8. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. **Existing Outlook:** The existing Pilbara Iron Ore industry is robust. It is effectively competing in the world market and existing producers are increasing capacity to meet demand. The industry must retain a competitive advantage to ensure longevity of operations with the subsequent public benefits, especially ongoing employment and State royalties.

2. **Short Term Outlook:** In the short term (less than 5 years) there is no material increase in public benefit in providing new potential iron ore producers with open access to existing Pilbara railways. An open access regime will not significantly increase short term annual quantity of iron ore sales from the Pilbara

3. **Long Term:** In the longer term (10 plus years) there is significant potential public to be realised by promoting an open access regime between producers. This has the potential to:

   - Improve world competitiveness by reducing rail transport costs (conservatively estimated to have an after-tax present value worth $500 million) and, more importantly,

   - Extend the life of the Pilbara resource base by maximising blending opportunities between mines and producers. If this expansion is only 10% of the existing resource base it would extend iron ore production by at least six years and slow the decline in quality of iron ore exported from the Pilbara.

4. **Open Access Benefits:** The majority of direct benefits from an open access regime will flow to existing producers who control 90% of identified resources. The more effective utilisation of both natural and capital resources will decrease adverse environmental impact from railway construction and mine development.

   Oligopolistic Producers: Existing producers are exporters. Oligopolistic rent flows to the State. The oligopoly provides an effective counter to the buyer oligopsony

RECOMMENDATIONS

1. Care should be taken to ensure the existing Pilbara Iron Ore industry is not destabilised. Open access considerations should apply only to the provision of a rail transport service, not open access for third party rolling stock to the railway tracks.

2. Growth of the industry should be encouraged by developing the existing rail networking not a third rail to optimise utilisation and efficiency and minimise adverse environmental and heritage impact.

3. Open access to the entire network should be Government Policy because of Public and Private sector benefits. The private benefits will be gained primarily by the existing producers who need to be made aware of potential benefits from an open access regime.

4. Open access rail systems should be developed through Government policy combining intervention and incentives designed to facilitate bilateral commercial agreements.

5. The State access regime should be via either:

   - Direct Commercial Negotiations; or
   - State Agreement framework

   but establishing Generic Frameworks under State or National regimes should not be attempted.

6. A consultative body should be established by the State and industry to develop efficient utilisation of the Pilbara iron ore industry infrastructure. This body should focus on establishing, within five years, a working agreement that enables existing and new iron ore producers to benefit from use of each other's infrastructure and within ten years an operating open access system.

7. An independent party should be appointed to head the consultative body referred to in point 6 above.

8. Although outside the Scope of the study it is also recommended that policy is developed to address Port and Power access and capacity to meet expected production growth.

APPENDIX 1 – GLOSSARY OF TERMS

Archaean	Geological era between 3.9Ga and 2.5Ga.
Banded iron-formation or bif.	Iron formation that shows marked banding, generally of iron-rich minerals and chert or fine-grained quartz. (Bates and Jackson, 1980)
Brockman Iron Formation	One of four banded iron-formation units of the Hamersley Group, see following page extracted from (Harmsworth, 1990)
Goethite	A yellowish, reddish, or brownish-black mineral: α-FeO(OH).
Granite-Greenstone Terrane or GGT.	Granite-greenstone terranes display a dome-and-keel geometry in which belts of supracrustal rocks (volcanic and sedimentary) occur as structural troughs wedged between dome-shaped bodies of granite-gneiss-migmatite.
Hematite or haematite.	A common iron mineral α-Fe_2O_3. Hematite is the principal ore of iron. (Bates and Jackson, 1980).
Hypogene enrichment.	Oxidation and enrichment by ascending solutions that occurs at depth within earth's crust. In the case of iron-formation, the ascending solutions oxidise magnetite and leach silica and the carbonates and aluminosilicates thus enriching the iron-formation in Fe.
Magnetite	A black, isometric, strongly magnetic, opaque mineral of the spinel group: (Fe,Mg)Fe_2O_4. Magnetite has the chemical formula Fe_3O_4.
Marra Mamba Iron Formation	One of four banded iron-formation units of the Hamersley Group, see following page extracted from (Harmsworth, 1990)
Martite	Hematite occurring in iron-black octahedral crystals pseudomorphous after magnetite. (Bates and Jackson, 1980) The product of oxidation of magnetite.
Precambrian	Geological eon that embraces the Proterozoic and Archaean eras.
Proterozoic	Geological era between 2.5Ga and 580Ma. Upper part of the Precambrian eon.
Robe Pisolite/CID	Pisolitic to oolitic, chemico-clastic sediments formed in estuarine of flooded valley systems of the Pilbara. The genesis of these deposits is problematical. One hypothesis suggest that these evolved from concretions on lag gravels washed in from the lateritised Hamersley Surface another hold the view that these evolved through ferruginisation of, and concretion on organic matter *in situ* in a sub-aqueous environment. Robe pisolite or Robe Formation is the formation name applied to these deposits. CID or channel iron deposits is used by BHPBIO and Rio Tinto geologists to describe these deposits whilst Robe pisolite is used by Robe River geologists.
Supergene enrichment.	Enrichment processes that occur as a result of near-surface oxidation and leaching. The acids produced by oxidation leach certain minerals and precipitate them elsewhere. In the case of iron-formations, silica and the carbonates and aluminosilicates are leached leaving the iron oxides thus enriching the supergene zone in Fe.
Tom Price/Whaleback-type iron ores (TP/W-type)	The Mt Tom Price and Mt Whaleback-type orebodies are characterised by their mineralogy (martite-microplaty hematite) and very low P. These ores are believed to have undergone at least two phases of enrichment with intervening burial metamorphism. See Harmsworth, (1990)

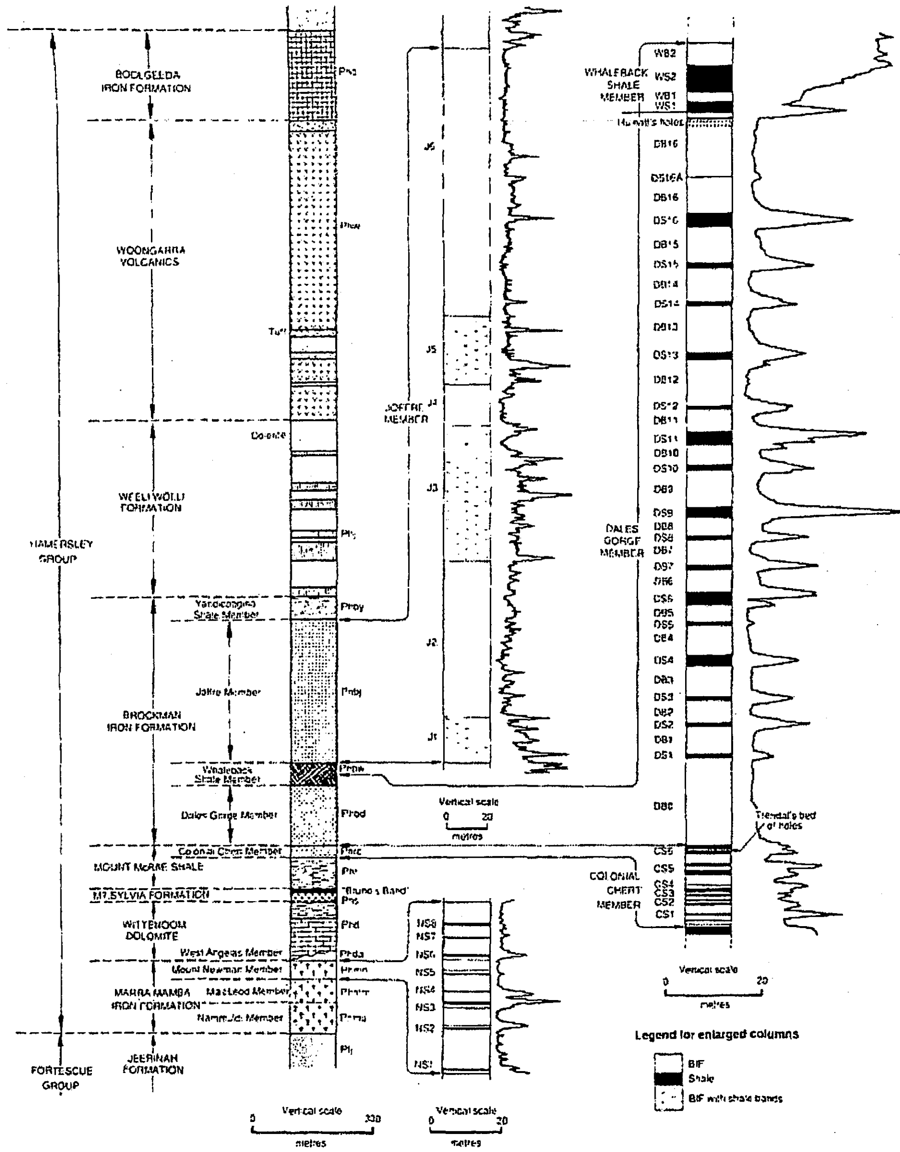


Fig. 4—Stratigraphic columns for the Hamersley Group including internal lithological unit numbering systems used by the major iron ore companies in the Hamersley Province, and the appropriate gamma log profiles.

APPENDIX 2 – SCOPE AND METHODOLOGY

1. Scope

Document 20DIR0204 scope:

"2. Scope
The Department requires advice on the public and private costs and benefits (environmental, social and economic) of implementing an effective open access rail regime in the Pilbara, in the global iron ore market context.

The following issues are of relevance and should be considered in the study:

- *Likely future iron ore market demand and supply*
- *Pilbara iron ore deposits: their ownership, nature, location and strategic importance*
- *Smaller producers – their role and significance in the global iron ore industry*
- *Description of current rail system/s and likely future rail and capacity developments*
- *Whether the iron ore transport system is constraining production from the Pilbara*
- *Need for and implications of constructing a new railway line*
- *Public and private costs and benefits of increasing competition on the Pilbara iron ore market (quantitative and qualitative), including environmental, conservation and social impacts*
- *Implications for policy*
- *Any other issues identified as being of relevance to the review*

As part of the examination of public interest issues the following modelling work may be necessary:

- *Model impact of effective open rail access on investment, royalties, exports, income and employment.*
- *Model pro-active and re-active policy options for achieving an effective rail access regime and the public interest impacts of each policy option.*

For the purposes of this tender the principles for an effective access regime contained in Clause 6(4) of the Competition Principles Agreement should be used. All assumptions made about these principles should be stated when evaluating costs and benefits."

2. Methodology

Team Selection

The key to delivering the study, in the time of 6-8 weeks with the efficacy required for credibility under industry scrutiny, was a team professionally knowledgeable to comment on the study issues.

The Right People

The members of our team have all had extensive experience in their fields of expertise. They are familiar with the theoretical and practical issues surrounding the production, transport and sales of iron ore from the Pilbara region and the availability of competitive iron ore on the world market.

Our team was:

- Tim Humphry – Principal Manager
- Warwick Davies – Iron Ore Marketing
- Ian Ellson – Railway Utilisation, Capacity and Design
- Angus Faulkner – Senior Consultant, Analyst and Modelling
- Chris Robinson – Geology and Mining
- Graham Walker – Economic Analysis and Economic Modelling, Iron Ore Industry economic specialist

- Philip Maxwell – Micro/Macro Economic Benefit Analysis, Public Policy
- Stuart Hohnen – State Agreement obligations, National Competition Policy, Government & Policy advice.

Our expert team possesses a combination of private sector, public sector and academic experience, and are described in the following brief biographies

Tim Humphry

Role in Project
▪ Principal and Study Manager
▪ Client liason
▪ Team Coordination
▪ Deliver recommendations

Tim Humphry is the Executive Consultant in the Evans & Peck Perth Office and is well qualified to assume the role of Principal Manager for the study team. He has over 30 years' experience with leading Australian construction firms and has extensive corporate and board experience with public and listed companies. Before joining Evans & Peck in August 2003, Tim was with Clough Engineering where he was a Director and Division Chief Executive Officer, responsible for the Minerals & Infrastructure Division. Immediately prior to this, Tim was Director responsible for all Clough's mineral activities and as such included feasibility and investment in certain mines and associated infrastructure in Australia and overseas.

Warwick Davies

Role in Study
▪ Iron Ore Market
▪ Pilbara
▪ World
▪ Impact of smaller producers

Warwick Davies is one of the leading iron ore marketing consultants operating in Australia. His well-developed relationships with and knowledge of steel producers in China, Japan, Korea and Europe ensures that he has a comprehensive knowledge of the iron ore market.

Warwick's clients over the past three years include existing iron ore producers, potential iron ore producers, steel manufacturers and international trading houses.

From 1994 to 2001, he was the Head of Marketing for Robe River Iron Ore Pty Ltd. During this period Robe River became the world's fourth largest exporter of iron ore by opening up new geographic and product markets and accurately anticipating trends in iron ore demand.

Under Warwick's leadership, Robe River secured the Letters of Intent and Sales Contracts that were necessary to underwrite the development of the Pilbara's first major development to produce and sell Marra Mamba iron ore from the West Angelas deposit.

Ian Ellson

Role in Study

- Rail study
- Rail capacity increase options

Ian Ellson is a civil engineer with extensive experience of infrastructure construction in the Pilbara. During the 1980s, Ian was involved in the design and project management for the expansion of Robe River's rail and port capacity. Ian was also responsible for the routing and design of the West Angelas to Cape Lambert rail link. Since leaving Robe River in 2001, Ian has worked extensively with Fluor Engineering on The construction of the West Angelas railway and design/construction of the Mining Area C railway links.

Chris Robinson

Role in Study

- Pilbara Iron Ore geological and resource assessment
- Impact of smaller producers
- Iron Ore Market
- Pilbara
- World

Chris Robinson has been involved with the geology of Marra Mamba iron ore deposits since the early 1970s when Cliffs International first carried out exploration work on the Robe River Joint Venture West Angelas exploration leases.

After those initial exploration programs, Chris became Robe River's Senior Manager Exploration, which he combined with the role of Senior Technical Manager for the West Angelas Feasibility Study. His comprehensive expertise and knowledge of the geology of Marra Mamba deposits was a major contributing factor to the successful development of the West Angelas deposit. Upon completing the geological feasibility study, Chris assumed responsibility for North Ltd's Global Iron Ore Resource Assessment Project in 1998.

Since leaving the North Group in 2000, Chris has expanded his global expertise by combining his Australian work with assignments involving iron ore deposits in Africa, North America and India.

Graham Walker

Role in Study

- Strategic analysis of producers
- Financial & Economic modelling
- Strategic analysis of rail options
- Strategic analysis of policy options

Graham Walker is a mineral economist with over twenty years' experience in mining, especially in the iron ore industry. Graham's forte is combining the expertise of technical experts to review the overall synergy of development proposals.

Graham has extensive modelling experience on strategic developments within the Pilbara, especially with respect to the impacts of infrastructure barriers-to-entry on new development proposals. These attributes, combined with a comprehensive knowledge of both the demand and supply side of the iron ore market, mean that Graham is able to provide an insightful overview of the Pilbara iron ore industry.

Philip Maxwell

Role in Study
▪ Economic and social impact analysis
▪ Iron ore industry
▪ Policy options

Philip is Metana Minerals Professor in Mineral Economics and Mine Management at the Western Australian School of Mines (WASM) at Curtin University of Technology. He coordinates WASM's Master's program in Mineral Economics, which attracts a wide student body from Australia and overseas.

Prior to accepting his current position in 1992, Philip was Head of the School of Economics and Finance at Curtin University. His previous academic appointments were at Deakin University, the New South Wales Institute of Technology and the Gordon Institute of Technology.

He holds a BEc degree from the University of Sydney, an MEc from Macquarie University, and MA and PhD degrees in Economics from the University of Georgia.

Philip's recent research interests have been in the regional economic impacts of mining and in mineral commodity markets

Stuart Hohnen.

Role in Study
▪ Assessment of State Agreements
▪ National competition policy
▪ Policy options

Stuart has more than 30 years' experience in the construction, resources and energy industries. His experience spans both public and private sectors at Chief Executive and Board level.

Stuart holds an honours degree in Civil Engineering from Adelaide University, and a Master of Business Administration degree from Stanford University.

Stuart gained his early private sector experience in the management of major civil construction and commercial development. He subsequently headed up a diversified mining and exploration group, and a mining and industrial services company.

He gained his public sector experience primarily in the Western Australian Department of Resources Development (DRD) – now DOIR - where he worked for fourteen years, including five as Chief Executive.

Stuart served as Deputy Chairman of AlintaGas from its formation in January 1995 to June 1998. During this time, he oversaw the sale of the Dampier to Bunbury Pipeline and also served as a Councillor of the National Competition Council.

As a consultant, Stuart has advised a wide range of corporate and public sector clients on commercial, strategic and regulatory issues affecting the resources and energy industries in Western Australia.

3. Approach And Methodology

Study management Evans & Peck approach
The Evans & Peck study team was the managed to defined sub-scopes of work, timelines and individual deliverables.

Evans & Peck take a project management approach to assignments of this nature which involve:

- Complex issues
- Broad scope

- Specialised knowledge requirements
- Diverse team

with an outcome requiring assimilation and processing of data, leading to logical and persuasive conclusions.

Kick off
Scope Interpretation was a key specification, and was agreed through the processes of:

Regular Team Communications
Progress and coordination meetings were held with the study team and with DOIR representatives. These meetings became an important forum to discuss contentious issues as the findings of the study begin to take shape.

Workshops

The qualitative modelling reported in section 7.1 and the policy options study reported in section 8.2 were workshopped :
Qualitative Model Workshop 26 May 2004

Government Policy Options Workshop 1 June 2004

Peer Review
An important element of Evans & Peck internal controls is a Peer Review of assignment deliverables before final issue. The Peer review for the DoIR Pilbara Iron Ore Rail access Study was carried out by two principals of Evans & Peck commencing 25 June 2004:

- Cris Dedigama – Principal & WA Manager
- Mal Evans – Consultant an founding partner

The draft report was issued for comment within the study team and to DOIR before issue of the final report issued.

Report Format & Deliverables

The team activities, inputs and individual deliverables were planned and controlled as follows:

Table 2.1 Study Deliverables and Team Tasks

Task Description	Team Deliverables	**Report Section**	
2 *Data Search*	Market Supply and Demand	2	WD
	Pilbara iron ore Deposits, Ownership, nature location an strategic importance	3	CR
	Smaller Producers – their role and significance in the iron ore industry	2	WD/CR
	Rail System Capacity	5	IE
3 *New Rail Decision*	Iron Ore Transport Constraints	5	IE
	Investigate New Rail Line (3rdTrunk)	5	IE
	Alternative Rail Routes/Costings (Double track + Connection to Existing or 3rd trunk)	5	IE, GW
4 *Policy*	Stakeholder Consultation	6	THu,G W
	Public/private costs & Benefits (qualitative) of increasing competition in Pilbara iron ore market	7.1	Thu,GW PM,SH
	Policy Implications	6	SH PM Thu GW
	Other Issues		All (TH)
	Define Policy Options	6	SH,PM, TH
5 *Modelling*	Economic Quantitative Impacts	7.2	GW
6. *Conclusions and Recommendations*		1	THu GW
7 *Report*	Compile		PC, GW TH
	Edit		TH, GW
	Draft		TH GW
	Evans & Peck Peer Review		E&P
	Working Committee Review		DIOR
	Final	16/7/04	

Methodology

Below is the study schedule, which also served as the study plan. This defined individual responsibilities, activity times and illustrates the interaction and coordination required to complete the study in the required time and with the necessary deliverables.

Table 2.2 Study Schedule

Description	Dur	2004 (APR, MAY, JUN, JUL)
1 - PRELIMINARIES		
Award	0	
Mobilise team	4	
Kickoff meeting	1	All, DOIR DPI, DT&F
Brief confirmed	0	
Government Workshop	0	All, DOIR
2 - DATA SEARCH		
Market supply & demand	10	WD, CR, GW
Pilbara iron ore deposits	15	CR
Smaller producers	15	WD
Current rail system capacity	15	IE, GW
Data complete	0	
3 - NEW RAIL DECISION		
Iron ore transport constraints	4	IE, GW
Investigate new rail line	5	GW
New rail line needed Y / N	0	
4 - POLICY		
Public / private costs & benefits	9	PM, GW
Policy implications	5	SH, PM
Policy Workshop	1	
Other issues	10	All
Policy Recommendations	0	
5 - MODELLING		
Modelling economic impacts	17	SH, PM, GW, WD, AF
Policy options	3	SH, PM, GW
Modelling complete	0	
6 - REPORT		
Compile	10	PC, GW
Edit	5	GW, TH
Draft	15	TH, GW
SIAC Presentation	0	ALL
Peer Review	2	PM, TH, GW, CD
Submit Draft	0	
Final & recommendations	0	

APPENDIX 3: MARKETING; DEMAND & SUPPLY

Introduction

This appendix is a commentary containing numbers that may be inconsistent with the main body of the report. This is because data in the main report has been updated as newer or more reliable data and information are obtained.

The inconsistencies do not however change the relevance of the overall narrative and the applicability of many of the observations contained in following commentary.

Demand Side:

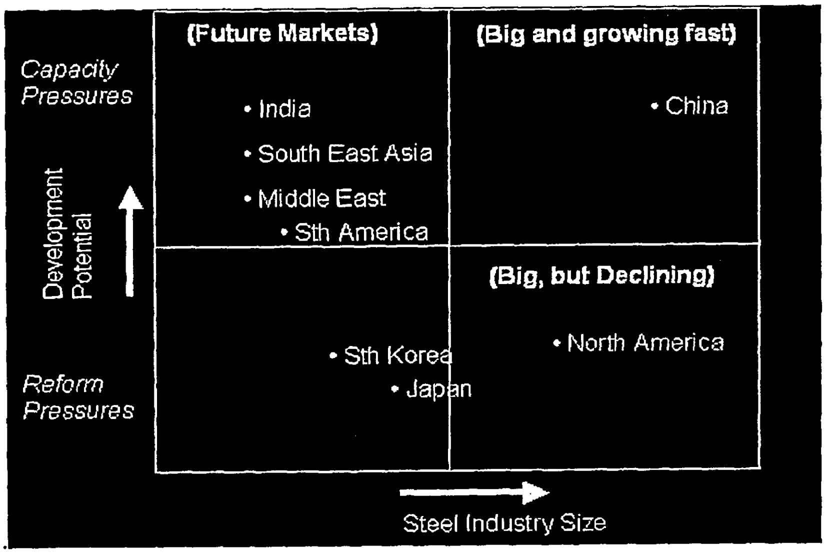
The following are some of the key questions that need to be considered when understanding the future of the iron ore industry in WA and its relationship to World Steel Production:

World's Steel Industry Questions:

- Where will industry be centred in 10, 20, 30, 40 years time?
- Where will the growth come from?
- Will the steel making growth continue in China?
- When will China become a net exporting force in steel?
- Will the economy of India grow to a similar extent as China to increase domestic demand for steel?
- Environmental issues for steel industry in 'Developed Countries'
- Alternative smelting methods as alternatives to blast furnaces
- Use of scrap and impact on iron ore consumption
- Availability of coke or suitable coals for reduction of iron ore
- Increased rationalisation of the steel industry with closure of inefficient plants
- Move away from 'National Steel Industries' to merchant steel from low cost production centres

WORLD STEEL MAKING

The industry will no doubt be centred on China in the next 10 years plus, however India and other future markets in the Middle East and South America have real development potential. Almost all the new regional steel capacity will come from China ~120Mt by 2006. Other producers are all at 100% utilisation



(RTIO Financial Community Visit, Sept 2003)

- When will China become a net exporting force in steel?

China imported 37Mt of steel (90% flat) in 2003 – forecast to continue in 2004. China's steel demand has historically been driven by construction investment. Around 60% has been for long products and around 50% of this for the construction sector. However with the industrial development of China focussed on manufacturing, the structure of steel consumption in China is undergoing substantial change. In 2003 demand for flat steel increased 32.7% YOY compared to 23.9% for long products – this trend is forecast to continue. Although steel-making capacity is expanding, the rate of growth in flat steel is not growing at a fast enough rates and the domestic shortage of flat steel will remain for a long period.

- Will the economy of India grow to a similar extent as China to increase domestic demand for steel?

Goldman Sachs forecast that India will be the world's third largest economy in the world by 2050. GDP

China US$45,000bn

US US$35,000bn

India US$27,000bn

Japan US$7,000bn

India's economy will probably grow in 'U' shape from 2020 with very large growth from 2030.

- Environmental issues for steel industry in 'Developed Countries'
- Alternative smelting methods as alternatives to blast furnaces

HiSmelt technology is a direct smelting technology that produces a premium grade hot metal without the need for sinter plants and coke ovens as required for the traditional BF route – offering significant environmental and economic benefits over the traditional iron making methods

- Use of scrap and impact on iron ore consumption
- Availability of coke or suitable coals for reduction of iron ore

The new factor in current markets apart from Chinese demand is the shortage of raw materials – coke and iron ore. Coke prices have exploded towards $450/ton fob. A major driver of this increase in price has been a sharp fall in net exports of coal and coking coal. This has led to production cuts in Italy, Egypt the USA, India and Japan. Some steel makers have even postponed iron ore shipments due to an inability to source coke.

- Increased rationalisation of the steel industry with closure of inefficient plants
- Move away from 'National Steel Industries' to merchant steel from low cost production centres

This might be the case for developed nations, however it is likely that China, India and even Brazil in the long-term will maintain the steel industry as the a key manufacturing industry.

STEEL MAKING:

There have been 15 identifiable steel cycles in the past 25 years. The current up-cycle, which began in mid 2003 is the second most powerful over that period (in terms of % change from low to peak) and has taken HRC prices to their highest level in nominal terms.

Previous cycles have been driven solely by the OECD economic cycle – with the relationship between steel prices and OECD economic growth being extremely close. Steel prices have tended to peak or bottom out around 6 months after the OECD leading indicator turning point. That is except for the most recent cycle where China prevented a more substantial decline last year.

(a) JAPAN

The Japanese Steel industry is currently running at 100% of capacity – driven by export demand of finished products. When the cycle bottoms, it can be assumed that the industry will retreat to 80% utilisation, with a continuation of mergers, (Nippon Steel with Sumitomo Metal industries and Kobe Steel)

- Limit to steel making output and Iron Demand at current level
- Potential rationalisation and subsequent blast furnace closure at older works
- Replacement of some blast furnaces with some form of direct smelting technology
- Continued development of use of lower priced Iron Ores, pisolites and Marra Mamba
- Magnetite from Australia as an ore source

- Freight implications and growth in reliance on Australia as a source 60% to 70%,is considered possible, but the trend would be over longer period of time Individual mills might increase their reliance on Australian sources through equity and long-term sales agreement vehicles which have become popular in the past year.

The Japanese steel market has reported 5-10% increases or Yen4, 000 to Yen5, 000 for long-term contracts with major customers. This will mark the second consecutive year since 2003 of rising contract pricing with major customers – overall trend positive.

The JISF project, that cost increases for raw materials could mount to 700Bn Yen for the entire steel industry in 2004 – whilst the industry is forecast to pass on the increasing raw material costs to major customers later this year, this is probably not sustainable in a cyclical market.

(b) KOREA

- Follow Japan's lead for how long?
- Different Iron Making strategy, eg use of Corex aiming at 100% fines use
- Potential for use/consumption of higher P ores once fines use perfected
- Replacement of Pohang blast furnaces with Corex units in the longer term, ability to use high P ores
- Current import levels to remain the same, limited diversification from Brazil to Australia re iron making approach
- Diversification to China through JV with steel makers is a possibility, especially given Posco's technical knowledge and the current 'explosion' of new developments
- Unification with North Korea or some form of economic/political alliance has the potential for a surge in steel demand to provide the level of infrastructure that North Korea needs.

(c) TAIWAN

- CSC's Kaohsiung works to remain the primary operating unit
- CSC plans to develop a new small steel plant at 3.0Mtpa at Taijung
- No additional blast furnace development in Taiwan, options are for investment on the mainland, particularly in Fujian Province
- Taiwan imports slab, the new facility at Taijung will significantly decrease dependency on slab imports

(d) CHINA

- China's steel industry growing at unprecedented rates
- China a net steel importer despite rapid domestic production growth
- 70,000 cu metres of new blast furnaces planned to come on-steam over the next 3 years
- Blast furnace development is across the total steel making spectrum from blast furnaces as small as 120 cu metres to units of +3,000 cu metres
- Steel mills capable of producing 1.0 Mtpa are being built for as little as US$40 million using Chinese designed, manufactured, and installed facilities

Aside from potential risk in slower than expected GDP growth a key risk is the level of fixed asset spending in the Chinese steel industry – 130bn Yuan in 2003, up 85% from 70bn Yuan in 2002.National Government measures to limit the rate of new steel capacity are centred on minimum technological and environmental standards. New Blast Furnaces must be over 1,000m3 – only impact will be on smaller mills that service regional markets.

Eg (TISCO)

Steel output 6.1Mt in 2002 increases to 8.0Mt in 2006. Plan is to increase capacity to 16Mt in 2007, 24mt in 2008 and 31Mt being the ultimate plan. This growth in production is forecast to be met by imported ore.

- The barriers to market entry are low as the technology is available "off-the-shelf"
- Steel Industry receiving massive financial resources from banks and other lending institutions as national economic growth, especially real estate, consumes significant amounts of steel
- Growth is a Middle Class in China is fuelling demand for, flats, cars, and white goods.
- China is investing heavily in road and rail networks with rapid development of toll based express and highway systems
- China is rapidly becoming the world's manufacturing base with cheap labour but sophisticate communications systems and access to land and good transport infrastructure.

Demand for finished steel remains strong. Supply/demand balance expected to remain tight for next 1-2 years. China's steel demand expected to reach 310Mt and 348Mt in 2004 and 2005 respectively – growth of 14.2% and 12.3% respectively. Whilst this is down from +57Mt in 2003, it still represents growth in steel demand of 39Mt and 38Mt respectively. Structural shortage of high quality flat products exists in China and is a major driver of imports. By 2006 with more HRC lines coming on stream and an improvement in the Capacity Utilisation Rate, the domestic shortage for HR is likely to decline.

CHINA'S STEEL OUTPUT FORECAST					
	2002	2003	2004E	2005E	2006E
Import Iron Ore Source					
World ex-China output	877	915	985	1037	1098
World ex-China Demand	752	781	796	816	832
World Export to China	112	148	189	221	226
Recoverable Iron	67	89	113	132	159
Domestic Iron Ore Source					
Domestic Iron ore Supply	231	261	300	350	380
Recoverable Iron	68	77	88	103	112
Other Source of Iron	34	37	37	37	37
Pig Iron Production	**169**	**202**	**238**	**272**	**308**
% YOY	15%	20%	18%	14%	13%
Crude Steel Production	**182**	**220**	**260**	**299**	**339**
% YOY	20%	21%	18%	15%	13%
Finished Steel Production	**194**	**241**	**277**	**320**	**359**
% YOY	20%	24%	15%	15%	12%
Steel Demand of China	**213**	**271**	**310**	**348**	**380**
Domestic Steel Shortage	19	30	33	28	21

Merrill Lynch, AsiaPac Steel Sector, 6 April 04

China bottlenecks remain an issue –raw materials, power and infrastructure (port and transport) expected to continue until end 2005. In 2004 China will produce 260Mt of crude steel and 270Mt of finished steel. China's main concern in 2004-05 is the potential for iron ore shortage, whereas other producing regions concern is coke supply – China will export 5Mt less coke in 2004 (down from 15Mt in 2003) to meet domestic requirement. Congestion of China's ports and rail will not ease until 2H 2005.

(e) OTHER ASIA

Indonesia, Thailand and Malaysia have indigenous steel industries primarily based on EAF or Direct Reduction technologies. Potential growth exists in all countries for further development of current infrastructure as well as the installation of blast furnaces or some other direct smelting technology. Economic growth in these countries will see a combination of local and imported steel.

Philippines, Vietnam, Cambodia, Laos, etc will see increased use of steel but with an unlikely level of significant growth in domestic steel production. Imported steel will primarily satisfy local demand, sourced from China/Taiwan/Korea/Japan.

(f) EUROPE

Europe will remain a steel producer but production levels will continue to ***decline*** as inefficient plants are closed, aged coke ovens and tight environmental laws force plant closures and as competition from a vibrant low cost Chinese and Russian/Ukrainian steel industry captures more of the market.

Market decline will continue with small, older plants closing first, (inland plants in Belgium, Germany and France), followed by those located some distance form the market, (Redcar UK, Finland, small mills in Italy).

(g) MIDDLE EAST

There is limited Blast Furnace based steel making in this area, except for Turkey and Iran. The former is supplied from imported and domestic sources, (low grade depleting rapidly), with limited potential for development, whilst the latter has undergone substantial growth fuelled by local sources of Iron Ore. Iran is expected to remain self-sufficient in Iron Ore. (Limited export potential as all ore is pelletised).

Growth in Steel Manufacturing seen in the EAF route fuelled by DRI sourced from imported pellets.

(h) EASTERN BLOCK

Romanian steel industry is a net iron ore importer, now controlled by the Ispat Group. Installed capacity exceeds production output, (antiquated facilities). Bulgaria, Yugoslavia, Moldova and other Central European States have domestic steel industries, generally remote from the coast, or served by small ports. Limited development opportunities seen to add to the world's demand for Iron Ore.

(i) South America including Brazil, Argentina, Mexico, Venezuela

Production will increase , Raw Materials will be sourced from within the continent.

(j) US and Canada

Relatively stable to marginally declining production.

SUPPLY SIDE

Iron Ore Industry

- Location and availability of resources current and future
- Impediments to further development at existing or increased levels
- Role of future "partnerships" between iron ore producers and steel makers, (Posco, Baoshan, Wuhan etc), what is the long-term impact on supply demand?

It is apparent that Rio Tinto Iron Ore, (RTIO), is strengthening its relationships with strategic Asian mills by locking in expansion volumes under long-term agreements:

- Nippon Steel – long-term contract for 150Mtpa underpins Yandi expansion. Equity in Beasley River enhances Robe JV development options.
- Baosteel – Eastern Range mine commissioned in April 2004. Additional 70Mtpa long-term supply agreement over 10 years. RTIO sales to Baosteel will reach ~20Mtpa

Long-term agreements are underpinning expansion capacity of the majors – what will be the potential for growth when market changes in 2007? Will smaller players be pushed out of the market?

- Political stability, low terrorist risks
- Infrastructure needs for future development
- Short/Long term effects of rationing from demand late 2003/full 2004. (Plant closures, delayed start-ups, effect on steel price)
- Logical development of future growth is Australia and Brazil. Will the steel industry support development elsewhere to maintain competition?
- Can the world's steel industry afford this support activity?

Current expansions will alleviate but not eliminate the current supply deficit. Supply/demand tightness will continue to favour producers at least throughout 2005

IRON ORE SUPPLY OUTLOOK				
	2003	2004E	2005E	2006E
Seaborne Supply	525	580	625	710
CVRD	170	185	195	240
Rio Tinto	110	125	138	162
BHP	84	100	110	120
Other	161	170	182	188

Merryl Lynch, AsiaPac Steel Sector, 6 April 04

1. Future Iron Ore Demand

General Steel Making Implications

- Steel demand to be satisfied by a combination of blast furnace or alternative smelting technologies PLUS a growth in EAF steel
- Growth in EAF based on increased availability of scrap from redundant infrastructure especially in China
- Limited non-China Asian growth with Japan, Korea, Taiwan "Mature" Markets
- China growth limited by access to capital and possibly coke

In 2003 China consumed 409Mt iron ore consisting 261Mt domestic ore up 12.8% YOY and 148Mt of imported ore, up 32.8% YOY. Due to China's low ore grade (Fe 32%), imported ore now supports half of domestic steel production.

According to China Iron & Steel Assoc. domestic iron ore output will increase 40Mt in 2004 and 50Mt in 2005. Imports of iron ore forecast to increase 41Mt in 2004 and 32Mt in 2005. Total capacity for blast furnace and steel smelting will reach 309Mt and 333Mt by end 2005 – as a result 10% of China's steel capacity will not be utilised due to iron ore supply bottleneck.

- European consumption expected to fall as environmental and cost pressures limit output
- US will become a significant steel importer as existing steel making facilities become outmoded and uneconomic
- Location of US steel facilities preclude iron ore imports replacing diminishing available high cost iron ore
- Assumptions made that former Eastern Block will remain supplied by a combination of Russian and Ukrainian ores together with imported material from Australia and Brazil
- Steel industries of South America to remain supplied from Brazil/Chile/Peru
- Middle East supplied by indigenous sources, (Iran), and imported pellets from Brazil/Bahrain
- Brazil has the potential to increase steel output with restrictions based on availability of coal, 100% imported
- China's economic growth and improvement of living standards will increase production costs
- Current competitive cost advantage China now enjoys over other steel makers will continue for 20 years when costs of Indian or Brazilian steel production could **impact**

2. Future Iron Ore Availability

General

There is consensus that China's steel production will reach 300Mt by 2010 (220Mt in 2003). Some analysts, (J.B. Were), predict as high as 361Mt.

BHPBIO production will be 110Mt by end 2004 and studying 145Mtpa (Newman 60Mtpa, MAC 40Mtpa and Yandi 45Mtpa)

Rio Tinto iron ore is expanding to 116mt by 2006 (HI only). Yandi, from 20Mtpa to 36Mtpa and West Angelas from 20Mtpa to 25Mtpa.

- Seaborne trade dominated by Australia and Brazil
- Potential growth from South Africa, high political risk, long ore transport

KUMBA

Northern Cape (significant lump ore reserves) could produce about 60Mtpa from 2008 with Sishen being expanded from 28Mt to 38Mtpa (expansion study complete Aug 04) and Sishen South being developed at 10Mtpa and also Beeshoek at 10mtpa being considered.

Saldanha Bay port expansion plan to 39Mtpa – phased commissioning Feb 2004 – June 2005.

Orex rail capacity expansion plan

2004 – 29Mtpa

2005/06 – 32.5Mtpa

2006/07 – 37.5Mtpa

2007/08 - 41Mtpa

Potential expansion to 60Mtpa?

- Potential growth from India but significant investment needed in infrastructure

Increasing iron ore imports by China in Q104 is staggering – rising 48.3% YOY – impressive given production problems faced by CVRD and Rio. CVRD fell 5.1% YOY due to rainfall and Rio down 12% YOY due to cyclone Monty.

CHINESE IMPORTS BY COUNTRY			
	Q1 04	Q1 03	% CHG YOY
Australia	18.12	13.46	35%
Brazil	10.41	8.02	30%
India	13.44	8.32	62%
South Africa	2.98	2.9	3%
Peru	0.8	0.3	163%
Canada	1.04	0.24	326%
Venezuela	0.7	0.07	876%
Chile	0.53	0.34	54%
Other	2.73	0.55	392%
Total	**50.75**	**34.2**	**48%**

Macquarie Research, 26 April 04

Growth in small country supply is a warning that high prices can turn around and impact

- Weather conditions remain a limiting factor for exports from Goa
- Other iron ore development potential includes Liberia and Guinea, (Simandou Deposit) in West Africa as well as Mauritania with significant undeveloped reserves.
- Longer-term outlook for Canadian ore is continuation of the same output levels. Reserves are large but environmental and cost issues mitigate against significant additional development
- Canadian ore reserves healthy but high cost. Industry marginally profitable at current prices, products are pellets, (price fluctuation significant), and concentrate, (bottom end of the market)
- US outlook is for diminished production as cost pressures increase with ageing mines
- US is a net importer of iron ore with greater future reliance on imports as local sources decrease in availability and increase in cost of extraction. (Coastal and Great Lakes works can be served by economic ore primarily from Canada and Brazil)
- Sweden has significant reserves but at increasing depth challenging conventional underground mining techniques. Mining will be necessary at depths where temperature becomes an inhibiting factor. Robot mining techniques already employed, future potential uncertain

(a) Australia

Hamersley Iron;

BHP Iron Ore

Significant iron ore assets acknowledged as the best in the Pilbara. Pioneered Yandi use and agreed a price level below the "Value-in-Use" of the product. Yandi price, officially 94% of Hematite, was secretly lowered to 92% with the JSM immediately prior to the introduction of HI Yandi. This lower price immediately matched by HI, with the result that the product is undervalued.

Marra Mamba, whilst priced respective to Hematite, is considered an ore in competition with Yandi pisolite.

BHP has signed a 15-year deal with Posco for 3.0 Mtpa of MAC and is in discussions with four Chinese companies for a similar deal, (tonnage and duration unknown). Companies include: Tangshan, Maanshan, Jiangsu Shagang, and Wuhan. Industry reports suggest that BHP has initiated similar discussions with up to ten (10) other mills for equity/long term ore supply agreements.

Recent BHP Wheeler JV (12Mt for 25 years) demonstrates long-term supply agreements possible.

BHP Asset Development Projects (Sept 03)

(www.bhpbilliton.com)

- MAC - $246M
- MAC-Yandi railway - $160M (first railings Nov 03)
- Port Capacity - $650M (Mar 04)
    - Takes port capacity from 81Mt to 100Mt
- Long-term expansion looking at 120Mt and now 140Mt.

BHP Market View

(ABN Amro, 15 March 2004)

- Seaborne iron ore 625-725Mt by 2007 – current demand is on the high side of this forecast
- Pilbara operations currently running at 90Mtpa
- 100Mtpa expansion expected to be completed by 3Q04, three months ahead of schedule.
- Feasibility study approved for 145Mtpa with focus on capacity and efficiency
- Unit costs should fall from A$15.80/t FY03 to A$12.0/t FY06 due to expansion
- Output in 2009 forecast to be 142Mt – Yandi and MAC operating at 50mtpa (ABN)
- US1.5bn to increase capacity to 142Mt (ABN)

Hope Downs

2. Brazil

- CVRD controls +90% of the ore exported from Brazil
- 2003 CVRD will purchase domestically +14Mt of iron ore to meet export demand
- Brazil is a net steel exporter with a vibrant growing steel sector, so domestic iron ore must supply both local and export markets
- Availability of ore is not a problem. Huge reserves are available in Minas Gerais and in the Amazon area
- The industry is mature, well organised, and has access to capital and technology the same as in Australia
- Mines are located remote from the coast, major development for expansion of export tonnage will centre on rail infrastructure
- Port facilities have the potential to be expanded, with real estate a potential issue for MBR and Ferteco. (The former facility is located on Guieba Island with finite stockpiling space, whilst the latter's, port is draft restricted and expensive to dredge.
- CVRD's loading facilities at Tubarao and Pont de Madera are efficient, both with expansion potential
- CVRD's control of the Brazilian industry, gives increased potential; for shared facilities in the future

Samarco: Forecast record production in 2004 of 14mtpa pellet production and 2.5Mtpa pellet feed. Currently studying feasibility to increase production of pellets from 14 to 21mtpa. Expansion proposal expected to go to the Board in Nov 04. Indicative CAPEX is US$550m over 3 years. Current resource 4Bn tonnes of 45% Fe.

Expect pellet market (seaborne) to increase 15% from 270Mtpa to 310mtpa – a much lower growth rate than for iron ore.

3. South Africa

- Mine location is distant from the ports, +800km, with rail access the limiting factor
- Reserves are understood to be sufficient to sustain current levels of output with additional upside possible
- National politics and ANC desire to ensure national wealth flows to the population could be an impediment top future development

4. Canada

IOC pellet and concentrate producer

- High cost, specialise in boutique products, limited stockpile space, icing in St Lawrence Seaway impacts on shipping season. North and Rio Tinto have endeavoured to make this operation profitable, limited success. Dormant pellet plant (4Mtap capacity at Sept Isles), planned to be reopened by North, plans cancelled after Rio take-over of North, development potential exists, if market conditions allow, now is the time.

QCM pellet and concentrate producer

- Excellent pellet plant, limited potential for expansion without very significant capex, company being sold by owners Mitsui/CVRD, as a stand-alone operation, limited expansion, mine development expensive as waste stocks need to be moved, environmental considerations apply in Western Canada, less prone to shipping interruptions with icing, but still a concern.

Wabush pellet and limited concentrate

- Relies on IOC railroad for ore transportation, high Mn pellet with limited blast furnace acceptance, controlled by Cleveland Cliffs, long term pellet manager/operator/owner with limited vision, 'old US' style operation is an impediment to development, reserves significant but rail issue will limit development

Canada General

- Potential for a re-organisation of the Eastern Canadian mines exists with the movement of IOC concentrate to QCM pellet plant, (new rail) to optimise production/product mix. Some expansion potential available overall, major long term concern will be ENVIRONMENTAL
- Roche Bay, magnetite deposits above the Arctic Circle, is seen as having very limited chance of development success over the next 5 to 10 years because of geographic location and limited shipping period.

5. Sweden

- Limited growth potential due to deep mining conditions
- Ore pelletised, some concentrate sold
- High cost operation, pellets the most 'difficult' sector of the market for sustainable profits
- Re-investment will be an issue when LKAB reaches the limit of the current mining areas 2006/07??

6. India

- Major producer, excellent reserves, limiting factor domestic railways and port infrastructure
- National and State Governments also impediments to development of iron ore export industry. National Government seeking to preserve India's high quality ore for domestic use by restricting exports
- Domestic steel industry receives support for Government but this has led to the 'rape' of some deposits with the high grade lump removed leaving fines to pollute water/land
- Limited infrastructure will prevent India from catching Australia and Brazil even if restrictions are lifted

Shipping Issues

- Loading Port facilities
- Maritime restrictions re safety of ships (overage, future anti-pollution requirements and possible impacts on shipping costs
- Availability of shipping to move the material
- Suitability of discharge ports to handle import requirements
- Port saturation, movement to larger ships, entry denied to smaller vessels
- Dry bulk capacity in 2004, 285Mt – expected to increase to 308Mt over next two years (34Mt new buildings, and 23Mt scrapings)
- 12-18% fleet (35-50mt) tied up in congested ports (2004) due to combined effects of loading delays from weather and discharging delays due to lack of stockpile space

General Comment

Whilst Shipping is not a direct issue to be considered here, it should be remembered that iron ore is ultimately purchased on a delivered basis. Freight and the cost of freight is an important issue in the determination of iron ore price and hence its source of supply

Iron Ore Pricing

- Long term Lump premium with likely decline in availability of lump
- Impact on limited pellet availability due to construction costs for new facilities
- Movement of Marra Mamba price as the premium ore when Brockman depleted
- Introduction of 'New' Marra Mamba producer at decline of current price cycle, say 2006/7 with market discount to gain entry
- Current "boom" leads to PREMIUMS on some categories of fines eg Yandi and/or Brockman
- Corporate issues: Potential merger BHP/Rio and price implication
- BHP/Rio/CVRD work to arrest the downward 'REAL PRICE DECREASE' top maximise NPV's profit, revenue etc
- Majors swallow minor competition
- Corporate move to further combine steel making raw materials under a few corporations. Coal and Iron Ore
- Move by iron ore producers into some form of partnership with steel makers, "special small discounts" included in the deal
- Current competitive cost advantage China now enjoys over other steel makers will continue for 20 years when costs of Indian or Brazilian steel production could impact
- Quality issues also influence price outcomes. Robe pisolite is cheaper than BHP pisolite based on the comparative quality aspects of the ores

General Pricing Issues

Merrill Lynch forecast +15% for 2005 prices.

Increase of crude steel in China to 299mt in 2005 from 260mt in 2004. Seaborne market forecast to expand from 585Mt for 2004 to 630Mt in 2005 (7.7% YOY). The seaborne market should grow to 730Mt by 2007.

The largest Bull Run in iron ore prices was during the 1989-1991 up-cycle, when prices rose 42%. 1980-82 saw prices rise 18% and most recently 1995-98 prices rose 17%. Merrill Lynch expects that prices will increase 47% during the current 2003-06 period with a roll-over in 2006.

A price correction could prove probable in 2007 given strong supply response and appropriate lead times. Prices are likely to fall 5% in 2007, and for 2-3 years thereafter following the peak in 2006.

Delivered iron ore prices in Asia have historically traded at a premium to those in Europe, but are now close. This shift is believed to reflect the emergence of Brazil as a swing supplier and greater market integration.

Iron ore prices have fallen at a trend rate of 0.7% a year over the last 30 years, driven by cost trends. Incremental management and technical gains, better inputs and sustaining or new capital expenditure are believed to explain this. Some analysts expect this trend to reverse, either due to the supply-demand balance issues or a reversal in cost trends – this would however run counter to established drivers.

The authors expect Chinese imports to increase over 250Mt by 2007 and up to 400Mt by 2015 – such a shift in both relative and absolute terms – will sooner or later impact pricing structures and mechanisms. China will no doubt assume an increased role in the determination of the reference price. Key concern to the iron ore Industry: can the Chinese Steel Industry mature to become a responsible participant in the setting of appropriate reference prices that ensure stable supply and quality?

The challenge facing the oligopoly pricing control of BHPB, RTIO, and CVRD, will be to manage the iron ore price to ensure the level provides satisfactory returns for recent investment, and at the same time, is maintained at a level sufficiently low to maintain the barriers to industry entry.

A PPENDIX 4 – PILBARA RESERVES AND RESOURCES

Pilbara Resources Sorted by Ore Type

NB: BHP Billiton Resources adjusted to reflect DEDUCTION of RESERVES. (See note below).

Project	Project Owner(s)	Project Group	Site(s)	Ore Reserves: Proven Mt	Proven Fe%	Proven P%	Probable Mt	Probable Fe%	Probable P%	Total Reserves Mt	Total Reserves Fe%	Total Reserves P%	Resources: Measured Mt	Measured Fe%	Measured P%	Indicated Mt	Indicated Fe%	Indicated P%	Inferred Mt	Inferred Fe%	Inferred P%	Total Resources Mt	Total Resources Fe%	Total Resources P%	Comments	Ore Type
Archaean BIF [illegible]																										
Mt Phil Ck	N/A	N/A	McPhee Ck										3095	45.93		377	49.8		28	49.3		3101.57	49.8	0.09	Archaean BIF	ABIF
Mt Rove	Fortescue Metals Group		Mt Rove																167	47		167	47.0	0.00	Archaean Goethite	ABIF
Mt Goldsworthy JV (Northern Areas)	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd	Nimingarra	Numerous	17	63	0.05	4	60.7	0.04	21	62.6	0.05	31	68.2	0.07	41	60.8	0.06				72	69.3	0.06	Enriched Archaean IF NB: BHPB Resources are Exclusive of Reserves (see note below)	ABIF
TOTAL ARCHAEAN BIF				17	63	0.05	4	60.7	0.04	21	62.6	0.05	3126	49.1		44.77	59.8		119.8	47.8		3348.57	49.1			
Proterozoic BIF [illegible]																										
Balmoral - George Palmer	Mineralogy Pty Ltd	Balmoral - George Palmer	Balmoral? OBanco? SW Fortescue?													800	33.5		3250	31.8		4050	32.1	0.00	Unenriched Brockman Iron Formation	PR
TOTAL PROTEROZOIC BIF																800	33.5	0	3250	31.8	0	4050	32.135802	0		
Enriched Brockman [illegible]																										
Channar JV	Rio Tinto Ltd CMIEC Lyons Group	Channar	Channar P4E P41E P94E Mt Channar	117	63.6		13	63.9		130	63.62	0.09	50	62.1	0	5	61.8					55	62.1	0.00	Enriched Brockman IF	EBR
Jimblebar JV (Brockman)	BHP Billiton Ltd Wuhan Iron & Steel (group) Corp. Maanshan Iron & Steel Co Limited Jiangshu Shagang Group Co Ltd CI Minerals Australia Ltd Mitsui Iron Ore Corporation	Jimblebar - McCamey's Monster	Numerous	175	62	0.07	72	61.5	0.08	247	61.854251	0.07	70	60.6	0.07	45	62	0.05	755	61.5	0.12	870	61.5	0.12	Enriched Brockman IF and Detritals. NB: BHPB Resources are Exclusive of Reserves (see note below)	EBR
Juna Lockyer	N/A	N/A	Juna - Lockyer																6	62		6	62.0	0.00	Enriched Brockman IF	EBR
Mindy Mindy (Brockman)	Consolidated Minerals Ltd Fortescue Metals Group Ltd	Mindy Mindy	Mindy Mindy																38.7	59.72		38.7	59.7	0.00	Enriched Brockman IF	EBR
Mining Area C (Brockman)	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd Pohang Iron and Steel Co Ltd	Mining Area C	Numerous										22	58.5	0.07	17	58.5	0.07	71	62.2	0.12	112	60.8	0.10	Enriched Brockman IF and Detritals. NB: BHPB Resources are Exclusive of Reserves (see note below)	EBR
Pamelia	Hancock Prospecting Wright Prospecting		Pamelia																40	60		40	60.0	0.00	Enriched Brockman IF	EBR
Prairie Downs (Brockman)	BHP Billiton Ltd Redison Goldfields Consolidated Ltd	Prairie Downs	Numerous													82	59.6	0.14	85	61.2	0.16	167	60.4	0.15	Enriched Brockman IF. NB: BHPB Resources are Exclusive of Reserves (see note below)	EBR
Newman JV (Brockman)	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd	Mt Newman	Numerous	802	62.9	0.07	148	61.9	0.07	950	62.744211	0.07	893	63.6	0.07	223	62.4	0.08	277	61.6	0.09	1393	63.0	0.08	Enriched Brockman IF. NB: BHPB Resources are Exclusive of Reserves (see note below)	EBR
RT Undev. Resources (Brockman)	Rio Tinto Ltd (includes Hamersley)	Various	Numerous													1735	62.6		2370	62.4		4105	62.4	0.00	Enriched Brockman IF	EBR
RT Undev. Resources (Detritals)	Rio Tinto Ltd (includes Hamersley)	Various	Numerous													220	62.1		60	61.3		280	62.0	0.00	Detritals (Scree) Ore	EDR
Mt Tom Price	Hamersley Iron	Mt Tom Price	Numerous	143	64.3		56	64.6		199	64.388141	0.00	35	62.7		65	64.3		19	61.5		119	63.9	0.00	Enriched Brockman IF	EBR
Mt Tom Price (Low Grade)	Hamersley Iron	Mt Tom Price	Numerous										38	56.9		20	59.4		3	58.6		[illegible]	58.1	0.00	Enriched Brockman IF	EBR
Paraburdoo (Brockman)	Hamersley Iron	Paraburdoo	Numerous	11	61.8		9	61		23	61.186957	0.00	30	63.2		25	63.9		65	63.2		120	63.3	0.00	Enriched Brockman IF	EBR
Hope Downs	Hancock Kumba Resources Ltd	Kalgan Ck	Several													90	61.3	0.14	195	60	0.15	285	60.4	0.14	Enriched Brockman IF	EBR
TOTAL ENRICHED BROCKMAN				1251	63		199	62.5		1549	62.9		1130	63		2559	62.4		3998	62.1		7687	62.3			
Enriched Marra Mamba [illegible]																										
Jimblebar JV (Marra Mamba)	BHP Billiton Ltd Wuhan Iron & Steel (group) Corp. Maanshan Iron & Steel Co Limited Jiangshu Shagang Group Co Ltd CI Minerals Australia Ltd Mitsui Iron Ore Corporation	Jimblebar - McCamey's Monster	Numerous																17	60.2	0.1	17	60.2	0.10	Enriched Marra Mamba IF NB: BHPB Resources are Exclusive of Reserves (see note below)	EMM
Hope Downs	Hancock Kumba Resources	Hope Downs	Hope Downs 2 - Wonmunna										100	63								100	63.0	0.00	Enriched Marra Mamba	EMM
Mining Area C (Marra Mamba)	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd	Mining Area C	Numerous	184	62.7	0.04	19	62.8	0.04	203	62.70936	0.04	208	61.8	0.04	191	62.1	0.04	373	61.3	0.06	775	61.5	0.04	Enriched Marra Mamba IF NB: BHPB Resources are Exclusive of Reserves (see note below)	EMM
East Pilbara Iron Ore Project	Fortescue Metals Group	Mt Nicholas	Mt Nicholas Mt Fraser Mt Fraser South																848	55.8		848	55.8	0.07	Enriched Marra Mamba IF	EMM
Mulga Downs	Hancock Prospecting Wright Prospecting	Mulga Downs	Murray's Hill																326	60.52		326	60.5	0.00	Enriched Marra Mamba IF	EMM
Prairie Downs (Marra Mamba)	BHP Billiton Ltd Redison Goldfields Consolidated Ltd	Prairie Downs	Numerous													53	60.4	0.04	158	61.8	0.06	299	61.2		Enriched Marra Mamba IF. NB: BHPB Resources are Exclusive of Reserves (see note below)	EMM
West Angelas	Robe River Iron Associates Rio Tinto Ltd Mitsui & Co (Aust) Ltd Nippon Steel Australia Ltd Sumitomo Metal Australia Ltd	West Angelas	Deposits A - H	133	62.5		315	62		[illegible]	62.182648	0.08				440	63	0	110	60		570	61.4	0.00	Enriched Marra Mamba IF	EMM
Newman JV (Marra Mamba)	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd	Mt Newman	Numerous	57	62.1	0.07	18	61.3	0.05	75	61.88	0.07	101	61.6	0.07	64	59.7	0.06	619	59.4	0.07	784	59.7		Enriched Marra Mamba IF. NB: BHPB Resources are Exclusive of Reserves (see note below)	EMM
RT Undev. Resources (Marra Mamba)	Rio Tinto Ltd (includes Hamersley)	Various	Numerous													575	62.6		1335	62.3		1910	62.4	0.00	Enriched Marra Mamba IF	EMM
Marandoo (Marra Mamba)	Hamersley Iron	Marandoo	Numerous	93	62.6		3	62.4		97	62.60	0.09				70	63		191	63		285	62.7	0.00	Enriched Marra Mamba IF	EMM
Mt Tom Price (Marra Mamba)	Hamersley Iron	Mt Tom Price	Numerous				22	60.7		22	60.7	0.07				3	61.2		19	61.3		20	61.1	0.00	Enriched Marra Mamba IF	EMM
Paraburdoo (Marra Mamba)	Hamersley Iron	Paraburdoo	Numerous				1	63.4		1	63.4	0.07													Enriched Marra Mamba IF	EMM
Nammuldi (Marra Mamba)	Hamersley Iron	Nammuldi	Numerous	19	62		83	61.6		102	61.98835	0.09	20	63.1		230	62.1					256	62.7	0.00	Enriched Marra Mamba IF	EMM
Nammuldi (Detritals)	Hamersley Iron	Nammuldi	Numerous													75	61.6					75	61.6	0.00	Detritals (Scree) Ore	EDM
Hope Downs	Hancock Kumba Resources Ltd	Hope Downs 1	Hope 1 N Hope 1 S										199			291			29			519	60	0.00	Enriched Marra Mamba IF	EMM
TOTAL ENRICHED MARRA MAMBA				469	62.5		279	61.9		848	62.3		530	62.7		1115	62.7		3731	59.77		4374	60.6		NB grades with Hope Downs 1 HMP - see note below	
Tertiary Channel Iron Deposits [illegible]																										
Bungaroo Ck Pisolites	Mineralogy Pty Ltd		Bungaroo Ck																229	55		229	55.0	0.00	Robe Pisolite	RP
Cane River Pisolites	Dorlan Pty Ltd		Cane River																103	47	0.06	103	47.0	0.06	Robe Pisolite	RP
Duck Ck North	Robe River Iron Associates Rio Tinto Ltd Mitsui & Co (Aust) Ltd Nippon Steel Australia Ltd Sumitomo Metal Australia Ltd	Duck Ck North																	50	55		50	55.0	0.00	Robe Pisolite	RP
Mindy Mindy (Pisolite)	Consolidated Minerals Ltd Fortescue Metals Group Ltd	Mindy Mindy	Mindy Mindy																123	55		123	55.0	0.00	Robe Pisolite	RP
Poonda Well Pisolites	Mineralogy Pty Ltd		Poonda Well Pisolites																200	50		200	50.0	0.00	Robe Pisolite	RP
Rocklea Limonites	Oakmead Rose		Rocklea Limonites																32	53.3		32	53.3	0.00	Robe Pisolite	RP
Robe River	Robe River Iron Associates Rio Tinto Ltd Mitsui & Co (Aust) Ltd Nippon Steel Australia Ltd Sumitomo Metal Australia Ltd	Pannawonica & Deepdale	Robe River and Deepdale Mesa Deposits	125	57		75	57		200	57	0.00	35	57		45	56.9		10	57		90	57.0	0.00	Robe Pisolite	RP
Robe River	Robe River Iron Associates Rio Tinto Ltd Mitsui & Co (Aust) Ltd Nippon Steel Australia Ltd Sumitomo Metal Australia Ltd	Pannawonica & Deepdale	Bungaroo Creek & Mesa A?													1343	59.3		371	57		1929	59.4	0.00	Robe Pisolite	RP
BHP Yandi JV	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd	Yandicoogina	Numerous	485	58.3	0.04	156	58.1	0.04	641	58.251	0.04	349	57.3	0.04	192	57.4	0.04	231	57.3	0.04	790	57.3	0.04	Channel Iron Deposits (equiv. To Robe Pisolite). NB: BHPB Resources are Exclusive of Reserves (see note below)	RP
RT Undev. Resources (Pisolites)	Rio Tinto Ltd (includes Hamersley)	Various	Numerous																493	56.5		493	56.5	0.00	Channel Iron Deposits (equiv. To Robe Pisolite)	RP
Yandicoogina (Alluvium 1.4%)	Hamersley Iron	Yandicoogina	Numerous	340	58.4					340	58.4	0.00	40	58.4		850	58		48	57.9		936	58.0	0.00	Channel Iron Deposits (equiv. To Robe Pisolite)	RP
Yandicoogina (Alluvium 1.5%)	Hamersley Iron	Yandicoogina	Numerous				71	57.8		71	57.8	0.00													Channel Iron Deposits (equiv. To Robe Pisolite)	RP
TOTAL PISOLITE/CID				850	58.2		302	57.8		1152	58.1		444	57.5		2412	58.8		1999	55.3		4855	57.2			
[illegible]																										
Hope Downs	Hancock Kumba Resources	Hope Downs	Hope Downs 3																							

EVANS & PECK

Project	Project Owner(s)	Project Group	Site(s)	Ore Reserves									Iron Resources												Comments	Ore Type
				Proven			Probable			Total Reserves			Measured			Indicated			Inferred			Total Resources				
				Mt	Fe%	P%	Mt	Fe%	P%	Mt	Fe%	P%	Mt	Fe%	P%	Mt	Fe%	P%	Mt	Fe%	P%	Mt	Fe%	P%		
Balmoral - George Palmer	Mineralogy Pty Ltd	Balmoral - George Palmer	Balmoral? Bilmoo? SW Fortescue?													807	33.5		3230	31.8		4037	32.1	0.00	Unenriched Brockman Iron Formation	BR
Boolgeeda Ck Pisolites	Mineralogy Pty Ltd		Boolgeeda Ck																220	50		220	50.0	0.00	Robe Pisolite	RP
Cane River Pisolites	Beafen Pty Ltd		Cane River																105	47	0.06	105	47.0	0.06	Robe Pisolite	RP
Chunnar JV	Rio Tinto Ltd CMIEC Lyttas Group	Chunnar	Chunnar P64E P84E P94E Mt Chunnar	117	63.6		13	63.8		130	63.62	0.00	50	62.1	0	5	61.8					55	62.1	0.00	Enriched Brockman IF	EBR
Duck Ck North	Robe River Iron Associates Rio Tinto Ltd Mitsui & Co (Aust) Ltd Nippon Steel Australia Ltd Sumitomo Metal Australia Ltd	Duck Ck North																	30	55		30	55.0	0.00	Robe Pisolite	RP
Jimblebar JV (Brockman)	BHP Billiton Ltd Wuhan Iron & Steel (group) Corp. Maanshan Iron & Steel Co Limited Jiangxi Shagang Grup Co Ltd CI Minerals Australia Ltd Mitsui Iron Ore Corporation	Jimblebar - McCamey's Monster	Numerous	173	62	0.07	72	61.5	0.08	247	61.854251	0.07	245	61.6	0.07	117	61.7	0.08	755	61.5	0.13	1117	61.5	0.11	Enriched Brockman IF and Detritals NB. BHPB Resources are INCLUSIVE of RESERVES	EBR
Jimblebar JV (Marra Mamba)	BHP Billiton Ltd Wuhan Iron & Steel (group) Corp. Maanshan Iron & Steel Co Limited Jiangxi Shagang Grup Co Ltd CI Minerals Australia Ltd Mitsui Iron Ore Corporation	Jimblebar - McCamey's Monster	Numerous																17	60.2	0.1	17	60.2	0.10	Enriched Marra Mamba IF NB. BHPB Resources are INCLUSIVE of RESERVES	EMM
Hope Downs	Hancock Kumba Resources	Hope Downs	Hope Downs 2 - Waramurra													109	63					109	63.0	0.00	Enriched Marra Mamba	EMM
Hope Downs	Hancock Kumba Resources	Hope Downs	Hope Downs 3																							
Juna Lekyer	N/A	N/A	Juna - Lekyer																6	62		6	62.0	0.00	Enriched Brockman IF	EBR
McPhee Ck	N/A	N/A	McPhee Ck										3095	48.95		3.77	49.1		2.5	49.3		3101.37	49.0	0.00	Archaean BIF	ABIF
Mindy Mindy (Pisolite)	Consolidated Minerals Ltd Fortescue Metals Group Ltd	Mindy Mindy	Mindy Mindy																123	55		123	55.0	0.00	Robe Pisolite	RP
Mindy Mindy (Brockman)	Consolidated Minerals Ltd Fortescue Metals Group Ltd	Mindy Mindy	Mindy Mindy																38.7	59.72		38.7	59.7	0.00	Enriched Brockman IF	EBR
Mining Area C (Marra Mamba)	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd Pohang Iron and Steel Co Ltd	Mining Area C	Numerous	184	62.7	0.06	19	62.8	0.06	203	62.70936	0.06	392	62.1	0.06	213	62.2	0.06	373	61.1	0.06	978	61.7	0.06	Enriched Marra Mamba IF NB. BHPB Resources are INCLUSIVE of RESERVES	EMM
Mining Area C (Brockman)	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd Pohang Iron and Steel Co Ltd	Mining Area C	Numerous										22	58.5	0.07	19	58.5	0.07	71	62.2	0.12	112	60.8	0.10	Enriched Brockman IF and Detritals NB. BHPB Resources are INCLUSIVE of RESERVES	EBR
East Pilbara Iron Ore Project	Fortescue Metals Group	Mt Nicholas	Mt Nicholas Mt Fraser Mt Fraser South Tongolulo																848	53.8		848	53.8	0.00	Enriched Marra Mamba IF	EMM
Mulga Downs	Hancock Prospecting Wright Prospecting	Mulga Downs	Murrays Hill																32.6	60.52		32.6	60.5	0.00	Enriched Marra Mamba IF	EMM
Pannelia	Hancock Prospecting Wright Prospecting		Pannelia																40	60		40	60.0	0.00	Enriched Brockman IF	EBR
Mt Rove	Fortescue Metals Group		Mt Rove																167	47		167	47.0	0.00	? Archaean Greenstones	ABIF
Pannawa Well Pisolites	Mineralogy Pty Ltd		Pannawa Well Pisolites																200	50		200	50.0	0.00	Robe Pisolite	RP
Prarie Downs (Brockman)	BHP Billiton Ltd Renison Goldfields Consolidated Ltd	Praria Downs	Numerous													82	59.6	0.14	95	61.2	0.16	147	60.1	0.15	Enriched Brockman IF, NB: BHPB Resources are INCLUSIVE of RESERVES	EBR
Prarie Downs (Marra Mamba)			Numerous													51	60.4	0.06	158	61.8	0.06	209	61.5	0.06	Enriched Marra Mamba IF NB. BHPB Resources are INCLUSIVE of RESERVES	EMM
Rocklea Limonites	Diamond Rose		Rocklea Limonites																32	53.3		32	53.3	0.00	Robe Pisolite	RP
Robe River	Robe River Iron Associates Rio Tinto Ltd Mitsui & Co (Aust) Ltd Nippon Steel Australia Ltd Sumitomo Metal Australia Ltd	Pannawonica & Deepdale	Robe River and Deepdale Mesa Deposits	125	57		75	57		200	57	0.00	35	57		45	56.5		10	57		90	57.0	0.00	Robe Pisolite	RP
Robe River	Robe River Iron Associates Rio Tinto Ltd Mitsui & Co (Aust) Ltd Nippon Steel Australia Ltd Sumitomo Metal Australia Ltd	Pannawonica & Deepdale	Bungaroo Creek A Mesa A?													1345	59.5		575	59		1920	59.3	0.00	Robe Pisolite	RP
West Angelas	Robe River Iron Associates Rio Tinto Ltd Mitsui & Co (Aust) Ltd Nippon Steel Australia Ltd Sumitomo Metal Australia Ltd	West Angelas	Deposits A - H	125	62.5		315	62		440	62.142045	0.00				460	62	0	110	60		570	61.6	0.00	Enriched Marra Mamba IF	EMM
Newman JV (Brockman)	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd	Mt Newman	Numerous	802	62.9	0.07	148	61.9	0.07	950	62.744211	0.07	893	63.6	0.07	223	62.4	0.08	277	61.6	0.09	1393	63.0	0.08	Enriched Brockman IF, NB. BHPB Resources are INCLUSIVE of RESERVES	EBR
Newman JV (Marra Mamba)	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd	Mt Newman	Numerous	57	62.1	0.07	18	61.3	0.05	75	61.884	0.07	160	61.8	0.07	82	60	0.06	619	59.4	0.07	861	59.9	0.07	Enriched Marra Mamba IF NB. BHPB Resources are INCLUSIVE of RESERVES	EMM
Mt Goldsworthy JV (Northern Areas)	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd	Nimingarra	Numerous	17	63	0.05	4	60.7	0.04	21	62.561905	0.05	48	61.2	0.06	43	60.8	0.06				93	61.0	0.06	Enriched Archaean IF, NB. BHPB Resources are INCLUSIVE of RESERVES	ABIF
BHP Yandi JV	BHP Billiton Ltd CI Minerals Australia Ltd Mitsui & Co (Australia) Ltd	Yandicoogina	Numerous	485	58.3	0.04	156	58.1	0.04	641	58.251326	0.04	834	57.9	0.05	348	57.7	0.04	239	57.3	0.04	1421	57.8	0.04	Channel Iron Deposits (equiv. To Robe Pisolite). NB. BHPB Resources are INCLUSIVE of RESERVES	RP
RT Undev. Resources (Brockman)	Rio Tinto Ltd (includes Hamersley)	Various	Numerous													1725	62.6		2390	62.6		4115	62.6	0.07	Enriched Brockman IF	EBR
RT Undev. Resources (Marra Mamba)	Rio Tinto Ltd (includes Hamersley)	Various	Numerous													575	62.6		1335	62.3		1910	62.4	0.06	Enriched Marra Mamba IF	EMM
RT Undev. Resources (Pisolites)	Rio Tinto Ltd (includes Hamersley)	Various	Numerous																405	56.5		405	56.5	0.05	Channel Iron Deposits (equiv. To Robe Pisolite).	RP
RT Undev. Resources (Detritals)	Rio Tinto Ltd (includes Hamersley)	Various	Numerous													229	62.1		60	61.7		289	62.0	0.07	Detritals (Scree) Ores	EBR
Marandoo (Marra Mamba)	Hamersley Iron	Marandoo	Numerous	93	62.4		3	62.6		96	62.40625	0.00				70	62		195	62		265	62.7	0.06	Enriched Marra Mamba IF	EMM
Mt Tom Price	Hamersley Iron	Mt Tom Price	Numerous	143	64.5		56	64.6		199	64.528141	0.00	35	62.7		65	64.3		10	61.5		110	63.8	0.06	Enriched Brockman IF	EBR
Mt Tom Price (Low Grade)	Hamersley Iron	Mt Tom Price	Numerous										30	54.9		20	55.4		5	54.6		55	55.1	0.06	Enriched Brockman IF	EBR
Mt Tom Price (Marra Mamba)	Hamersley Iron	Mt Tom Price	Numerous				23	60.7		23	60.7	0.00				5	61.3		15	61.1		20	61.1	0.07	Enriched Marra Mamba IF	EMM
Paraburdoo (Brockman)	Hamersley Iron	Paraburdoo	Numerous	14	64.8		9	64		23	64.486957	0.00	30	63.2		25	63.9		65	63.2		120	63.3	0.00	Enriched Brockman IF	EBR
Paraburdoo (Marra Mamba)	Hamersley Iron	Paraburdoo	Numerous				1	63.4		1	63.4	0.00													Enriched Marra Mamba IF	EMM
Nammuldi (Marra Mamba)	Hamersley Iron	Nammuldi	Numerous	10	62		0.3	61.6		10.3	61.99835	0.00	20	63.1		230	62.7					250	62.7	0.00	Enriched Marra Mamba IF	EMM
Nammuldi (Detritals)	Hamersley Iron	Nammuldi	Numerous													73	61.6					73	61.6	0.09	Detritals (Scree) Ores	EMM
Yandicoogina (Alumina 1.4%)	Hamersley Iron	Yandicoogina	Numerous	240	58.6					240	58.6	0.00	60	58.6		830	58		40	57.9		930	58.0	0.06	Channel Iron Deposits (equiv. To Robe Pisolite)	RP
Yandicoogina (Alumina 1.9%)	Hamersley Iron	Yandicoogina	Numerous				71	57.8		71	57.8	0.00													Channel Iron Deposits (equiv. To Robe Pisolite).	RP
Hope Downs	Hancock Kumba Resources Ltd	Hope Downs 1	Hope 1N Hope 1S										192			291			29			519	0.0	0.00	Enriched Marra Mamba IF	EMM
Hope Downs	Hancock Kumba Resources Ltd	Kalgan Ck	Several													70	61.3	0.14	195	60	0.13	285	60.4	0.13	Enriched Brockman IF	EBR

APPENDIX 5. MONOPOLY POWER IN THE IRON ORE INDUSTRY

(Commentary Prof. Philip Maxwell)

The Costs of Monopolistic Behaviour

A **monopoly** exists where one firm or seller supplies a particular good or service to the entire market. Where monopolies operate, they control either price or output to maximise their profits. Collusive agreements between several firms in an industry can generate production and pricing outcomes similar to that of a monopoly. Cartel arrangements are extreme forms of these agreements. Where there are only a few firms selling a product - the **oligopoly** situation - there is a natural tendency to expect firm behaviour patterns that more closely approximate the monopoly situation. Rivalry between large firms, the pursuit of market share and uncertainty about the response of a large competitor can, however, maintain competitive practices.

Simple standard textbook models argue that consumers

- pay higher prices; and
- consume less output

under monopoly than in a competitive market framework.

There is a net loss of welfare to society. This outcome seems intuitively in line with consumer experiences where monopoly power in an industry suddenly increases e.g. where one or two major airlines servicing a town decides that it is no longer

A typical feature associated with both monopoly and oligopoly is the existence of substantial **barriers to entry** to potential new producers. In many industries, production efficiency issues lead to **natural monopoly** situations. Here, single producers erect entry barriers so that potential competitors find it unprofitable to enter an industry. Recognition of this situation has, in the past, led governments to form public utilities to provide goods and services such as water, electricity, gas, telecommunications, postal services, railways, ports, airports and so on. Public provision of these services has often been **inefficient** because of the surrounding political environment. This has led in the recent past to their privatisation, often with government assuming a regulatory role.

Because larger producers can take advantages of **economies of scale** to produce more efficiently, the monopolisation of an industry may lead to lower prices and higher output, even when the monopolist is maximising profits. In such circumstances it is conceivable, however, that society could be even better off with a monopoly provider.

Economies of scale in production and have been recently led to a tendency for mining companies to become involved in merger and acquisition activity. This has occurred against a background of poor mineral industry profitability and it has led to significant changes in the structure of several sectors of the industry

Monopoly Power in the Iron Ore Industry

The overwhelming use of iron ore is in the production of steel. Estimated production of crude steel passed 900 million tonnes for the first time in 2002. World iron ore production in 2002 stood at 1.128 million tonnes. There was continued significant growth in both sectors in 2003. (IISI, 2003).

Yet even though the level of steel production and consumption in the twentieth century was greater than in all previous centuries combined, the rate of growth of production (and apparent consumption) of iron ore and steel has been modest since 1960. The following data derived from IISI (2003) and the United States Geological Survey shows this well.

	Average annual percentage growth in	
	Iron ore production	*Steel production*
1960 - 2002	1.9	2.3
1990- 2002	1.2	1.3
1990 - 2001	0.7	1.0

The higher rate of growth in steel, as opposed to iron ore, production reflects a growth in recycling which is destined to become more important in the future.

The recent strong growth in the iron ore industry since 2001 has been driven in large part by increased demand from China. If the rate of expansion of the Chinese economy slows, iron ore demand growth is likely to subside. At another level, however, there has been an increased rate of substitution of steel for timber in construction. This trend seems likely to continue.

Where consumption levels are **relatively static**, established producers often compete strongly to retain their established market share.

Growing markets offer opportunities in two ways:

- Established iron ore producers may be able to increase their market share if they can move rapidly to meet the increased demand;
- New iron ore producers may be able to enter the market, if conservative management practices by established producers leave increased demand unsatisfied.

In situations where current producers exert considerable market power, buyers will often welcome the entry of new producers because it makes the market more competitive.

Ericcson (2002, 23) has recently observed: "the iron ore industry is one of the few metal industries that has experienced a consolidation trend since the 1970s". It is now among the most concentrated of all minerals. This high level of concentration is one reflection of an apparently increased level of monopoly power.

Some feeling for the change can be seen in Figure 10.1. According to Ericcson, the three largest iron ore producers - Companhia Vale Rio Doce (CVRD), Rio Tinto and BHPBIO - accounted for 46.2 per cent of production in 2001. The largest ten producers were responsible for 70.2 per cent of production

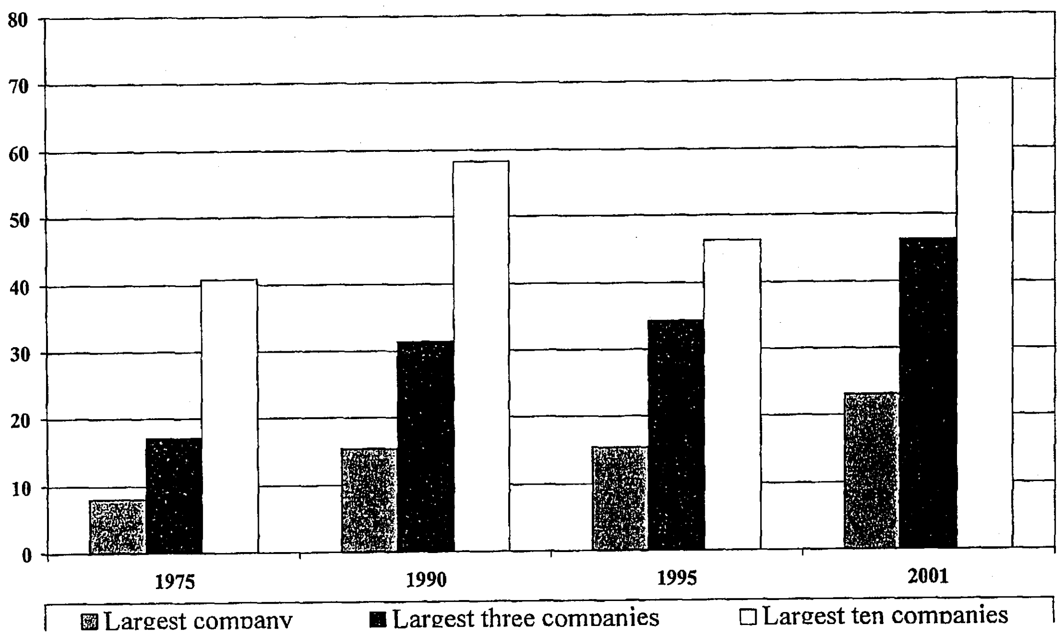


Figure 1: Percentage Concentration of Production in Iron Ore Industry - 1975, 1990, 1995 and 2001

.1

Where sellers of a product possess considerable market power, buyers may band together to offset this, thereby generating more competitive market outcome in which prices are lower and output less constrained. With the rise of the Japanese steel industry in the 1960s, iron ore buyers tended to negotiate directly with sellers as a group. Annual price negotiations with Japanese steel makers became a major event. The other major iron ore importers - Korea, Taiwan and now China - have tended to take their lead from these negotiations. The fall and rise of prices for standard iron ore products in the annual price round reflects both the stage of the business cycle and movements in the relative market influences of sellers and buyers. A reflection of recent movements in these prices appears in Figure 10.2 below.

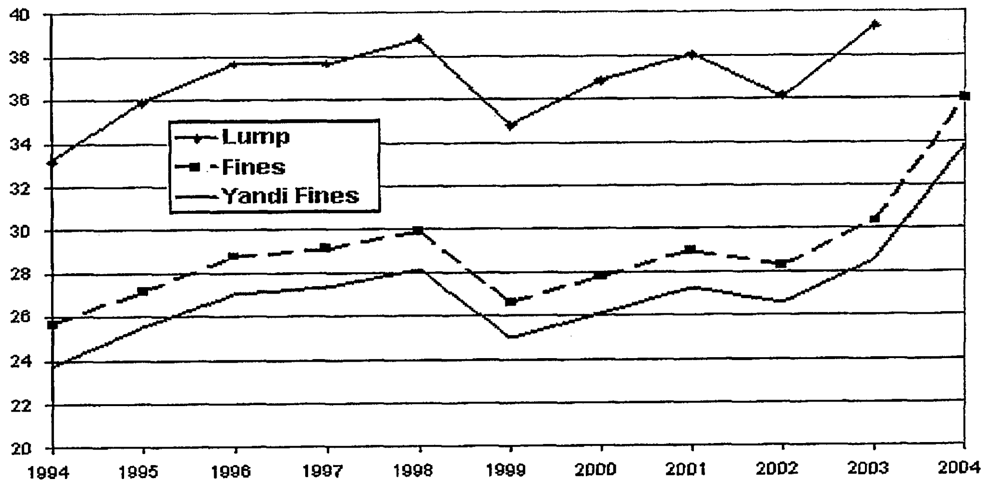


Figure 2 FOB Prices for Western Australian Iron Ore in Japan ($US per dry metric tonne unit)

Strongly rising recent prices suggest that the continuing concentration of iron ore production has apparently more than offset similar trends in buyer power. Percentage price increases in of 9 per cent in 2003 and more than 18 per cent in 2004 reflect an apparent recent dramatic change favouring the major producers in the iron ore market.

The views of our two colleagues - Stuart Hohnen and Warwick Davies - are of considerable interest in relation to the current state of competition within the iron ore industry in the Pilbara. Stuart's point about the range of **barriers to entry** currently in place seems very pertinent. Quoting selectively from his commentary.

"Rail access is only one of the barriers to entry faced by a new market entry".

The others include

- access to resources;
- port access;
- lack of scale for production and support services; and
- a lack of product range and blending capability."

We noted above that "new iron ore producers may be able to enter the market, if conservative management practices by established producers leave increased demand unsatisfied." Given the range of barriers in place, entry by new firms in a highly profitable way seems unlikely.

We take this view because the production efficiency of the two current producers - Hamersley/ Robe and BHPBIO - is high. Their current positions have arisen because of major efficiency drives, based in large part on the need to reform work practices on their Pilbara sites to ensure continuing profitability in the 1980s and 1990s when demand for steel was static.

Given the recent strong rise in iron ore prices, many commentators would take the view that the three major iron ore producers may recently have had the opportunity to pursue the monopoly-type policies to control supply of specific iron ore products to ensure higher prices and greater profitability. However their stated expansion plans and long term marketing alliances with China mills exhibits pursuit of market share and long term growth rather than short term profiteering.

A Public Policy Perspective

The current buoyant conditions in the world iron ore industry provide interesting policy questions for the Western Australian government, given that State Agreement Acts oblige the current Pilbara iron ore producers to carry the freight of third parties on their railways.

The government expects the existing producers to meet this obligation by negotiating commercial access terms with any third parties seeking to share their facilities, either under their State Agreements or under the Rail Transport Agreement. The November 2003 Supreme Court decision, concerning Hope Downs' attempts to gain access to the Mount Newman railway, supports this position.

The government's final policy position with respect to rail access for new producers will be driven by issues such as expected impacts in areas of:

- the level and continuing flow of iron ore royalty receipts;
- overall growth in the Western Australian economy;
- regional economic development in the Pilbara;
    - environmental and heritage impacts.

Iron ore royalties

Mining royalties in general and iron ore royalties in particular make a significant contribution to the revenue base of the Western Australian government. With rises in petroleum prices and the phasing in of the gold royalty, the level of total royalty payments to the state rose above a billion dollars for the first time in 2000. They have remained above that level since that time.

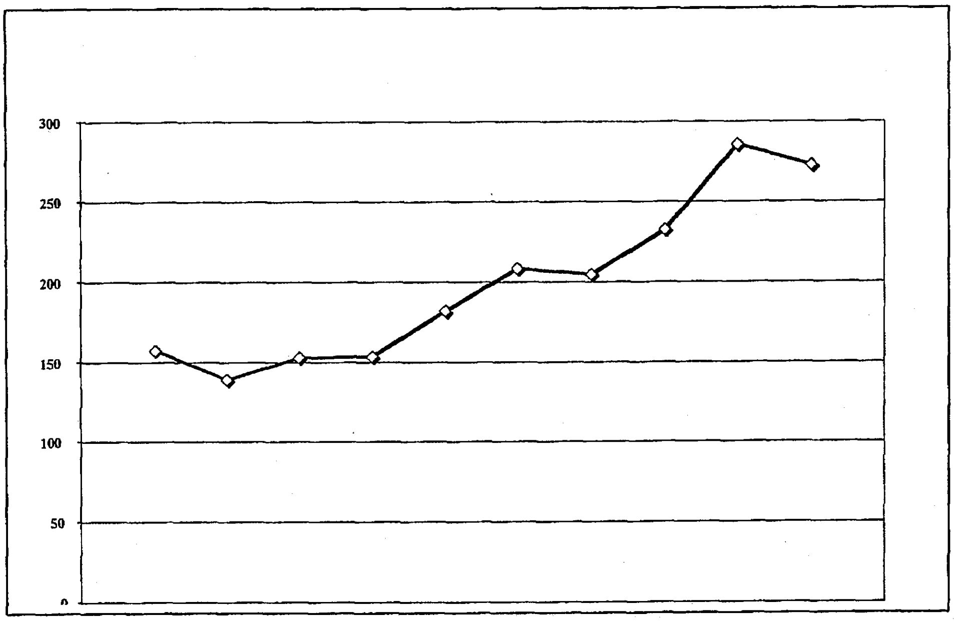


Figure 3: Iron Ore Royalties paid to Western Australian Government 1993-2002 ($A)

Iron ore royalties have made, and continue to make, a major contribution to that revenue stream. This is apparent from the data presented in Figure 3, which covers the ten-year period from 1993 to 2002. The downturn in royalty receipts in 2002 is somewhat misleading in the light of what has happened since. Rising iron ore prices, together with rising volumes of production in 2003 and 2004, will lead to further strong rises .in this revenue flow.

A particular interest of government is in maintaining the size and stability of this revenue flow over an extended period. High iron ore prices, driven in part by increased monopoly power in the industry, will make a contribution to this stream. If new players bring mines on stream, there is some possibility that their presence will have a dampening effect on these prices because of their positive impact on the level of competition in the industry. Even though the resulting percentage increment to iron ore output would add to royalty payments, a more than offsetting percentage decline in prices could bring reduced royalty payments.

The tenor of this argument is that, despite the overall benefit of competition to consumer welfare on a worldwide basis, the continuation of significant monopoly power in iron ore supply by Australian-based producers is arguably in the interests of Western Australia from the viewpoint of maintaining healthy mineral royalty flows.

OveRall Growth in the Western Australian Economy

Having proposed this view, one can of course argue that new mineral development has been a major driving force behind this state's strong economic growth, development and diversification for the past four decades. Major investment in new projects such as Hope Downs will add to that momentum. Granting rail access to the new players would facilitate this.

Colleagues from the Economic Research Centre at the University of Western Australia have modelled the impacts of mineral sector investment on Western Australian in a number of studies. Some of their results appear in Clements and Ye (1995) and in Ahammad and Clements (1996). In these studies the authors estimate the following output, income or employment multipliers:

Sector	*Output*	*Income*	*Employment*
Metallic minerals mining	2.1	3.0	4.1
Services to mining	3.0	3.1	3.2
Basic metal products	2.3	3.4	4.3

It seems likely that the size of these overall multipliers have remained at similar levels for the state economy during the past decade. Given this situation, reasonable rail access, combined with major new investment in iron ore mining projects, will make a significant contribution to the economic growth of the state. The size of this contribution will depend on the initial investment injection and the subsequent operational expenditures involved.

The Gross State Product of Western Australia is now in excess of $A70 billion per annum. A major new investment of say $1Bn to launch the Hope Downs project, combined with associated rail infrastructure expenditure, would provide an initial stimulus to economic growth of in excess of 2 per cent. During the production phase of the mine, this would subside

The development of Hope Downs and other viable projects in the Pilbara not currently owned or controlled by Rio Tinto or BHPBIO seem inevitable, even if the new prospective producers do not gain open access to current rail facilities. **Delayed development may be in the interests of the state if the majors are in a position to reap economies of scale and maintain the competitiveness of the Australian iron ore industry over longer periods. In developing these new projects they will invest similar amounts and the economic stimulus to the state's economy, though slightly delayed, will be equally important.**

Regional Economic Development in the Pilbara

Before the mining of iron ore and the exploitation of oil and gas deposits, the Pilbara region was sparsely populated, depending mainly on a small pastoral industry. Mining existed in a small way in towns such as Marble Bar, Nullagine and Wittenoom. The small towns of Port Hedland and Roebourne were the main centres in the region. The resources boom of the 1960s brought dramatic development of about ten new mining towns and ports, as well as the associated rail and road infrastructure. Some of the new towns included Karratha, Newman, Tom Price, Paraburdoo, Pannawonica, Goldsworthy, Shay Gap, Dampier, Wickham and Cape Lambert. The population of the region grew dramatically between 1961 and 1981 - see Figure 4. - It stabilized until 1991 and then declined between 1991 and 2001.

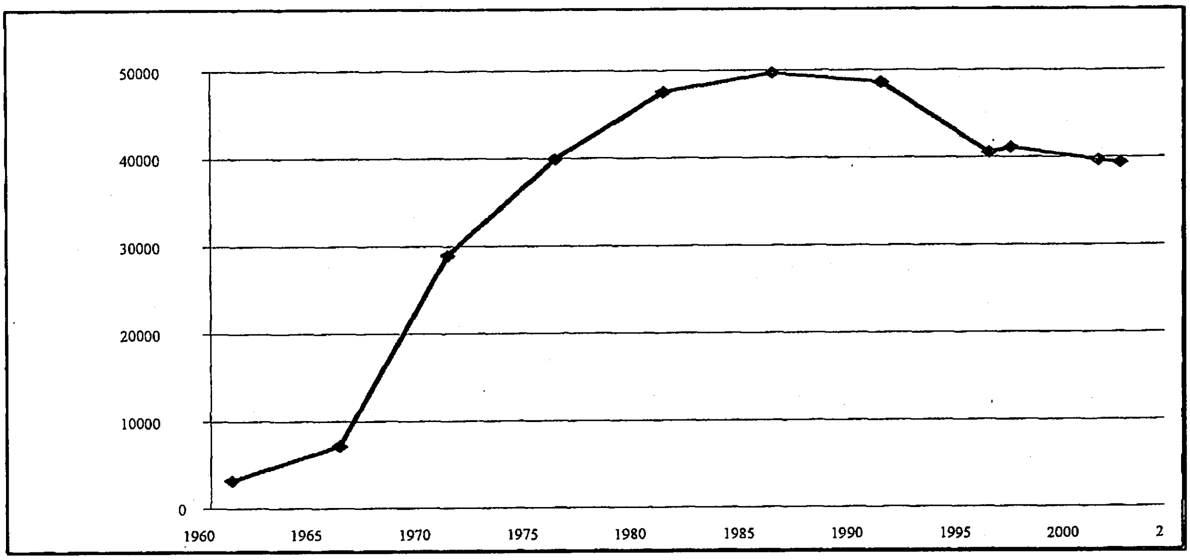


Figure 4 - Estimated Resident Population in the Pilbara 1961 to 2001

The Pilbara has now been a major mining region for four decades. In addition to the major contributions of the iron ore and oil and gas sectors, other mining activity is also of some importance. This includes gold (particularly at Telfer), copper (at Nifty), tantalum (at Wodgina), manganese (at Woodie Woodie) and nickel (at Radio Hill).

The recent population decline has been due in large part to the closure or contraction of several of the "new" company towns and the widespread adoption of fly-in, fly-out work practices. While Newman, Tom Price and Pannawonica retain significant resident mining workforces, FIFO mining camps hosting workforces on a variety of work rosters have become the norm in the region. Workers typically leave their families and residences in Perth and undertake rosters such as 14/7, 9/5,42/7 or 5/2/4/3 depending on the company, the mineral, occupational status, and whether the worker is a company or contractor employee.

Large mining companies operating in remote regions have often tended to favour "enclave-type" developments in the past. These minimised links with local populations, together with investment in human capital and infrastructure that might form the basis of subsequent sustainable economic activity when mines ceased operations. The competitive nature of minerals sector and the expectations of shareholders and workers has often driven this approach. While large mining companies now emphasise the importance of their interactions with local communities and the pursuit of sustainable development ideals, "fly-in, fly-out" work practices have worked against the impact of these policies.

We have seen that the size of income, output and employment multipliers from metallic mining and downstream processing are quite high for the state of Western Australia. This is not the case, however, in remote regions with extreme climates such as the Pilbara. Much of the initial spending undertaken in the mining sector "leaks" to other regions. Estimates of the regional multipliers for mining in parallel regions in other places show income and output multipliers to be low.[2] This situation applies in the Pilbara and will continue to do so.

The development of new mines and associated railway infrastructure will provide only a limited stimulus to the future economic development of the region. Downstream processing in things such as HBI plants offers more hope but such analysis is beyond the brief of this study.

While public policy should not discourage the development of regional Western Australia, it seems to us that market forces will tend to overwhelm political decisions to promote the movement of population to remote mining regions within the state.

Environmental and heritage impacts

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[2] Aroca (2002) has recently completed a large input-output study for the remote Second region in Northern Chile, which is responsible for twenty per cent of world copper production. He estimates Type II output multipliers for mining of 1.8

My contribution is this area is minimal. My general view in that large mining companies are now acutely aware of such issues and that they pay considerable attention to them. There is little likelihood that this situation will change. It is unlikely therefore that the environmental and heritage impacts of a new rail development or access to them will cause major detrimental impacts in these areas. It is simply not in the interests of companies involved to allow this to take place.

Conclusions, which may be drawn in the context of the Pilbara Iron Ore Rail Access Public Interest study, are:

An oligopoly currently exists in the Pilbara and world seaborne iron ore supply markets. The classical economic negatives of high prices and lower inefficient production are offset by economies of scale required in the industry, the need to counter buyer oligopsonies, and the benefits to State royalty streams from producers with strong market powers.

Further the two existing Pilbara producers have demonstrated competitive performance through cost reductions during the 80's and 90's and production expansion in pursuit of growing market share since 2000.

New producers will no doubt further energise competitive behaviour but will be vulnerable to the market and the existing producers.

From a Government Policy perspective:

1. Royalties could be diminished under open access due to price decrease which is in the interests of world consumers but not the State of Western Australia.
2. GSP will be enhanced by new investment – the multiplier effect producing a 2% increase in GSP of each $1Bn invested in the iron ore industry. The State should therefore encourage expansion whether by existing or new producers.
3. Regional Economic Development

   The Pilbara population grew rapidly in the 60's and 70's and early 80's during the initial resources boom, plateaued during late 80's and early 90's as investment slowed and reforms were introduced, and diminished in late 90's as efficiencies and slowed growth took effect.

   Iron ore investment economic multipliers in regional Pilbara development are low, due to increasing efficiencies and the revolution of FIFO employment policies. Pilbara iron ore development will not promote the movement of population and market forces will overwhelm political policies.

   The conclusion is that policy issues are world, national and state, but not regional.

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APPENDIX 6 QUALITATIVE ANALYSIS

PUBLIC & PRIVATE COSTS & BENEFITS OF INCREASING COMPETITION IN THE PILBARA IRON ORE MARKET

This study addresses the question of whether third party access to the existing rail lines is in the public interest. The specific requirement of the study brief is to identify the public and private costs and benefits (environmental, social and economic) of implementing an effective open access regime for the Pilbara iron ore railways. The Study brief states:

> *"As part of the examination of public interest issues the following modelling work may be necessary:*
>
> - *Model impact of effective open rail access on investment, royalties, exports, income and employment."*

Output Key Indicators

To respond to this requirement E&P utilised a Qualitative Modelling technique whereby outputs from the model are impact assessments as measured by the following indicators:

▪	Economic – Royalties, Export Volume (of iron ore), Gross State Product, and investment,
▪	Environmental and Heritage impact
▪	Community Development

The outputs were weighted within the model in accordance with the relative qualitative impact each has on the Public Interest, regardless of the rail access regime. For example the economic measures were given the highest rating.

Inputs

Inputs to the model are issues and criteria prescribed in the study brief (and expanded here) that are seen to have a significant impact on the above outputs when transmitted through the rail options of Open or Closed access regimes. The inputs are:

▪ Demand & Supply
› Pricing
› Maximising Tonnage
▪ Nature and Location of Deposits
› Availability of Resource
› Quality of Resource
▪ Smaller Producers
› Producer Oligopoly
› Buyer Oligopsony
› Processing Technology
› Innovation/Management
› Product Differentiation
› Supplier Reliability
› Development of Marginal Deposits
▪ Rail Capacity
› Speed of new Development
› Access to small deposit
› Double Tracking
▪ Other Issues
› Larger Producers (existing)
› Stranded Infrastructure
› Investor risk
› Competitiveness in world market Existing Producers
› Competitiveness in world market New Producers

The inputs of the model were weighted in accordance with the relative impact each criteria has on the model outputs when considering the criteria regardless of whether there is an Open or Closed Rail access regime.

It is important to understand the E&P interpretation of Open and Closed Access in terms of the modelling exercise.

Model Definitions

- Closed

Producers including new producers own and operate their own rail systems without other party access.

- Open & Open

All producers **including existing** can use any existing or new rail system as a **service.**

- Closed & Open

All producers can use new third rail, which will operate as an open access rail. No new producers can use existing rail systems

Assumptions - Applied to all Regimes

- New producers have own stockpiling facilities at Port
- Ownership of existing rail systems remain as is. Rolling stock on existing systems is operated and maintained by existing producers, i.e. Access is to **the service** not the physical track.

Qualitative Assessments were carried out for Closed v. Open & Open, and Closed v. Closed & Open rail access options. These options were selected as the most meaningful options as, Closed is the status quo, Open & Open is possible under the State Agreements, and Closed & Open is a practical outcome that might be proposed by a new entrant.

RESULTS:

The qualitative analysis was conducted in a workshop on May 2004. The model output is attached in this appendix.

The results of the workshop assessment are summarised in Table A6.1.

Rail Access Option		
	Closed	Open Open
SCORE	3486	10400
Rank	2	1
	33.5%	100%

Table A6.1

	Closed	Closed Open
SCORE	5029	5027
Rank	1	1
	48.3%	48.3%

Table A6.2 Workshop 1 - Qualitative Assessment Results

Note the numbers are for comparative assessment purposes; they have no absolute meaning.

- The results (Table A6.1) indicate that the Open:Open Rail Access regime by qualitative assessment is strongly beneficial (3 fold) in terms of economic impact when measuring outputs of Gross State Product, Royalties and Environmental Impact, as compared with the existing closed access regime.

- The sensitivity assessment (Table 6.2) shows that there is no identifiable difference in the output benefits when comparing the Closed Rail Access Regime by qualitative assessment with the Closed Open Access regime of the style proposed by FMG.

Our interpretation of the strong result for the Open: Open Access Regime is that the big beneficiaries would be the existing large producers who would have access to each others' rail system, thereby removing the rail constraint of developing their own extensive outlying resources where these are closer to the other rail systems. Existing producer's blending capability of ores from different mines would be greatly enhanced by Open-Open access thereby optimising product development. The Open: Open access regime would also enable a maximisation of use and reliability of existing rail capacity by utilisation optimisation between the two systems, and thereby driving down monetary and environmental cost.

A6.1 - Open-Open v Closed Model

With regards the individual outputs of the Open vs Closed model, the following conclusions can be reached.

Export Volume showed the greatest positive impact from an Open-Open access regime because:

- existing producers control 90% of identified resource in the Pilbara. Some of this is remote to their rail lines but not the other system.
- existing producers gain the advantage of access to the entire rail network enabling them to develop remote reserves quicker and cheaper.
- Enhanced blending capability of ores from different mines.
- pricing competition and flexibility introduced by greater availability of ore (from whichever producer) will encourage market share growth by larger producers, not rigid or restrictive supply pricing practices.

Investment showed the next most positive impact from an Open-Open access regime compared to a closed regime because:

- lower quality resources become available as a blending product enabling their sale which otherwise might not occur as a stand alone ore. Again this advantage flows mostly to the existing producers who have the production, facilities and product range to make use of 'blending' ores
- diversification of mine sites and ores generates greater supplier reliability which commands premium pricing
- existing large producers have capital resources to make required investments.

Royalties next in descending hierarchy of positive impacts was the benefit to Royalties arising from an Open-Open access regime because:

- tonnage maximised
- remote resource volume and quality availability producing a wider product range and sales of marginal (blending) ores – more saleable product
- speed of development of new deposits because of available rail access
- tonnage increase outweigh downward pressure on prices which were expected to be small or immaterial in a balanced growth of demand and supply.

Gross State Product showed a positive impact from an Open-Open access regime because:

- tonnage is maximised
- new deposits brought on sooner because of improved accessibility and opportunity to make use of marginal quality ores as blending ores. This

advantage is primarily gained by the existing producers who have the production, facilities and product range to make use of blending ores

- smaller deposits become viable because of easier, quicker and cheaper access.

Disadvantage of Open-Open Access:

A risk to GSP could be the fragmentation of sellers in the face of a buyer Oligopsony and a subsequent reduction in prices. This risk was considered small as new producers could at best represent 10% of Pilbara supply and would not be price setters.

Environment & Heritage showed a marginal benefit from a Closed access regime because:

- tonnage and industry expansion would be constrained
- assuming a closed access regime restricts new entrants, there is less likelihood of irresponsible environmental behaviour or impact. The existing producers have a track record of environmental performance.

<u>Open v Closed Model - Input Analysis</u>

The most significant input factors in terms of impact were:

1. Pricing which favoured Closed System
2. Tonnage which favoured Open System
3. Availability of resource which favoured Open System
4. Quality of resource which favoured Open System
5. Advantage of the Oligopoly which favoured Closed System
6. Countering buyer Oligopsony which favoured Closed System

A6.2 Open-Closed v Closed Model

This model was developed as a sensitivity test of the benefits of a partially open access system in the form of a new 3rd rail with open access, whilst the existing rails remain closed.

The model showed no identifiable difference in output benefits when comparing the Closed Rail Access Regime by qualitative assessment with the Closed-Open Access regime. The lack of differentiation we interpret to reflect the immateriality of the new producers (at best 10% of Pilbara production) in terms of impact on the modelling outputs.

Appendix 6. Qualitative model Outputs

Existing rail systems open access: Existing rail system expanded to meet growth: Existing producers can use each others' systems

Pilbara Rail Acess - The table below will be used to define any qualitative issues arising from the existing, limited access status quo and an open access scenario
Weighting factors determined by perceived public interest. For this study that is defined as **"Capitalise on Rapid Growth in Iron Ore Demand & Increase Market Share"**
Weighting Factors From 0 to 10
Allocate values for existing and open access regimes
Allocated Values range from 0 to 10 **0 = Neutral to No Impact: 10 = Strongly Positive** *show least imapct as zero*
Some example values have been included below as a guide to process - *They are indicative only*

Existing rail systems open access; Existing rail system expanded to meet growth; Existing producers can use each others' systems		Economic								Environmental				Social				
		Royalties 5		Export Volume 1		Gross State Product 10		Investment 1		Environmental 8		Heritage 2		Community Dev't 10				
Access Regime		Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open			
	Weight																	
Demand & Supply																Closed	Open	Diff.
Pricing	8	2	0	0	3	0	0	3	0	2	0	2	0	4	0	584	24	560
Maximising Tonnage	10	0	3	0	3	0	4	0	2	0	5	0	5	0	4	0	1500	-1500
																		0
Nature and Location of Deposits																		0
Availability of Resource	10	0	4	0	2	0	8	0	8	2	0	2	0	0	6	200	1700	-1500
Quality of Resource	8	0	4	0	2	0	6	0	3	0	0	0	0	0	0	0	680	-680
																		0
Smaller Producers																		0
Producer Oligopoly	8	2	0	0	4	0	4	0	3	3	0	3	0	0	2	320	536	-216
Buyer Oligopsony	6	2	0	0	2	4	0	2	0	2	0	2	0	0	4	432	252	180
Processing Technology	4	0	0	0	0	0	0	0	0	0	2	0	2	0	3	0	200	-200
Innovation/Management	10	0	4	0	2	0	4	0	2	2	0	2	0	0	2	200	840	-640
Product Differentiation	4	0	4	0	1	2	0	0	3	0	0	0	0			80	96	-16
Supplier Reliability	7	0	4	0	3	0	1	0	3							0	252	-252
Development of Marginal Deposits	5	0	6	0	2	0	3	0	3	2	0	2	0	0	5	100	575	-475
																		0
Rail Capacity																		0
Speed of new Development	9	0	4	0	4	3	0	2	0	0	4	0	4	0	2	288	756	-468
Access to small deposits	7	0	2	0	3	0	4	0	3	2	0	2	0	0	3	140	602	-462
Double Tracking	9	0	3	0	0	0	3	0	2	0	3	0	3	0	3	0	963	-963
																		0
Othe Issues																		0
Larger Producers (existing)	10	0	3	0	1	0	2	0	2	4	0	4	0	0	4	400	780	-380
Stranded Infrastructure	2	0	0	0	0	0	2	2	0	2	0	2	0	0	0	44	40	4
Investor risk	8	0	2	0	2	0	2	0	2	2	0	2	0	2	0	320	272	48
Competitiveness in world market Existing Producers	9	4	0	2	0	2	0	0	2	0	0	0	0	0	2	378	198	180
Competitiveness in world market New Producers	2	0	4	0	3	0	1	0	4	0	0	0	0	0	3	0	134	-134
Total																		
Closed Access Total	3,486	400		18		770		58		1,408		352		480		3486		
Open Access total	10,400		1,735		278		3,590		317		968		242		3,270		10400	

Existing rail systems closed: New rail system is open access

Pilbara Rail Acess - The table below will be used to define any qualitative issues arising from the existing, limited access status quo and an open access scenario
Weighting factors determined by perceived public interest. For this study that is defined as **"Capitalise on Rapid Growth in Iron Ore Demand & Increase Market Share"**
Weighting Factors From 0 to 10
Allocate values for existing and open access regimes
Allocated Values range from 0 to 10 **0 = Neutral to No Impact: 10 = Strongly Positive** *show least imapct as zero*
Some example values have been included below as a guide to process - *They are indicative only*

Existing rail systems closed / New rail system is open access		Economic								Environmental				Social				
		Royalties 5		Export Volume 1		Gross State Product 10		Investment 1		Environmental 8		Heritage 2		Community Dev't 10				
Access Regime	Weight	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Difference
Demand & Supply																		
Pricing	8	4	0	0	2	0	0	2	0	2	0	2	0	4	0	656	16	640
Maximising Tonnage	10	0	2	0	2	0	2	0	1	2	0	2	5	0	2	200	630	-430
																		0
Nature and Location of Deposits																		0
Availability of Resource	10	0	2	0	1	0	4	0	4	3	0	3	0	0	4	300	950	-650
Quality of Resource	8	0	2	0	1	0	4	0	2	0	0	0	0	0	0	0	424	-424
																		0
Smaller Producers																		0
Producer Oligopoly	8	4	0	0	2	2	0	2	0	5	0	5	0	0	1	736	96	640
Buyer Oligopsony	6	3	0	0	2	6	0	3	0	4	0	4	0	0	6	708	372	336
Processing Technology	4	0	0	0	0	0	0	0	0	0	2	0	2	0	2	0	160	-160
Innovation/Management	10	0	3	0	2	2	0	0	2	2	0	2	0	0	1	400	290	110
Product Differentiation	4	0	3	0	1	2	0	0	1	0	0	0	0			80	68	12
Supplier Reliability	7	1	0	2	0	1	0	0	2							119	14	105
Development of Marginal Deposits	5	0	3	0	1	0	1	0	1	4	0	4	0	0	2	200	235	-35
																		0
Rail Capacity																		0
Speed of new Development	9	0	2	2	0	2	0	2	0	0	2	0	2	0	2	216	450	-234
Access to small deposits	7	0	1	0	2	0	2	0	2	2	0	2	0	0	1	140	273	-133
Double Tracking	9	0	1	0	0	0	1	4	0	2	0	2	0	0	0	216	135	81
																		0
Othe Issues																		0
Larger Producers (existing)	10	0	2	0	1	4	0	0	2	0	0	2	0	0	2	440	330	110
Stranded Infrastructure	2	0	0	0	0	0	2	2	0	0	0	0	0	0	0	4	40	-36
Investor risk	8	0	1	1	0	2	0	0	2	0	2	2	0	0	2	200	344	-144
Competitiveness in world market Existing Producers	9	5	0	1	0	2	0	0	2	0	0	0	0	0	1	414	108	306
Competitiveness in world market New Producers	2	0	2	0	2	0	1	0	4	0	0	0	0	0	2	0	92	-92
Total																		
Closed Access Total	5,029	670		49		1,790		108		1,616		476		320		5029		
Open Access total	5,027		895		139		1,260		185		336		152		2,060		5027	