Iron Road Ltd Information and Technical Data Sheet
Central Eyre Iron Project (CEIP)

Introduction

Iron Road Ltd (IRD) is the owner and developer of the Central Eyre Iron Project (CEIP, 100%), an advanced mining, beneficiation and infrastructure development on the Eyre Peninsula in South Australia. The CEIP will produce a coarse-grained, high quality, low impurity iron concentrate suitable to both sintering and pelletising processes. Project studies, including a definitive feasibility study and subsequent optimisation studies, are complete.

Primary State approvals and a registered Indigenous Land Use Agreement (ILUA) are in place. The project includes the largest magnetite Ore Reserve in Australia and the infrastructure components have been declared a priority for the nation by Infrastructure Australia. Approximately $180 million has been spent studying the CEIP and developing the business case since IRD's 2008 inception. Current planned mine life is an initial 22 years, producing 12 million (dry) tonnes of high quality (67% iron), low impurity iron concentrate – a cleaner and superior blending product for steel mill customers – with defined mineral resources and identified project expansion potential >50 years.

The deep-water port at Cape Hardy is designed to be South Australia's first Capesize port. No dredging and the protected location within the Spencer Gulf underscore the significance of the site. IRD own circa 1,200ha at the proposed port site.

Third party access, including early planning to accommodate potential grain exports, green hydrogen and a green manufacturing precinct, will stimulate additional regional growth opportunities.

A future rail line from Cape Hardy was identified by Infrastructure Australia as capable of linking into the Australian National Rail Network.

The South Australian Government formed the CEIP Taskforce in an endeavour to best capture regional benefits and eradicate impediments to the project schedule.

Government

Federal Assistance – Major Project Facilitation

State Assistance – Major Development Status

Infrastructure Australia – Priority Project (infrastructure component, full business case review)

Approvals

- State – Mining Lease (mine site) and Development Approval (Infrastructure) granted 3 May 2017, draft Program for Environmental Protection and Rehabilitation (PEPR) & Construction and Environmental Management Plan (CEMP) submitted
- Federal – EPBC (controlled action at port only - southern right whale)

Assessments included – Traffic Impact, Air Quality, Noise and Vibration, Mine Groundwater, Viewpoint

Native Title

Agreement – Multi-commodity Amended Indigenous Land Use Agreement (ILUA) with the Barngarla (Registered August 2022 - National Native Title Tribunal)

Area – Mine site, infrastructure corridor and port (landside and gulfside)

Studies

Type – Pre-feasibility study, definitive feasibility study, optimisation study, re-scaling study

Study Methodology – Multidisciplinary team with involvement of vendors and tier 1 mining/engineering contractors

Companies involved:

- Target Generation – UTS Geophysics, Hawke Geophysics
- Mineral Resource Estimate – Coffey, AMC Consultants, Xstract
- Ore Reserve Estimate – SRK Consulting
- Mining – Coffey, AMC Consultants, Thiess-RWE, Orica, MMD, Komatsu/Joy Global, Thyssenkrupp, Sandvik
- Tailings/IWL – ATC Williams, SKM (Jacobs), Thyssenkrupp
- Infrastructure – SKM (Jacobs); GHD
- Mineral processing – Tenova, Mineral Technologies, KWA Kenwalt/SysCad, BV, ALS, Magotteaux, Donhad, Kemcore, Moly-Cop, John Holland, Sinostruct, Weir, FL Smidth, Metso, Outotec, Emez, Thyssenkrupp, Siemens, ABB, Schenckprocess, Metalytics (flowsheet technical review)
- Infrastructure Corridor – SKM (Jacobs), Fugro, Downer EDI Rail, Optika Solutions, BIS, Kalari, ARTC, Harsco, RCR-Kiruna
- Module Access Route (MAR) – Sarens, Fugro
- Port – SKM (Jacobs), BAM, McConnell Dowell, Biglift, Clough, John Holland, Leightons
- Power – Cowell Electrical, ElectraNet, SA Power Networks, AGL
- Water – Groundwater Science, MWH Global, Osmoflo, Aqualin
- Diesel – Petro Diamond Australia
- Estimate – Aecom
- Market – Metalytics, Wood Mackenzie
- Approvals – SKM (Jacobs), JBS&G, Rose Bowey and Associates, Econsearch, Visionation, RPS Consulting
- Legal / Financial – Finlaysons, PwC, EY

Exploratory Drilling

- Mineral Resources (JORC) – 4.51Bt @ 16.0% Fe (2.22Bt in measured category)
- Exploration Target – 8-17Bt (across exploration licence)
- Exploratory Drilling (type) – 98% diamond (NQ2 core), 2% RC (5.5")
- Exploratory Drilling (no. of holes/type // total m/type) – 478 diamond/22 RC // 160,025m diamond/3,208m RC
- Drilling spacing – Nominal 200m x 100m grid (and 50m x 50m infill to assess variography)
- Orientation – Majority angled -60 degrees to the north with some deeper holes drilled vertically
- Core recovery – >98%
- Assay – Routine XRF (total of 42,680 iron ore suite) and DTR (total of 7,928 tests)
- Other – No asbestos minerals observed or detected from several tests by assay and test work laboratories

Geology

- Magnetite gneisses at Warramboo were previously believed to be an Archean BIF formed during the interval ca 2555-2460Ma and therefore to be part of the Sleaford Complex
- Current assessments consider it to be a package of iron-rich sediments (pelitic mineralogy containing detrital zircons) deposited between ca 1750-1730Ma onto rocks of the ca 2480Ma Sleaford Complex and subsequently deformed and metamorphosed to granulite facies during the Kimban Orogeny
- The large-scale structural architecture of the Warramboo deposit appears to be a syncline with metamorphism and melt loss significantly increasing the iron content of the magnetite gneiss.

Ref: K. Lane, E. A. Jagodzinski, R. Dutch, A. J. Reid & M. Hand (2015) Age constraints on the timing of iron ore mineralisation in the southeastern Gawler Craton, Australian Journal of Earth Sciences: An International Geoscience Journal of the Geological Society of Australia, 62:1, 55-75.

Mineralogy

Warramboo magnetite-bearing lithologies may be divided into three groups

1. *Magnetite±hematite-biotite-K-feldspar-quartz migmatitic gneiss.* Abundant 5mm magnetite±specular hematite is disseminated within a biotite-quartz matrix with coarse-grained 20mm magnetite mineralisation developed adjacent to K-feldspar-quartz leucosomes. Magnetite-hematite-biotite is strongly foliated with deformed layer parallel leucosomes.
2. *Magnetite-garnet-sillimanite-cordierite-biotite-K-feldspar-quartz gneiss.* Magnetite occurs as discrete 2-5mm grains disseminated within a foliated matrix of garnet-cordierite-sillimanite-biotite. Sillimanite and cordierite are abundant. Garnets are euhedral 1mm grains and abundant. Foliation is defined by aligned biotite and sillimanite and decimetre-scale variation of K-feldspar, biotite and sillimanite mineral abundance.
3. *Magnetite-hematite-biotite-quartz-K-feldspar gneiss.* Magnetite-hematite-biotite banding is abundant throughout with aligned grains defining a strong foliation with minor quartz and feldspar. Shear bands and S-C fabrics can be well developed within this unit.

Ore Generation

- Metamorphism experienced by the precursor Warramboo pelites has produced a coarse-grained gneiss, and the abundance of partial melting suggests that the granulite-facies metamorphism has effectively upgraded the deposit as a result of melt loss.
- Deposit style, where the metamorphism directly upgrades the iron formation to an economic deposit, is in contrast to the BIF and IOCG deposits known in the Gawler Craton.
- Magnetite-bearing Price Metasediments (iron-rich phyllites) on the southern Eyre Peninsula have remarkably similar geochronology and Sm-Nd isotope values as the Warramboo magnetite gneisses and it is believed that they have a common sedimentary origin and likely formed within the same basin system. By extension, the Cape Hunter phyllite in Antarctica is also a correlative of the Warramboo magnetite gneiss.
- Price Metasediments may thus be considered as low-metamorphic grade equivalents of the magnetite gneisses at Warramboo.

Geotechnical

A high reliability material properties database has been developed for the CEIP which is based primarily on laboratory and field test work which has been completed to appropriate international material testing standards.

Rock Mass Quality

- The oxidised (upper saprolite) unit for both magnetite and unmineralised gneiss is a “poor” quality rock mass with “extremely weak” intact rock strength.
- The transition (lower saprolite) unit is a “poor” quality rock mass with “very weak” intact rock strength.
- The fresh rock mass for both magnetite and unmineralised gneiss is a “good” quality rock mass with “very strong” intact rock strength.

Slope Design (oxidised rock mass)

- For the upper saprolite slope design comprises 50° batter face angles, 12m batter heights and 10m berm widths for an IRSA of 31° over an inter-ramp slope height (IRSH) of 24m.
- For the lower saprolite unit (footwall) comprises 50° batter face angles, batter heights of 12m and berm widths of 9m for an IRSA of 32°.
- The slope design for the lower saprolite unit (hanging wall and side walls) comprises 50° batter face angles, batter heights of 24m and 10m berm widths for an IRSA of 35°.

Slope Design (fresh rock mass)

- For the south (hangingwall), east and west pit walls (fresh rock mass); the slope design comprises 75°batter face angles, 24m batter heights and 10m berm widths for an IRSA of 55.5°.
- The northern unmineralised gneiss slope design for the north wall (footwall) comprises 65° batter face angles, 24m batter heights and 10m berm widths for a maximum IRSA of 49°.

Note that a separate study by RMIT ‘…observed discontinuity spacing and orientation indicates that the gneiss is massive to blocky. On that basis it is proposed that the open pit footwall design can be conducted on the same basis as the hangingwall design.’ *Ref: John V. Smith (2018) Rock structure characterization of a magnetite gneiss with foliation-parallel discontinuities for footwall slope design, International Journal of Rock Mechanics and Mining Sciences 108 (2018) 105-117.*

Also, a 2019 research thesis by Nikhil Urmale, RMIT, entitled *Role of veins and vein parallel fractures in rock slope stability* demonstrated that the veins in the magnetite gneiss from Warramboo, assessed in the lab, showed significant strength and there was no conclusive evidence to prove that veins downgrade the overall strength of the rock mass. Veins failed at a very high-tension value typical of a Quartzite rock without any discontinuity.

Ref: Nikil T Urmale and John V Smith (2019) A study of the tensile strength of veins and its influence on Rock Mass Strength, 9th International Conference on Geotechnique, Construction Materials and Environment, Tokyo, Japan, 20-22 November 2019.

Seismicity – A desktop assessment determined that the study area is at negligible risk of potential seismic events, confirmed by the earthquake hazard map, Australia 1991.

Metallurgical Test Work

CEIP magnetite is not hosted in a Banded Iron Formation (BIF) – and requires a different paradigm to understand processing philosophy

Test work observations:

- Very coarse grain and texture
- No clays present in material to be treated, only competent rock
- Most work undertaken at Bureau Veritas labs, Perth
- NQ2 diamond core used for test work with two PQ holes drilled to provide core for future milling test work
- Extensive DTR testing undertaken – to determine magnetite content of ore (NB DTR <> product spec)
- Low impurity, essentially no P or S present and Al_2O_3 and SiO_2 are easily liberated and separated due to coarse texture of the ore
- Hematite level in ore is low and consequently no effort has been made to recover
- 145 samples submitted for QEMSCAN – 609 QEMSCAN analyses undertaken. Samples range from core samples, composites, DTR products and pilot trial stream samples. Six XRD's undertaken to calibrate the above.
- No fibrous or asbestiform minerals are present in the ore

Flow Sheet

- Flow sheet development driven by mineralogy/mineral texture and objective to keep concentrate product coarse
- Target sinter feed vs pellet feed
- Only standard equipment specified for processing
- Developed in consultation with equipment vendors
- Scalability of test work valid as coarse size and standard equipment used
- No clays or ultra-fines in the process leads to ease of separation and dewatering of both concentrate and tailings
- Flowsheet developed in eight test campaigns using NQ core
- Final flowsheet demonstrated in three lab campaigns – final test of 5 tonnes to create bulk concentrate samples for customers

Orebody Variability

- Low variability spatially, in both composition and properties

Bulk Sample

- Five tonne bulk sample was used to demonstrate final flowsheet configuration

Sinter Test Work

Bulk sample testing by China Iron and Steel Institute (CISRI) Beijing and several Chinese steel mills

Main advantages when using CEIP iron concentrate

Sintering process (up to 30% in blend)

- Decreased solid fuel rates- the fuel effect that magnetite adds in the sintering process
- Increased average Fe grade

Pellet process

- Increased average Fe grade
- Considerably less energy is used (as compared to hematite concentrate- due to the fuel effect that magnetite provides)

Sinter Test Work (Cont'd.)

- Can be used in grate-kiln, travelling grate and shaft furnace (hematite cons is difficult to use in shaft furnace which is 40% of production)
- Coarse particle size of the target CEIP concentrate sizing is undesirable for pelletising

Blast Furnace

- Increased average Fe burden grade, when added as sinter or pellet
- Productivity increased
- Fuel rate decreased
- Slag rate decreased
- Carbon dioxide emissions decreased
- Reduced sulphur burden will reduce SO_2 emissions

Sinter quantity per tonne pig iron decreases with increased sinter Fe grade so solid fuel consumption and pollutants emissions decrease correspondingly

Summary of the quantified benefits identified by CISRI for steel mills when using CEIP iron concentrate:

Sintering process – when substituting 30% CEIP for Pilbara fines

- Decreased solid fuel rates (0.69kgce/t or 1.5%)
- Increased average Fe grade (0.87% Fe or 1.5%)
- Reduced pollutant emissions (18mg/m3 or 1.4%)
- Reduced SO_2 emissions (0.279kg per tonne of iron or 13.1%)

Pellet process – when substituting 30% CEIP for Chinese concentrates

- Increased average Fe grade (0.81% Fe or 1.3%)
- Reduced energy use (0.45kgce/t or 1.3%)
- Reduced pollutant emissions (15mg/m^3 1.3%)
- Reduced SO_2 emissions (1.992kg per tonne iron or 25.9%)
- Can be used in grate-kiln, travelling grate and shaft furnace (hematite cons is difficult to use in shaft furnace which represents 40% of production)

Blast Furnace – when substituting 30% CEIP for Pilbara fines

- Increased average Fe burden grade (0.65% Fe or 1.1%)
- Productivity/yield increased (1.64%)
- Fuel rate decreased (5.39kg/t or 1%)
- Slag rate decreased (19.7kg/t)
- Carbon dioxide emissions decreased (31.4kg/t or 1.6%)

Dephosphorisation

- Reduced energy and flux usage

The quantified benefits will vary depending on the individual mill feedstock blend and as such this information is indicative.

Groundwater

Water table depths vary between approximately 5m below ground level (mbgl) near salt lakes and exceed 20mbgl in elevated areas (e.g. sand ridges).

Main points from mine conceptual hydrogeological model:

- Two main aquifers exist in the project area, the Tertiary sediment aquifer and fractured rock (gneiss) aquifer. The aquifers are separated by the low permeability saprolite layer which acts as an aquitard, limiting flow between the aquifers.

Groundwater (Cont'd.)

- Local to the proposed mine area, groundwater salinity in the Tertiary sediment aquifer ranges from 35,000 to 53,600mg/L, while groundwater salinity in the fractured rock aquifer is significantly higher ranging from 113,000 to 150,000mg/L.
- A bore audit and landowner survey of historic water bore records found that no groundwater suitable for agricultural use has been identified within approximately 20km of the mine site.
- Recharge rates are around 1mm/yr over the majority of the study area.
- Regional groundwater flow in both aquifers is in a southwesterly direction.
- Locally, groundwater also discharges through evaporation to salt pans and playa lakes.
- In-pit seepage is to be collected and transferred to the process water pond via in-pit sump pumps. The predicted inflow rates range from 4 to 17ML/day from the previous Murphy South pit (Rob Roy pit significantly smaller).
- Dewatering wells (four in-pit and seven ex-pit wells) are predicted to abstract a further 12ML/d (two years prior to mining) to 4ML/d (end of mining) (previous Murphy-South/Boo-Loo pit design).

Product Specification – CEIP Iron Concentrate

Element	*Typical (%)*
Fe	66.7
SiO_2	3.36
Al_2O_3	1.90
P	0.009
S	0.003
CaO	0.10
MgO	0.39
TiO2	0.29
Mn	0.73
$Na_2O + K_2O$	0.23
FeO	27.5
Moisture $_{average}$	7.00
Moisture $_{target\ maximum}$	8.00
LOI $_{0\text{-}1000}$	-2.80
LOI $_{650\text{-}1000}$	-1.33
P_{80}	~106µm
P_{40}	~40µm

Mining

24Mtpa dry *(former option)*	***12Mtpa dry*** *(current option)*
Fleet Ownership – Owner operator model	Fleet Ownership – Contractor mining
Method –IPCC (semi-mobile in-pit crushing of ore and waste)	Method – IPCC (ex- and in-pit crushing ore only)
Ore Reserve (JORC 2012) – 3.7Bt @ 15.1% Fe; independent project review (SRK)	Ore Reserve (JORC 2012) – Not estimated, new pit shell wholly within previous pit shell
Pre-strip – 322.3Mt	Pre-strip – 176.8Mt
LOM Ore Production – 27 years	LOM Ore Production – 22 years
LOM TMM – 4,235.7Mt ore; 5,681.7Mt waste	LOM TMM – 1,700.8Mt ore; 1,646.5Mt waste
LOM Strip Ratio – 1.34:1	LOM Strip Ratio – 0.97:1
Blasting and mineral sizers as first stage of crushing	Blasting and mineral sizers as first stage of crushing
Only over size ore and waste crushed to minimise wear	Only over size ore crushed to minimise wear
Conventional truck and excavator in-pit	Conventional truck and excavator in-pit
Waste crushed and conveyed out of pit by in-pit conveyors	Waste trucked from pit to IWL
Ore crushed and conveyed by in-pit crusher and conveyors to COS	Ore trucked to ex-pit crusher and conveyed from crusher to COS

Integrated Waste Landform (IWL)

24Mtpa dry *(former option)*

- Initial Tailings Storage Facility (TSF) concept replaced by IWL, (dry stacking of mine waste and tailings), with water recycled in-process
- Dewatered coarse tailings (~3mm) and filtered fine tailings (~1mm) with 8% moisture, co-mingled with crushed waste rock from pit, conveyed by belt to spreaders on three tiers and dry stacked
- 2,299Mm^3 total waste material

12Mtpa dry *(current option)*

- IWL with significantly reduced footprint; dewatered coarse tailings (~3mm) and filtered fine tailings (~1mm) with 8% moisture, co-mingled with blasted waste rock from pit, tailings conveyed by belt to two spreaders and waste rock by truck
- Voids within waste rock filled with finer tailings and the need for separate waste rock storage and tailings storage facilities is removed
- 710Mm^3 total waste material

Mineral Processing

24Mtpa dry *(former option)*	***12Mtpa dry*** *(current option)*
LOM Production – 589Mt iron conc. Ore feed rate 175Mtpa % Fe – 15.50% % Fe Recovery – 59.3% Mass Recovery – 13.9% Magnetite recovery – 86.1% Plant – 3 x 8Mtpa modular processing trains	LOM Production – 250Mt iron conc. (<50% of Ore Reserve) Ore feed rate 81.72Mtpa % Fe – 15.93% % Fe Recovery – 61.8% Mass Recovery – 14.8% Magnetite Recovery- 91.7% Plant – 2 x <8Mtpa modular processing trains
SAG Mill 3 x 26MW mills at 12.1m dia Discharge P80 of 3,170µm BRWi 15.3kWh/t	***SAG Mill*** 2 x 20MW mills at 12m dia Discharge P80 of 3,170µm BRWi 15.3kWh/t
Ball Mill 3 x 12MW mills at 6m dia Discharge P80 of 460µm BBWi 16.8kWh/t	***Ball Mill*** 2 x 9MW mills at 5.5 dia Discharge P80 of 460µm BBWi 16.8kWh/t
Rougher Magnetic Separation 192 x 1 Roll x 1.2m dia Eriez	***Rougher Magnetic Separation*** 96 x 1 Roll x 1.2m dia Eriez
Cleaner Magnetic Separation 120 x 3 Roll Eriez	***Cleaner Magnetic Separation*** 60 x 3 Roll Eriez
Gravity Circuit 96 Rougher spirals 48 Cleaner spirals	***Gravity Circuit*** 48 Rougher spirals 24 Cleaner spirals

Infrastructure

24Mtpa dry *(former option)*	***12Mtpa dry*** *(current option)*
Corridor • Capital intensive heavy haulage rail, service road constructed on engineered Module Access Route (MAR), pipeline and powerline for part of route	***Corridor*** • Capital light private haul road constructed on engineered Module Access Route (MAR), pipeline and powerline for part of route
Port • Owner operator model • MOF for module receipt • Jetty and wharf – Cape class capable • Rail bottom discharge receival and stockpiling system • 70Mt/a bulk material load out system	***Port*** • Build, own, operate delivery model • MOF for module receipt • Jetty and wharf – Cape class capable • Road receival and stockpiling system • 30Mt/a bulk load out system
Power • 275kV line to Yadnarie West substation • Powerline via infrastructure corridor • Total CEIP power requirement 418MW (mean)	***Power*** • 275kV line to Yadnarie West Substation • Powerline via infrastructure corridor • Total CEIP power requirement 167MW (mean)
Water • Borefield drawing on very large saline aquifer not used by any others 60km to south of mine • Processing of ore is performed using raw water and the concentrate is washed with RO water in the final dewatering stage, processing water is recycled in the process • 12GL pa make up water required and wash water site-based RO plant for concentrate wash water	***Water*** • Borefield drawing on very large saline aquifer not used by any others 60km to south of mine • Processing of ore is performed using raw water and the concentrate is washed with RO water in the final dewatering stage, processing water is recycled in the process • 6GL pa make up water required and wash water site-based PO plant for concentrate wash water

Carbon Abatement Opportunities

There are several opportunities to de-carbonise the mining and processing of ore and the manufacture of green iron, as outlined below, which rely on localised renewable energy and hydrogen and ammonia manufacture (see Port below) initiated in conjunction with the CEIP development.

For a 12Mtpa concentrate production:

Mine

- Diesel
  - Consumption: 85 MLpa
  - Carbon emissions: 224ktpa CO_2-e
  - Replace diesel fleet with hydrogen fuel cell or electric trucks
- Explosives
  - Consumption: 63ktpa ANFO
  - Carbon emissions from manufacture: 11ktpa CO_2-e
  - Use green ammonia for manufacture

Processing

- Pit to port energy consumption: 1.3GWhr/yr
  - 96% is consumed in the mine and process plant
  - Carbon emissions: 706ktpa CO_2-e
  - Replace with renewable energy (wind, solar, H_2 and storage)
- Magnetite concentrate suits pelletisation, sintering or Direct Reduced Iron (DRI)
  - Process at Cape Hardy using green hydrogen (see below)

Concentrate Haulage

- Diesel
  - Consumption: 18MLpa
  - Carbon emissions: 44ktpa CO_2-e
  - Replace diesel fleet with hydrogen fuel cell vehicles

Carbon Abatement Opportunities (Cont'd.)

Port

- Cape Hardy is well suited to hydrogen and ammonia manufacture with:
  - 1224ha of wholly owned gulf side land
  - Proximity to world class renewable energy as wind and solar
  - High energy gulf zone suited to desalination
  - Natural deep water to suit Capesize vessels
- H_2 production at the port facilitates green ammonia manufacture. Together these fuels can power a variety of green follow-on production facilities such as:
  - Green iron manufacture, preferably DRI, but also partial treatment into pellets or sinter. The 12Mtpa of concentrate will produce 8Mtpa iron and release 16Mtpa CO_2-e via BOF/BF technologies. There is a significant opportunity to abate these scope 3 emissions, being 87% of the total supply chain emissions.
  - Local iron manufacture eliminates the shipping requirement for concentrate, which to China is approximately 1.6Mtpa CO_2-e, or 9% of the supply chain emissions.
  - Green ammonium nitrate manufacture for fertilizer, urea or explosives. The Eyre Peninsula consumes circa 300ktpa fertilizer per annum, at 180kgCO_2-e per tonne of nitrate produced, this is an abatement opportunity of the order of 54kt CO_2-e per annum (plus the proximity of supply, greatly reducing transportation requirements).
  - Hydrogen itself could be used as a base load power supply or a fuel source for future hydrogen powered agricultural equipment.