230 for a 24-month period.

Management

The construction period is relatively short term but there will be a concentrated impact on the transport network during the peak construction period. The roads that will experience the greatest impact due to construction traffic will be Rockingham Road, Beard Street and Leath Road. The standard of these roads is considered to be adequate to cope with the construction traffic.

7.3 AIR EMISSIONS

7.3.1 Air Quality Criteria

The EPA assesses any new proposals in terms of emissions at stack and the resultant ambient ground level concentrations. The following two sections outline the relevant criteria for the Project.

7.3.1.1 Atmospheric Emission Criteria

For emissions from industrial sources, the EPA requires that "*all reasonable and practicable means should be used to prevent and minimise the discharge of waste*" (EPA, 1999a). The EPA requires an assessment to be undertaken of the best available technologies for minimising the discharge of waste for the processes and justification for the adopted technology.

The EPA has published a Guidance Statement for gas turbine emissions (EPA, 2000a), in which it refers to guidelines promulgated elsewhere for other emission sources. In general, the most stringent guidelines routinely applied within Australia are those from the New South Wales EPA (1997), which includes an emission limit of $0.10 g/m^3$ for particulates and $0.35 g/m^3$ for oxides of nitrogen for steam boilers using gaseous fuels.

7.3.1.2 Ambient Ground Level Standards

The Kwinana region is covered by the Environmental Protection (Kwinana) (Atmospheric Wastes) Policy (EPP) (EPA, 1992b and 1999c). The Kwinana EPP defines limits (concentrations of atmospheric wastes that shall not be exceeded) and standards (concentrations of atmospheric wastes that should not desirably be exceeded) for TSP and SO_2 as shown in Table 7.1. For modelling assessments the standards for the 1 hour averaging period relate to the 9th highest hour in that year, with the maximum concentrations being compared to the standards and limits.

When only one year's data is modelled the predicted concentration for the 9th highest hour in that year is compared to the standard. The EPP Areas A and B, and some of Area C are shown on Figure 5.2.

Table 7.1

Kwinana EPP Ambient Air Quality Standards and Limits for Sulphur Dioxide and Particulates

Species	Area	Averaging Period	Standard (μg/m³)	Limit (μg/m³)
Sulphur Dioxide	Area A (Industrial)	1-hour	700	1400
		24-hour	200	365
		1-year	60	80
	Area B (Buffer)	1-hour	500	1000
		24-hour	150	200
		1-year	50	60
	Area C (Residential)	1-hour	350	700
		24-hour	125	200
		1-year	50	60
Particulates	Area A,B,C	15-minute	-	1000
	A	24-hour	150	260
	B	24-hour	90	260
	C	24-hour	90	150

The EPA requires that the air pollutants that are not covered in the Kwinana EPP are to meet the NEPM standards (NEPC, 1998) listed in Table 7.2. These standards specify the maximum concentration and the goal that is to be achieved within ten years (i.e. by 2008).

Table 7.2

National Environmental Protection Measures – Standards and Goals

Pollutant	Averaging Period	Maximum Concentration		Goals within 10 years Maximum allowable exceedances
		(ppm)	($\mu g/m^3$)	
Carbon Monoxide	8 hours	9.0	11,240	1 day a year
Nitrogen Dioxide	1 hour 1 year	0.12 0.03	246 62	1 day a year none
Photochemical oxidants (as ozone)	1 hour 4 hours	0.10 0.08	214 171	1 day a year 1 day a year
Lead	1 year	Not applicable	0.50	None
Particles as PM_{10}	1 day	Not applicable	50	5 days a year

The NEPM standards and goals have yet to be implemented in State legislation. However, the EPA intends to implement them through the development of a statewide EPP (EPA, 1999b). Throughout Western Australia, these standards will apply outside industrial areas and residence free buffer areas around industrial estates (EPA, 1999b). As the Buffer Zone (EPP Area B) contains residences in Hope Valley and Wattleup the NEPM criteria have been applied to those residences within Area B and all of Area C.

7.3.2 Modelling

The Proponent engaged a consultant to undertake an air modelling study of the potential ground level concentrations resulting from the air emission from the Plants on the air quality in the Kwinana Region (Sinclair Knight Mertz, 2002). The complete study report is provided as Appendix C. A summary of the study is provided in the following sections.

Two air dispersion models were used to assess the potential ground level concentration from both the Stage 1 and Stage 2 Plants. The Western Australian DEP dispersion model DISPMOD was used for the assessment of emissions from the taller stacks, and for impacts beyond the buffer zone. DISPMOD was run to assess the impacts of emission of SO_2, NO_2 and CO from the Plant on the local ambient concentrations.

The Victorian regulatory model AUSPLUME (V5.1) was used to assess the impacts of emissions from the shorter stacks, which may be subjected to influence from the turbulence created by building structures.

7.3.3 Sulphur Dioxide

7.3.3.1 Issue

SO_2 is a colourless gas with a sharp irritating odour. It is produced in the combustion of material containing sulphur, such as coal, where the sulphur can be oxidised. SO_2 acts directly on the respiratory system with elevated concentrations triggering rapid responses within minutes. The maximum effect occurs within 10 to 15 minutes of exposure, particularly in those individuals with sensitive airways such as asthmatics. The most common symptoms are coughing, wheezing and shortness of breath (DEP, 2000a).

7.3.3.2 Determination of Existing Sulphur Dioxide Emission Levels

In recognition of the potential for the air quality around Kwinana to revert to a degraded state, the EPA moved in 1992 to establish environmental objectives and associated procedures to maintain acceptable air quality (EPA, 1992a). To this end the Government promulgated an EPP for the Kwinana area that:

- Identified the area to be covered by the EPP and the three regions (industrial, buffer zone and rural/residential) within that area.
- Established through associated regulations, the air quality objectives for sulphur dioxide.
- Allowed "*the EPA to establish a procedure for determining and applying limits on the emissions from each industrial source so that the cumulative impact of all these emissions does not exceed the air quality objectives*".
- Required appropriate emission and ambient monitoring.

In the original "determination" of emission allocation to the industries, the Kwinana Industries Council (KIC) allocated maximum permissible quantities (emission limits) to each of the industries such that predicted ground level concentrations were just at or below the Kwinana EPP standards. This process was achieved using the DEP's coastal dispersion model (DISPMOD v4.1), which had been extensively validated for the region.

A review of the 1992 determination had not been finalised at the time of preparing the PER, but it is understood that the redetermination will use a more reliable probability of emissions from the various industries, and that allowances will be made for emissions from future industries (DEP, *pers. comm.*, 2001).

7.3.3.3 Predicted Concentrations from Existing Industry

Predicted maximum and 9^{th} highest 1-hour ground level concentrations of SO_2 using the current allocated emission limits (as provided by the DEP, *pers. comm.*, 2001) are summarised in Table 7.3.

Table 7.3

Predicted Maximum and 9th Highest Hourly Ground Level Concentrations of SO_2 from the Various Plant Scenarios using DISPMOD ($\mu g/m^3$)

Scenario	Maximum						9th Highest					
	(Area A) Industrial		(Area B) Buffer		(Area C) Residential		(Area A) Industrial		(Area B) Buffer		(Area C) Residential[2]	
	Conc.	% of Limit	Conc.	% of Limit	Conc.	% of Limit	Conc.	% of Limit	Conc.	% of Limit	Conc.	% of Limit
Existing Industry Allocation	1001	71.5	1001	61.0	540	77.1	537	76.7	380	76.0	310	88.6
HRDF Maximum Permissible Quantity (in isolation)	111	7.9	111	6.0	47	6.7	41	5.9	37	7.4	22	6.3
Stage 1 Plant	45	3.2	45	3.8	18	2.6	23	3.3	21	4.2	9	2.6
Existing Industry Allocation with Stage 1[2]	1001	71.5	1001	56.0	530	75.7	537	76.7	350	70.0	310	88.6
Stages 1 and 2	69	4.9	69	7.2	34	4.9	43	6.1	45	9.0	17	4.9
Existing Allocation with Stages 1 and 2[3]	1001	71.5	1001	56.0	530	75.7	537	76.7	350	70.0	310	88.6
	Kwinana EPP Limit						Kwinana EPP Standard					
	1400		1400		700		700		500		350	

Notes:
1 Based on modelling with a 500m grid.
2 Modelling with a 50m grid found the concentrations were just below the 350μg/m³ standard.
3 The scenario of existing industry and the Plant replaces the emissions from the existing HRDF with those from the Stage 1 and 2 Plants.

Data in Table 7.3 indicate that the concentrations resulting from industry emitting at their allocated SO_2 emission rates are at or just below the 1-hour limits and standards in all three areas. Of the various criteria, the predicted concentrations are closest to the residential standard of 350μg/m³ outside the buffer zone (Area B) to the north east of Cockburn Cement. Modelling with a grid resolution of 50m for the 1992 determination found that the concentrations at this point were predicted to be just below 350μg/m³. Emissions from the current industries in the area are generally well below their allocated permissible emissions. Ground level concentrations as detailed in Section 5.3.1 are well below the standards and limits with concentrations generally much less than a third of the standards and limits.

7.3.3.4 Predicted Concentrations from the HIsmelt Research and Development Facility

For the operations of the HRDF, HIsmelt was allocated a maximum permissible emission rate of 35 g/s of SO_2. This emission rate was set to allow for discharges under upset plant conditions. Figure 7.1 presents the 9^{th} highest 1-hour ground level concentrations of SO_2 predicted using DISPMOD and using the allocated maximum permissible quantity emission of 35g/s.

In the 1992 determination the emissions from the HRDF were modelled as being constant at 35 g/s, which was the maximum expected emission rate from the HRDF. At the time reliable estimates of the actual probability of the maximum emissions occurring due to plant upset conditions were not available. For this emission rate and the existing stack conditions, the predicted maximum 1-hour ground level concentrations resulting from the HRDF emissions in isolation are presented in Table 7.3 together with the percentage of the respective criteria. The maximum ground level concentrations for the HRDF are shown on Figure 7.2. The HRDF, as modelled for its allocated maximum permissible emissions, contributed between 5.9% to 7.9% of the respective EPP criteria.

7.3.3.5 Predicted Concentrations from the Stage 1 Plant in Isolation

For modelling purposes, the emission rate for the Stage 1 Plant was estimated by conservatively assuming that emissions were 11 g/s for 98.5% of the time and at 24 g/s for the remaining 1.5% of the time (see Section 4.20.2). This results in an annual average emission rate of 11.2 g/s, compared to anticipated actual emission rates of between 6.7 to 8.8 g/s from the main Plant (see Table 4.9).

Results from the modelling indicate that the ground level concentrations from the Stage 1 Plant shown in Table 7.3 range between 2.6% and 4.2% of the respective standards and limits in the EPP Areas. This is around half that predicted for the HRDF emitting at its emission limit as modelled in the 1992 determination (see Section 7.3.3.2).

7.3.3.6 Stage 1 Plant with Existing Industry

For modelling of the Stage 1 Plant with existing industry the existing HIsmelt allocation limit was replaced with the new Plant emissions. The results shown in Table 7.3 indicate that the maximum predicted concentrations in Areas B and C will be slightly less than those modelled for the HRDF emissions, although generally the changes in predicted concentrations will be negligible.

7.3.3.7 Stage 1 and Stage 2 Plants In Isolation

Table 7.3 and Figure 7.3 present the predicted 9th highest 1-hour ground level concentration of SO_2 for both the Stage 1 and Stage 2 Plants in operation in isolation using the probability of the maximum emissions occurring. For modelling purposes the emission rates of the Plants were approximated by conservatively assuming that the emissions from the two Plants were a total of 22 g/s for 98.4% of the time, and 35g/s (one Plant at 11g/s and the other at 24g/s) for 1.6% of the time. The results from the modelling indicate that ground level concentrations shown in Table 7.3 and on Figure 7.3 will be between 4.9% to 9% of the respective standards and limits in the EPP Areas. The predicted concentrations indicate that the emissions from Stages 1 and 2 Plants will be similar to those modelled for the HRDF in the 1992 determination.

7.3.3.8 Stages 1 and 2 Plants with Existing Industry

Table 7.3 and Figure 7.4 present the predicted 9th highest 1-hour average ground level concentration of SO_2 from the existing industry allocation together with both Stage 1 and Stage 2 Plants in operation. The results shown in Table 7.3 and Figure 7.4 indicate that the concentrations will be essentially the same as for the 1992 determination (EPA, 1992a). Therefore, the replacement of the HRDF with Stages 1 and 2 will result in similar concentrations to those modelled for the HRDF in the 1992 determination.

7.3.3.9 Maximum 24-hour Concentrations

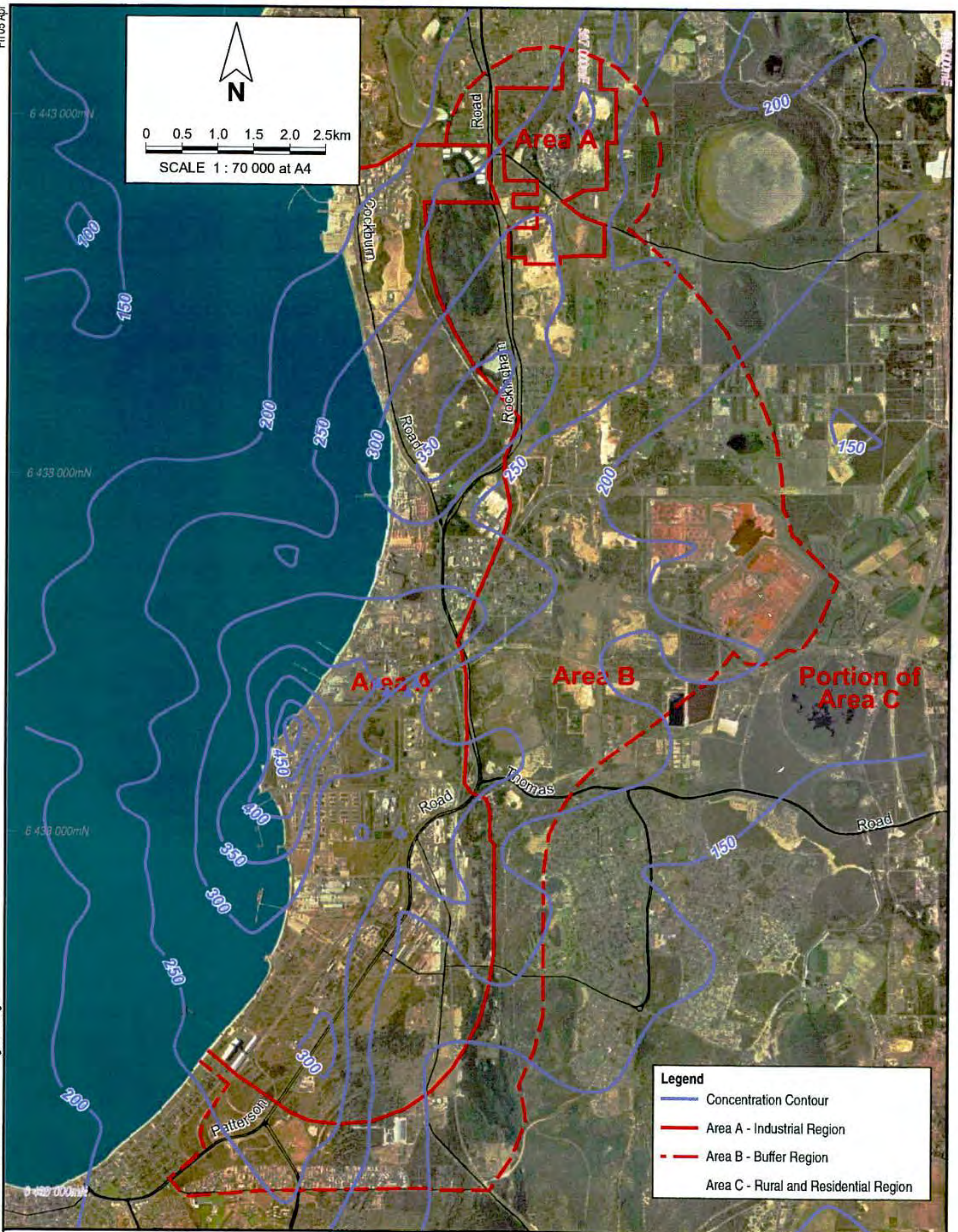
The predicted maximum 24-hour average ground level concentrations of SO_2 from the HRDF, using the maximum permissible emission rate of 35g/s, and from Stage 1 and for both the Stages operating are summarised in Table 7.4. These data have been obtained by assuming an emission rate of 12.6g/s for Stage 1, and 23.6g/s for Stages 1 and 2. These emission rates are equivalent to assuming six maintenance shutdowns during a single day, which is unlikely to happen, with the higher emissions of 24g/s lasting for 30 minutes each time.

Table 7.4

Predicted Maximum 24-Hour and Annual Sulphur Dioxide Concentrations ($\mu g/m^3$)

Averaging Period	Scenario	Maximum Predicted Concentration ($\mu g/m^3$)			Percentage of EPP Standard[1]		
		Area A	Area B	Area C	Area A	Area B	Area C
24 hour	Existing HRDF Maximum Permissible Emission	12.3	12.3	5.0	6.2	8.2	4.0
	Stage 1	7.0	5.5	2.8	3.5	4.7	2.2
	Stages 1 and 2	12.6	12.6	5.6	6.3	8.4	4.5
Annual	Existing HRDF Maximum Permissible Emission	1.44	1.15	0.43	2.4	2.3	0.9
	Stage 1	0.76	0.64	0.19	1.3	1.3	0.4
	Stages 1 and 2	1.42	1.35	0.37	2.4	2.7	0.7

Notes: 1 24 hour Standard 200$\mu g/m^3$ (Area A), 150 $\mu g/m^3$ (Area B) and 125 $\mu g/m^3$ (Area C)
Annual Standard 60 $\mu g/m^3$ (Area A), 50 $\mu g/m^3$ (Areas B and C)



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PREDICTED 9th HIGHEST 1 HOUR GROUND LEVEL CONCENTRATIONS OF SULPHUR DIOXIDE (µg/m³) FROM EXISTING INDUSTRY

Figure 7.1

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PREDICTED 9th HIGHEST 1 HOUR GROUND LEVEL CONCENTRATIONS OF SULPHUR DIOXIDE (µg/m³) FROM THE HRDF

Figure 7.2

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PREDICTED 9th HIGHEST 1 HOUR GROUND LEVEL CONCENTRATIONS OF SULPHUR DIOXIDE (μg/m³) FROM STAGE 1 AND STAGE 2 PLANTS OPERATING IN ISOLATION

Figure 7.3

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The results in Table 7.4 show that maximum concentrations from the Stage 1 Plant will be less than those modelled for the HRDF in the 1992 determination, whilst the concentrations from the Stages 1 and 2 Plants will be slightly higher than those predicted for the HRDF. The greater concentrations predicted are a result of lower plume rise due to the cooler plumes from the new Plants. Comparison to the standard presented in Table 7.4 operating together indicates that the Stage 1 and Stage 2 Plants will contribute up to 8.4% of the standard.

7.3.3.10 Annual Average

The predicted annual average concentrations for the Stage 1 and Stage 2 Plants are presented in Table 7.4. The data indicate that predicted concentrations from the Stage 1 and Stage 2 Plants operating together are up to 2.7% of the standard. These concentrations are approximately equivalent to those modelled for the HRDF in the 1992 determination.

7.3.3.11 Discussion on Modelling Results

The predicted concentrations of SO_2 from the Stage 1 Plant in isolation, and from both the Stage 1 and 2 Plants operating will be relatively (See Tables 7.3 and 7.4). Predicted maximum 1-hour concentrations will be between 2.6% to 4.2% of the Kwinana EPP standards and limits for Stage 1, and 4.9% to 9.0% for Stages 1 and 2 operating. Predicted 24-hour concentrations will be between 2.2% to 3.5% for Stage 1, and 4.5% to 8.4% for Stages 1 and 2 of the applicable standards. Annual average concentrations will be around 1.3% and 2.7% of the annual standard for Stage 1 and Stages 1 and 2, respectively.

Comparison with the modelled concentrations for the HRDF's maximum permissible emission rate of 35g/sec indicates that concentrations from the Stage 1 Plant will be around half of those predicted for the HRDF. Concentrations from both the Stage 1 and 2 Plants operating would be approximately the same as for the 1992 determination, therefore, no increase in the maximum permissible emission rate allocated in 1992 would be required for the operation of the Commercial HIsmelt Plants.

7.3.3.12 Management

Emissions of SO_2 from the Plants will be managed by the:

- use of low sulphur coals; and
- Flue Gas Desulphurisation.

Coal Selection

The amount of sulphur input into the process will be minimised by using low sulphur coals. The coal specifications provided to potential suppliers include an upper limit sulphur content of 1.0% on a dry basis, with a preference for the sulphur content to be less than 0.8%.

Flue Gas Desulphurisation

Experience at the HRDF showed that the sulphur reporting to the offgas stream is predominantly present in the form of H_2S with minor quantities of other species such as SO_2 also present at times.

The Proponent decided it would be beneficial to combust the cleaned process gas as a fuel in the stoves and Waste Heat Recovery system, which will result in the conversion of all sulphur species to SO_2. The waste gases will be captured and passed through a Flue Gas Desulphurisation system that will remove at least 95% of the SO_2 (see Section 4.15 and Appendix B).

The FGD system will be sized to handle a SO_2 load significantly greater than that expected for normal operation of the Plant so that the removal efficiency is not compromised if greater SO_2 levels are present in the process gas during certain operating conditions. Redundancy will be built in to the FGD in the form of a sufficient number of pumps to allow for a pump to be taken out of service for maintenance if required.

In the unlikely event of a complete failure of the FGD system, the Process will be shutdown until the fault in the FGD system has been rectified.

7.3.3.13 Monitoring

A continuous emission-monitoring instrument will be installed on the FGD stack to provide process control input on the operation of the FGD, and to also collect SO_2 emission data for performance reporting. The instrument will be designed to measure SO_2 in a gas stream with a high water vapour content, as the gas scrubbing will be a wet process. An independent stack-testing contractor will check the calibration and accuracy of the instrument periodically by sampling the stack using appropriate standard techniques.

Monitoring data will be stored in the Plant Control System and will be reported to the DEWCP and Rio Tinto on a six monthly basis and annually as part of the National Pollutant Inventory (NPI).

Commitments

The Proponent will incorporate a Flue Gas Desulphurisation System in the Plant design that is considered Best Available Technology at the time of Plant design.

The Proponent will install a continuous monitoring instrument to measure SO_2 emissions in the gas stream exiting the main stack of the Plant.

Monitoring data for SO_2 will be reported by the Proponent to the DEWCP and Rio Tinto on a six monthly basis and annually as part of the NPI.

7.3.4 Particulates

7.3.4.1 Issues

Airborne particles are produced by a wide range of natural and human activities including combustion processes in motor vehicles, power generating plants and solid fuel domestic heating. Natural sources include fine soil particles and smoke from bush fires. Inhalable particles are grouped into the following two size categories:

- PM_{10} particles with an effective aerodynamic diameter of up to 10μm; and
- $PM_{2.5}$ particles with an effective aerodynamic diameter of up to 2.5μm.

Inhalable particles are associated with increases in respiratory illnesses such as asthma, bronchitis and emphysema. PM_{10} particles have been associated with increases in the prevalence of respiratory symptoms. Recent evidence suggests that $PM_{2.5}$ may be more directly related to the cause of the health impacts associated with PM_{10} (DEP, website 2000).

TSP are considered to be particles of an equivalent aerodynamic diameter of less than 50μm. TSP are generally associated with aesthetic effects rather than health effects as they tend to settle on surfaces and cause soiling and discolouration.

The process offgas exiting the SRV will contain particulate material in the form of unreacted char and slag droplets together with iron oxide fume. It is estimated that this gas will contain particulate material in the range of 10 to 20g/Nm^3 (based on data from the HRDF) and therefore must be cleaned prior to combustion and its subsequent release.

Emissions from the other stacks will comprise:

- coal dust from the coal drier stack;
- iron ore dust from the Preheater stack; and
- iron oxide fume from the cast house and pig caster fume extraction stack.

Fugitive emissions may also arise from the Project activities on-site. These are addressed in Section 7.5.

7.3.4.2 Modelling Results

Predicted maximum concentrations of particulate emissions as TSP and PM_{10} from the stacks of the Stage 1 and Stage 2 Plants in isolation are presented in Table 7.5 and the predicted 24 hour PM_{10} concentrations are shown on Figure 7.5.

Table 7.5

Predicted Maximum Particulate Concentrations from the Stage 1 and 2 Plants Operating

Parameter	Averaging Period	Maximum Modelled Concentration ($\mu g/m^3$)			Percentage of Criteria[1] (%)		
		Area A	Area B	Area C	Area A	Area B	Area C
TSP	15-minute	87	43	25	8.7	4.3	2.5
	24-hour	25.1	11	2.1	16.7	12	2.3
		Area A	Residences in Area B	Area C	Area A	Residences in Area B	Area C
PM_{10}	24-hour	25.1	3.0	2.1	na	6.0	4.2

Notes: Criteria are:
15 minute TSP limit for all three EPP Areas is $1000\mu g/m^3$. 24 hour standard for Area A is $150\mu g/m^3$, and $90\mu g/m^3$ for Areas B and C.
24-hour PM_{10} standard of $50\mu g/m^3$ applies to residential areas only.

Maximum concentrations of particulates are predicted to occur on-site and will then rapidly decrease with distance. The high concentrations will arise from the induced turbulence from the nearby coal feed bins which rapidly mix the plumes from the short fume extraction stack. For TSP the maximum concentrations predicted shown in Table 7.5 will be up to 16.7% of the criteria in Area A decreasing to 2.5% of the criteria in Area C. The PM_{10} concentrations are predicted to be less than 6% of the NEPM standard at the nearest residence.

7.3.4.3 Management

The emission of airborne particulates from the Plant will be managed by the following:

- Wet scrubbers on both the Preheater and main offgas lines (see Section 4.10) will clean the process offgas to ensure that the particulate level is less than $5mg/Nm^3$. This type of scrubber is considered Best Available Technology by the European Commission (European Commission, 2000) and has demonstrated to be very reliable and to consistently be below the $5mg/Nm^3$ output level.
- The performance of the wet scrubbers is a function of the pressure differential between inlet and outlet gas streams. The HIsmelt® Process will be operating at 80kPa above ambient pressure with the scrubbers controlling the pressure. The pressure differential is a key process parameter, which will be monitored and controlled from the Plant control room.
- Particulate emissions from the main stack will average 0.17g/s.
- Particulate emissions from the other stacks will be designed to be less than $50mg/Nm^3$. Greater than 95% of the particulates will be less than $1\mu m$.
- Fume resulting from the operations with molten materials will be minimised by covering launders through which the material are tapped and captured using forced draught fume extraction hoods above susceptible areas. The fume will be captured in two bag filter modules, both of which will be designed to clean the gas to particulate concentrations of less than $50mg/Nm^3$ prior to release to atmosphere, which is considered Best Available Technology in Europe (European Commission, 2000).

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PREDICTED MAXIMUM 24 HOUR PM_{10} CONCENTRATIONS (µg/m³) FROM BOTH THE STAGE 1 AND STAGE 2 PLANTS OPERATING IN ISOLATION

Figure 7.5

- Any storage bins that are filled by the pneumatic conveying of solid materials, such as the ground coal storage bin and the three lime bins, will be vented through bag filter cleaning systems designed to clean the exhaust gas stream to particulate concentrations of less than $50mg/Nm^3$ prior to release to the atmosphere.

As any particulates emitted will have passed through wet scrubbers and bag filters it is expected that the particulates will be all considered PM_{10}.

7.3.4.4 Monitoring

Particulate emissions will be monitored six monthly to ensure that the levels from the main stack are less than $5mg/Nm^3$, and less than $50mg/Nm^3$ from the other stacks. A size distribution of particulates in the emissions will be undertaken in the initial sampling programme to determine the percentage to TSP, PM_{10} and $PM_{2.5}$. Monitoring data will be reported to the DEWCP and Rio Tinto on a six monthly basis.

Commitments

To minimise particulate emissions from the Plant, the Proponent will incorporate scrubbers and bag filters that are considered Best Available Technology at the time of Plant design.

The Proponent will measure particulate emissions from the Plant stacks on a six monthly basis.

Particulate monitoring data will be reported by the Proponent to the DEWCP and Rio Tinto on a six monthly basis.

7.3.5 Oxides of Nitrogen

7.3.5.1 Issue

Combustion processes result in the generation of nitrogen oxides (NO_x). The levels produced are related to the quantity of nitrogen species in the fuel (fuel NO_x), the reaction of hydrogen cyanide (produced from hydrocarbon radicals from fuel fragmentation) with nitrogen and oxygen in the combustion air (Prompt NO_X), and the temperature at which the fuel is combusted (thermal NO_x). Emissions of NO_x can contribute to the formation of photochemical smog.

Emissions of NO_X from the main stack can arise from the smelting process and be present in the offgas. NO_x can also be generated in the subsequent burning of the gas in the hot blast stoves and Waste Heat Recovery system prior to release to the atmosphere. Typically around 90% of the NO_x emitted from gas-fired burners is in the form of NO with the remainder as NO_2. Following release, the NO is slowly oxidised to the more reactive NO_2, which has a greater environmental impact than NO.

NO_2 is a respiratory irritant that may lower immunity to respiratory infection and may contribute to bronchitis in infants, children and susceptible adults. Exposure to high levels of NO_2 can cause lung injury. The National Environment Protection Council (NEPC, 1998) has set a 1-hour standard of 0.12 ppm for NO_2.

7.3.5.2 Hourly Average Concentrations

Oxides of Nitrogen

Predicted maximum 1-hour concentrations of NO_X from the Stage 1 and Stage 2 Plants are summarised in Table 7.6 and the contours for both the Stage 1 and Stage 2 Plants operating are shown on Figure 7.6.

Table 7.6

Predicted Maximum NO_X and NO_2 Concentrations from the Stage 1 and Stage 2 Plants in Operation Together with Existing Industry

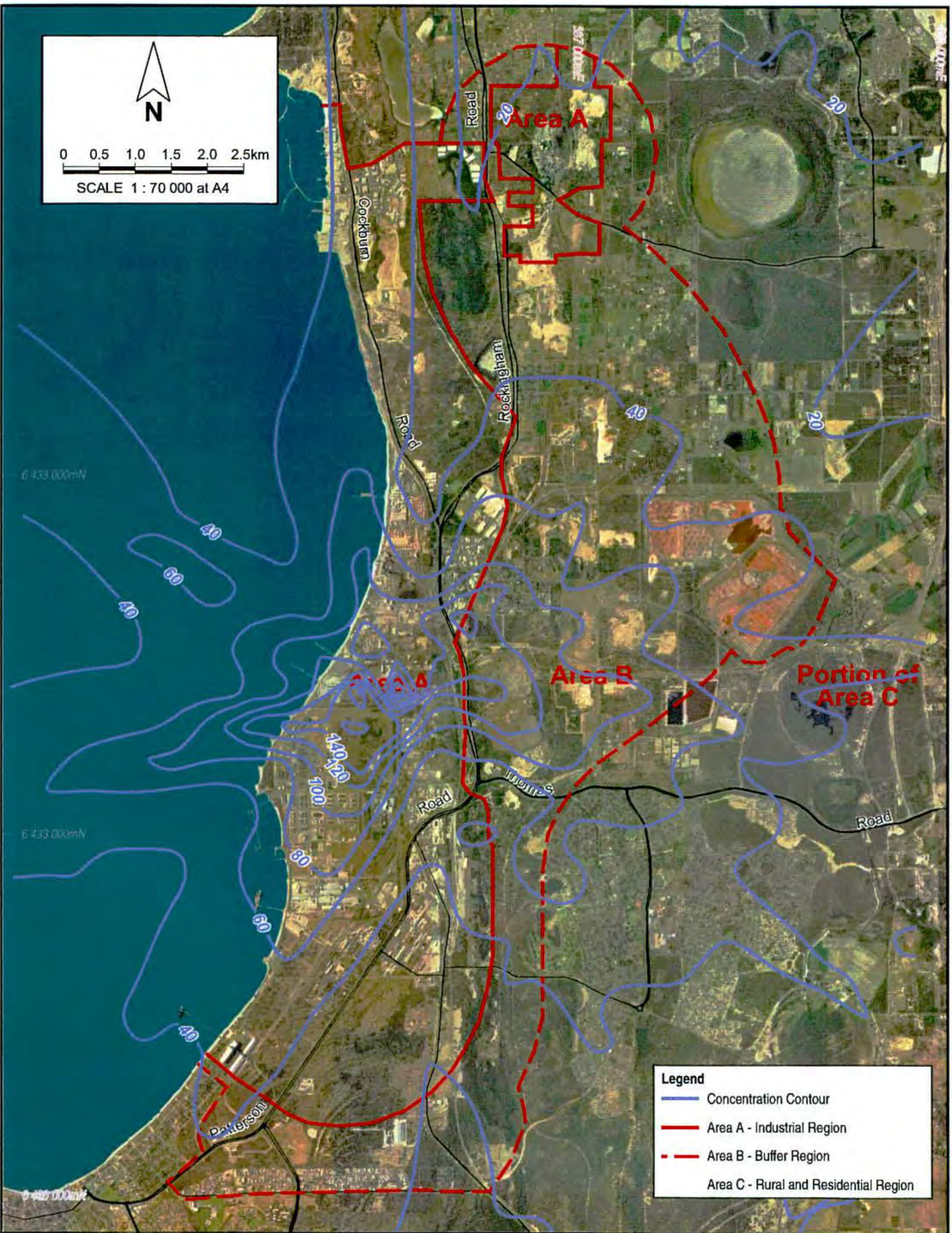
Plants	Maximum Predicted 1-hour NO_X[1] Concentration from the Plants ($\mu g/m^3$)				Maximum Observed (1996) 1-hour NO_2 Conc. ($\mu g/m^3$)		Maximum Observed 1-hour NO_2 Conc. With HIsmelt Plants[3] ($\mu g/m^3$)			
	Area A	Area C[2]	Monitoring Site[2] (Area B)				Concentrations ($\mu g/m^3$)		Percentage of NEPM standard	
			HV	RK	HV	RK	HV	RK	HV	RK
Stage 1	121	38	43	24	93	84	103	86	42	35
Stage 1 and 2	186	75	69	44	93	84	113	105	46	43

Notes: HV – Hope Valley, RK – Rockingham
1 NO_x concentrations are reported as NO_2.
2 NEPM standard of 0.12 ppm (not to be exceeded more than once per year) converted to 246 ug/m^3 at 0 deg C and 1 atmosphere applies at these locations.
3 Maximum cumulative concentrations estimated by adding NO_X concentrations to monitored NO_2 levels from the preceding and following hours to that observed hour.

The results indicate that the maximum 1-hour concentrations of NO_X are predicted to occur within 1 km from the Plant within the Industrial EPP Area A. The maximum concentrations are estimated to be 121$\mu g/m^3$ for the Stage 1 Plant, and 186 $\mu g/m^3$ for both Stage 1and Stage 2 Plants operating. At the nearest residential area within Buffer Area B (near the Hope Valley monitoring site) the highest concentrations of NO_X predicted are 43$\mu g/m^3$ and 69$\mu g/m^3$, for Stage 1 and for Stage 1 and 2 operating, respectively. Within Area C the maximum 1-hour concentrations of NO_x predicted are 38 $\mu g/m^3$ and 75 $\mu g/m^3$ for Stage 1 and both Stages operating, respectively.

Nitrogen Dioxide

As a conservative assumption predicted NO_2 concentrations have been derived assuming that 100% of the NO_X is NO_2. In practice, the NO_2 will only be a fraction of the NO_X with the remainder being NO. Using the assumption of a 100% conversion, the predicted maximum concentrations of NO_2 at residential areas is 75$\mu g/m^3$, which is equivalent to 30% of the NEPM standard (246$\mu g/m^3$) (NEPC, 1998).



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PREDICTED MAXIMUM 1 HOUR NITROGEN OXIDES CONCENTRATIONS (µg/m³) FROM BOTH THE STAGE 1 AND STAGE 2 PLANTS OPERATING IN ISOLATION

Figure 7.6

To determine cumulative impacts of existing industry and the HIsmelt Plants, hourly predicted NO_X concentrations from the Plants (assumed to be 100% NO_2) were added to the hourly measured NO_2 concentrations reported in the DEP 1996 database from the NO_2 monitoring stations at Hope Valley and North Rockingham for each hour. This allowed the modelled concentrations from the Plant to be added to the observed concentrations. To ensure that the measured and predicted peaks are not offset by an hour, the modelled concentrations for the preceding and following hours were added.

The results show that the increase in the existing NO_2 concentrations is predicted to be small with maximum concentrations increasing from 93 to 113μg/m^3 (equivalent to 38% to 46% of the NEPM standards) at Hope Valley, and 84 to 105μg/m^3 (equivalent to 34% to 43% of the NEPM standard) at North Rockingham. This small increase in the maximum 1-hour concentration occurs as the hours with predicted high concentrations from the Plants do not coincide with those hours with highest monitored concentrations at these locations.

7.3.5.3 Annual Average

Annual average concentrations from the Stage 1 Plant and for both the Stage 1 and 2 Plants are summarised in Table 7.7.

Table 7.7

Predicted Annual Average NO_X and NO_2 Concentrations from the Plant

Together with Existing Industry

Plants	Maximum Predicted annual NO_X Concentration from the Plant (μg/m^3)				Annual (1996) Average NO_2 Conc. (μg/m^3)		Maximum Annual NO_2 Concentration with Hismelt (μg/m^3)			
	Area A	Area C	Mon. Site		Mon. Site		Concentrations (μg/m^3)		Percentage of NEPM	
			HV	RK	HV	RK	HV	RK	HV	RK
Stage 1	1.6	0.77	0.62	0.13	8.4	9.7	9.03	9.83	14.5	15.9
Stage 1 and 2	2.9	0.37	1.35	0.26	8.4	9.7	9.75	9.97	15.7	16.0

Notes: NEPM standard of 0.03 ppm converted to 62 ug/m^3 at 0 deg C and 1 atmosphere.
Maximum cumulative impacts assumed by adding NO_X concentrations to monitored NO_2 levels.

The results indicate that the contribution from the Plants to existing annual NO_x concentrations will be small. Annual concentrations at the monitoring stations at Hope Valley and North Rockingham based on the 1996 DEP database are 8.4 and 9.7μg/m^3 (13.5% and 15.6% of the NEPM), respectively. With the addition of the Stage 1 Plant these concetrations will increase to 9.03 (14.5% of the NEPM standard at Hope Valley and 9.83μg/m^3 (15.9% of the NEPM standard) at North Rockingham. With the addition of both the Stage 1 and 2 Plants the concentrations will increase to 9.75 and 9.97μg/m^3 (15.7 and 16.0% of the NEPM standard), at Hope Valley and Rockingham, respectively.

7.3.5.4 Management

Sampling and measurement of gas streams at the HRDF indicate that the HIsmelt Process offgas will have a very low potential for the generation of fuel NO_x and that the emissions of NO_x from the Plant will be predominantly due to thermally generated NO_x. The production of Prompt NO_x is also considered highly unlikely as the high temperatures present in the top space of the SRV destroy the hydrocarbon radicals.

NO_x emissions will be managed by the following:

- Specifying that the burners, to be used in equipment modules where process offgas will be combusted as a fuel, be designed to keep NO_x emissions as low as reasonably practicable while maximising the energy recovery from the gas. The process gas has a low calorific value and will tend to burn with a low flame temperature, which is typically around 950°C. (It should be noted that other techniques used for NO_x reduction such as Low Excess Air, Flue Gas Recirculation and water injection simply reduce the flame temperature, which is already a consequence of burning the low calorific value gas).
- Specifying low NOx burners for applications where natural gas will be used as the fuel, such as in the coal mill.

7.3.5.5 Monitoring

The gas stream exiting the main stack will be sampled and analysed for NO_x on a six monthly basis to measure the actual NO_x emissions. An independent stack-testing contractor will undertake the sampling and analysis using appropriate standard techniques.

Monitoring data will be reported to the DEWCP and Rio Tinto on a six monthly basis and annually as part of the NPI.

Commitments

The Proponent will incorporate burners that are designed to keep NO_x emissions as low as reasonably practicable where process gas will be combusted, and low NO_x burners where natural gas will be combusted in the Plants.

The Proponent will sample and analyse the gas stream exiting the main stack of the Plant for NO_x emissions on a six monthly basis.

Monitoring data for NO_x emissions will be reported by the Proponent to the DEWCP and Rio Tinto on a six monthly basis and annually as part of the National Pollutant Inventory.

7.3.6 Photochemical Smog

7.3.6.1 Issue

Photochemical smog forms when pollutants such as NOx and reactive organic compounds react together under the influence of sunlight and high temperature. The principal component of smog formation is ozone and consequently it is used to define smog levels.

Ozone is a colourless, highly reactive gas with a distinctive odour. It is a strong oxidant which reduces pulmonary function and can damage vegetation and susceptible materials at higher concentrations. Symptoms of exposure to ozone include irritation of the air ways and minor lung function changes. To protect human health and welfare the NEPC has set a 1-hour standard of 0.10 ppm with at most one exceedance per year.

To address the potential for the Plant to increase photochemical smog in the Perth region, an assessment was conducted using the relative increase of the emissions of concern (nitrogen oxides) and the implications that this has on smog levels as determined by modelling undertaken in the Perth Photochemical Smog Study (PPSS) (Western Power/ DEP, 1996).

7.3.6.2 Emissions of Smog Forming Pollutants

The primary contributors to photochemical smog are emissions of oxides of nitrogen and non-methane volatile organic compounds (NMVOC). The emissions of these substances have been estimated in a number of studies including the PPSS (Western Power/DEP, 1996) and more recently as part of the NPI (DEP, 2002b).

Table 7.8 lists the emissions of NO_X within the Perth region and in the KIA for the financial years 1992/1993 and 1998/1999.

Table 7.8

Sources of NO_X (tpa) within the Perth Airshed

Source	1992/1993	1998/1999
Motor Vehicles	23,100	28,100
Industry Kwinana	Not known	13,418
Total Industry Perth	20,300	15,000
Other Area Sources	2,300	18,900
Total Perth Region	**45,700**	**62,000**

Note: Sources Western Power/DEP,1996 and DEP, 2002b

Data in Table 7.8 indicate that:

- emissions from motor vehicles are the major source of NO_X with this source increasing substantially through the 1990s;
- NO_X emissions from industry have reduced and as at 1998/1999 were estimated to be around 24% of the total NO_X emissions. This is primarily due to a reduction in emissions from the Kwinana Power Station for this period; and
- emissions from other area sources have increased, which is primarily due to the inclusion of other area sources such as forest fires that were not assessed in the 1992/1993 assessment.

Emissions of NO_x by industry for the Kwinana region for 1998/1999 are presented in Table 7.9 together with estimates for proposed industry for the year 2003.

Table 7.9

Emissions of NO_X from the Kwinana Industrial Area (tpa)

Source	1998/1999[1]	Estimate 2003[3]
Existing Sources		
Western Power Kwinana	6900	4900
Cockburn Cement	4000	4000
Alcoa	1100	1100
BP Refinery	900	900
Western Power Cogeneration	190	190
Wesfarmers CSBP	150	150
WMC Resources	110	110
Tiwest	43	43
Cockburn Cement Kwinana Operations (formerly Swan Cement)	11	11
Coogee Chemicals	9.7	9.7
Nufarm	3.9	3.9
Existing - SubTotal	13418	11418
Proposed Sources		
Proposed Western Power Stage B Replacement	NA	580
Global Olivine Waste to Energy Plant[2]	NA	803
HIsmelt[4]	NA	640 (Stage 1) 1280 (Stages 1 and 2)
Proposed - Sub Total	0	2023 (Stage 1) 2663 (Stages 1 and 2)
Total	13418	13440 (Stage 1) 14080 (Stages 1 and 2)

Notes:
1 1998/1999 emissions are from DEP 2002b.
2 Global Olivine emissions are from Table 9-9 of Global Olivine (Barker & Associates, 2000) at average emissions. Daily emissions may be up to twice this.
3 Emissions from existing sources for 2003 are assumed constant from 1998/1999 except for Western Power. This is due to the removal of the existing Western Power Stage B. The emissions from Western Power's replacement plant are indicated under proposed sources.
4 Emissions for the HIsmelt Plant based on a Plant availability of 96% and emissions predicted for 2005.

Data in Table 7.9 indicate that at present the major industrial sources of NO_x are from Western Power's Kwinana Power Station, and Cockburn Cement. In the future, although new industry is being developed, the emissions from industries in Kwinana are estimated to only increase a small amount. This is due to Western Power replacing their existing Stage B plant with a gas-fired combined cycle power station that will include dry low NO_X burners, which will emit much lower quantities of NO_X per unit of energy generated.

Emissions of NO_X from the Plant are estimated to be 640tpa of NO_X from the Stage 1 Plant, and 1280tpa from the Stage 1 and 2 Plants operating. This is equivalent to 4.8% and 9.6% of the 1998/1999 industry NO_X emissions from Kwinana, and 1% and 2% of the 1998/1999 total Perth emissions.

Industrial emissions of NMVOCs are not publicly available for 1998/1999. However, emissions from Kwinana are known to have reduced from the 1992/1993 emissions of 11,696 tpa (Western Power/ DEP, 1996) with the major emitter (BP Refinery) undertaking a significant fugitive NMVOC emission reduction program. The BP Refinery expects to have reduced emissions from over 10,000 tpa in the mid-1990s to around 2,200 tpa by 2001 (Luketelich, 2001). Only negligible, if any, amounts of NMVOCs will be emitted by the HIsmelt Plants.

7.3.6.3 Impact of Kwinana Emissions

In the assessment of Perth's smog, the PPSS found that the impact of the plume of atmospheric emissions from Kwinana industry was to lower ozone levels in the region downwind of Kwinana. This initially counter intuitive finding is presumably due to the NO emissions reacting with the ozone in the Perth region to form NO_2.

Recent modelling, using modelled events for a wider range of days and new emission estimates for the year 1998/ 1999, have now shown that the effect of Kwinana industry is to increase ozone levels by 4% to 6% over that without industry (DEP, *pers.comm.*, 2002). The reasons for the difference between the PPSS study and the current assessment has not yet been determined but it may be due to the better statistical sample events, and/or the changed emissions mix for the new inventory.

Photochemical modelling, using the current modelling mix, indicates that the:

- current impact from the Kwinana industrial emissions on Perth ozone levels is small (4% to 6% contribution);
- emissions from the Stages 1 and 2 Plants will be a small component (up to 9.6%) of the 1998/ 1999 Kwinana industry emissions; and
- overall emissions from the Kwinana industries are estimated to only increase a small amount from the 1998/1999 inventory due to the replacement of the Kwinana Power Station Stage B with a gas-fired plant.

It is considered that the addition of the Stage 1 and 2 Plants will have only a minor negligible impact on Perth's ozone levels, with only a small change in NO_x emissions from Kwinana industry.

7.3.7 Carbon Monoxide

Issue

Carbon monoxide (CO) is absorbed via the lungs, enters the bloodstream and reduces the blood's ability to deliver oxygen to organs and tissues and is therefore poisonous to humans at high exposure levels. Exposure to CO may result in increased attacks of angina, visual impairment, reduced motor skills, poor learning ability and low birth weight.

Modelling Results

Predicted 8-hour maximum concentrations of CO are presented in Table 7.10.

Table 7.10

Predicted Maximum 8-hour Concentrations of CO from Stage 1 and Stage 2 Plants Operating

Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$)			Percentage of Criteria		
	Area A	Residences in Area B	Area C	Area A	Residences in Area B	Area C
8-hour	34	18	13.5	na	0.16	0.12

Notes: Carbon monoxide 9 ppm criteria converted to 11,240 $\mu g/m^3$ at 0 deg Celsius and 1 atmospheric pressure. This applies at residential areas only.

Data in Table 7.10 show that CO concentrations at the nearest residential area are predicted to be less than 0.16% of the NEPM standard and are not considered to be an issue.

Management

The gas combustion systems in the Plant will be designed to maximise the energy efficiency and to maximise the conversion of CO to CO_2, thereby minimising CO emissions.

Monitoring

The gas stream exiting the main stack will be sampled and analysed for CO on a six monthly basis to measure the actual CO emissions. An independent stack-testing contractor will undertake the sampling and analysis using appropriate standard techniques.

Monitoring data will be reported to the DEWCP and Rio Tinto on a six monthly basis, and annually as part of the NPI.

Commitment

The Proponent will sample and analyse the gas stream exiting the main stack of the Plant for CO emissions on a six monthly basis.

Monitoring data for CO emissions will be reported by the Proponent to the DEWCP and Rio Tinto on a six monthly basis, and annually as part of the National Pollutant Inventory.

7.3.8 Dioxins and Furans

Issue

Integrated iron and steel plants have been identified as major sources of Dioxin and Furan emissions. Figures from the European Union estimate that in 1995 the Iron and Steel Industry was responsible for 19% of total European emissions of Dioxins and Furans (European Commission, 2000). This has largely been due to emissions from sinter plants, which are used to recycle waste oxide materials arising from operations at the integrated works. Oily mill scale from the casting and rolling of steel is a source of chlorine that reacts with carbonaceous particles and oxygen in the exhaust gas stream to produce the Dioxins and Furans. Dioxins and Furans have the potential to cause health impacts.

Management

The offgas handling system for the Plant was selected to ensure that no Dioxins and Furans would be emitted to the atmosphere. A discussion on the rationale to the selection of the offgas handling systems in relation to Dioxins and Furans is provided in Appendix G.

Monitoring

Sampling of the offgas will be undertaken during the first year of the Stage 1 Plant operation to establish if there are any Dioxins or Furans present. Monitoring results will be provided to the DEWCP. Future monitoring will depend upon the results of the initial monitoring. In the unlikely event that Dioxins and Furans are being generated by the Process and emitted to the atmosphere the Proponent will investigate the source of the emissions and will continue regular monitoring.

If monitoring confirms that no Dioxins and Furans are being generated by the Process and emitted then sampling and analysis of the offgas for Dioxins and Furans would be undertaken less frequently, upon review of the results with the DEWCP.

Commitment

During the first year of operation, the Proponent will sample and analyse the offgas emissions to establish if there are any Dioxins or Furans present.

Monitoring results for Dioxins and Furans will be provided by the Proponent to the DEWCP following the first year of monitoring.

Future monitoring of the offgas emissions for Dioxins and Furans will be reviewed by the Proponent in conjunction with the DEWCP once the results of the first year's monitoring have been assessed.

7.3.9 Heavy Metals

Issue

Iron ore, coal and fluxes contain trace quantities of metallic elements such as zinc, lead and cadmium. These elements may be released during processing and have the potential to impact on the environment.

Management

Experience from the HRDF, and information from other iron and steel making processes, indicates that metallic elements such as zinc, lead and cadmium will report predominantly to the SRV offgas stream as metallic vapour. The flowsheet for the Process estimates that 19kg/h of Zn, 1kg/h of Pb and a few g/h of Cd may be present in the gas leaving the SRV. An investigation of the thermodynamics of these species indicates that they will remain in the gas as vapours at temperatures above 800°C. Half of the total present will pass into the Pre-heater, where they will condense on the hot ore particles and be recycled to the SRV, with the remainder being passed into the wet scrubber. Wet scrubbing, at a temperature between 900°C and 1000°C, prevents these species from condensing on the surface of dust particles. The low pH liquid phase in the quench zone of the wet scrubber will result in the dissolution of these elements. Should any metals pass through the wet scrubber they will be subjected to further scrubbing with water in the offgas cooler. Combustion of the gas in the WHR will be followed by another scrubbing stage in the FGD. It is therefore considered unlikely that there will be any emissions of heavy metals to the atmosphere.

The metallic elements will remain in solution through the scrubber circuit and report in the slurry to the clarifier as discussed in Section 4.10.2. In the clarifier the addition of caustic for pH control and the reaction of metallic elements with dissolved hydrogen sulphide will result in a high proportion of the metallic elements being precipitated. These will be recycled to the SRV with the clarifier sludge. Any of these metals remaining in solution will be directed to the process water tank in the scrubber circuit blowdown. The addition of lime to raise the pH to 8 will precipitate the remaining metals as hydroxides.

Monitoring

Sampling of the offgas will be undertaken during the first year of the Stage 1 Plant operation to establish if there are any significant concentration of heavy metals being emitted to the atmosphere. The results will be provided to the DEWCP. Future monitoring will depend upon the results of the initial monitoring. In the unlikely event that significant concentrations of heavy metals are being emitted then the Proponent will investigate the source of the emissions and will continue regular monitoring.

If monitoring confirms that there are no significant concentrations of heavy metals being emitted then sampling and analyses of the offgas for heavy metals would be undertaken less frequently, upon review of the results with the DEWCP.

Commitments

During the first year of operation, the Proponent will sample and analyse the offgas to establish if there are any significant concentrations of heavy metals present.

Monitoring results for the heavy metals will be provided to the DEWCP following the first year of monitoring.

Future monitoring of the offgas emissions for heavy metals will be reviewed by the Proponent in conjunction with the DEWCP once the results of the first year's monitoring have been assessed.

7.3.10 Odour

Issue

Odours may be generated on site due to the release of hydrogen sulphide (which has a rotten egg odour) as sulphur is contained in the metal, slag and offgas. The most likely cause of any odour will be when the slag is cooled with water. Leakage of cooled offgas may also result in a release of hydrogen sulphide.

Management

Odour from slag quenching, due to the release of hydrogen sulphide, is recognised as an issue in iron making plants. This occurs in blast furnace operations where the sulphur content is a factor of 10 times higher than will be in the HIsmelt slag. Measures to control the odour include the addition of potassium permanganate or lime to the cooling water (UNEP, 1997).

The water that will be used for cooling the slag will have been treated with lime, which will reduce the potential for hydrogen sulphide to form. Experience at the HRDF showed that the odour was localised in the vicinity of the slag pits. Lime or permanganate was not added to the cooling water for the HRDF operations.

The Core Plant building will be adjacent to the slag pits, therefore, any hydrogen sulphide emissions will be of a health and safety issue for site personnel and will be managed on-site. It is unlikely that any off-site odour issues will result from the cooling of the slag.

The leakage of cooled fuel gas is considered a risk issue and is addressed in Section 9.4.

Commitment

The Proponent will implement measures to minimise the potential for odours to be produced or released to the environment.

7.3.11 Air Separation Unit

The ASU will not produce atmospheric wastes as only the oxygen and some nitrogen will be removed in the process whilst the remaining constituents of air are returned to the atmosphere. Waste nitrogen gas and small quantities of CO_2 and water will be released from the air purification system. Oxygen will occasionally be released when oxygen demand for the HIsmelt Plant is reduced. The ASU will have no impact on the level of greenhouse gases.

7.4 GREENHOUSE

7.4.1 General

The combustion of fossil fuels, particularly coal, is a significant contributor to anthropogenic CO_2 emissions. As outlined in the Process Description (Section 4.8), the Process involves the use of coal as a reductant. The subsequent combustion of the gaseous reaction products (CO and H_2) will result in the Stage 1 Plant emitting around 1.5Mtpa of greenhouse gases to the atmosphere. An additional 1.5Mtpa will be emitted for the Stage 2 Plant. The 3Mtpa represents 0.66% of Australia's net greenhouse emissions as listed in the Greenhouse Inventory Report for 1999 (AGO, 2001) or 6% of Western Australia's emissions as listed in the 1995 state inventory. Whilst the Plant is considered to be a significant contributor to both the state and national CO_2 inventory the successful implementation of the Project will ultimately lead to a reduction in future global CO_2 emissions.

The HIsmelt® Process, due to its ability to utilise raw coal and un-agglomerated iron ore fines, has the potential to achieve the lowest greenhouse emissions per unit of production for a coal-based smelting process. The commercialisation of the Process will provide the global iron and steel industry with an alternative ironmaking route that is capable of lowering global greenhouse emissions.

7.4.2 HIsmelt's Greenhouse Emissions

Greenhouse emissions from the Process will be predominantly as CO_2 in the main exhaust gas stream, which will be generated by the:

- reaction of coal in the molten bath with oxygen from the iron ore;
- post combustion of CO in the furnace top space;
- pre-reduction of iron ore in the Preheater; and
- combustion of cleaned process offgas, containing residual CO, plus some natural gas in the hot blast stoves and the Waste Heat Recovery system for steam generation.

The CO_2 emissions will be minimised by very efficient use of the input energy from the coal. The emissions will be, on a 'per unit of product' basis, 1.87 tonnes of CO_2 per tonne of hot metal produced. The CO_2 will be contained in a large volume of offgas (approximately 480,000 Nm^3/hr) at a concentration of 21.4% (v/v), which makes it impracticable to scrub the CO_2 from the gas.

7.4.3 Greenhouse Measures

For assessment purposes the greenhouse emissions from the Plants are considered in the context of:

- **Business as Usual** – considered to be the application of technology or processes of similar capacity using 1990 performance as a benchmark.
- **No Regrets** – those measures that can be implemented by a proponent which are effectively cost neutral and provide the proponent with returns in savings, which offset the initial capital expenditure that may be incurred.
- **Beyond No Regrets** – measures that can be implemented by a proponent which involve some additional cost that is not expected to be recovered.

7.4.3.1 Business as Usual

Smelting of iron ore to produce metallic iron is an energy intensive process and historically the source of energy has been coal, usually in the form of coke. The carbon in the coal is utilised both as a reductant and a fuel facilitating the production of a molten iron product and the separation of impurities to a molten slag layer.

Pig iron sold on the commodity market has historically been produced in blast furnaces but generally only as a small proportion of blast furnace output. The majority of blast furnace iron is used in the molten state for steel production in the basic oxygen steelmaking process. Some smaller blast furnaces produce pig iron as the sole product.

The total production capacity of the Project, 0.82Mtpa for Stage 1 and 1.6Mtpa for Stage 2, is relatively low in terms of the capacity of modern blast furnaces which typically produce greater than 3Mtpa of molten iron. However, a large number of smaller blast furnaces with production levels comparable to the proposed Stage 1 Plant, are currently in operation throughout the world. These small blast furnaces will be used for a comparison of greenhouse emissions with those from the HIsmelt Plant. Production levels of the BHP Newcastle Blast Furnaces, Numbers 3 and 4, which closed in 1999, were around 1Mtpa each. The production level at the AIS blast furnace at Kwinana, which closed in 1982, was around 750,000tpa. These plants are considered to be appropriate 'Business as Usual' benchmarks when undertaking a comparison of greenhouse gas emissions.

Typical inputs for the Newcastle blast furnaces are listed in the Annual Blast Furnace Roundup (Iron and Steel Society, 2001). A typical mass balance for the AIS blast furnace at Kwinana was obtained from AUSIMM (AUSIMM, 1981). A number of similar sized furnaces in North America were also included for comparison purposes. A carbon balance has been derived from these data and is summarised in Table 7.11. A carbon balance allows the total greenhouse emissions per tonne of molten iron (including those from the production of coke, sinter or pellets) to be calculated.

Table 7.11

Carbon Balance of Iron Plants

Plant	Input (kg/thm)				Emission (kg /thm)
	Coke	Coal	Oil	Natural Gas	CO_2
BHP Newcastle 3	498.5	0	0	65	2331
BHP Newcastle 4	483.5	0	0	55	2248
AIS Kwinana	550.0		20		2427
AHMSA (Mexico)	544.5			22.5	2398
Ispat Inland 5 (USA)	399.0	110			2091
Ispat Inland 6 (USA)	473.0			33.5	2137
AHMSA 4 (Mexico)	471			30.5	2137
HIsmelt Plants		635		33.9	1868

Notes: thm- tonne of hot metal
The Blast Furnace Roundup does not list data for plants in China, the Former Soviet Union or India where CO_2 emissions are considerably higher for small blast furnaces (IEA, 2000)

Table 7.11 presents the gross emissions for the blast furnaces, which are attributed to the production of hot metal. The nett emissions may be less due to the use of the coke oven and blast furnace gases as fuel in other processes within the steel plant. The nett value will vary for each plant depending upon its configuration therefore it is difficult to calculate. If the blast furnaces listed in Table 7.11 are considered as stand alone pig iron producers the comparison of the gross CO_2 emissions may be undertaken. The data in Table 7.11 represent on-site emissions only, emissions associated with transport are not included as transport distances for the various sources of raw material suppliers is unknown. For the HIsmelt Plants values of 2t CO_2/MT/km (Source: Rio Tinto Technical Services, *pers comm.*, 2001) may be applied for the shipping of ore and coal. This results in around 10,000tpa of CO_2 being generated for the transportation of materials for each Stage of the Project.

The CO_2 emission from the HIsmelt Plant will be considered to be both a nett and gross value as the site operations will be in energy balance and represent a significant reduction in greenhouse emissions compared to an equivalent size blast furnace. Considerable improvements in energy intensity, and consequently greenhouse emissions, have been made in blast furnaces. However, a considerable proportion of the reductant must be in the form of coke and the iron ore fines must be agglomerated (sintered or pellets). The additional process steps involved in the preparation of the feed materials result in a higher than optimum energy consumption, estimated at between 3 and 3.8GJ/t steel (IEA, 2000).

7.4.3.2 No Regrets

It is considered that the decision to commercialise the HIsmelt Process by establishing the Plant at Kwinana can be considered a 'No Regrets' measure on behalf of Rio Tinto. The development of the Process represents a considerable investment in research and development expenditure over the past 16 years, which ultimately will deliver global benefits in the form of lower energy usage and lower greenhouse emissions per tonne of iron and, therefore, per tonne of steel.

The International Energy Agency (IEA) lists the greenhouse emissions of the global Iron and Steel Industry at 1442 Mtpa CO_2 equivalent (7% of the global inventory), of which 70% is attributable to the production of iron in blast furnaces (IEA, 2000). The proliferation of HIsmelt plants as a replacement for existing blast furnaces, which is expected to occur over the next one to two decades, will have a significant impact on greenhouse emissions based on the emission values presented in Table 7.11. A reduction in CO_2 emissions from iron making worldwide would result in a saving of around 200Mtpa of CO_2.

The following examples show that proliferation of the technology will occur upon successful implementation at Kwinana:

- The United States Department of Energy has recognised the HIsmelt process as qualifying as a 'Clean Coal Technology'. This was reinforced by the fact that the US Department made a grant of US$150 million available to a US steel producer for the replacement of blast furnace ironmaking capacity with a HIsmelt plant. A portion of that grant has been used on a detailed feasibility and cost study. The current downturn in the United States steel industry resulted in the steel producer delaying its decision on whether to proceed with that project. Under the Kyoto Protocol such projects may qualify as Joint Implementation projects, with emission credits being returned to Australia.

- One of the Project's Joint Venture partners is the Shougang Group of China, who has become involved in the Project for a number of reasons. Firstly there are considerable environmental pressures on its steel business, which is primarily located in Beijing. These pressures have intensified since the naming of Beijing as the host city for the 2008 Olympics. The HIsmelt technology will provide Shougang with a cost effective solution to some of its environmental problems. Secondly, Shougang is keen to be recognised as a company with a focus on high technology. Shougang's involvement will provide HIsmelt with an avenue for proliferation of the technology in China, the world's largest growth market for steel consumption. Under the Kyoto Protocol, projects in China may qualify as Clean Development Mechanism projects with subsequent greenhouse emission credits accruing to Australia.

While the development of the Process has primarily focused on the SRV it had been recognised from an early stage in Process development that the optimum energy efficiency would be from the coupling of the SRV with a suitable technology that enabled hot, pre-reduced material to be produced and fed directly to the SRV. A number of process flowsheet options that combine a HIsmelt SRV with various pre-treatment modules are outlined in a paper available on the HIsmelt web site (HIsmelt® - Competitive Hot Metal from Ore Fines and Steel Plant Wastes).

HIsmelt has performed testing in laboratory scale versions of several of the pre-reduction technologies such as the Circofer® Process, being developed by Outokumpu Lurgi, and multi hearth furnaces. The Circofer Process is a coal-based direct reduction process that has the potential, when coupled with the HIsmelt Process, to provide an ironmaking route with significantly lower greenhouse emissions than any process currently available. The emissions are expected to be around 1300 kg CO_2 /tonne of pig iron compared to those presented in Table 7.11 from blast furnaces. The natural gas based version of Circofer, the Circored® Process, has been implemented at a commercial scale in the Cliffs HBI plants in Trinidad and Tobago. The successful implementation of the HIsmelt Process at the Kwinana Plant will provide greater impetus for the commercialisation of the Circofer® Process.

The International Energy Agency considers one of the Flowsheets for future steelmaking processes to be as shown below. This flowsheet has a lower specific energy consumption, and hence greenhouse emissions, than the integrated route or the direct reduction/EAF route.

Smelt Reduction Process (eg HIsmelt)	→	Basic Oxygen Furnace	→	Refining & Casting & Shaping

The European Commission document (European Commission, 2000) contains an overview of previous, current and future routes for iron and steelmaking. One of the future routes listed is shown below.

Smelt Reduction Process	→	Continuous Oxygen Steelmaking	→	Advanced Ladle and Vacuum refining	→	Near net shape casting

The Project, even though considered a significant greenhouse emitter, is a necessary step in the development of processes that will lead to a reduction in future emissions of greenhouse gases from the global iron and steel sector. Figure 7.7 shows the relative CO_2 emissions per tonne of hot metal produced for iron making processes.

Figure 7.7 shows that the blast furnace process has demonstrated continual improvement over its considerable history. The HIsmelt Process, once accepted as a viable alternative ironmaking process to the blast furnace, would be expected to undergo further development (such as combination with other processes as discussed above) leading to further improvements in emissions.

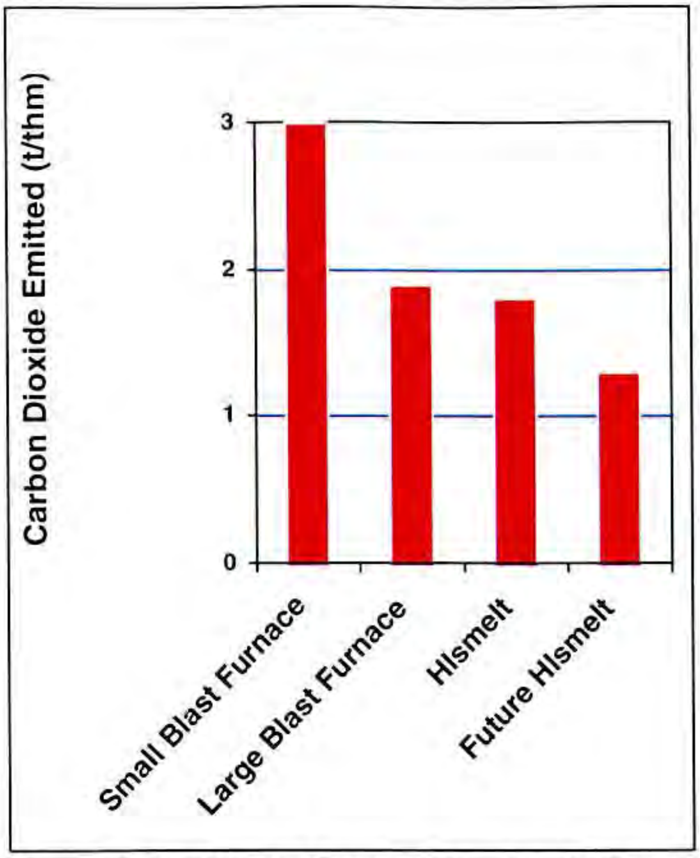


Figure 7.7 Carbon Dioxide Emissions from Iron Making Processes
(Emissions are net emissions after credits for energy recovery from process offgas)

7.4.3.3 Rio Tinto's Initiatives on Greenhouse Gas Reduction (Beyond No Regrets)

Sustainable Development

Rio Tinto and its businesses are currently evaluating how they can contribute to society's transition to sustainable development. For Rio Tinto, a challenge is to continue to deliver the many economic and social benefits that its products bring while also reducing greenhouse gas emissions and other environmental impacts associated with mining and mineral processing.

Greenhouse is a major issue that needs to be addressed in terms of social, environment and economic considerations. The HIsmelt process provides an opportunity to achieve greater eco-efficiency for steel making technology - doing more, with less - which can make an important contribution to society.

Greenhouse Challenge Programme

Rio Tinto was one of the first companies to sign on to the Australian Greenhouse Office's Greenhouse Challenge Programme, and remains committed to its goals. Rio Tinto is committed to:

- increasing efficiency and thereby reducing greenhouse gas emissions per unit of product wherever practicable throughout the life cycles of its products;
- research and development of new technologies to reduce greenhouse emissions of its processes and products;
- continuing to participate constructively in the ongoing international and national policy debate; and
- ensure that the specific actions it takes have social, environmental and economic value and withstand future scrutiny.

Climate Change Strategy

Rio Tinto has implemented a climate change strategy which provides a framework to reduce risks and maximise opportunities arising from local, national and international greenhouse responses. Elements of the strategy include the following:

- Gathering an accurate understanding of its current greenhouse gas practices throughout the group. This involves awareness of its current greenhouse emissions, development of an emissions baseline, and an inventory of opportunities to reduce emissions.
- Developing greenhouse gas emissions reduction targets.
- Undertaking a number of research projects, such as clean coal projects, to reduce greenhouse gas emissions from its processes and products.
- Joining in voluntary agreements such as the Greenhouse Challenge to reduce its greenhouse emissions.
- Working constructively with a range of external partners, such as the Pew Business Environmental Leadership Council, to improve information flows and collaborate on greenhouse policy initiatives.
- Benchmarking its greenhouse and energy performance with other businesses and sectors.

Research and Development

Examples of Rio Tinto's commitment to research and development of new technologies that will reduce greenhouse emissions include:

- **Enhanced Bio-Fixation of CO_2** – Rio Tinto commenced a three year research collaboration with a company called Maxygen, a major biotechnology company based in California, in February 2000 to develop proprietary technologies known as Molecular Breeding. Rio Tinto identified the technology as a potential route to new chemical and biological processes such as those involved in bioleaching and CO_2 sequestration.

The aim is to apply Molecular Breeding to the key enzyme involved in CO_2 fixation, which is one of the basic processes of photosynthesis. Enhancement of CO_2 fixation will lead to cost-effective control of CO_2 emissions and production of renewable energy via bio fuels. The technology has the potential to achieve the fixation of CO_2 from the atmosphere and transform it into algal biomass. The goal of the research programme is to develop cyanobacteria (blue-green algae) with three to five times increased efficiency of atmospheric CO_2 fixation. The first step is to shuffle the gene coding for the target enzyme to achieve an increase in the rate at which CO_2 is fixed into organic compounds.

Maxygen technology also has the potential for application in the emerging use of hydrogen as a fuel. Hydrogen has the potential to replace fossil fuels as a clean and sustainable source of energy. For hydrogen to be produced, stored and utilised in a cost effective manner, new technologies must be developed. Rio Tinto is active in supporting research and development in this area. Developments in carbon sequestration (such as Maxygen) mean that CO_2 fixed as biomass could become a low cost feedstock for hydrogen production.

- **Energy Efficiency** – More efficient use of energy across all aspects of mining and processing will significantly reduce greenhouse gas emissions. Rio Tinto is supporting research and development to:

  - improve the way in which grinding mills are operated;
  - develop neural network software designed to optimise the combustion system in power plants; and
  - lower heat losses in smelting furnaces by controlling slag chemistry in order to form insulating slag layers on water cooled panels. The HIsmelt Process is one example of this and there will also be implications for non-ferrous smelters.

- **Advanced Smelting Cells** - Changing cell designs to reduce energy usage and increase productivity has resulted in substantial gains in productivity at Comalco's (a Rio Tinto subsidiary) aluminium smelters over the past decade. The current research and development studies aim to extend that work by the improved modelling of the cells to give better stability through the control of flow and the overall heat balance. The improved cells should have a lower specific energy consumption, and also enable productivity increases of the order of 10 to 20% within existing smelters.

The HIsmelt Project is consistent with the Rio Tinto initiatives discussed above, and it will have long-term benefits to the global inventory of greenhouse emissions. The Proponent, as part of the Rio Tinto Group, will comply with the Rio Tinto policies and initiatives as outlined above.

Commitments

The Proponent will employ optimum energy efficiency in Plant design and operations.

The Proponent, as part of the Rio Tinto Group, will continue to participate in the Australian Greenhouse Office Greenhouse Challenge Programme.

The Proponent, as part of Rio Tinto, will support the research and development of new technologies that will result in a reduction of greenhouse emissions.

The Proponent will calculate annual greenhouse emissions from the Plant and will report the findings to the DEWCP and Rio Tinto.

7.5 DUST

7.5.1 Issue

The issues associated with particulate emissions from the Plant stacks are discussed in Section 7.3.4. In addition, fugitive dust may also be generated at the site. Larger dust particles, ranging from 10 to 50μm in size, in the air may reduce visibility by scattering light, hence causing haze and affecting visual amenity. Finer dust particles, less than 10μm in diameter pose a risk to health, as they are inhalable, with that fraction smaller than 2.5μm being of particular concern as they are respirable and may lodge in the lungs.

7.5.2 Criteria

The Kwinana EPP and regulations stipulate concentrations of TSP allowable in the air for the EPP Areas (See Section 7.3.1 and Table 7.1).

The NEPM for Ambient Air Quality sets an ambient particulate standard of $50\mu g/m^3$ for particles less than 10μ in size (NEPC, 1998). As the Buffer area (EPP Area B) contains residences in Hope Valley and Wattleup the NEPM criteria have been applied to those residences within Area B and all of Area C.

7.5.3 On- Site

Issue

Fugitive dust may be generated on site from:

- cleared areas;
- construction activities;
- transporting and unloading of raw materials;
- conveying of materials;
- stockpiling and recovery of raw materials; and
- movement of vehicles on unsealed areas.

Management

Dust related to the construction activities is addressed in Section 7.2.

Iron Ore fines, Coal, DRI and Dolomite were stockpiled on site during the period of operation of the HRDF. Remnants of those stockpiles still remain. The management of fugitive dust emissions from the stockpiles was based on the use of water sprays, with a network of fixed high-pressure spray guns positioned to cover the stockpiles. The materials, once wetted by the application of sprays were found to form a surface crust that effectively prevented the generation of fugitive dust emissions from static stockpiles. Further application of water sprays was only necessary on the working faces where material was being disturbed.

A Dust Management Plan will be prepared and implemented as part of the EMP for the site, which will be submitted to the DEWCP prior to commissioning. To ensure that dust generation from the activities listed above is minimised the following dust management measures will be incorporated:

- the integration of dust control provisions into work practices;
- monitoring (visual and high volume sampling) and feedback mechanisms to ensure that appropriate controls are implemented where monitoring indicates additional control is required;
- liaison with suppliers of raw materials to the Project to ensure that the delivered product has a moisture content that minimises dust generation during unloading and delivery to the stockpiles;
- atomizing water sprays will be used at transfer points, dump hoppers and conveyor discharge points to:
  - wet dust and particles;
  - prevent liberation;
  - increase fall out rates; and
  - prevent dust surges due to the up-flow of displaced air;
- materials will be stockpiled using a stacker conveyor that has luffing capabilities allowing the discharge height to be minimised, thereby minimising the generation of dust at the stacker conveyor discharge;

- covering of conveyors and transfer points, where practicable (internal conveyors and transfer points will be enclosed, the stacker conveyor cannot be enclosed, however, due to the requirement for movement along the entire length of the stockpile area);
- use of water sprays on stockpiles – a network of high-pressure water cannons will be installed to provide coverage of the entire stockpile area;
- water tankers will be used to apply water, possibly dosed with a dust suppressant, to disturbed areas such as unsealed roads and front end loader routes at the raw material reclamation area;
- a high standard of housekeeping such as the regular cleaning and sweeping of areas to remove fugitive dust;
- establishing and maintaining a vegetation buffer around the Plant site.

The Proponent is currently undertaking a study of raw material delivery and storage facilities at large iron and steel mills that are acknowledged as achieving a high environmental standard of dust control. If practicable any control measures identified during this study that have not already considered by the Proponent will be implemented at the Plant.

Monitoring

Dust monitoring at the HRDF site is currently undertaken on a six day cycle using a single high volume dust sampler. The dust-monitoring programme will be expanded to provide quantitative feedback on the effectiveness of dust control measures. Additional high-volume dust samplers will be installed, together with the possible use of static samplers. The data from this monitoring will be used to optimize the dust control measures and ensure that dust levels from the site are within the EPP standards and limits. Monitoring data will be reported to the DEWCP at a frequency to be determined.

Commitments

The Proponent will prepare a Dust Management Plan as a component of the EMP for the site. The EMP will be submitted to the DEWCP prior to commissioning.

The Dust Management Plan will be implemented by the Proponent during the construction and operations of the Plant.

The Proponent will continue and expand the dust monitoring programme currently undertaken for the site.

Dust monitoring data will be reported by the Proponent to the DEWCP at a frequency to be determined.

7.5.4 Rail Transport and Unloading of Ore Trains

Issue

Ore will be transported from Koolyanobbing to Kwinana using the existing railway line as shown on Figure 5.18. Rail transport of the ore has the potential to generate dust from:

- ore blowing from the rail wagons; and
- dumping of ore from the wagons at the Kwinana Bulk Terminal.

Management

The selected rail freight provider (see Section 7.1.2) is proposing to use wagons that were originally designed for the carriage of coal with a maximum capacity of 75 t per wagon. As the bulk density of iron ore is more than double that of coal the ore will take up less than half of the available volume in the wagon. The upper surface of the ore will thus be well below the top of the wagon and it is unlikely that any significant quantities of ore dust will be blown from the wagons. The moisture content of the ore (3 to 5%) will help prevent dust losses from the wagons.

Dust monitoring was undertaken in 1994 by Koolyanobbing Iron Pty Ltd to determine if the trains transporting iron ore from Koolyanobbing to Esperance were generating dust (Dames & Moore, 1999). Dust deposition monitoring gauges were placed near the Koolyanobbing mine site, at Norseman and at Esperance. The data indicated that dust generation during the wetter months was not an issue. However, during the drier months the dust levels monitored along the railway line in the vicinity of the mine were found to be greater than the NSW EPA standard of $4mg/m^2$/month. It was found that as the train leaves the mine site, it gathers speed and the fine particulate matter blows off the top of the load in the first few kilometers. Therefore dust generation was only considered to be an issue directly around the mine site. There is unlikely to be significant quantities of dust generated by the ore trains in the Perth Metropolitan Region.

This finding was confirmed by the DEP in the EPA Report and Recommendations for the Kwinana Export Facility (EPA, 1999c). DEP Officers observed iron ore trains from several vantage points as the trains left the Koolyanobbing mine site. The Officers found that there were no visible dust emissions and there was no noticeable dust on the rail infrastructure or surrounding vegetation. The EPA reported that it is unlikely that dust would be a problem after the train has traveled 400km to the Perth Metropolitan Region (EPA, 1999c). Koolyanobbing Iron fill the train wagons to the top with iron ore so there is greater potential for dust to blow from the wagons than would be the case for the ore wagons proposed for the HIsmelt Project.

The ore will unloaded by positioning each rail wagon over a dump hopper and opening the gates on the bottom of the wagon, thus allowing the ore to drop into the hopper. The existing dump station (see Figure 1.3) is situated in a small shed through which the wagons are shunted. This system is currently used for the unloading of silica sand and mineral sand concentrates, which are delivered dry, without dust emissions being a problem. From the dump hopper the ore will be removed by a below ground conveyor and conveyed to the conveyor that delivers ore from the jetty to the HIsmelt Stacker Conveyor. The dump station and conveyor will be enclosed therefore minimising dust emissions from the unloading of iron ore wagons.

7.5.5 Ship Unloading of Iron Ore and Coal

Issue

Iron ore and coal will be unloaded from the ship's holds using a Grab Bucket Ship Unloader. The unloading operation has the potential to generate dust and spillage.

Management

Dust management at the KBB2 unloading area will be the responsibility and management of Fremantle Ports'. Fremantle Ports' currently handles materials with similar dust generation potential, utilising the existing equipment at the KBB2. These operations are undertaken in accordance with the existing licence and to the satisfaction of the DEWCP (Fremantle Ports, *pers.comm.* 2001).

The current dust extraction and suppression systems are being reviewed by Fremantle Ports' to ensure that they are effective and compliant with the existing environmental licence for the KBB2. Any necessary improvements will be implemented to the reasonable satisfaction of the DEWCP. New conveyors will be covered where required for dust control (Fremantle Ports, *pers.comm.* 2001).

Dust emissions from the receival hopper of the unloader, which is the main potential source of dust, will be monitored by Fremantle Ports and improvements implemented as required (Fremantle Ports, *pers.comm.* 2001).

Monitoring

Fremantle Ports' will implement a dust monitoring programme to ensure compliance with the EPP requirements. The programme will be undertaken in accordance with Fremantle Ports' existing dust monitoring programmes where high volume sampling will be conducted over a 24 hour period whilst ships are being unloaded to measure the concentration of TSP within the premises boundary. This programme will be managed and the reports forwarded to the DEWCP in accordance with the environmental licence for Fremantle Ports' operations (Fremantle Ports, *pers.comm.* 2001).

Fremantle Ports' Marine Quality Monitoring Program will be utilised to establish baseline water quality. Monitoring will be undertaken by Fremantle Ports' directly following unloading events to ensure that any dust reaching the marine environment is not having a significant impact using the ANZECC Water Quality Guidelines as a basis for assessment (ANZECC, 2001). Following this monitoring, the long term marine water quality monitoring requirements will be incorporated in Fremantle Ports' overall Marine Quality Monitoring Program (Fremantle Ports, *pers.comm.* 2001).

7.6 NOISE

7.6.1 Issue

Noise can seriously disrupt people's lives, causing loss of sleep, interference to activities and emotional stress. Noise will be generated by the Plant and activities associated with the Project.

A regional noise study has been undertaken for the Kwinana area by KIC (see Section 5.4.1). The results of the study were not available during the preparation of the PER.

7.6.2 Criteria

Environmental noise is governed by the Environmental Protection (Noise) Regulations, 1997 (as amended). The Regulations are prescribed standards under the *Environmental Protection Act, 1986.* Noise emissions, which exceed the prescribed standard can be regarded as pollution and "unreasonable noise" under the *Act.* The Regulations stipulate maximum allowable external noise levels determined by the calculation of an influencing factor which is then added to the baseline assigned outdoor noise levels shown in Table 7.12. The influencing factor is calculated for the usage of land within the two circles, having radii of 100m and 450m from the premises of concern.

Table 7.12

Baseline Assigned Outdoor Noise Level

Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		$L_{A\,10}$	$L_{A\,1}$	$L_{A\,max}$
Residential	0700 - 1900 hours Monday to Saturday	45	55	65
	0900 - 1900 hours Sunday and Public Holidays	40	50	65
	1900 - 2200 hours all days	40	50	55
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays	35	45	55
Industrial and utility premises	All hours	65	80	90

Note: The L_{A10} is the noise level exceed for 10% of the time.
The L_{A1} is the noise level exceed for 1% of the time.
The L_{Amax} is the maximum noise level.

It should be noted that with regards to the criteria for neighbouring industrial premises, there have been discussions by a working group, involving the DEWCP, with a resolution that the 65 dB(A) L_{A10} criteria, would be increased to 75 dB(A) at the boundary, or 70 dB(A) at the boundary if an office is within 15 metres of the boundary (DEP, 2000b).

The levels presented in Table 7.12 are conditional on no annoying characteristics such as tonality, amplitude modulation or impulsiveness existing in the noise of concern. If such characteristics exist and cannot be practicably removed at the source, then any measured level is adjusted according to the adjustments presented in Table 7.13.

Table 7.13

Adjustments to Measured Levels for Intrusive Characteristics

Where **tonality** is present	Where **modulation** is present	Where **impulsiveness** is present
+5 dB(A)	+5 dB(A)	+10 dB(A)

Note: these adjustments are cumulative to a maximum of 15 dB(A).

It is considered that at the residences, the magnitude of the noise will be low enough and effectively masked by the existing ambient noise, such that noise from the HIsmelt Plant will not exhibit intrusive characteristics therefore no adjustments will need to be added to the assigned noise levels.

At the Plant boundary, it is likely that the noise would be considered tonal due to the:

- higher noise levels;
- relatively low ambient level; and
- type of equipment.

Therefore a plus 5dB(A) adjustment should be applied to the predicted levels for the site boundary.

As the Plant will be a 24-hour operation, the L_{A10} night time level will be applied at the following sites:

- Hope Valley
- Medina
- North Rockingham
- Wattleup

The applicable assigned noise levels for these locations are presented in Table 7.14.

Table 7.14

Assigned Noise Levels at the Most Constraining Residences

in Hope Valley, Wattleup, Medina and North Rockingham

Time of Day	Hope Valley/Wattleup			Medina/North Rockingham		
	Type of Assigned Noise Level (dB(A))			Type of Assigned Noise Level (dB(A))		
	L_{A10}	L_{A1}	L_{max}	L_{A10}	L_{A1}	L_{max}
0700-1900 – Monday to Saturday	55	65	75	45	55	65
0900-1900 – Sunday and Public Holidays	50	60	75	40	50	65
1900-2200 – All days	50	60	65	40	50	55
2200-0700 – Monday to Saturday	45	55	65	35	45	550
2200- 0900 – Sunday and Public Holidays	45	55	65	35	45	55

Notes: L_{A10} – not to exceeded for more than 10% of the time
L_{A1} – not to be exceed for more than 1% of the time
L_{max} - not to be exceeded at any time

As noise at a residence is the total of noise emissions from a number of individual industries, the requirements for "significantly contributing" under Regulation 7 of the Regulations must be considered when assessing compliance with the Environmental Protection (Noise) Regulations, 1997. In accordance with Regulation 7, noise emissions from the Plant would be considered as not "significantly contributing" to the noise emission at a noise sensitive premises, if the noise at that premises is 5 dB(A) below the assigned noise level. Therefore, to comply during the night period, noise emissions from the Plant are required to be:

- 40 dB(A) at the most constraining residences within Hope Valley and Wattleup.
- 30 dB(A) at the most constraining residences in Medina and North Rockingham.

Note that the "most constraining residences" are the closest locations with negligible influence (in terms of the assigned noise levels) from land zoned for industrial use (Hope Valley and North Rockingham) and from EPP Area B (Medina and North Rockingham).

7.6.3 Modelling

The Proponent engaged a consultant to undertake an acoustical modelling study on the predicted noise emissions associated with the operation of the Plant at Kwinana (Herring Storer Acoustics, 2002a). Modelling has also been undertaken on the noise from the activities associated with the shipping unloading and loading of the raw materials and product for Fremantle Ports (Herring Storer Acoustics, 2002b) and the results are discussed in Section 7.6.5. A copy of the noise study for the HIsmelt Plant is presented as Appendix H. The findings of the study are summarised in the following sections.

Modelling of the noise emissions was undertaken using the Environmental Noise Model (ENM) program. Both overall noise level contour plots and single point calculations were performed. Noise contours show the overall noise levels over the surrounding areas whilst single point calculations show the influence of individual items of plant on the overall noise level at a specific location.

Weather conditions used to model worst case propagation were as stipulated within the EPA's Draft Guidance for Assessment of Environmental Factors No. 8 - Environmental Noise. (EPA, 1998b), which are as follows:

- Temperature 15°C
- Relative Humidity 50%
- Temperature Inversion 2°C/100m
- Wind Speed 3m/s

Winds from the south-west through west to north-east were considered in the calculations, to assess the worst case wind directions for the various locations.

7.6.4 Modelling Results

Resultant noise levels at the most constraining residences, for the Stage 1 and Stage 2 Plants scenarios and wind directions, are listed in Table 7.15.

Table 7.15

Predicted Noise Levels at Residences from the Stage 1 and Stage 1 and 2 Plants Under Various Wind Directions

(L_{A10} dB(A))

Location	Wind Direction				
	W	SW	NW	N	NE
Stage 1 Only					
Hope Valley	36	36	34	27	25
Medina	28	26	28	27	22
North Rockingham	16	14	17	18	18
Wattleup	21	23	14	11	11
Stage 1 & 2					
Hope Valley	38	38	36	29	27
Medina	30	28	30	29	24
North Rockingham	17	15	18	19	19
Wattleup	24	25	16	13	13

Noise contours for the scenarios presented in Table 7.15 (with all wind directions combined) are shown in Appendix H. The noise contours for the Stage 1 Plant and the Stages 1 and 2 Plants operating with all the wind directions combined are shown on Figures 7.8 and 7.9, respectively. It should be noted that by showing the winds occurring in all directions simultaneously an unrealistic worst case scenario is presented as winds cannot be from all directions at once.

Data in Table 7.15 show that the predicted noise levels from the Stage 1 Plant will be at least 5dB(A) below the assigned noise levels (see Table 7.12) at the surrounding residences. The predicted noise levels from the Stage 1 and 2 Plants operating will also be 5dB(A) below the assigned noise levels shown in Table 7.14. Therefore, the noise levels at the resedential areas from the Stage 1 Plant and the Stages 1 and 2 Plants will comply at all times with the Environmental Protection (Noise) Regulations, 1997.

Single point calculations were carried out for the boundary of the site and are summarised in Table 7.16.

Table 7.16

Predicted Noise Levels At The Plant Boundary (dB(A))

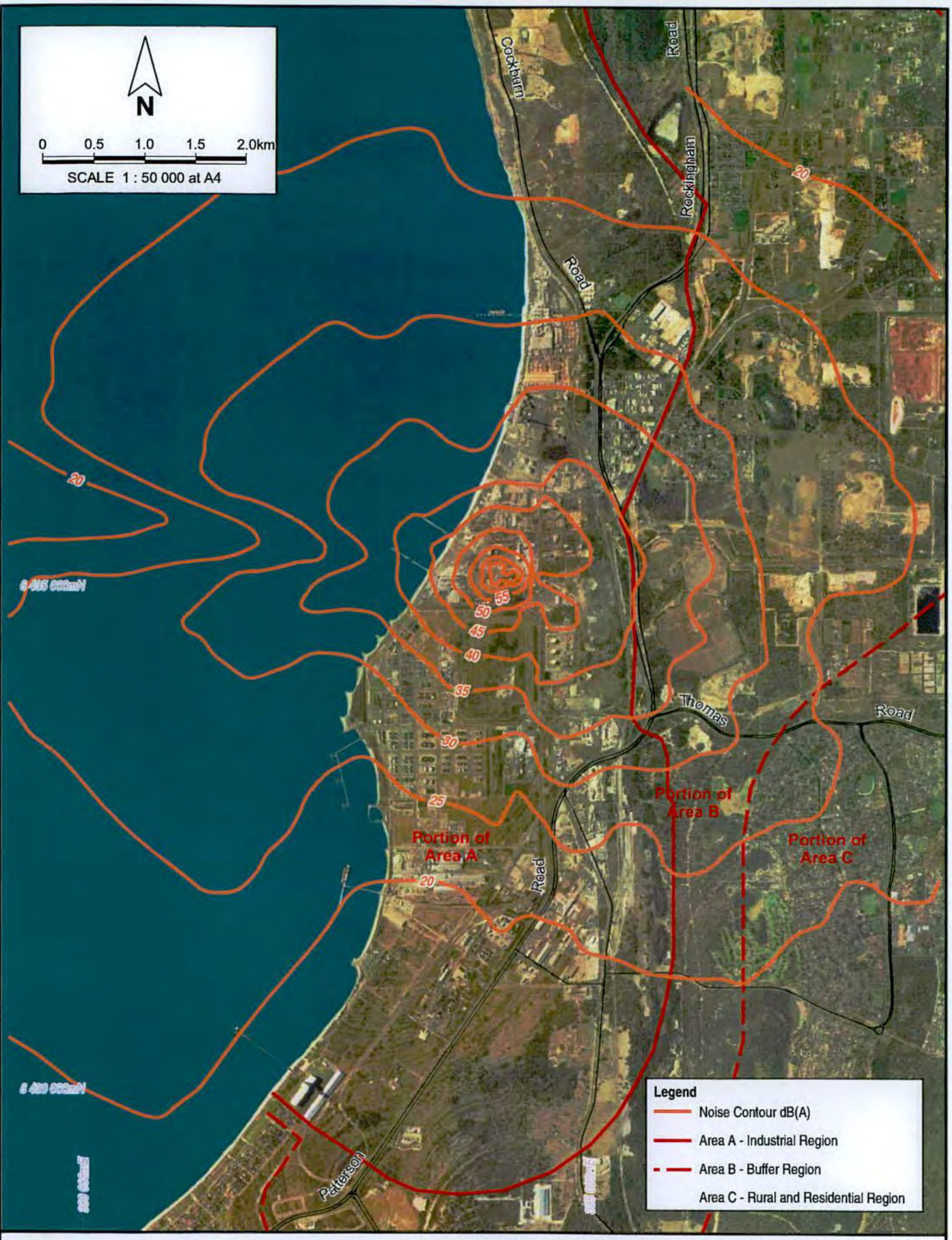
Location	Stage 1 Plant	Stage 1 and 2 Plants
South Boundary	59	60
East Boundary	55	64
North Boundary	65	65

Predicted noise levels at the site boundary, are up to 65 dB(A) for both the Stage 1, and Stage 1 and 2 Plants. At the site boundary the noise is likely to be considered tonal as discussed in Section 7.6.2 so 5dB(A) must be added to the predicted level. Therefore, the worst case noise level at the boundary for assessment purposes would be 70dB(A).

The allowable noise level specified by the Noise Regulations is 65dB(A). However, the review of the Regulations by a working group suggested that the criteria should be amended to:

- 70dB(A) at a plant boundary where an office is within 15 metres of this boundary; and
- 75dB(A) at a plant boundary where an office is more than 15 metres from this boundary.

The DEWCP recommended that the above criteria be adopted and the EPA also believe this change should be considered (DEP, 2000b). The predicted noise level from the Plants at the site boundary is 70dB(A), inclusive of the 5dB(A) adjustment for tonality, which is above the existing criteria but is in accordance with the suggested new criteria. However, should the proposed change not be endorsed through the review, then the Proponent will review the actual noise levels and noise attenuation measures implemented at the site and will meet the criteria.



HIsmelt®

Kwinana HIsmelt Process Plant
PUBLIC ENVIRONMENTAL REVIEW

NOISE CONTOUR FOR THE STAGE 1 PLANT
3m/s WINDS (South Westerly, through Westerly to North -Easterly)
AND 2°C/100m TEMPERATURE INVERSION

Figure 7.8

PINPOINT CARTOGRAPHICS 0417 904 798 figure 7-8.dgn Fri 05 Apr

7.6.5 Management

The Proponent will ensure that noise levels from the Project's operations comply with the Environmental Protection (Noise) Regulations, 1997.

Noise specification upper limits will be applied when sourcing items of equipment for the Plant. The Proponent will ensure that the equipment sound power levels used in the modelling (see Appendix H) are the upper limit for equipment noise specifications. Noise attenuation measures, such as the establishment of enclosures around equipment with a high noise level, will be incorporated where practicable.

The Proponent will consult with KIC on the findings of its study to discuss the noise levels from the Plant in relation to the regional noise levels and other Kwinana industries.

7.6.6 Monitoring

A noise monitoring survey will be undertaken once normal operation of the Plant has been established to ensure that the actual noise levels are within those predicted. Noise monitoring will then be undertaken on an annual basis. The results of the noise survey will be provided to the DEWCP and the KIC.

Commitments

The Proponent will design the Plant and incorporate noise attenuation measures on equipment to minimise noise levels, where practicable.

The Proponent will ensure that noise levels generated by the Plant are in compliance with the Environmental Protection (Noise) Regulations, 1997 by implementing a noise monitoring programme.

A noise monitoring survey will be undertaken by the Proponent once the Plant is operational to ensure that noise levels are within those predicted.

Noise monitoring at the site will be undertaken by the Proponent on an annual basis.

The Proponent will provide the results of the noise survey to the DEWCP and the KIC.

The Proponent will consult with KIC on the findings of the regional noise study.

7.6.7 Shipping Operations

Issue

The shipping, unloading and loading operations to be undertaken by Fremantle Ports' at the KBB2 have the potential to generate noise. Environmental noise is governed by the Environmental Protection (Noise) Regulations, 1997 which stipulate maximum allowable noise levels as discussed in Section 7.6.2.

Modelling

Fremantle Ports' has undertaken an acoustical modelling study to predict the noise emissions associated with the shipping, unloading and loading operations at the KBB2 related to the HIsmelt Project (Herring Storer, 2002b).

The same modelling methodology described in Section 7.6.3 has been used in the Fremantle Ports study. Results from the noise modelling for the most constraining residences and the unloading and loading operations under the various wind directions are presented in Table 7.17.

Table 7.17

Predicted Noise Levels at Residences from Fremantle Ports' Unloading and Loading Operations Related to the HIsmelt Project Under Various Wind Directions

L_{A10} dB(A)

Location	Wind Direction				
	W	SW	NW	N	NE
Unloading of Materials					
Hope Valley	28	28	26	24	18
Medina	23	17	23	18	11
North Rockingham	17	11	18	18	18
Wattleup	16	18	14	5	4
Loading of Pig Iron					
Hope Valley	34	34	32	30	23
Medina	28	21	28	23	13
North Rockingham	15	8	15	16	16
Wattleup	23	25	21	9	8

Source: Herring Storer, 2002b.

The results show that the predicted noise levels from Fremantle Ports' unloading and loading operations for the Project will be 5dB(A) below the assigned levels presented in Table 7.12. Therefore, the noise levels at the residential areas will comply at all times with the Environmental Protection (Noise) Regulations, 1997.

Management

Noise emissions from the ship unloader and associated conveyors during import and transfer of iron ore and coal are not expected to be greater than the noise levels from the existing material handling operations at the KBB2.

Measures will be taken to control the noise associated with the export of pig iron, these may include:

- Provision of noise reducing liners in transfer chutes.
- Review of transfer chute impact tables.
- Control of "on board" loading operations including:
  - use of timber dunnage on ship's hold floor to reduce noise from falling pig.
  - control of loader position to minimise free fall of pig iron.

A review of the world's best practice for the handling of pig iron is currently being undertaken.

7.6.8 Road and Rail

Issue

Road and rail movements have the potential to cause noise impacts to residences along the transport routes. The existing road movements are presented in Table 5.14. It is estimated that there will be an additional 73 truck movements per day for Stage 1 and 146 for the Stage 1 and Stage 2 operations. The main truck usage will be for the transport of lime from the Cockburn Cement site on Russell Road to the Plant, and for the transport of slag from the site to a local slag processing facility (negotiations are currently underway with appropriate operators in the area). As the likely route to a slag processing facility is currently unknown, the Proponent considered the most critical residences for the impact of truck noise to be those along Rockingham Road in Wattleup.

There are currently around 230 rail movements per week between Forrestfield and Kwinana as presented in Section 5.15.2. This number includes around seven movements per week either to or from the existing BHP Transport Logistics operations adjacent to the HIsmelt site. These trains are between 600 and 800m in length which are similar size to the trains proposed to transport the ore for the Project. These train movements will cease in 2003 when the BHP Transport Logistics operation is relocated to another site.

It is anticipated that there will be around ten rail movements per week related to Stage 1 of the Project. This will result in a net increase of three movements per week (once the trains to the BHP site cease), for Stage 1 and around 13 per week (two per day) when both Stage 1 and Stage 2 Plants are operating. The trains will comprise a locomotive and 39 wagons and will be approximately 600m long.

Criteria

Noise from road and rail traffic on public roads and railway lines is not covered in the Noise Regulations as specified under Regulation 3. The EPA has produced a draft document: EIA No. 14 (Version 3) Road and Rail Transportation Noise (EPA, 2001f) to assess such activities. The document lists acceptable noise increases when a change in the infrastructure occurs (such as increased traffic, or change of alignment), where the acceptable increase is dependent upon the existing noise levels at the residences. The acceptable noise level increases are tabulated in Appendix H.

It is estimated that residences adjacent to the railway line, which are typically 30 metres from the track, would be in Rating N4 as shown in Appendix H, based on maximum noise levels from existing Western Australian freight trains. Therefore, a 0.0dB(A) increase in L_{Aeq} (the average noise level over a certain period) is acceptable.

Modelling Results

The estimated change in L_{Aeq} values are shown in Table 7.18 for road and rail transportation. Assuming the increased traffic flow is distributed evenly during the day and night periods, the increase shown applies to both times (day and night).

Table 7.18

Increase In L_{Aeq} Noise Level For Road And Rail Transportation

Transport	Increase in L_{Aeq}, dB(A)	
	Stage 1	Between Stage 1 and Stage 2
Road	0.0	0.0
Rail	0.1	0.1

Note: L_{Aeq} - average noise level over a certain period.
Calculations based on noise levels from existing Australian Railroad Group Trains.
Increase shown for Stage 1 and 2 is the increase between Stage 1 only and Stages 1 and 2.

Noise from the trucks transporting materials for the Project along Rockingham Road are predicted to have no significant effect on the residences due to the existing high volumes of traffic and existing high noise levels.

Calculations indicate that the noise level increase for train movements in L_{Aeq} would be in the order of 0.1dB(A) to the existing conditions for the Stage 1 Plant and an additional 0.1dB(A) between the Stage 1 and Stage 2 Plants. This results in an overall increase of 0.2dB(A), which is marginally above the criteria of 0.0dB(A). This increase is not considered significant as the calculations were conservative, due to the noise levels used in the calculations were for maximum power and speed, and the existing road and rail noise levels at the time of Stage 2 commissioning are expected to be higher.

Management

The freight service provider will determine the most appropriate driver techniques for the noise sensitive areas to minimise pass by noise such as appropriate throttle settings, braking techniques and fuel saving techniques. The provider advised the Proponent that there are no steep gradients adjacent to the noise sensitive areas so low power settings can be used in these locations.

7.7 VIBRATION

Vibrations can occur from both Plant and rail operations.

Vibration at the Plant site may be caused by large items of rotating machinery. All such equipment items will be placed on concrete footings to dampen any vibrations. The extent of the foundations for the footings will be based on engineering calculations using parameters such as the soil conditions and the equipment manufacturer's load data. Where additional measures are recommended by the manufacturer to dampen vibration these will be implemented. Significant vibration levels are not expected to result from the operation of the Plant.

Vibration associated with the rail operations can cause instability and damage of structures, and annoyance to residents. The vibration from the proposed trains is likely to be similar to those already emitted by the existing trains. Hence, the magnitude of vibration will not increase. From previous studies undertaken by Herring Storer Acoustics (Herring Storer Acoustics, 2002a), these vibration levels are not high enough to cause any structural damage but are of a level where they may be perceptible. The frequency of occurrence of perceptible vibration may increase once Stage 2 commences, although this is considered to be of negligible impact.

7.8 SURFACE WATER RUNOFF AND WASHWATERS

Issue

The site is located within the Environmental Protection (Cockburn Sound) Policy Area. There is a potential for stormwater or washwaters from the site to directly, or indirectly via groundwater, enter Cockburn Sound and impact on the marine environment. The main areas where there is a potential for contaminated water to be generated will be the stockpile area, wash down areas on the site and maintenance areas of the ASU.

Sulphur present in the coal has the potential to be oxidised or leached by bacterial action, which may result in acidic runoff from the stockpiles. Fine particulate material may be mobilised as suspended solids in stormwater runoff. Washwaters from the wash down areas and maintenance areas have the potential to contain hydrocarbons.

Management

A Surface Water Management Plan will be prepared and implemented as a component of the site EMP. The Plan will include the management for both clean stormwater runoff, and for potentially contaminated runoff and washwaters. The key strategy of the Plan will be the segregation and collection of any potentially contaminated stormwater runoff. The Plan will be formulated using the Draft Guidance Document No.26, Management of Surface Run-off from Industrial and Commercial Sites (EPA, 1999e).

The objectives of the Cockburn Sound EMP (CSMC, 2001) in relation to surface water and groundwater will be incorporated in the Surface Water Management Plan and applied at the site. The objective in the Cockburn Sound EMP in relation to contamination is to integrate planning and management of catchment land uses to minimise the overall impact of ground and surface water contamination on the environmental values of Cockburn Sound. This resulted in the following key recommendations:

- Initiate a Catchment Partnership between industry, urban and rural land users, local and State Government, schools and the local community to identify those activities that presently have the greatest impact on groundwater quality and to develop and implement best management practices to minimise future impacts.
- Ensure comprehensive groundwater management plans are incorporated into new industrial projects under the Fremantle – Rockingham Industrial Area Regional Strategy.

Clean Stormwater Runoff

Stormwater management at the site will be based on the principle of directing the clean runoff to soaks or settling ponds from where it can infiltrate the porous soil layer and replenish the groundwater resource rather than directly discharging it into Cockburn Sound. A hydrogeologist from DEWCP advised the Proponent that the use of soaks for the collection of stormwater is the preferred method for this site (WRC, *pers comm.* 2001).

The settling pond at the North West corner of the current HIsmelt office car park will be relocated a short distance to the north. Existing drains on the expanded HIsmelt lease, other than those affected by the stockpile installation, that ultimately flow to either the North or South Drains will be terminated at or near the lease boundary. Soaks will be installed at these points to collect and dissipate the runoff water.

Drainage of the area to the east of Leath Road currently occurs through infiltration through the porous soils. Drainage systems will be installed when and if construction of facilities, such as the slag processing area, proceed in that area.

Potentially Contaminated Runoff and Washwaters

Washwaters from around the raw material bins, stormwater accumulating in bunds around fuel or chemical storage tanks and drainage from the cooling water circuits will be directed to the sump to the east of the Plant from where it will be pumped to the process water tank.

Stockpiles of ore and coal will be established south of the Plant on a site that is currently occupied by the BHP Transport and Logistics business (see Figure 4.2). Stockpile management measures will be implemented to minimise the potential for runoff, which will include minimising the quantity of coal and ore stockpiled and the effective rotation of the raw material inventory. The stockpile area is currently bituminised and drains into the Southern Drain as discussed in Section 5.9. The bitumen will be removed and replaced with a layer of compacted low permeability material such as clay, crushed slag or a synthetic liner that will form the base of the stockpiles A decision as to the most suitable material will be made during the detailed design phase of the Project in liaison with the authorities.

The drainage system associated with the currently sealed area will be removed, or blocked off, and a stockpile drainage system will be installed. The stockpiles drainage system will drain to a common, concrete lined sump, from where the collected runoff water will be pumped to the process water tank. Water from the tank will be used for the cooling of the slag and pig iron.

The existing clarifier basin for the HRDF will be used as a process water tank for the Plant. The clarifier basin was constructed for use as the clarifier for the wet scrubber on the old AIS blast furnace offgas system. The rake mechanism was removed prior to its use as a process water tank for the HRDF. The basin is a concrete structure with a conical base section that directs settled solids to the intakes of two underflow pumps situated in a tunnel underneath the clarifier. The capacity of this tank is around 4000 kL. The tank is in good condition and there is no evidence of any leakage. A bore is located immediately down gradient of the tank, which is used to monitor the groundwater so any leakage may be identified.

During and following rainfall events, run off from the stockpile area will be collected in a sump and pumped to the process water tank for later use for the cooling of pig iron and slag. The process water tank will generally be only half filled so that there is a sufficient buffer capacity to allow for an influx of rain water. By only filling half the volume of the tank, an additional influx from 20mm of rainfall over a 24 hour period can be accommodated in the tank.

The stockpile sump pumps will be designed to remove water from the stockpile area at a maximum rate of 7000kL per day, which is equivalent to 1 in a 100 year storm. The process water tank will be able to contain the 87kL per hour of stormwater runoff from the stockpile area which may occur during a 1 in a 10 year storm event of 72 hours duration as required in the EPA Draft Guidance on the Management of Surface Runoff (EPA, 1999e). Surface water management infrastructure has been designed for a 1 in a 20 year rainfall event as required in Water Quality Protection Guidelines for Mining and Mineral Processing (WRC, DME, DEP; 2000). Table 7.19 presents an overview of the process water tank's stormwater input rates.

Table 7.19

Process Water Tank Stormwater Input Rates

	100yr Storm	10 yr Storm
kL per day Input Rate	7000	2075
kL per hour Input Rate	292	86.5

The capacity of the process water tank may be exceeded during extended periods of extreme rainfall events. The potential for establishing an additional facility for the storage of runoff from heavy rainfall events will be investigated during the detailed design phase of the Project. If the Kwinana Wastewater Recycling Plant is operational at the time of Plant commissioning, the overflow may be discharged through the Water Corporation's Point Peron outfall. Any discharge would be subject to approval from the Water Corporation and the DEWCP.

Discussions with representatives from the Water Corporation have indicated that if the Proponent obtains water for the Project from the Wastewater Recycling Plant, effluent from the HIsmelt Plant may be accepted for discharge through the Point Peron outfall subject to it meeting quality criteria set by the Water Corporation. The Wastewater Recycling Plant will recycle approximately 20ML per day of the 120ML currently discharged through the Point Peron line. The removal of the 20ML of wastewater per day will provide capacity for other wastewater to enter the line.

As part of the Environmental Impact Assessment of the Wastewater Recycling Plant the Water Corporation will include an assessment of the impact of accepting industrial effluent for disposal through the Point Peron outfall. The Proponent has supplied the Water Corporation with estimates of effluent composition and flow rates for incorporation in their environmental assessment for the Wastewater Recycling Plant.

If discharge through the Point Peron outfall is not feasible at the time of commissioning of the Plant then an additional on-site water storage facility would be installed.

Monitoring

The groundwater monitoring programme established for the HRDF will continue using the existing bores to identify any significant changes in the groundwater. Additional bores will be installed within the extended HIsmelt lease area, and will be included in the groundwater monitoring programme. The monitored parameters would also be reassessed in liaison with the DEWCP. The location of the existing and proposed bores is shown on Figure 5.15. Groundwater monitoring data will be provided to the DEWCP on an annual basis.

Commitments

The Proponent will prepare a Surface Water Management Plan as a component of the site EMP, which will be submitted to the DEP prior to commissioning. The Surface Water Management Plan will include the management for both clean stormwater runoff and for potentially contaminated runoff and washwaters.

The Proponent will implement the Surface Water Management Plan during the operation of the Plant.

The Proponent will continue and extend the groundwater monitoring programme undertaken on the site to identify any significant changes in the groundwater, and will reassess the parameters monitored in liaison with the DEWCP.

The Proponent will report the results of the groundwater monitoring to the DEWCP on an annual basis.

7.9 SLAG

Issue

The Project will result in a large quantity of slag being produced (225,000tpa for Stage 1 and 450,000tpa for Stage 1 and 2) as discussed in Section 4.12.2. To ensure the slag is a by-product, and not simply a waste stream, it is important that uses for the slag are identified. Iron and Steel Industry experience suggests that the slag will be useful in the construction industry as a crushed rock substitute and possibly as an input for the production of cement. If slag is to be suitable for use as a road base or fill material it is imperative that there is no potential for harmful components to leach and pollute groundwater or waterways. This issue also applies if slag is to be stockpiled on the site.

Management

The on-site slag collection pits will be lined with an impermeable clay liner and will have a drainage system which will collect any water in the pit area and direct it to a sump for re-use.

Potential uses for the slag by-product are discussed in Section 4.12.2. Discussions are being held with potential customers for the slag by-product and the Proponent will continue to investigate options for the value added use of the slag. When the AIS blast furnace operated on the same site CSR Readymix operated a slag processing operation that disposed of the blast furnace slag into the construction industry. Advice to the Proponent from a local company, Waste Stream Management, is that there is ample capacity in the aggregate market to use the quantity of slag that will be produced by the HIsmelt Plants. Any stockpiling of slag on site will be kept to a minimum.

The transport, storage and use of hazardous materials on the site will be in compliance with the Australian Standard 2508, Australian Dangerous Goods Code (Federal Office of Road Safety, 1992), Dangerous Goods Regulations, 1992, the Dangerous Goods (Transport) (General) Regulations, 1999, and Dangerous Goods (Road and Rail) Regulations, 1999 as the minimum standard. The site's Safety and Environmental Management Systems will also have specific standards for hazardous material control, storage, use and disposal. HIsmelt currently holds a Dangerous Goods Licence for the storage of a range of materials on the site.

The main principles to be applied for the management of hazardous materials include:

- appointment of a Hazardous Materials Controller;
- maintenance of a set of Material Safety Data Sheets (MSDS) for each material used on site;
- training of all staff in the storage, handling and correct disposal of hazardous materials (this includes ensuring that contractors responsible for the delivery of hazardous materials to site have appropriate training; and
- an Emergency Response Team trained for incidents involving hazardous materials.

Storage of hazardous materials will be subject to a Dangerous Goods Licence. Other management measures for the storage of these materials will include:

- bulk quantities (as defined by the Dangerous Goods Regulations, 1992) of chemicals, fuels and other materials will be stored in tanks of an approved design;
- all storage tanks will be of an approved design;
- bunds will be constructed using impervious materials, such as concrete, steel or plastic around the tanks to contain any spillage;
- Plant operating procedures will ensure that all storage tanks and bunds are subject to regular inspections, with special attention to stormwater accumulation in the bunded areas and any accumulated water will be pumped to the process water tank for re-use for cooling; and
- an Emergency Response Plan will be prepared to cater for any incidents involving hazardous materials.

The use of hazardous materials will be subject to standard operating procedures that will incorporate the principles outlined in the site Safety Management and Environmental Management Plans. Particular attention will be given to the prevention of pollution of groundwater or the marine environment by only using hazardous materials in areas where stormwater runoff or wash water can be collected for disposal in the cooling of slag and pig iron or to an approved facility if re-use on site is not possible. A dedicated concrete paved area, with bund walls and a collection sump, will be provided for vehicle maintenance and wash down activities.

Commitment

A Hazardous Materials Management Plan will be prepared by the Proponent as a component of the site EMP, which will be submitted to the DEWCP prior to commissioning. The Hazardous Materials Management Plan will also be submitted to the MPR prior to commissioning as part of the Project Management Plan.

7.11 WASTE MANAGEMENT

7.11.1 Solid Waste

7.11.1.1 Issue

Solid waste streams generated during the operation of the Plant will be mainly from gas cleaning, refractory replacements, and general solid waste. The main types of solid wastes that will require disposal will be:

- Scrubber Sludge;
- Refractory Materials; and
- General Waste.

Scrubber Sludge
The wet scrubbers used to clean the offgas from the SRV and Preheater (see Section 4.10.1) will produce a thickened slurry that will be filtered to produce a filter cake with a moisture content of approximately 20%. This material, termed scrubber sludge, will be recycled back into the process via the Preheater. When the concentrations of elements such as Zn, Pb and Cd build up there may be an adverse effect on the process, therefore, some of the sludge must be removed. It is expected that around 0.5tph to 1.5tph of sludge will require to be removed.

An estimated composition of the sludge is presented in Table 7.21. The actual composition will be determined once the Plant is in operation.

Table 7.21

Estimated Composition of Sludge from the HIsmelt Plant

Element	%wt
C	5.03
S	0.04
Fe_2O_3	60.75
FeO	9.39
SiO_2	4.46
CaO	3.03
Al_2O_3	2.26
MnO	0.11
Cr_2O_3	0.01
P_2O_5	0.37
MgO	0.69
$CaCO_3$	1.72
$MgCO_3$	1.38
H_2O	3.46
TiO_2	0.09
ZnO	0.02
Cl	0.03
Na_2O	0.02
K_2O	0.01
As_2O_3	0.02
Bi	0.05
Other	0.06
FeS	6.89
ZnS	0.11

The concentration of some species in the estimates provided in Table 7.21 result in the material failing to meet the inert waste criteria on composition alone. Leaching tests will be required to determine the class of landfill that could accept this material if re-use on-site or at a neighbouring facility proves not to be feasible. It should be noted that the proposed offsite use of this material would lock up any species of concern in a product, from which leaching would not be an issue.

Refractory Materials

Refractory materials will be used to protect the steel in the high temperature areas within the Plant such as the hearth section of the SRV. The refractory lining in the hearth section of the SRV is expected to require a partial replacement after one year of operation and a full reline every 18 months, resulting in the spent refractory requiring disposal. There will be two types of refractory material; magnesia-chromite and alumina.

Magnesia – Chromite Refractories

Testwork has shown that the refractory material most suitable for application in the hearth region of the SRV, where it is exposed to high temperatures, molten metal and slag is magnesia-chromite spinel. The SRV hearth lining will be slowly worn away through the action of the molten bath constituents and will require replacement.

Alumina Refractories

Alumina spinel refractories are commonly used in applications where the lining will not contact molten slag, such as offgas ducts and hot gas cyclones.

General Waste

Other sources of solid waste will include packaging from delivery of consumables, scrap metal waste from maintenance activities and putrescible wastes from the site operations.

Management

Both the Federal and State Governments have set targets to significantly reduce the quantity of solid waste going to landfill. Waste will be minimised by re-use and recycling and any waste requiring disposal will be disposed at an appropriate and approved facility.

A Waste Management Plan will be prepared as a component of the EMP for the site. The Plan will be based on the principles of Reduce, Recycle and Re-use and will define the waste disposal practices on site. The Plan will establish a framework for waste segregation, waste collection and disposal, and auditing of waste management.

Wastes will be divided into the following categories:

- **Recyclable** - such as steel scrap, process dusts, cardboard and paper.
- **Re-use** - such as slag as a construction material.
- **Waste Processing Facility** - such as refractory materials and construction rubble.
- **Return to Supplier** - such as packaging for chemicals
- **Landfill** - putrescible wastes.
- **Special Waste** - such as magnesium chrome refractories.

Examples of waste management measures that will be implemented include:

- **Reduce** - Enter into agreements with suppliers of consumables for the re-use of packaging such as the return of empty containers to suppliers for refilling where applicable.
- **Re-use** - Process materials that may be considered waste, such as sludge, gypsum and slag will be converted to by-products by investigating possible uses. Preliminary investigations and iron and steel industry practice suggest that this is feasible for these materials.
- **Re-cycle** - Bins will be provided to facilitate the segregation of waste material for re-cycling where possible such as for - cardboard packaging, steel and plastics.

Scrubber Sludge

The quantity of sludge requiring disposal will be minimised by the maximum recycling of the sludge. A sampling programme will be implemented during commissioning, and operation, which will determine what proportion of the sludge is able to be recycled.

Preliminary investigations by the Proponent undertaken to assess the suitability of the sludge as a processing input to a local facility have indicated that it may be suitable. If the processing option is not considered feasible then the sludge will be sent to an approved landfill facility following the analysis of the sludge, and in liaison with the DEWCP.

The Proponent is also currently investigating technologies that:

- can use the sludge as feed material;
- produce a pre-reduced or partially metallised product for feed to the SRV; and
- recover the heavy metals (Zn, Pb and Cd) in a concentrate suitable as feed to a smelter or refinery.

An example of such technology is the Primus® Multi Hearth Furnace being developed by Paul Wurth Technology (of Luxembourg) (Freiden, 2000). In 2001, HIsmelt sent some iron ore and coal to be trialled at the Multi Hearth Furnace test facility. Modules of the Multi Hearth Furnace may be included in the Stage 2 Plant design once the composition of the sludge from Stage 1 is known and an assessment of the suitability of the Primus technology has been undertaken.

Waste Refractory Materials

It is currently planned that the worn magnesia–chromite refractory lining will be sent to an approved landfill as the chromium content generally precludes it use as an aggregate in construction applications. The class of landfill will be determined at the time of disposal through consideration of the material chemical analysis and the results of leaching tests. Methods of recycling of this material will continue to be explored in order to reduce the quantity of solid waste from the site going to landfill.

The alumina refractories contain no potentially harmful constituents. When these materials are replaced it is expected that they will either be recycled for use on-site or directed to a waste management facility for processing into an aggregate material.

Commitment

The Proponent will prepare a Waste Management Plan based on the principles of Reduce, Recycle and Re-use. The Waste Management Plan will be a component of the site EMP, which will be submitted to the DEWCP prior to commissioning.

The Proponent will implement the Waste Management Plan during the operations of the Project.

7.11.2 Process Wastewaters

Issue

The main wastewater generated by the Plant will be scrubber blowdown from the clarifier circuit, which has the potential to contain high concentrations of TDS and some heavy metals.

The ASUs will produce only small amounts of wastewater, which will be returned to the HIsmelt Plant's water circuit.

Management

The blowdown from the Plants will be directed to the process water tank from where it will be used for the cooling of the slag and pig iron. The water balance for the Plant (see Figure 4.10) shows that during normal operations, with the exception of extreme rainfall events, no process effluent will require disposal off site. Additional make-up water will be required as the blowdown from the water circuits will be insufficient to match the quantity required for the cooling of the pig iron and slag.

The existing clarifier basin for the HRDF will be used as the process water tank as discussed in Section 7.8.

Contact blowdown and stockpile runoff will be treated with lime to raise the pH to around 8.0 as it enters the process water tank so that any residual heavy metals will precipitate. The precipitates, together with suspended solids in the stockpile runoff, will settle in the cone section of the tank. The resulting sludge will be pumped out periodically using the underflow pumps and then be de-watered in a filter system.

Estimates of the effluent composition at the intake and with dilution from stormwater where the process tank was 25%, 50% and 75% full at the commencement of a major rainfall event are presented in Table 7.22. For estimation purposes the stormwater has been assumed to be free of dissolved species as the concentrations in the water will not significantly change the estimate of the effluent composition.

Table 7.22

Estimated Effluent Composition at Intake and Overflow

Analyte	Intake	% Process Water in Tank Prior to Stormwater Input and Estimated Overflow Composition		
	ppm	25%	50%	75%
Na	1606	402	803	1205
K	839	210	420	630
Cl	2060	515	1030	1545
F	94	24	47	71
S(SO4)	1	<	1	1
Zn	<	<	<	<
Pb	<	<	<	<
Cd	<	<	<	<
Fe	3	1	2	2
Ca	36	9	18	27
Mn	<	<	<	<
Ni	<	<	<	<
B	<	<	<	<
P	<	<	<	<
Cr	<	<	<	<
Mg	<	<	<	<
Al	1	<	<	<
Si	14	4	7	11
Cu	<	<	<	<
Mo	<	<	<	<
Ba	<	<	<	<
Co	<	<	<	<
TSS	100	100	100	100

Note: < expected to be less than ANZECC criteria

It should be noted that where the < sign is presented in Table 7.22 this implies it will be less than the ANZECC criteria for discharge to marine environments, the relevant criteria being that applicable for the Sepia Depression where the outfall is located. Note also that the disposal of industrial effluent through the Point Peron outfall will be the subject of an environmental impact assessment as part of the Water Corporation's Kwinana Wastewater Recycling Project. Advice from the environmental section of the Water Corporation is that the mixing zone of the outfall is a highly disturbed zone according to the ANZECC criteria but outside the mixing zone the applicable criteria is for a slightly - moderately disturbed system (Water Corporation, *pers.comm.*2002).

Monitoring

Water in the process water tank will be sampled and analysed for a range of relevant parameters on a monthly basis in order to provide baseline analysis of the process water for the first three years of operation. Following this period monitoring will be undertaken on a quarterly basis. Data will be recorded to allow a correlation of process water quality with Plant operations and rainfall.

In the event that water from the process tank is to be discharged through the Water Corporation's Point Peron outfall, the discharge will be sampled and analysed and the results will be provided to the Water Corporation. The sampling and analysis will be undertaken as stipulated by the Water Corporation in its conditions allowing industrial effluent from the HIsmelt Plant to be discharged through the Point Peron outfall.

Commitments

The Proponent will sample and analyse water in the process water tank for a range of relevent parameters on a monthly basis for the first three years of operation.

From the fourth year of operation, the water in the process water tank will be sampled and analysed by the Proponent on a quarterly basis.

In the event that water from the process water tank is to be discharged through the Water Corporation's Point Peron outfall, the Proponent will sample and analyse the overflow from the process water tank and the results will be provided to the Water Corporation.

7.11.3 Sewage

Issue

Nutrients such as phosphorus and nitrogen species have been identified as the major contaminant load in Cockburn Sound. Discharge from inappropriately designed septic systems is a potential source of such nutrients.

Management

The Water Corporation's, or a local, sewer network do not currently service the site and there is no possible point with which the site could be linked in the Naval Base vicinity (Water Corporation, *pers. comm.*, 2002b). Consequently, the site will have to continue to use septic type systems for the treatment of sewage on site. The two existing septic systems on site will be replaced with Nutrient Retentive Sewerage Systems following approval from the Environmental Health Section of the Town of Kwinana and the WA Health Department. This type of system is similar to common systems in that it involves a below ground tank and leach drains. However, the process that takes place inside the tank reduces the quantity of nitrogen and phosphorous in the effluent stream. The system will not result in any unpleasant or offensive odours.

Commitment

The Proponent will install appropriate Nutrient Retentive Sewerage Systems on the site. Prior to installation, approval for the System will be obtained from the Town of Kwinana and the Health Department of Western Australia.

7.12 SITE CONTAMINATION

Site contamination issues can be divided into the following two components:

- the identification, management and disturbance of existing contamination on the site; and
- the potential for the Project activities to contaminate soil and groundwater on the site.

7.12.1 Existing Site Contamination

Issue

The site has been extensively investigated for soil and groundwater contamination as discussed in Section 5.8.1. The areas of known contamination that are within the Project Area for the Stage 1 and Stage 2 Plants are:

- an area of known hydrocarbon contamination in the proximity of the now decommissioned oil pipeline to the AIS power station (demolished in 1992) which is located in the proposed stockpile area; and
- areas of minor hydrocarbon contamination in the vicinity of the existing above surface storage tanks for diesel located on the site.

Management

A Stage II site assessment for on-site contamination will be undertaken prior to commencement of construction. The aim of the assessment will be to determine the extent of known contamination, and to identify other areas of contamination that may be disturbed by Project activities. Should any contaminated areas have the potential to be disturbed during construction and/or require remediation, a Remediation Plan will be prepared in conjunction with Landcorp prior to construction. All remediation work will be undertaken in an environmentally acceptable manner consistent with the DEP's Guidelines for Contaminated Sites (DEP, 2000d). Remediation would be undertaken to achieve the appropriate clean up standards for the proposed land use.

7.12.2 Potential Contamination due to the Project

Issue

The Project has the potential to cause contamination of the soil and groundwater on the site from the:

- storage, use and disposal of process wastewaters;
- stockpiling of raw materials;
- storage, use or spillage of hazardous materials; and
- contaminated surface water runoff and washwaters.

Management

Process wastewater will be stored in a process water tank located as shown on Figure 4.2, prior to its use for the cooling of the pig iron and slag. The existing clarifier established for the HRDF will be used as the process water tank. The existing clarifier is constructed of concrete and is designed to ensure that there is no seepage. The design of the tank is discussed in Section 7.11.2.

The cooling of the pig iron will be undertaken by a series of water sprays of process water as discussed in Section 4.12.1. Most of the water will evaporate and any surplus water will be collected by a series of drains and returned to a sump at the pig caster. Water level detectors will control the volume of water in the sump. When the level is low, water will be pumped from the process water tank to the sump. Should the water levels increase to a high level, due to an influx of stormwater, the water will be pumped back to the process water tank to avoid an overflow of the pig caster sump.

Process water will also be used to spray cool the slag in the slag pit area. The slag pits will be lined with an impermeable clay layer to prevent seepage of surplus water into the soil and groundwater. Most of the water used for cooling will evaporate with the remaining water draining to a concrete sump located at the end of the pits. The water from the sump will be returned to the sprays. Level detectors will control the volume of water in the sump. When the water level in the sump is low, water will be pumped from the process water tank to the sump. Should water levels increase to a high level, due to an influx of stormwater, water will be pumped back to the process water tank to avoid an overflow of the slag pit sump.

The stockpiles will be designed to minimise the potential for leachate and runoff to impact on the groundwater. The stockpiles area will be designed with a base of compacted low permeability material such as clay, crushed slag or a synthetic liner. The decision on the most appropriate base material will be made during the detailed design phase of the Project in liaison with the authorities.

The stockpile area will have a drainage system which collects runoff and directs it to the process water tank as discussed in Section 7.8 together with the management for other contaminated surface water runoff and washwaters.

Hazardous Materials management is addressed in Section 7.10.

7.12.3 Monitoring

Groundwater monitoring is currently undertaken at the site as discussed in Section 5.7.2, and the programme will continue and be extended as discussed in Section 7.8.

Commitment

The Proponent will undertake a Stage II site assessment to identify on-site contamination prior to the commencement of construction.

A Remediation Plan will be prepared for any contaminated areas on the site that have the potential to be disturbed by construction, and require remediation, in conjunction with Landcorp prior to construction.

7.13 FLORA AND VEGETATION

As the site has been extensively cleared and used for industry for decades, there will be no additional impact on native flora or vegetation.

7.14 FAUNA

Due to the degraded nature of the site and lack of suitable faunal habitats there is unlikely to be an impact on any native fauna in the area.

7.15 MARINE ENVIRONMENT

7.15.1 Issues

The site is located on the eastern foreshore of Cockburn Sound. Cockburn Sound is the most intensively used marine embayment in Western Australia as discussed in Section 5.12.

The competing uses place an increasing pressure on the Sound therefore there is a need to manage these complex multiple uses and the associated impacts. Direct industrial discharge and contaminated groundwater entering the Sound has resulted in contamination (see Sections 5.12.3 and 5.12.4).

Raw materials required for the HIsmelt Process and the pig iron product will be shipped through Cockburn Sound. The shipping and unloading of these materials has the potential to impact on the marine environment of the Sound.

The significant issues associated with the shipping and loading and unloading operations in Cockburn Sound are due to contamination from:

- Dust (Section 7.5.5).
- Tributyltin (Section 7.15.4).
- Ballast water (Section 7.15.5).
- Oil spills (Section 7.15.6).
- Spillage of materials (Section 7.15.7).

7.15.2 General Management

Fremantle Ports will be responsible for the management of shipping in Cockburn Sound and the material transfer operations at the KBB2. The following sections discuss the general issues and management of the shipping activities related to the HIsmelt Project. Issues relating to shipping traffic are presented in Section 7.16.3. The issues of dust and noise from the shipping operations were addressed in Sections 7.5.5 and 7.6.5, respectively.

The planning and management of marine waters is guided by a range of strategies at the national and state level. These include:

- National Strategy for Ecologically Sustainable Development (Commonwealth of Australia, 1992);
- National Strategy for the Conservation of Australia's Biological Diversity (Commonwealth of Australia, 1996);
- Biological Diversity (Commonwealth of Australia, 1998);
- National Water Quality Management Strategy. Paper No.4 (ANZECC/ARMCANZ, 2001); and
- Environmental management framework for Perth's coastal waters.

7.15.2.1 Cockburn Sound Environmental Protection Policy

In response to the increasing pressures on Cockburn Sound, the Cockburn Sound Management Council (CSMC) was established by Government in August 2000 to coordinate environmental planning and management of Cockburn Sound and its catchment. The EPA, together with the CSMC, has developed a draft EPP for Cockburn Sound (EPA, 2001) which outlines the environmental values, objectives and criteria for managing Cockburn Sound. The environmental values and objectives were identified in "Perth's Coastal Waters: Environmental Values and Objectives" (EPA, 2000). The HIsmelt site is located within the EPP terrestrial base catchment area (EPA, 2001c).

"The Cockburn Sound EPP broadly aims to:

- establish environmental values (EV), environmental quality objectives (EQO) and environmental quality criteria (EQC) for waters in Cockburn Sound;
- identify a program to protect the EV of Cockburn Sound;
- requires a response to any exceedances of the EQCs;
- integrate environmental planning and management for the land and marine environment for the Sound and its catchment;
- provide for the establishment of an Environmental Management Plan to coordinate appropriate actions and their management against agreed objectives;
- provide a mechanism for the Cockburn Sound Management Council to coordinate environmental management efforts; and
- provide for a monitoring framework and regular reporting on progress against objectives." (EPA, 2001c)

The EPA has incorporated the national strategies and principles into the Cockburn Sound EPP. Through the EPP, the EPA will establish the management framework to declare and protect the environmental values of Cockburn Sound, under the *Environmental Protection Act, 1986.*

The EPA is broadly adopting the national approach to water quality management detailed in the ANZECC/ ARMANCZ guidelines (ANZECC/ARMZNCZ, 2001). Using this approach the environmental values and objectives for Cockburn Sound have been determined and have formed the basis of the Cockburn Sound EPP. Three levels of protection have been defined in terms of structure and function which are shown in the draft EPP (EPA, 2001c). The levels of protection reflect the community's expectation that Cockburn Sound should be a healthy, abundant, and diverse natural environment, yet at the same time accommodate other valid societal uses such as industrial, development, shipping and harbours, even though they can lower environmental quality or preclude certain social uses in localised areas (EPA, 2000).

The EPA has also issued a Draft Environmental Quality Criteria Reference Document which provides the benchmarks to enable the policy to be implemented (EPA, 2001c). The Criteria Reference Document contains EQCs and decision schemes that explain how the EQC should be applied.

7.15.2.2 Cockburn Sound Environmental Management Plan

A draft EMP for Cockburn Sound and its Catchment has been prepared by the CSMC (CSMC, 2001) which details the following five point plan of action towards implementing the EPP:

1. Protecting the environmental values of Cockburn Sound.
2. Facilitating multiple use of Cockburn sound and its foreshore.
3. Integrating management of the land and marine environments.
4. Coordinating research and investigations.
5. Monitoring and reporting on performance.

In relation to the management area, the primary focus of the EMP is on the marine environment of Cockburn Sound. The EMP only deals with the terrestrial environmental issues that directly or indirectly impact on the water quality of Cockburn Sound, such as groundwater and surface water contamination. Any initiative to manage the marine waters must be fully integrated with the planning and management of land based activities in the catchment (CSMC, 2001).

The EMP:

- recognises and facilitates multiple use management of Cockburn Sound;
- incorporates the EQO and EQCs of the EPP; and
- fosters the integration of environmental planning and management of the land and marine environment.

EMP and Industry

The objectives of the EMP in relation to industrial use are to:

- ensure that industrial activities are managed in a manner that is consistent with maintaining Cockburn Sound's ecological and social values;
- recognise and facilitate industrial use as one of the multiple uses of Cockburn Sound and its foreshore; and
- work cooperatively with industry and the local community to integrate the requirements of industrial land use into the environmental planning and management in Cockburn Sound and its foreshore.

The key recommendations made by the CSMC relating to industry include the following:

- Incorporate the requirements of industry into the broader planning for Cockburn Sound and its foreshore.
- Work with Government departments, industry groups and local communities to implement environmental components of existing industrial management strategies for Kwinana.
- Support the proposal by the Water Corporation and Kwinana industries to recycle wastewater and eliminate industrial discharge (other than sea cooling water) flow to the Sound.

The Proponent will be guided by the principles of no net loss of ecological or social, function in Cockburn Sound as recommended in the EMP (CSMC, 2001).

EMP and Shipping

The objectives of the Cockburn Sound EMP in relation to shipping are to:

- Ensure that port facilities and shipping activities are managed in a manner that is consistent with maintaining Cockburn Sound's ecological and social values.
- Recognise and facilitate shipping activities and port facilities as one of the multiple uses of Cockburn Sound.
- Work cooperatively with the Department of Planning and Infrastructure, Fremantle Ports, jetty and harbour operators and the local community to integrate environmental planning and management of port facilities and shipping activities within Cockburn Sound.

7.15.3 HIsmelt Management

The Proponents management of the potential impacts on the marine environment from the shipping activities will include:

- the selection of reputable shipping contractors (see section 7.1.2);
- management by Fremantle Ports (see Section 7.1.3); and
- compliance with the Draft Cockburn Sound EPP and EMP (see Sections 7.15.2.1 and 7.15.2.2).

7.15.4 Tributyltin

Issue

Tributyltin (TBT) contamination is a concern in Cockburn Sound as high levels were found during surveys undertaken in 1994 and 1999 (refer Section 5.12.4). TBT is the active ingredient in antifouling paints used by the world's shipping fleets. TBT based paints offer up to five years protection against both the growth of organisms such as barnacles on the ships hulls and the spread of foreign marine organisms. TBT is highly toxic to a wide range of marine organisms and accumulates in marine sediments.

Management

Fremantle Ports' has produced a Fact Sheet on the Management of TBT Anti-Foulants in Western Australia (Fremantle Port Authority, 2001a). A copy is provided in Appendix I.

In 1991 the Western Australian Government, through the DEP, introduced legislation which banned the use of TBT paints on vessels less than 25m long and restricted its use to low leaching paints on boats over 25m. The Royal Australian Navy has banned TBT use on ships less than 40m long and is replacing TBT on war ships with copper-based paint. In 1998, the Fremantle Port Authority banned in-water hull cleaning within Port waters, which is consistent with the Australian and New Zealand Environment and Conservation

Council's (ANZECC) Code of Practice for Antifouling and In–water Hull Cleaning and Maintenance (ANZECC, 1997). The International Maritime Organisation has recently announced its intention to pursue an international ban on the application of TBT to ship's hulls from 2003.

The TBT levels in sediments in Cockburn Sound appears to be more related to shipping maintenance areas than shipping movements (D.A.Lord, 2001). DEWCP licences ship maintenance facilities to ensure that any toxic residues and discharges from hull cleaning activities are collected and disposed of at an approved landfill.

It is expected that even with increased shipping activities TBT levels in local marine sediments will reduce to levels that will not impact on the marine environment due to:

- the international and national initiatives to reduce and replace TBT paints are in place;
- the fact that TBT degrades naturally over time; and
- controls being in place to manage the accumulation that has occurred, predominantly related to hull cleaning (Fremantle Port Authority, 2001a).

7.15.5 Ballast Water

Issue

The use of seawater as ballast in ships presents an opportunity for marine organisms to transfer from one marine environment to another. Foreign marine organisms such as those discussed in Section 5.12, have been found in the waters of Cockburn Sound and have most likely entered through the discharge of ballast water or have been attached to ships hulls.

Management

Fremantle Ports' has prepared a fact sheet on Ballast Water Management in Western Australia (Fremantle Port Authority, 2001b). A copy is provided in Appendix I.

The Australian Quarantine and Inspection Service (AQIS) is designated as the lead agency for the ballast water management in Australia and has issued Mandatory Ballast Water Requirements (AQIS, 2001) which are enforced under the *Quarantine Act*, 1908.

The Requirements aim at reducing the risk of introducing exotic marine organisms into Australian waters. Management measures include:

- the exchange of ballast water at sea;
- no high risk ballast water being discharged in Australian ports or waters;
- the use of a "Decision Support System" which provides AQIS with details of ballast water uptake and the intended discharge whilst the ship is still at the last port of call or no later than five days prior to arriving in Australia.

The information provided through the System will enable a risk assessment to be undertaken on the ballast water in terms of introducing exotic species. No ballast water can be discharged in Australian waters without written permission from AQIS.

7.15.6 Oil Spills

Issue

Oil spills may result from vessel collisions, groundings, and during fuel oil transfer.

Oil can harm the marine environment by smothering marine life and can bioaccumulate in organisms thus affecting organisms higher in the food chain. Sea animals and birds can be harmed when their fur or feathers are covered with oil.

Management

Oil spill response capability is legislated at national, state and local levels. The Australian Maritime Safety Authority (AMSA) administers the National Plan to Combat Pollution of the Sea by Oil and other Noxious and Hazardous Substances.

Fremantle Ports' is required by legislation to have an oil spill response capability and they are well equipped and prepared to respond to any spills that occur within the vicinity of Fremantle Ports' waters (Fremantle Ports, *pers.comm.* 2001). Fremantle Ports has developed an Environmental Fact Sheet on their Oil Spill Response (Fremantle Port Authority, 2001c). A copy is provided in Appendix I.

The Fremantle Ports' Marine and Safety Plan discussed in Section 7.1.3.2 includes emergency preparedness and the Ports' Emergency Response Plan.

7.15.7 Spillage of Materials

Issue

There is the potential for spillage of the ore and coal being unloaded at the KBB2 to contaminate the environment.

Management

Fremantle Ports has considerable experience in the management of bulk cargoes and in minimising or eliminating spillage from cargo handling. Modifications made to the Fremantle Ports' Kwinana Bulk Jetty (formerly the Kwinana Bulk Cargo Jetty) are considered to be best practice for an existing facility (Fremantle Ports, pers. comm., 2001). The installation of a combination of deflector plates, bunding, sumps, recovery tanks and stringent operating procedures has resulted in an estimated 95% reduction in the amount of spillage at the Kwinana Bulk Jetty. Industrial sweepers and operational procedures ensure any spillage onto the wharf or onto land is recovered and returned to the product owner for recycling or appropriate disposal.

Using the Kwinana Bulk Jetty as a benchmark, Fremantle Ports will implement a plan to upgrade the existing transfer equipment at the KBB2 to the reasonable satisfaction of DEWCP to minimise the risk of material spillage onto land or water with a target of zero spill. The extent to which any modifications are necessary will be determined through the operation of the Kwinana Bulk Terminal and Prior to the commissioning of the HIsmelt Plant. Spillage prevention and/or containment will be incorporated into the design of any new equipment. Fremantle Ports' standard operating procedures for the cleanup of any spillage, which are documented as part of its certified EMS, will be applied (Fremantle Ports, *pers.comm.* 2001).

In the unlikely event of a significant spillage of ore and coal into the marine environment due to an accident or equipment failures, an immediate assessment of the potential impacts of the spillage will be conducted by Fremantle Ports and an appropriate recovery plan initiated. The facilities at the KBB2 will be incorporated in the Fremantle Ports' Marine Quality Monitoring Program in order to monitor for any contamination arising from material handling (Fremantle Ports, *pers.comm.* 2001).

7.15.8 Multiple Use

Issue

Competing uses of the marine and foreshore environment of Cockburn Sound needs to be balanced in an ecologically sustainable manner. The Sound's deep sheltered waters are used for:

- commercial and recreational activities;
- the support of a port;
- servicing a heavy industrial area; and
- a naval base.

Shipping operations from the Project have the potential to impact on the multiple uses of Cockburn Sound.

Management

CSMC recognises that industry is the primary use of the Kwinana area. Secondary uses include natural and cultural heritage with recreational and commercial uses being restricted in the Kwinana area.

The HIsmelt operations will not impact on the multiple uses of Cockburn Sound. This is supported by the Fremantle Ports who believe that the impacts of the increase in shipping to the Sound from this Project and other factors presented in Section 7.16.3, will be insignificant (Fremantle Ports, 2002).

7.16 TRANSPORT

7.16.1 Road

Issue

The Plant will be operated on two 12-hour shifts per day with around 16 people working on each shift. Assuming every person drives to the site then there would be an additional 64 employee vehicle movements per day. The Stage 2 Plant would require around the same number of employees therefore there would be an additional 64 movements for Stage 2. Other vehicles will also visit the site for various business reasons.

The estimated number of truck movements associated with the operation of the Plant for Stage 1 are summarised in Table 7.23. It is estimated that these numbers will conservatively double when Stage 2 becomes operational.

Table 7.23

Estimated Truck Movements

Material	Frequency (including return trips)	Truck Type
Lime	12 per day	B-Double
Lime Kiln Dust	2 per day	Silo tanker
Consumables	2 per day	Medium
Water Chemicals	2 per week	Medium
Slag	48 per day	Semi-Trailer (Tip)
Waste	4 per day	Semi-Trailer (Tip)
Gypsum	4 per day	Semi-Trailer (Tip)
Fuel	2 per week	Fuel Tanker
Total (estimated)	**73 per day**	
Stage 1 and Stage 2 (estimated)	**146 per day**	

The number of vehicle movements along the main roads that service the site are presented in Table 5.14. Counts at Leath Road in 1995 showed that the Annual Average Daily Traffic (AADT) on the road was 1657. Beard Street recorded an AADT of 2247 in 2000 with a heavy vehicle component of around 25% (Kwinana Town Council, *pers. comm.* 2002). Assuming that Leath Road also has a 25% heavy vehicle component, then there are 414 trucks per day using Leath Road and 561 trucks per day using Beard Street.

Based on the currently available data the increase on Leath Road would be 8.3% in total vehicle movements and a 17.6% increase in truck movements for Stage 1. The increase in total vehicle movements for both the Stage 1 and Stage 2 Plants operating would be 16.5% with an increase of 35.2% in heavy vehicles on Leath Road. The increase in total vehicle movements on Beard Street would be 6.1% with an increase of 13% in heavy vehicle movements for Stage 1. At this stage the estimated increase in total vehicle movements for Stage 1 and Stage 2 operating would be 12.2% with a 26% increase in heavy vehicles on Beard Street. It is planned to commission Stage 1 in 2004 with the potential Stage 2 Plant being commissioned in 2007. Therefore the actual percentage increase in traffic and heavy vehicles is likely to be lower than currently estimated due to increased traffic at the time of commissioning the Plants.

The counts on Rockingham Road at the rail bridge south of Beard Street are around 38000. The heavy vehicle component for Rockingham Road (south of Russell Road) is 12% (Main Roads, 2002) which can be calculated at around 4560 trucks per day. The Project will increase the heavy vehicles on Rockingham Road by around 1.6% for Stage 1, and up to 3.2% with Stage 2 operating.

Management

The increase in road traffic due to the Project is not expected to have a significant impact on the roads servicing the site. The Rockingham Road/Beard Street intersection is where all trucks will enter into Beard Street. Main Roads WA has advised that the additional truck movements due to the Project will not have a significant impact on the operation of this intersection.

7.16.2 Rail

Issue

There will be five trains per week transporting ore from Koolynobbing to Forrestfield and then from Forrestfield to the Kwinana site for Stage 1 as discussed in Section 4.5.1. There will be five return empty train movements per week resulting in a total of 10 train movements per week for Stage 1. The trains will comprise a locomotive and 39 wagons and will be approximately 600m long. If Koolyanobbing ore is also used for the Stage 2 Plant then the number of train movements may double or the number of wagons may be increased. If Stage 2 proceeds and the same quantity of ore is sourced from Koolyanobbing and the same length trains are used then there would be an additional 10 train movements per week for the Stage 2 operations. The trains will utilise the existing railway line as discussed in Section 5.15.2.

Management

The numbers of existing train movements per week supplied by Australian Rail Group (Australian Rail Group, *pers. comm.*, 2002) for the sections of rail between Koolyanobbing and Kwinana are presented in Section 5.15.2. The percentage increase for each section is presented in Table 7.24.

Table 7.24

Increase in Rail Movements from the Transport of Ore

Rail Section	Percentage Increase in Rail Movements[1]	
	Stage 1	Stage 1 and 2[2]
Koolyanobbing to Merredin	9	18
Merredin to Northam	7	14
Northam to Forrestfield	4	8
Forrestfield to Kwinana	4	8

Notes: 1 Percentage increase in rail movements as at April 2002.
2 Assuming that an equal amount of ore is sourced from Kollyanobbing for Stage 2.

However, the number of existing train movements provided by Westnet included those that currently service the BHP Transport Logistic operation adjacent to the HIsmelt site. Landcorp has purchased the BHP site. BHP's Transport Logistic business will be relocated at the end of 2003. There are currently around 7 train movements per week servicing the BHP Transport Logistics business. The trains transport mainly steel and are between 600 and 800m in length (BHP, *pers, comm.*, 2002), which are a similar size to those proposed to transport the ore for the Project. The net increase of train movements due to the Project will be an additional three movements per week for Stage 1 (an increase of 1%) and 13 movements per week for both the Stage 1 and Stage 2 Plants operating (an increase of 6%).

The issues and management relating to dust and noise associated with the rail transport of ore were discussed in Sections 7.5.4 and 7.6.8, respectively.

7.16.3 Shipping

Issues

There will be an estimated additional 30 to 50 ship movements in Cockburn Sound for each stage of the Project. The actual number of ships will depend upon whether the raw material ships are backloaded with pig iron and the quantity of ore that is shipped for the Stage 1 and Stage 2 Plants. Based on these estimates and the shipping numbers for 2000 presented in Section 5.15.3 as 967 (including 232 naval vessels), shipping to the Sound will increase by around 3% to 4% for Stage 1 and 6% to 8% when Stage 2 comes into operation. If Stage 2 proceeds and the number of ships is equivalent or greater than those proposed for Stage 1 then the Fremantle Ports' KBB1 will be required to be recommissioned to accommodate the additional shipping to the Ports' Kwinana Bulk Terminal.

In addition to the increase in ship numbers due to the Project, shipping into Cockburn Sound may also increase due to:

- general growth in current shipping levels predicted to be 5% (35 vessels) per year;
- a 25% (50 vessels) increase in Navy ships by 2004;
- 120-130 ships for the James Point Stage 1 development;
- the establishment of the Fremantle Ports Outer Harbour; and
- recreational boating (CSMC, 2002).

Fremantle Ports' has estimated that the projected increase in ship numbers for the next ten years (excluding Fremantle Ports' proposed Outer Harbour development, which if it proceeds will be subject to a separate cumulative impact assessment) is likely to be around 50% (Fremantle Ports, 2002).

There is a concern that the growth in shipping levels to Cockburn Sound will increase the loading of TBT into the Sound and also increase the risk of introducing toxic species from ballast water discharge as discussed in the EPA's Strategic Environmental Advice of the Marine Environment of Cockburn Sound (EPA, 1998a). The issues of the increased potential for oil spills and spillage of materials due to the cumulative increase of shipping to the Sound has been identified by the CSMC (CSMC, 2002).

Management

The management associated with the potential impacts of shipping on Cockburn Sound are addressed in Section 7.15.

If recommissioning of KBB1 is required, then Fremantle Ports will seek environmental and other required approvals prior to recommissioning and the commencement of shipping operations at KBB1 (Fremantle Ports, *pers.comm.* 2001).

Fremantle Ports' believes that there will be no significant impacts from the predicted cumulative increase in shipping to Cockburn Sound. The number of ship visits, which is currently just less than 1000 per annum, is relatively low compared to other commercial ports (Fremantle Ports, 2002).

TBT management is discussed in Section 7.15.4 and this management applies to all ships visiting the Sound.

Fremantle Ports' does not expect any significant risk of introduced marine pests from ballast water as the AQIS Mandatory Ballast Water Requirements are enforced (see Section 7.15.5) (Fremantle Ports, 2002). HIsmelt will aim to charter ships that carry materials to the Sound and then can be backloaded with pig iron product. This would:

- avoid the exchange of ballast water;
- minimise the number of ships entering the Sound; and
- would reduce costs.

Oil spill management is addressed in Section 7.15.6. Fremantle Ports has trained teams and the required equipment to clean up any oil spills that may occur in the Sound.

Fremantle Ports advised that the risk of spillage of bulk materials handled over its facilities is very low (Fremantle Ports, 2002). This is supported by comments made in a DEWCP audit report on the Fremantle Ports' Kwinana Bulk Jetty operations (KBB3 and KBB4), which stated "spills or dust losses to the marine environment appear to be kept to an absolute minimum" (Fremantle Ports, 2000). The management of spillage of materials is discussed in Section 7.15.7.

Fremantle Ports' advised that commercial shipping operations are a very low contributor to the input of contaminants to the Sound compared to all other sources (Fremantle Ports, 2002). For example the Pressure State Response Report (D.A. Lord & Associates, 2001) identified that commercial shipping contributed approximately 2% of nutrient loadings to Cockburn Sound.

8. SOCIAL ISSUES AND MANAGEMENT

8.1 GENERAL

Social issues are those issues that have the potential to impact on the community. The Proponent considers the social issues to comprise all the issues raised by the community during the extensive consultation programme conducted during the EIA Process. HIsmelt will continue to liaise with the community during the development, construction and operation of the Plant. The issues raised are presented in Section 6 and a more detailed outcome of the consultation is presented in Appendix F.

Many of the issues raised are addressed in other sections of the PER, particularly in Section 7 (Environmental Issues and Management). The remaining issues that have the potential to impact on the social environment are discussed in this section.

HIsmelt (Operations), as part of the Rio Tinto Group, will produce publicly available Annual Social and Environmental Reports which will detail its performance in environmental, community and safety aspects.

Commitment

The Proponent will continue to liaise with the community and other stakeholders during the development, construction and operation of the Plants.

8.2 SOCIO-ECONOMIC

The Project will have regional and local benefits on the social environment by providing direct and indirect employment opportunities and other economic advantages brought to the state and region by establishing a HIsmelt Plant in Kwinana, Western Australia. The economic benefits are discussed in Section 2.

The construction workforce is expected to peak at around 320 with an average of around 230 for a period of 24 months. Stage 1 of the Project will provide up to 65 full time positions, with an additional 60 positions for Stage 2. The breakdown of the workforce for Stage 1 of the Project is provided in Table 4.10. In addition to the permanent workforce, there will be maintenance and service providers and many other indirect employment opportunities associated with the Project.

Much of the Plant is expected to be fabricated at the local engineering businesses, which will again provide direct and indirect employment benefits.

Kwinana and Rockingham have a high percentage of tradespersons and related workers (see Section 5.14.2.3). These trades will be valuable for the construction and operational phases of the Project, as workers can be directly or indirectly employed through local suppliers.

Unemployment figures from the Department of Employment and Workplace Relations estimate for June 2001 show there was a 12.6% unemployment rate in Kwinana, and 9.1% in Rockingham. These unemployment rates are higher than those estimated for the total South West Metropolitan Region of 7.2% (see Section 5.14.2.3).

The Kwinana Industries Council (KIC) and the Chamber of Commerce and Industries Council of WA (CCI) in association with the MPR, Department of Planning and Infrastructure, LandCorp and Environment Australia commissioned an economic impact study on heavy industry in Kwinana. At the time of preparing the PER the economic study report was in draft form (Sinclair Knight Merz, 2002b) and was provided to the Proponent by the CCI to assist in the socio–economic assessment of the Project. The major findings of the study show that Kwinana industries:

- have a major positive impact on the Western Australian economy through their large operational and capital expenditures;
- link to the energy, minerals and agricultural industries of the State, as suppliers of essential inputs and as value-adding processors of primary outputs;
- make a major positive contribution to Australia's international balance of payments through exports and import replacementing;
- create a much larger amount of employment than their direct employment through multiplier effects;
- produce a much larger amount of income than the wages and salaries of their employees through multiplier effects, dividends and payment of taxes;
- generate significant benefits to the local community by providing employment, employee training and sponsorship of community activities; and
- demonstrate an increasing level of environmental performance and initiative which benefits the local community (Sinclair Knight Merz, 2002b).

All of the above benefits will be relevant to the HIsmelt Project in Kwinana.

The heavy industry economic study also determined economic multipliers for nine Kwinana industry groups. The two types of multipliers applied in the economic study were:

- ***"Type I multiplier*:** this is the output, employee income or employment that is generated directly in the activity ***plus*** the outputs, income or employment generated through the industries and services that supply inputs to the activity, ***divided*** by the amount of output, income or employment generated directly in the activity.
- ***Type II multiplier:*** this multiplier takes account not only of the output, employee income or employment in supplying activities, but also includes the output, employee income and employment generated when employees' incomes from both the activity itself and its suppliers are spent, thus increasing activity throughout the economy " (Sinclair Knight Merz, 2002b).

Table 8.1 presents the output (sales), earnings and employment multipliers for the average of the nine combined Kwinana industry groups as determined in the economic study.

Table 8.1

Output (Sales), Earnings and Employment Multipliers Average for all Kwinana Industry Groups

Type I Multiplier			Type II Multipler		
Total Output	**Wages and Salaries**	**Employment**	**Total Output**	**Wages and Salaries**	**Employment**
1.51	1.66	3.37	1.75	2.04	4.60

Source: Sinclair Knight Merz, 2002b

In addition to the output, employee incomes and jobs that are generated by industry in Kwinana the economic study has also considered the impacts of capital investment. The report presented the multiplier effects of an annual capital investment of $300M (the actual annual average between 1995-1996 and 1999-2000) by Kwinana industries these are presented in Table 8.2.

Table 8.2

Direct and Indirect Effects of Capital Investment Undertaken by Kwinana Industries Annually (Based on Annual Average Investment for 1995-1996 to 1999-2000)

	Output ($M)	Wages and Salaries ($M)	Employment (jobs)
Direct Effect	300	78	3092
Total Production Effect (Type II)	474	117	4669
Total Effect (Type II)	627	144	5875
Type I Multiplier	1.58	1.50	1.51
Type II Multiplier	2.09	1.85	1.90

Source: Sinclair Knight Merz, 2002b

The multipliers in Tables 8.1 and 8.2 could be applied to the HIsmelt Project.

8.2.1 Fishing

Issue

There are four commercial fisheries that operate within Cockburn Sound and another two which operate partly in the Sound (CSMC, 2001). Mussel farming is also undertaken in Cockburn Sound. Cockburn Sound is also popular for recreational fishing and crabbing. Fishing and aquaculture are recognised as some of the multiple uses of Cockburn Sound.

The main requirements of the fisherman are for continued beach access, healthy fish stocks and clean relatively unpolluted and productive waters. Both commercial and recreational fishing are generally compatible with other users, with the current controls and the level of management in place (CSMC, 2001).

The increased shipping activities due to the Project and other factors presented in Section7.16.3 has the potential to impact on commercial and recreational fishing in Cockburn Sound.

Management

The HIsmelt operations will not impact on the current access to the beach or the waters in Cockburn Sound. The management of impacts associated with the shipping operations will be coordinated by Fremantle Ports (see Section 7.1.3, 7.15 and 7.16.3).

Fremantle Ports has advised that the increase in shipping operations due to the Project and the cumulative increase predicted for the Sound will not impact on fishing activities in the Sound. Currently more than 1000 ships per year visit Fremantle Inner Harbour which is a much smaller area of water that is used for shore based, river and ocean fishing. There is little (if any) impact of comercial shipping operations on fishing activities (Fremantle Ports, 2002).

8.3 VISUAL AMENITY

Issue

The HIsmelt Plants and associated facilities have the potential to impact on visual amenity. The Plants will be located at the HIsmelt site where the HRDF is constructed. Photographs were taken from vantage points along Rockingham Road at:

- Beard Street intersection; and
- Anketell Road intersection.

A 3D model of the Plants was superimposed on these photographs as shown on Figure 8.1. The before and after views show that the Plants can be seen form these vantage points but there will be no significant impact to the viewscape of the area.

Management

The photographs indicate that the Plant is unlikely to impact on visual amenity in the area. Screening vegetation will be established around the Plant site to act as a site buffer for visual, dust and noise aspects.

Commitment

The Proponent will establish screening vegetation around the Plant site to act a site buffer.

HIsmelt®

Kwinana HIsmelt Process Plant
PUBLIC ENVIRONMENTAL REVIEW

View from Beard Street Intersection

View from Anketell Road Intersection

PHOTO VIEWS OF THE STAGE 1 AND 2 PLANTS

Figure 8.1

8.4 RECREATION, TOURISM AND AESTHETICS

Issue

The Plant site is located within the KIA and near Cockburn Sound. The KIA is not an area considered high for tourism with the exception of when visitors may wish to inspect industrial plants. Raw materials for the Project will be shipped through the Sound. The increase in the number of ships and the potential contamination for the shipping activities may impact on the recreation, tourism and the aesthetics of Cockburn Sound.

Cockburn Sound with its easily accessible, sheltered waters, diversity of marine and coastal habitats and proximity to Perth provides a range of opportunities for people to enjoy the marine environment (CSMC, 2001). The Sound provides a sheltered expanse of water for small motor boats, yachts and sail boards, particularly when strong sea breezes can make off shore conditions hazardous (CSMC, 2001). Recreational fishing is also conducted in the Sound both from boats and beaches (see Section 8.2.1)

Dolphin tours currently operate in Cockburn Sound, which are generally compatible with the other uses. However there are times when the dolphin tours may be impacted by encroaching on shipping, naval and industrial activities. For example, restricted areas have long been designated around commercial jetties to provide for exclusion of other marine craft on the infrequent occasions that hazardous cargoes are handled. Any such exclusions are of limited duration and implemented only when necessary for the safety of the public and of the cargo handling operation. It should be noted that there are no hazardous cargo shipments associated with the HIsmelt Project (Fremantle Ports, 2002).

The café strip and public walkways at Palm Beach in Rockingham are popular with locals and tourists and the enjoyment of this area depend on the scenic value of the coastal features, the clarity of the water and the ambience of the area.

A study was undertaken for the CSMC on the development of aesthetic criteria, particularly in relation to water pollution, by Cleary in 2001 and was reported in the EMP (CSMC, 2001). The Cleary study reports that the interplay between existing natural and cultural characteristics, and the experience and enjoyment people derive from them, creates the aesthetic values of the Sound. Clean water is an essential attribute to the recreational and aesthetic values of Cockburn Sound.

Development may threaten aesthetic values by restricting access, affecting water quality, creating conflicts between uses and users, degrading natural and cultural features, reducing the extent of natural areas, and spoiling views (CSMC, 2001).

Management

HIsmelt's operations will not have an adverse impact on existing recreation, tourism and aesthetics in the Kwinana area. The additional shipping operations, to be managed by Fremantle Ports, will have no significant impact on the recreation, tourism and aesthetics aspects of Cockburn Sound. Commerical shipping numbers should be viewed in context as there is a total of 1000 commercial ship visits per year represents an average of approximately three ships per day. Each ship has a transit time in Cockburn Sound of approximately one hour, hence the potential conflict with recreation, tourism and aesthetics is considered very low (Fremantle Ports, 2002).

There are expected to be a large number of visitors to the Kwinana Plant as members of the world steel industry inspect the HIsmelt Process and Plant.

The CSMC in its EMP recommended that strategies be developed together with the Department of Planning and Infrastructure and Fremantle Ports to manage conflict between tour operators and shipping and port operations within the Sound (CSMC, 2001).

The aesthetics of the marine environment will be maintained by ensuring that the unloading of ore and coal from the ships is managed so it does not result in dust contaminating the marine waters (see Section 7.5.5).

8.5 ABORIGINAL HERITAGE

The site of the Plant is within the KIA, which has been used by industry for decades. The site has been cleared and much of it has been filled with industrial and processing wastes.

There are no Aboriginal sites within the Plant site area recorded on the Department of Indigenous Affairs database.

If construction activities uncover any Aboriginal artifacts or skeletal remains, then work in that area will cease and the Department of Indigenous Affairs will be notified in accordance with the *Aboriginal Heritage Act, 1972.*

Commitment

If construction activities uncover any Aboriginal artifacts or skeletal remains then the Proponent will notify the Department of Indigenous Affairs in accordance with the **Aboriginal Heritage Act, 1972.**

9. RISK AND HAZARDS

9.1 ISSUE

Any chemical or pyro-metallurgical process, such as the HIsmelt Process, may have a number of potential hazards including:

- raw material and intermediate toxicity and reactivity;
- energy releases from chemical reactions;
- high temperatures and pressures; and
- quantity of material used.

9.2 RISK MANAGEMENT

The design philosophy being adopted for the Plant will ensure that all potential hazards are identified and appropriately addressed at an early stage of Project development. This will result in the development of a Plant that is safe to operate (from both an internal and external perspective), environmentally acceptable and commercially viable.

The Plant, once operating, will be required to comply with the following guidelines as a minimum:

- **Jurisdiction and Expectations of the Department of Mineral and Petroleum Resources, Western Australia**

  The Plant site is classified as a mine site and is under the jurisdiction of the *Mines Safety and Inspection Act, 1994,* which is administered by the MPR.

  The Mines Inspectorate Branch of MPR ensures that the mining and petroleum industries protect the health and safety of their employees. The main strategies for ensuring safety are regulation under the *Mines Safety and Inspection Act, 1994* and through education. However, for new plants the Mines Inspectorate also have a role in reviewing the plant's design prior to construction to ensure that the plant meets its minimum requirements. In addition a Project Management Plan (PMP) must be submitted to the Mines Inspectorate once Works Approval has been obtained.

- **Rio Tinto's Occupational Health, Safety and Environment (OHS&E) Expectations**

  Rio Tinto has very clear policies on, and recognises the importance of managing its health, safety and environmental responsibilities and that these are considered essential to the long-term success by minimising adverse impacts these may have on the community. Rio Tinto's philosophy is set out in its policy document " *The Way We Work*" (www.riotinto.org), in which it clearly decrees how these objectives will be achieved, and the minimum requirements all subsidiaries, which includes the Proponent, must meet in implementing the Rio Tinto Health, Safety and Environment policy.

It is important to emphasise that the Rio Tinto standards will be implemented as a minimum level of compliance unless:

- **HIsmelt** demands an equal or higher standard be used;
- **Legislation** demands a higher standard be used; or
- **Operational experience** demands a higher standard be used.

In order to achieve the above requirements and expectations the following risk management steps will be implemented.

- Appointment of an engineer with expertise in the design, construction and commissioning of iron making plants (the engineering will be performed by a Kvaerner/Clough Joint Venture, Kvaerner has globally recognised expertise in the iron and steel sector).

- The scoping document that the engineer must work to will specify that the design must be consistent with relevant Australian Standards as a minimum.

- HIsmelt has adopted the six-stage, ICI developed, technique for studying plant and process design, primarily at the pre-construction stage, called Hazard and Operability (HAZOP) Study.

- Development of a Site Safety Management Plan.

- Development of Emergency Response Procedures, including the establishment and maintenance of an Emergency Response Team, to respond to and minimise the impact of Process related incidents on site.

Commitments

The Proponent will undertake HAZOP studies as part of the design, construction and operation of the Plants. The findings of the HAZOP studies will be submitted to the MPR.

The Proponent will prepare Site Safety Management Plans, as part of the Project Management Plan for the site, which will be submitted to the MPR prior to construction and commissioning.

The Proponent will develop Emergency Response Procedures, which will include the establishment and maintenance of an Emergency Response Team. The Procedures will be provided to the Kwinana Industries Mutual Aid group.

9.3 HAZOP OPERABILITY STUDIES

9.3.1 Study Technique

A HAZOP study is a systematic technique to identify potential hazards and operating problems, which involves a multi-disciplinary team methodically 'brainstorming' the plant design. The objective of the study is to:

- facilitate smooth, safe prompt start up;
- minimise extensive last minute modifications; and
- ensure trouble-free long term operation.

The HAZOP procedure takes a full description of the process and systematically questions every part of it to discover how deviations from the design intent can occur.

9.3.2 The Six Stages of the HAZOP Process

Hazard Study 1.

Hazard Study 1 is carried out in the Process Development stage and considers safety, health and environmental issues that relate to the materials alone. Key aspects of Study 1 are to:

- identify hazards associated with the process chemicals and materials;
- identify major environmental problems and assess suitability of proposed sites;
- establish acceptable criteria for hazards where appropriate;
- decide on authorities to be consulted, standards and regulations with which to comply, and codes and practices to be used; and
- review information on previous hazardous incidents.

Hazard Study 2.

Hazard Study 2 is carried out in the Process Definition stage, or once it has been agreed that the process is feasible, and considers hazards from Plant items and equipment. Key aspects of Study 2 are to:

- examine plant items and equipment on process flow diagram and identify significant hazards;
- identify areas where redesign is appropriate;
- assess Plant design against relevant hazard criteria; and
- prepare an environmental impact assessment.

Hazard Study 3

Hazard Study 3 is carried out in the design stage when most of the detail is available with the interconnecting of the plant by lines. This study completes all Hazard Studies on the design of the Project. The key aspect of Study 3 is the critical examination of Plant operation on firm engineering diagrams, operating instructions, maintenance methods, transient operating conditions and emergencies.

Hazard Study 4

In order to ensure that the Plant complies with both design and legislative safety requirements, Hazard Study 4 will be undertaken during procurement. The key aspect of Study 4 is to conduct a safety review that verifies that the provisions in all the previous studies have been implemented.

Hazard Study 5

Hazard Study 5 will be carried out during the construction phase. The key aspect of Study 5 is to conduct a safety audit of the constructed Plant.

Hazard Study 6

When the Plant is operational, a final Hazard Study 6 is carried out to:

- conduct a final review to confirm that design intent has been fulfilled opposite safety, health and environmental aspects;
- confirm that assumptions in hazard studies are borne out in actual Plant operation; and
- ensure that all documentation is available and in place.

9.4 POTENTIAL HAZARDS

The following generic hazards apply to the Plants on site:

- Loss of containment - Molten iron.
- Loss of containment - Molten slag.
- Explosion caused by mixing hot metal/slag with water.
- Hot, toxic, flammable gases.
- Cooled, toxic, flammable gases.
- Coal Dust.
- Flammable cryogenic gases and liquids.
- Non-flammable cryogenic gases and liquids.

Loss of Containment of Molten Iron and/or Slag

The molten bath inside the SRV will have a temperature of between 1400 and 1500°C. Any breakout can result in injury to personnel, fire, damage to peripheral equipment and toxic gas and fume generation. The fact that the SRV operates at a pressure of 80kpa above atmospheric pressure can result in molten material being sprayed a considerable distance from the vessel walls.

In order to minimise the likelihood of such an event and the consequences if such an event does occur a number of safeguards and procedures will be implemented, including:

- Regular monitoring of the structural integrity of the SRV using built in monitoring instrumentation, and regular inspections using an infra red thermal imaging camera.

- The hearth section of the SRV will be lined with refractory bricks for containment of the molten metal bath. The vessel shell above the hearth will be protected from molten slag and high gas temperatures by a series of water-cooled panels attached to the vessel walls. Flow rate and water temperature will be continuously monitored to ensure they are within design criteria.

- Two bottom cooling fans (one operating and one on standby) will be installed between the bottom plate and the SRV sidewall. The cooling air will be ducted to a series of channels formed between the SRV support girders. These channels will be sized to provide adequate air velocity for efficient cooling.

- In the event of a breakout, hot metal and or slag will be captured in a bunded area around the base of the SRV and will flow into an emergency pit that will be installed for such emergency situations.

- Personnel working in the immediate vicinity of the SRV will receive special training with regards to working with hot molten materials and will also wear appropriate protective clothing.

- To prevent over pressurisation of the SRV (which could result in a rapid surge of molten material flowing from the forehearth) a pressure relief valve will be situated at the top of the offgas hood that will vent the pressurised gases at a location that is remote from normally occupied areas. The activation of this valve will cause an immediate emergency shutdown of the process, thus limiting the quantity of gas vented in such an incident.

Explosion caused by mixing hot metal/slag with water

When a large volume of molten metal or slag comes into contact with a quantity of water the sudden vaporisation of the water to steam will result in an explosion of molten or hot solidified metal or slag that can cause injury or equipment damage. The hot metal and slag pits will be designed so that any water that enters the pits will rapidly drain away to prevent such incidents. Good housekeeping practices will be employed to ensure that pools of water do not accumulate or remain in any areas where hot metal or slag may be present.

Toxic and Flammable Gas

The offgas from the SRV contains flammable components such as CO, H_2 and also toxic components such as H_2S (CO can also be toxic). Any loss of containment prior to the wet scrubber may result in a jet flame (if a large release) or a toxic plume in the immediate vicinity if a small leak. A release that causes a jet flame may cause fires in nearby equipment modules. Any loss of containment of the cooled Process gas after the wet scrubber will result in a toxic plume of varying extent depending on the size of the leak. The most likely source of such releases will be flanges where segments of the offgas train are joined. During hot commissioning these flanges will be tested for leaks and also subjected to 'hot bolting', where the bolts are tightened at various times as the system heats up to allow for expansion effects.

Pressure sensors located throughout the offgas train will detect major leaks and cause an emergency stop of the process, thereby limiting the inventory of gas available for release (no storage of process gas occurs, the total inventory is that contained within the process ducts).

A network of CO monitors strategically located throughout susceptible areas will detect both major and minor leaks. These monitors are calibrated to alarm at 30ppm CO (the TLV/TWA value for occupational exposure). In addition personnel working in susceptible areas will be issued with portable CO monitors (that alarm at 30ppm) for personal protection.

Coal Dust

The coal used in the process is subjected to drying and grinding prior to use. A number of design features will be incorporated to minimise risks and reduce the consequences of fire and/or explosion due to elevated coal dust concentrations in the coal storage and grinding areas of the Plant. The operation of the coal drying and grinding circuit is outlined in Section 4.6.2.

An oxygen sensor that only permits operation once the oxygen content in the exhaust gas stream is below 10%V/V controls the introduction of coal to the circuit to prevent explosions. The fine coal storage bin will be normally flushed with nitrogen to ensure that coal combustion does not occur. A number of temperature measuring devices will be located on the silo to provide a warning should excessive temperatures occur, and the bin will be purged with nitrogen if a high temperature is detected. The bin will be vented to a vent filter to ensure that the bin is not subjected to any significant pressures. A silo pressure relief system will also be provided.

Cryogenic Gases and Liquids at the ASU

The hazards associated with an ASU are known and understood by the companies which operate them. The ASUs at the site will be installed and operated by Air Liquide WA, a company with extensive experience in the operation of ASUs.

The Compressed Gas Association (based in Arlington, Virginia, USA) has published a Safe Practice Guide for Air Separation Plants that outlines safe operating and maintenance procedures for working with cryogenic gases and liquids (Compressed Gas Association, 1989). Air Liquide apply these procedures in the ASUs that they operate.

9.5 RISK ASSESSMENT

9.5.1 Risk Study

The Proponent commissioned risk consultant Det Norske Veritas (DNV) to undertake a qualitative risk assessment and to provide risk management details of the Project (DNV, 2001). The report has been submitted to the DEWCP and MPR as a supporting document to the PER. The following is a summary of the study.

The scope of work undertaken for the study was:

- Hazard identification of on-site events that could impose an offsite effect.
- Hazard identification of events from neighbouring facilities which could impact site personnel and/or facilities and process.
- Qualitative assessment of identified hazards to determine those hazards that will be major risk contributors at HIsmelt's boundary.
- Quantitative review of the major risk contributors to demonstrate likely compliance with EPA criteria.
- Development of risk management plan for the future phases of the Project.

The EPA has published risk criteria for the assessment of the acceptability of a major hazards industry in its Guidance Note for Risk Assessment and Management for Offsite Individual Risk from Hazardous Industrial Plants (EPA, 2000b). The criteria for the assessment of the fatality risk of a new industrial installation are stipulated as:

- A risk level in residential areas of one in a million per year or less, is so small as to be acceptable to the EPA.
- A risk level in "sensitive developments", such as hospitals, schools, child care facilities and aged care housing developments, of one half in a million per year or less is so small as to be acceptable to the EPA.
- Risk levels from industrial facilities should not exceed a target of fifty in a million per year at the site boundary for each individual industry, and the cumulative risk level imposed upon an industry should not exceed a target of one hundred in a million per year.
- A risk level for any non-industrial activity or active open spaces located in buffer areas between industrial facilities and residential areas of ten in a million per year or less, is so small as to be acceptable to the EPA.

The HIsmelt Plant in Kwinana is not classed as a Major Hazard Facility and therefore is not bound by the "Control of Major Hazard Facilities" standard.

The risk assessment methodology used in the study is consistent with AS4360 "Risk Management" and incorporated the:

- identification of potential hazardous events;
- analysis of these hazardous events to determine their credibility; and
- level of harm (consequence).

The level of risk was then determined.

9.5.2 Study Findings

The analysis of the consequences for the credible hazardous events determined that the level of harm is limited to the immediate area of the Plant, with the worst scenario being a process gas release with harmful effects for a distance of approximately 50m. The level of harm due to hazardous events such as fires is restricted to the range of the harm due to heat, which is approximately 20m. The distance from the Plant to the nearest site boundary (the north-eastern boundary) is 130m therefore it is concluded that minimal, if any, harmful effects will be incurred at the site boundaries. Therefore the risk level at the site boundary due to these hazardous events (both individual and combined) is determined to be below the EPA criteria for industrial facilities of fifty in a million per year.

The distance from the HIsmelt Plant to the nearest residential area at Hope Valley is approximately 1,500m. A similar analysis to that above determined that the risk level in the nearest residential area will be below the EPA criteria of one in a million per year.

9.6 AIR SEPARATION UNIT RISK

The ASU will be located on the HIsmelt site. There will be no storage of liquid oxygen on the site and only a minor quantity of liquid nitrogen.

There are health and safety issues associated with the operation of a plant where oxygen rich and oxygen deficient gas streams are present and these will be addressed in the site's Safety Management Plan. The major potential hazard associated with the operation of an ASU is a build up of hydrocarbons in the liquid oxygen stream within the ASU process and a potential for a violent reaction between the hydrocarbons and the oxygen. Excess CO_2 in the air can also build up in the liquid oxygen but is more easily removed from the inlet air than the hydrocarbons.

The same management risk principles that are applied at the Air Liquide Air Separation Plant in Kwinana will be implemented for the ASU on the HIsmelt site. One particular aspect on risk management will be to reduce the potential for the reaction of hydrocarbons and oxygen as mentioned above. The management of this risk will include:

- analysing the intake air and other process streams for hydrocarbons and CO_2; and
- not positioning the air intake directly downwind of the HIsmelt Plant.

Should the hydrocarbon and CO_2 levels at the inlet exceed a critical value the ASU will be shut down until the air quality improves.

Commitment

The Proponent will ensure that the operator of the ASU analyses for hydrocarbons and CO_2 at appropriate locations within the ASU.

9.7 RISK ASSOCIATED WITH SHIPPING OPERATIONS

Accidents such as ship collisions may cause substantial ecological damage, put workers and the community's health at risk and incur massive clean up costs. The risk of such accidents is minimised by strictly adhering to international and Commonwealth marine guidelines. Fremantle Ports has a comprehensive EMS in place (see Section 7.1.3.2).

As a requirement under the *Port Authorities Act, 1999*, Fremantle Ports maintains a Marine Safety Plan approved by its Minister, which sets out the arrangements for ensuring safe operations within the Port of Fremantle. Due to the integrated manner in which Fremantle Ports manages safety and environmental issues, Fremantle Ports has produced a Marine Safety and Environment Plan (Fremantle Port Authority, 2000).

The Marine Safety and Environment Plan is a high level document that:

- describes the activities that occur within the port;
- identifies the key safety and environmental risks; and
- identifies and assesses the suitability of the controls that are in place to manage these risks.

The main safety issue affecting the Outer Harbour operations is identified as "Collision, Grounding, Capsize or Foundering of Ships or Ferries".

This group of loss exposures is controlled by the procedures, standards and guidelines under the umbrella of the "The Navigation Policy for the Port of Fremantle". The policy provides for the establishment of Operational Parameters for the safe transit, berthing and unberthing of all vessels operating within waters under the control of Fremantle Ports. The Policy and the Operational Parameters are documented as "The Operational Parameters for the Port of Fremantle" (Fremantle Port Authority, 1999).

Fremantle Ports has produced a booklet, "General Information for Ship's Masters" (Fremantle Port Authority, 2001d) which provides Ships' Masters with important information regarding the Port such as:

- seaward approaches;
- relevant charts;
- anchorages;
- navigation restrictions;
- pilot requirements;
- documentation;
- communications;

- draft and berth information;
- tidal data;
- towage and mooring services;
- port facilities and services; and
- cargo handling and emergency response.

9.8 RISK ASSOCIATED WITH TRANSPORT AND TRAFFIC

Issue

The increase on road and rail traffic in the area due to the Project is discussed in Sections 7.16.1 and 7.16.2, respectively. There may be some minor increase in the risk for accidents on the road, due to the increase in traffic.

Management

The percentage increase in traffic on the roads and rail due to the Project is relatively small and will be easily accommodated on the existing road and rail network without issue.

Any hazardous materials brought to site by trucks will be transported in accordance with the Dangerous Goods (Transport) (General) Regulations, 1999 and the Dangerous Goods (Road and Rail) Regulations, 1999.

10. DECOMMISSIONING AND CLOSURE

10.1 RIO TINTO'S POLICY ON CLOSURE

Through its policies the Rio Tinto Group aims to minimise adverse impacts on the environment and make a positive contribution to community life in areas where it operates. Effective decommissioning and closure of operations is an integral part of delivering consistent environmental and commercial performance.

Rio Tinto's Health, Safety and Environment (HSE) Policy states on closure:

'To implement the Rio Tinto HSE Policy, all subsidiaries must meet the following minimum requirements:

- Prepare and maintain a plan for the eventual closure of each operation including: management of social and environmental impacts, estimates of closure costs and financial provisions, and consultation and cooperation with local communities."

HIsmelt will comply with the Rio Tinto Policy and will prepare a Closure Plan, which will be submitted to Rio Tinto and the appropriate regulators at the required timeframe. The objectives, principles and components of Rio Tinto's closure planning are discussed in the following sections.

10.2 CLOSURE PLANNING

Rio Tinto's objectives of closure planning, which will be applied by HIsmelt, are to:

- ensure that the Rio Tinto operations are closed in accordance with good industry practice;
- provide a statement of closure measures required so all parties have a clear vision of what will be required to achieve adequate closure;
- estimate total closure costs (to a +/- 20% accuracy);
- identify any closure measures that will require investigation to confirm their effectiveness;
- assist in identifying potential liabilities that could be reduced by adopting more appropriate management practices during the life of the operation;
- ensure that any programmes required to facilitate closure are initiated early enough in the life of the operation to meet the closure requirements; and
- engage the community in the closure planning process.

The activities of closure planning will include:

- conducting a Closure Study
- deriving the Closure Strategy; and
- ultimately preparing a Closure Statement.

10.2.1 Closure Study

The Closure Study will provide the primary data and understanding on which practical decisions on remediation and rehabilitation can be based. In the process of carrying out the closure study the key steps will be to:

- identify the legal and regulatory requirements for the operations closure;
- determine what expectation the landowner and the community has regarding post closure decommissioning of the operation; and
- assess the environmental, social and employee impacts of the closure.

10.2.2 Closure Strategy

The Closure Strategy will be based on the information in the Closure Study. The Strategy will outline the objectives of closure and the actions required to achieve closure, and provide a means to ensure that post closure decommissioning is considered in project design and operations management.

The principles that are to be included in the Rio Tinto closure planning process are as follows:

- Physical features at the end of the closure are to be safe and stable.
- The closure work, as a minimum, is to be compliant with local, provincial and national legal and regulatory requirements, Group and business policies, and accepted mining industry practice.
- The community is aware of the implications of the closure and the changes needed to adjust beyond the economic contribution of the project.
- Existing or potential ongoing contamination of surface and ground waters, soil and air is minimised.
- The works are to be designed to minimise any future obligations, exposures or risks to Rio Tinto;
- The Closure Statement needs to balance the financial constraints of maximising the return on shareholder investment and minimising future liabilities.
- Benefits accrued to the community during the operation are retained as much as possible;
- As far as practicable the pre-existing landscape capability is restored to a pre-operation level.
- Government and the local community understand and support the closure strategy.
- The Closure Strategy brings credit to the operation, business and Rio Tinto.

The first step in the Closure Strategy will be to identify the landuse options for the site following closure. These may be defined by the regulators, commitments made to the landowners and the community, and the condition prior to disturbance. Objectives and targets for closure can then be set based on an understanding of:

- legal and regulatory requirements;
- landowner and community expectations;
- impacts that need to be mitigated;
- generic closure principles associated with the industry;
- the hierarchy of priorities; and
- final land use of the operation.

Once the closure objectives and targets have been defined, measures which are likely to meet these objectives and targets will be established. The closure measures are to be costed to an accuracy of plus or minus 20%.

10.2.3 Closure Statement

The Closure Statement will document the proposed Closure Strategy, and will be a reference document that will be subject to periodic review and revision. The Closure Statement will be submitted to Rio Tinto and may include:

- an outline of legal and regulatory requirements;
- landowner and community expectations; description of impacts;
- identification of final land use;
- operation specific objectives and targets;
- measures required to achieve decommissioning;
- any modifications to the operation's plan;
- cost estimate;
- the form of accounting provision; and
- next closure strategy review.

The Closure Strategy will be regularly reviewed and modified in response to changing regulatory community requirements and expectations, changes in management practices and the introduction of new technology.

10.3 DECOMMISIONING PLAN

Decommissioning is the activity, after production has ceased, needed to achieve closure of an operation. Prior to decommissioning a detailed Decommissioning Plan will be prepared. Rio Tinto recommends that the Decommissioning Plan be prepared two to five years prior to the estimated date of closure. HIsmelt will prepare a Decommissioning Plan and submit it to Rio Tinto and the appropriate regulators in the required timeframe.

The Decommissioning Plan will contain specific details of how closure will be achieved, and will be based on the Closure Strategy. Key elements of decommissioning may include the:

- management of raw materials to ensure that minimal inventories remain on-site at the cessation of the operation;
- disposal of any raw materials remaining upon cessation of the operations, with a preference for the materials to be used in other plants;
- purging of all process gas lines with nitrogen and then air to render them safe;
- removal and disposal of the contents of all material bins in an environmentally sound manner;
- removal and disposal of water from the water circuits in an environmentally sound manner;
- demolition of the Plant in a manner that maximises the revenue generated by the sale of equipment modules, recycling of scrap steel and other metals, and minimises the generation of solid waste;

- assessment of the site to identify if any contamination of soil or groundwater has been caused by the Project;
- development of a management strategy for any areas where remediation is deemed necessary by Landcorp or the DEWCP; and
- return the site to the landowner (Landcorp) in a condition acceptable to Landcorp and regulatory authorities and that allows development for other industrial projects.

Commitments

The Proponent will prepare and regularly update a Closure Plan in accordance wth Rio Tinto's requirements.

The Proponent will prepare a Decommissioning Plan which will be submitted to Rio Tinto and DEWCP, prior to closure.

The Decommissioning and Closure Plans will be submitted by the Proponent to DEWCP prior to closure.

The Proponent will decommission and close the Plant site in accordance with the regulatory requirements at the time.

11. CONCLUSION AND PROPONENT COMMITMENTS

The proposed HIsmelt Plant, to be constructed on the site occupied by the existing HRDF within the KIA, will be the first commercial application of the HIsmelt Process and when proven successful is expected to be the forerunner of a new generation of iron making plants around the world. The Project will provide significant economic and environmental benefits locally, to the State, nationally and worldwide.

The Process is a direct smelting technology that utilises iron ore fines, coal and fluxes. The Project will use lower value iron ore fines, adding value to the State's reserves of ore. The Process will produce by-products of slag and gypsum, and will generate only a relatively small quantity of solid wastes.

The major environmental issues associated with the Project are related to air emissions, noise, and the potential for contamination in the Cockburn Sound area. The Proponent is committed to responsible environmental management and will incorporate Best Available Technology in Plant design to manage the environmental impacts.

The Kwinana region is covered by an EPP, which sets limits for SO_2 and TSP. The criteria for other atmospheric emissions are to meet NEPM standards. The Plants will operate within the maximum permissible SO_2 emission rate allocated to HIsmelt for the HRDF in the 1992 determination, therefore, no increase in these emission rates would be required for the operation of the Commercial Plants. All air emissions from the Plants are predicted to be below the required standards.

Modelling has predicted that noise levels at the residential areas from the Plants will comply at all times with the Environmental Protection (Noise) Regulations 1997.

Groundwater under the site will be protected from potential contamination by the management of surface water runoff, and the installation of appropriate facilities for the storage of materials. Fremantle Ports will be responsible for the management of shipping, loading and unloading operations at the KBB2 in Cockburn Sound. Fremantle Ports will apply its EMS to its operations associated with the HIsmelt Project.

To ensure that all of the environmental issues associated with the Project are managed, resulting in an environmentally sound Project, the Proponent has made the management commitments presented in Table 11.1.

Table 11.1

Summary of the Proponent's Environmental Management Commitments

Topic	Environmental Objective	Action (Commitment)	Timing	Whose Advice
1. General Environmental Management	To ensure that that any potential environmental impacts associated with the construction and operations of the Project are minimised or ameliorated.	**Commitment 1.1** The Proponent will comply with all applicable environmental standards and regulations pertaining to and appropriate for an iron ore processing Plant and its operations in Western Australia.	**1.1** During the construction, operation and decommissioning of the Plant.	**1.1** All appropriate regulatory authorities.
		Commitment 1.2 Prior to commissioning, the Proponent will prepare an Environmental Management Plan (EMP) for the site, which will be submitted to the Department of Environment, Water and Catchment Protection (DEWCP) for approval prior to commissioning.	**1.2** Prior to commissioning.	**1.2** EPA Service Unit, DEWCP and other appropriate regulators.
		Commitment 1.3 The Proponent will prepare an Environmental Management System (EMS) for the operations of the HIsmelt Plant prior to commissioning.	**1.3** Prior to commissioning.	**1.3** DEWCP.
		Commitment 1.4 The Proponent will implement the EMS during the commissioning and operation of the Plant.	**1.4** During the commissioning and operation of the Plant.	**1.4** DEWCP.
		Commitment 1.5 The Proponent will consider environmental performance and standards in the selection process for a rail freight provider.	**1.5** During the selection process for a rail freight provider.	
		Commitment 1.6 The Rightship vetting system, developed by Rio Tinto Shipping and BHP Billiton, will be applied by the Proponent to ensure that any vessels chartered by the Proponent for the Project are well-maintained and are operated by companies with good management principles and competent crews.	**1.6** During operations.	

Table 11.1 (*cont'd*)

Topic	Environmental Objective	Action (Commitment)	Timing	Whose Advice
2. Construction	To ensure that appropriate environmental management measures are incorporated in the construction phase of the Project.	**Commitment 2.1** The Proponent will develop an EMP for the construction phase of the Project. The Construction EMP will be submitted to the DEWCP for approval prior to the commencement of construction.	**2.1** Prior to the commencement of construction.	**2.1** DEWCP
		Commitment 2.2 The Construction EMP will be implemented at the site during the construction period by the Proponent and the contractors undertaking the construction activities.	**2.2** During construction.	**2.2** DEWCP
		Commitment 2.3 During construction, the Proponent will implement dust minimisation measures such as the use of water sprays on disturbed areas and unpaved roads on the site.	**2.3** During construction.	**2.3** DEWCP
		Commitment 2.4 The Proponent will ensure that construction activities comply with the Environmental Protection (Noise) Regulations, 1997.	**2.4** During construction.	**2.4** DEWCP
		Commitment 2.5 Waste disposal management will be included in the Proponent's Construction EMP, which will be submitted to the DEWCP for approval prior to the commencement of construction.	**2.5** Prior to the commencement of construction.	**2.5** DEWCP

Table 11.1 (*cont'd*)

Topic	Environmental Objective	Action (Commitment)	Timing	Whose Advice
3. Sulphur Dioxide	To ensure that emissions of SO_2 from the Plant are managed and monitored so that they are below the maximum permissible levels.	**Commitment 3.1** The Proponent will incorporate a Flue Gas Desulphurisation System in the Plant design that is considered Best Available Technology at the time of Plant design. **Commitment 3.2** The Proponent will install a continuous monitoring instrument to measure SO_2 emissions in the gas stream exiting the main stack of the Plant. **Commitment 3.3** Monitoring data for SO_2 will be reported by the Proponent to the DEWCP and Rio Tinto on a six monthly basis, and annually as part of the National Pollutant Inventory (NPI).	**3.1** During Plant design. **3.2** Prior to commissioning. **3.3** DEWCP - six monthly Rio Tinto – six monthly. NPI – annually	 **3.2** DEWCP **3.3** DEWCP
4. Particulates	To manage and minimise the emissions of airborne particulates from the Plant, and to ensure that the ground level concentrations resulting from these emissions are below the relevant Environmental Protection Policy (EPP) and National Environmental Protection Measure (NEPM) standards.	**Commitment 4.1** To minimise particulate emissions from the Plant, the Proponent will incorporate scrubbers and bag filters that are considered Best Available Technology at the time of Plant design. **Commitment 4.2** The Proponent will measure particulate emissions from the Plant stacks on a six monthly basis. **Commitment 4.3** Particulate monitoring data will be reported by the Proponent to the DEWCP and Rio Tinto on a six monthly basis.	**4.1** During Plant design. **4.2** During operations - on a six monthly basis. **4.3** On a six monthly basis	 **4.2** DEWCP **4.3** DEWCP

Table 11.1 (*cont'd*)

Topic	Environmental Objective	Action (Commitment)	Timing	Whose Advice
5. Nitrogen Oxides	To ensure that NOx emissions from the Plant are minimised and that ground level concentrations resulting from these emissions comply with the NEPM standard in residential areas.	**Commitment 5.1** The Proponent will incorporate burners that are designed to keep NOx emissions as low as reasonably practicable where process gas will be combusted, and low NO_x burners where natural gas will be combusted in the Plants. **Commitment 5.2** The Proponent will sample and analyse the gas stream exiting the main stack for NO_X emissions on a six monthly basis. **Commitment 5.3** Monitoring data for NOx emissions will be reported by the Proponent to the DEWCP and Rio Tinto on a six monthly basis, and annually as part of the NPI.	**5.1** During design. **5.2** During operations on a six monthly basis. **5.3** DEWCP - six monthly Rio Tinto – six monthly. NPI – annually	**5.1** DEWCP **5.2** DEWCP **5.3** DEWCP
6. Carbon Monoxide	To ensure that emissions of carbon monoxide from the Plant do not result in an exceedance of the NEPM standard in residential areas.	**Commitment 6.1** The Proponent will sample and analyse the gas stream exiting the main stack of the Plant for CO emissions on a six monthly basis. **Commitment 6.2** Monitoring data for CO emissions will be reported by the Proponent to the DEWCP and Rio Tinto on a six monthly basis, and annually as part of the NPI.	**6.1** During operations on a six monthly basis. **6.2** DEWCP - six monthly Rio Tinto – six monthly NPI – annually	**6.1** DEWCP **6.2** DEWCP
7. Dioxins and Furans	To ensure that the offgas handling system employed in the Plant does not allow Dioxins and Furans to be emitted.	**Commitment 7.1** During the first year of operation, the Proponent will sample and analyse the offgas emissions to establish if there are any Dioxins or Furans present. **Commitment 7.2** Monitoring results for Dioxins and Furans will be provided to the DEWCP following the first year of monitoring. **Commitment 7.3** Future monitoring of the offgas emissions for Dioxins and Furans will be reviewed by the Proponent in conjunction with DEWCP once the results of the first year's monitoring have been assessed.	**7.1** During the first year of operation. **7.2** Following the first year of monitoring. **7.3** Following the first year of monitoring.	**7.1** DEWCP **7.2** DEWCP **7.3** DEWCP

Table 11.1 (*cont'd*)

Topic	Environmental Objective	Action (Commitment)	Timing	Whose Advice
8. Heavy Metals	To ensure that there are no significant concentrations of heavy metals emitted to the atmosphere in the offgas from the Plant.	**Commitment 8.1** During the first year of operation, the Proponent will sample and analyse the offgas emissions to establish if there are any significant concentrations of heavy metals present. **Commitment 8.2** Monitoring results for the heavy metals will be provided to the DEWCP following the first year of monitoring. **Commitment 8.3** Future monitoring of the offgas emissions for heavy metals will be reviewed by the Proponent in conjunction with the DEWCP once the results of the first year's monitoring have been assessed.	**8.1** During the first year of operation. **8.2** Following the first year of monitoring. **8.3** Following the first year of monitoring.	**8.2** DEWCP **8.3** DEWCP
9. Odour	To ensure that any odours emanating from the Project do not adversely effect the welfare and amenity of other land uses.	**Commitment 9.1** The Proponent will implement measures to minimise the potential for odours to be produced or released to the environment.	**9.1** During operation.	**9.1** DEWCP

Table 11.1 (*cont'd*)

Topic	Environmental Objective	Action (Commitment)	Timing	Whose Advice
10. Greenhouse Gas Emissions	To minimise greenhouse gas emissions per unit of product, and implement measures for greenhouse gas management.	**Commitment 10.1** The Proponent will employ optimum energy efficiency in Plant design and operations.	**10.1** During Plant design and operations.	
		Commitment 10.2 The Proponent, as part of the Rio Tinto Group, will continue to participate in the Australian Greenhouse Office Greenhouse Challenge Programme.	**10.2** During operations.	**10.2** AGO
		Commitment 10.3 The Proponent, as part of the Rio Tinto Group, will support the research and development of new technologies that will result in a reduction of greenhouse emissions.	**10.3** During operations.	**10.3** AGO
		Commitment 10.4 The Proponent will calculate annual greenhouse gas emissions from the Plant and will report the findings to the DEWCP and Rio Tinto.	**10.4** Annually.	**10.4** DEWCP
11. Dust	To minimise dust generation from Project operations, and to ensure that dust levels from the site are within EPP standards and limits.	**Commitment 11.1** The Proponent will prepare a Dust Management Plan as a component of the EMP for the site. The EMP will be submitted to the DEWCP prior to commissioning.	**11.1** Prior to commissioning.	**11.1** DEWCP
		Commitment 11.2 The Dust Management Plan will be implemented by the Proponent during the construction and operations of the Plant.	**11.2** During commissioning and operations.	**11.2** DEWCP
		Commitment 11.3 The Proponent will continue and expand the dust monitoring programme currently undertaken for the site.	**11.3** During commissioning and operations.	**11.3** DEWCP
		Commitment 11.4 Dust monitoring data will be reported by the Proponent to the DEWCP at a frequency to be determined.	**11.4** Reporting frequency to be determined.	**11.4** DEWCP

Table 11.1 (*cont'd*)

Topic	Environmental Objective	Action (Commitment)	Timing	Whose Advice
12. Noise	To ensure that noise levels from the Project operations comply with the Environmental Protection (Noise) Regulations, 1997.	**Commitment 12.1** The Proponent will design the Plant and incorporate noise attenuation measures on equipment to minimise noise levels, where practicable.	**12.1** Plant design and construction.	**12.1**
		Commitment 12.2 The Proponent will ensure that noise levels generated by the Plant are in compliance with the Environmental Protection (Noise) Regulations, 1997 by implementing a noise monitoring programme.	**12.2** During Plant operations.	**12.2** DEWCP
		Commitment 12.3 A noise monitoring survey will be undertaken by the Proponent once the Plant is operational to ensure that noise levels are within those predicted.	**12.3** Once Plant is operational.	**12.3** DEWCP
		Commitment 12.4 Noise monitoring at the site will be undertaken by the Proponent on an annual basis.	**12.4** Annually	**12.4** DEWCP
		Commitment 12.5 The Proponent will provide the results of the noise survey to the DEWCP and the KIC.	**12.5** Annually	**12.5** DEWCP, KIC
		Commitment 12.6 The Proponent will consult with the KIC on the findings of the regional noise study.	**12.6** Once KIC noise study report is publicly released.	**12.6** KIC

Table 11.1 (*cont'd*)

Topic	Environmental Objective	Action (Commitment)	Timing	Whose Advice
13. Surface Water Runoff and Wash Waters	To ensure that surface water runoff and washwaters are managed and do not impact on the environment.	**Commitment 13.1** The Proponent will prepare a Surface Water Management Plan as a component of the site EMP, which will be submitted to the DEWCP prior to commissioning. The Surface Water Management Plan will include the management for both clean stormwater runoff and for potentially contaminated runoff and washwaters.	**13.1** Prior to commissioning.	**13.1** DEWCP
		Commitment 13.2 The Proponent will implement the Surface Water Management Plan during the operation of the Plant.	**13.2** During operations.	**13.2** DEWCP
		Commitment 13.3 The Proponent will continue and extend the groundwater monitoring programme undertaken on the site to identify any significant changes in the groundwater, and will reassess the parameters monitored in liaison with the DEWCP.	**13.3** Monitoring continuing on a quarterly basis.	**13.3** DEWCP
		Commitment 13.4 The Proponent will report the results of the groundwater monitoring to the DEWCP on an annual basis.	**13.4** Annually.	**13.4** DEWCP
14. Slag	Minimise the quantity of solid waste produced by investigating uses for the slag by-product produced in the Process.	**Commitment 14.1** The Proponent will continue to investigate the value-added options for the slag by-product.	**14.1** Prior to and during operations.	
15. Hazardous Materials	To ensure that the handling, storage and disposal of hazardous materials related to the Project does not result in impacts on the environment or people.	**Commitment 15.1** A Hazardous Materials Management Plan will be prepared by the Proponent as a component of the site EMP, which will be submitted to the DEWCP prior to commissioning. The Hazardous Materials Management Plan will also be submitted to the Department of Mineral and Petroleum Resources (MPR) prior to commissioning as part of the Project Management Plan.	**15.1** Prior to commissioning.	**15.1** DEWCP, MPR

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12.2 GLOSSARY

Anthropogenic	Caused by human activity; in relation to climate change it describes greenhouse gas emissions resulting from human activities.
Aquifer	A permeable rock formation, which stores and transmits sufficient groundwater to yield quantities to wells, bores or springs.
Basic Oxygen Furnace	A refractory lined furnace in which molten iron is converted to steel by blowing oxygen into the bath.
Blast Furnace	A shaft furnace in which iron ore, flux and coke are reacted with hot air to produce molten iron and slag.
Blowdown	A purge stream from a water circuit used to control the maximum level of dissolved salts in the system.
Calorific Value	The amount of heat liberated when coal is combusted under standard conditions.
Calcine	To heat a mineral containing carbonates, such as limestone, dolomite or magnesite, at an elevated temperature (>850 °C) to a stage where all carbonates are converted to oxides by the evolution of CO_2.
Clarifier (Thickener)	A tank, incorporating a mechanical rake, designed to separate solid and liquid phases from a slurry stream.
Coke	The solid product resulting from heating certain types of coal in the absence of air to remove volatile components. Coke is used as a fuel in metallurgical processes.
Coke Oven	Refractory lined chamber in which coal is heated to form coke, it incorporates a means for capturing the gaseous and liquid components driven off at high temperatures.
Counter current	The practice of having two streams (solid & gas, solid & liquid or liquid & gas) flow in opposing directions to optimise the transfer of heat or other constituents from one to the other.
Dolime	A mixture of Calcium and Magnesium Oxides formed by subjecting Dolomite (a mixture of Calcium and Magnesium Carbonates) to high temperatures thereby removing Carbon Dioxide (calcine).
Effluent	A liquid waste stream.
Epiphytes	Plants that grows on another plant but is not parasitic eg moss on a tree trunk.
Flocculant	A chemical added to slurry to promote the rapid separation of solid and liquid constituents in a clarifier.
Fluidised Bed	A bed of solid material that has the properties of a fluid induced through the introduction of a gas.
Fluxes	Materials added to a furnace to facilitate the removal of gangue constituents (impurities) in the ore and coal through the formation of a mixture (slag) with a suitable melting point, common fluxes include lime and dolime.
Fugitive Dust	Uncontrolled dust emissions arising from activities associated with raw material or construction operations.
Gangue	The mineral impurities in an ore.
Goethite-limonite.	Iron ore containing a mixture of Goethite ($Fe_2O_3.H_2O$) and Limonite ($(Fe(OH)_6.Fe_2O_3)$).

Greenhouse Effect	The warming of the Earth's atmosphere caused by a build up of carbon dioxide and other gases.
Greenhouse Gases	The gaseous constituents of the atmosphere, both natural and man made, that maintain the earth's temperature at a level necessary to sustain life but may contribute to global warming when present at elevated concentrations. These include carbon dioxide, methane and nitrous oxide.
Hematite-goethite	Iron ore containing a mixture of Hematite (Fe_2O_3) and Goethite ($Fe_2O_3.H_2O$)
Heterogeneous	To have more than one constituent or phase, thus exhibiting different properties in different portions.
HIsmelt Process	A process for the smelting of iron ore to produce molten iron.
Holocene Period	Geological period – the most recent epoch of the quaternary period, marked by the development of human culture.
Hot Blast Stoves	Counter current heat exchange system in which a stream of air is heated by passing through a large volume of heated refractory bricks contained in a cylindrical vessel. The refractory bricks are heated by the combustion of process gas.
Hydrogeology	The science dealing with groundwater and its relationship with geology.
Hydrology	The science of the properties of the earth's water, especially its movement relative to land.
Ion Exchange	A reversible process by which dissolved species (ions) are removed from a liquid onto a solid phase by means of the electrical charge of the species.
L_{Aeq}	Noise level average over a certain period of time.
L_{A1}	Noise level exceeded for 1% of the time.
L_{A10}	Noise level exceeded for 10% of the time.
L_{AMAX}	Maximum noise level not to be exceeded.
Lances	Water cooled tubes through which solid and gaseous materials are injected into a furnace.
Life Cycle Analysis	The process of evaluating the effects that a product has on the environment over the entire period of its life cycle.
Loss on Ignition	That portion of a material that is driven off by heating to a temperature of around 900°C (includes mineral bound water and Carbon Dioxide).
Make Up Water	Water that has to be added to a cooling circuit to replace that portion lost through evaporation, blowdown or leakage.
Metalliferous	Containing, yielding or producing metal or ore.
Metallurgical Coal	Types of coal suitable for use in metallurgical processes.
Microphtobenthos	Microscopic algae similar to phytoplankton and live on an in the sea bed.
Offgas	The gas stream that flows from the furnace in a smelting process.
Ore Fines	Iron ore with a particle size less than 8mm.
Pellet Plant	Plant that transforms fine iron ores into robust spherical pellets by a series of steps that include grinding, mixing with flux, rolling into spheres and firing in a kiln.
Pig Iron	Solid form of the iron produced by a blast furnace or HIsmelt Process, generally cast into 'Pigs', ingots weighing 5 – 10 kg.

Preheater	Process module designed to dry, pre-heat and pre-reduce iron ore prior to its use in a smelting process.
Post Combustion	The reaction of carbon monoxide and hydrogen, driven off when coal is injected into a molten iron bath, with oxygen in the top space of a smelting furnace.
Rake Mechanism	Rotating component of a clarifier or thickener designed to aid the rapid settling of solids.
Reductant	Material capable of reacting with a metalliferous ore to effect the removal of oxygen leaving the metal as a product.
Refractory	A material of very high melting point with properties that makes it suitable for lining components in high temperature applications.
Scrubber	Equipment module for removing particulate or gaseous contaminants from a gas stream.
Seiches	
Sinter Plant	Plant used to heat (sinter) a mixture of iron ore fines, flux, coke and recycled steel plant wastes such that the materials are partially fused to form an agglomerated material, with good physical strength, for use as a blast furnace feed.
Slag	Molten material formed by the reaction, at high temperature, of fluxes with the gangue constituents of ores and coal in smelting processes.
Slurry	A semi-liquid mixture of fine solid particles in water.
Smelting	The high temperature process used to produce metal from an ore.
Specular hematite	Hematite occurring in tabular or disklike crystals of grey colour and splendent metallic lustre.
Spinel	A mineral group of general formula $AO.B_2O_3$ where A = Mg, Fe, B= Al, Fe Mn, Cr.
Transition Zone	Fountain of liquid metal and slag droplets thrown up into the top space of the SRV by the evolution of CO, H_2 and N_2 from the molten bath.
Transmissivity	The rate at which groundwater is transmitted at a specified hydraulic gradient through rock of a specified width.
Tuyeres	Nozzles through which gaseous and solid materials are introduced to a furnace.
Volatile Matter	Components of a solid material, other than moisture, that are driven off by heating the material.
Vuggy	Having cavities, often with a mineral lining of different composition to that of the surrounding rock.

12.3 ABBREVIATIONS AND ACRONYMS

AADT	Annual Average Daily Traffic
ABS	Australian Bureau of Statistics
AEC	Australian Environment Council
AHD	Australian Height Datum
AIS	Australian Iron and Steel
AMSA	Australian Maritime Safety Agency
ANZECC	Australian and New Zealand Environment and Conservation Council
AQIS	Australian Quarantine Inspection Services
ARMCANCZ	Agriculture and Resources Management Council of Australia and New Zealand
ASLP	Australian Standard Leaching Procedure
ASU	Air Separation Unit
AWT	Average Weekday Traffic
BOF	Basic Oxygen Furnace
BP	British Petroleum
^0C	Degree Celsius
Ca	Calcium
$CaCO_3$	Calcium Carbonate
CaO	Calcium Oxide (Burned Lime)
CCI	Chamber of Commerce and Industries Council of WA
Cd	Cadmium
CFB	Circulating Fluidised Bed
CH_4	Methane
Cl_2	Chlorine
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
Cr	Chromium
CSMC	Cockburn Sound Management Council
DEP	Department of Environmental Protection
DEWCP	Department of Environment, Water and Catchment Protection
DMA	Decision Making Authority
DNV	Det Norske Veritas
DRI	Direct Reduced Iron
EAF	Electric Arc Furnace
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
ENM	Environmental Noise Model
EPA	Environmental Protection Authority
EPP	Environmental Protection Policy

EQC	Environmental Quality Criteria
EQO	Environmental Quality Objectives
ERMP	Environmental Review and Management Programme
EV	Environmental Values
Fe	Iron
FGD	Flue Gas Desulphurisation
FRIARS	Fremantle- Rockingham Industrial Area Regional Strategy
GDP	Gross Domestic Product
GLpa	Gigalitres per annum
h	hour
HAZOP	Hazard and Operability
H_2	Hydrogen
H_2O	Water
H_2S	Hydrogen Sulphide
HAB	Hot Air Blast
HBI	Hot Briquetted Iron
HCl	Hydrogen Chloride
HCO_3^-	Bicarbonate ion
HF	Hydrogen Fluoride
HGI	Hardgrove Grindability Index
HRDF	HIsmelt Research and Development Facility
HSE	Health Safety and Environment
H_2S	Hydrogen Sulphide
KIA	Kwinana Industrial Area
KBB1	Fremantle Ports Bulk Berth No.1
KBB2	Fremantle Ports Bulk Berth No.2
KIC	Kwinana Industrial Council
kg	kilogram
kL	kilolitres
km	kilometres
K_2O	Potassium Oxide
kPa	Kilo Pascals
kPag	Kilo Pascals Gauge
L	Litre
LOI	Loss on Ignition
LPG	Liquefied Petroleum Gas
m	metre
m^3	cubic metre
mg	Milligram
Mg	Magnesium
MgO	Magnesium Oxide
$MgCO_3$	Magnesium Carbonate
MJ/Nm^3	Mega Joules per normal cubic metre

ML	Mega Litres
mm	millimetres
MPR	Department of Mineral and Petroleum Resources
MSDS	Material Safety Data Sheets
Mtpa	Mega tonnes per annum
MW	Mega Watt
Na	Sodium
Na_2O	Sodium Oxide
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
Nm^3	One cubic metre of gas at 101.3 kPa pressure and 0 °C (1 atmosphere and 273 °K)
NMVOC	Non –Methane Volatile Organic Compounds
NOx	Nitrogen Oxides
NO_3^-	Nitrate ion
NPI	National Pollutant Inventory
O_2	Oxygen
OHS&E	Occupational Health Safety and Environment
pa	per annum
PAH	Poly Aromatic Hydrocarbons
Pb	Lead
PCDD	Polychlorinated dibenzo-dioxin
PCDF	Polychlorinated dibenzo-fluran
PER	Public Environmental Review
$PM_{2.5}$	Particles with a diameter up to 2.5μm
PM_{10}	Particles with a diameter up to 10μm
PMP	Project Management Plan
ppb	parts per billion
ppm	parts per million
PPSS	Perth Photochemical Smog Study
ppt	parts per thousand
RO	Reverse Osmosis
Se	Selenium
SO_x	Sulphur Oxides
SO_2	Sulphur Dioxide
SO_4^{2-}	Sulphate ion
SRV	Smelt Reduction Vessel
t	Tonnes
TBT	Tributyltin
TCLP	Toxic Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TEQ	Toxic Equivalent

thm	tonne of hot metal
TJpa	Terra Joule per annum
TLV	Threshold limiting value
TOC	Total Organic Carbon
tpa	Tonnes per annum
tph	tonnes per hour
TSS	Total Suspended Solids
TWA	Time Weighted Average
VOC	Volatile Organic Compound
V/V	Volume per Volume
WAPC	Western Australian Planning Commission
WHR	Waste Heat Recovery
WRC	Water and Rivers Commission
WSAC	Wet Surface Air Cooler
Zn	Zinc

12.4 STUDY TEAM

HIsmelt Corporation

Peter Bates	General Manager - Development
Colin Prickett	Manager - Environment

Corporate Environmental Consultancy - Public Environmental Review and Consultation Programme

Cathy Gupanis	Director

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Herring Storer Acoustics - Noise

Terry George	Engineer
Tim Reynolds	Director

Fremantle Ports' - Shipping, Loading and Unloading Information

Gino Valenti	Manager - Port Safety and Environment

Environ - Technical Review of the PER

Brian Bell	Manager

Pinpoint Cartographics - Illustration and Word Processing

Colin Reeves	Partner
Pauline Kirkup	Partner