

April 2014

**Grant Craighead** | Research Manager  
gcraighead@breakawayinvestmentgroup.com

**Mark Gordon** | Senior Research Analyst  
mgordon@breakawayinvestmentgroup.com

### Company Information

ASX Code	SFX
Share Price	A\$0.985
Ord Shares	119.58m
Options	5.08m
<b>Market Cap</b>	<b>A\$122.79m</b>
Cash (Dec 13)	A\$3.37m
Total Debt	A\$0
<b>Enterprise Value</b>	<b>A\$119.42m</b>

### Directors and Management

Executive Chairman	Will Burbury
Managing Director	Bruce McQuitty
Technical Director	David Archer
Exploration Manager	David Boyd
Sustainability Manager	Wayne Groeneveld
Project Devl. Manager	Mark Teakle

### Company Details

Address	Level 1, 57 Havelock Street West Perth WA 6005
Phone	+618 6424 8440
Web	www.sheffieldresources.com.au

### Top Shareholders

Will Burbury	6.4%
Bruce McQuitty	6.4%
David Archer	6.4%
Top 20	36%

### 1 Year Price Chart



# Sheffield Resources (SFX)

## Thunderbirds Are Go

*Recommendation: Speculative **BUY***

### Key Points

- **World class Thunderbird mineral sands deposit returns very robust scoping results**
- **Scoping Study based on a high grade part of the overall resource, capable of supporting a long term, high volume operation**
- **Metallurgical testwork indicates the potential to produce marketable zircon and titanium dioxide products**
- **Excellent early stage exploration results at the Red Bull Ni-Cu Project**
- **These have outlined a number of Ni-Cu anomalies that now require follow up**
- **Red Bull is located in the emerging Fraser Range nickel province, close to the Nova discovery of Sirius Resources**
- **The Eneabba and McCalls HMS project provide excellent option value, potentially being standalone producers in their own right**
- **Experienced and motivated Board and Management**

*Sheffield Resources has recently completed a robust Scoping Study on its headline world class Thunderbird discovery, located near Broome in Western Australia. The deposit is one of the largest mineral sands discoveries in recent years, and includes a large high grade component with in-ground values per tonne similar to, and in some cases significantly higher than existing global operations. Sheffield has now commenced a Pre-feasibility Study on the project.*

*Excellent early stage exploration results have also been obtained from the Red Bull Ni-Cu Project in the Fraser Range of WA. This project is located in an area that is considered very prospective for layered intrusive related massive sulphide Ni-Cu mineralisation, similar to that at the nearby Nova discovery.*

*We see good value in Sheffield Resources, and thus rate it as a Speculate Buy. The stock price has seen significant momentum over the last 9 months, and we see this continuing, with ongoing positive news from Thunderbird and Red Bull being the key price drivers.*

### Company Overview

Sheffield Resources (ASX: SFX) is a Western Australian based explorer, with a diverse 100% held exploration and development portfolio in Western Australia.

The Company's headline project is the world class Thunderbird HMS project, which is a Sheffield discovery. The project is located in the Cretaceous Canning Basin, and is the first mineral sands discovery in what could develop into a new mineral sands province.

The second key project is the Red Bull Ni-Cu Project, located in the Fraser Range area of SE Western Australia. This project is part of a group of tenements that are held over the Albany-Fraser Belt, which has seen a number of discoveries over recent years, and is emerging as a new mineralised province.



## Investment Thesis

*The Thunderbird HMS deposit is a world class discovery by Sheffield*

*Marketable zircon and titanium dioxide products can be produced from the mineralisation*

*Robust economics indicated by the Thunderbird Scoping Study*

*Capital and operating costs estimates are realistic, and our review supports the robust nature of the scenario*

*Thunderbird is close to infrastructure and markets*

*Sheffield has 100% interests in other mineral sands projects*

*The Red Bull Ni-Cu project has returned very encouraging exploration results to date*

### World Class Mineralisation at the Thunderbird Mineral Sands Deposit

In their Thunderbird Deposit discovery, Sheffield Resources (“Sheffield” or “the Company”) has a world class mineral sands deposit, both in size and grade, containing some 72Mt of contained valuable heavy minerals (VHM) grading at 2.73%, within an overall resource of 2.62Bt grading 6.5% total HM. This contains a coherent high grade component, which in itself can be considered as a world class deposit, containing some 36Mt contained VHM grading at 4.90%, within a resource of 740Mt @ 12.1% total HM.

This is one of the largest global mineral sands discoveries in the last 30 years, and also opens up the Canning Basin as a potential new mineral sands province.

Metallurgical testwork done to date has indicated that marketable titanium and zircon products can be produced from the mineralisation. The products include premium grade zircon, sulphate grade ilmenite (suitable for sulphate or chloride slag plant feed or direct sulphate pigment plant feed) and a high titanium (80% TiO<sub>2</sub>) leucoxene product.

### Robust Scoping Study – Thunderbird Deposit

A recently completed Scoping Study has indicated very robust economics for Thunderbird, with the potential to produce a 32 year LOM operating cash flow of \$5.0 billion, including \$204 million a year for the first 10 years. The scenario in this study envisages mining 20.8Mtpa, producing some 545,000tpa of ilmenite, 118,200tpa of zircon and 21,700tpa of high titanium leucoxene.

The Company envisages an upfront capital expenditure in the order of \$300 million, and life of mine operating costs (including royalties) of \$253/tonne of product, with an EBIT margin of \$183/tonne of product.

We have undertaken an indicative review and DCF model of the proposed project, which indicates that the project is most sensitive to prices, however can accommodate reasonable adverse price (and exchange rate) movements. In addition estimated capital and operating costs used by the Company are comparable (when scaled for project size) with recent studies from other companies.

### Close to Infrastructure and Markets

The Thunderbird deposit is within 35km of the Great Northern Highway, and within 140km of both Derby and Broome Ports. The Company has yet to undertake port studies, however has indicated that both ports are options, with these also being close to potential Asian offtake markets.

### Other Mineral Sands Projects

The Company has 100% interests in two other projects – Eneabba, which is in a proven mineral sands mining district, and McCalls, which at 40Mt of contained ilmenite has one of the largest concentrations of chloride-grade ilmenite in the world, albeit at a low grade of 1.13% VHM, however comparable with the producing Grande Côte operation.

### Excellent Exploration Potential at the Red Bull Ni-Cu Project

The Red Bull Ni-Cu Project, which is located 20km from Sirius Resources’ (ASX: SIR, “Sirius”) Nova discovery in the emerging Fraser Range nickel province. Work to date has returned very encouraging results. The Company continues to explore this project, which is considered prospective for layered ultramafic intrusive related massive Ni-Cu-PGE sulphide mineralisation.



## Other Projects

The Company continues to work on other projects, include iron ore in the Pilbara, and talc and unconventional potash projects in the mid-west of WA.

## Strong and Motivated Board and Management

*The Company has a strong and motivated board and management*

The Board and Management have had extensive industry experience in varied regions and commodities, including mineral sands. In addition directors hold significant shareholdings (over 19% combined), and thus will be motivated to produce strong returns for shareholders.

## Peers

Sheffield is one of a number of ASX-listed mineral sands developers and producers, as presented below.

*Sheffield is one of a number of ASX-listed mineral sands producers and developers*

Of this group, which includes producers, Sheffield is at the earliest stage, with a Scoping Study recently being completed at Thunderbird. We have, as far as possible included the total resource base for the companies in the following table.

As an indication of relative value we have included (and ranked the companies on) the enterprise value per tonne of payable product. We have two entries for Sheffield – one calculated on all projects, and one on the Thunderbird high grade resource only, discounting the Eneabba and McCalls projects. Note that EV/t figures are indicative of value only, and should be used with caution. A number of factors in addition to grade will affect this value. However there is a general trend for increasing value with project advancement, and also a bimodal distribution, split between producers and others.

### ASX Listed Mineral Sands Developers

Company	Location	EV Diluted (\$m)	Global Resource (Mt)	Payable HMS Grade	Payable HMS Mt Coy Share <sup>1</sup>	EV/T Payable HMS Coy share <sup>2</sup>	Project Stage
<b>Base Resources</b>	Kenya	\$408	146	3.52%	5.14	\$79.41	Producer
<b>Mineral Deposits</b>	Western Senegal	\$261	1,030	1.29%	6.62	\$39.39	Producer
<b>Iluka</b>	Vic, SA, WA, VA - USA	\$3,895	2,590	5.20%	134.57	\$28.95	Producer
<b>MZI Resources</b>	Mandurah, WA	\$33	135	1.74%	2.35	\$13.96	Financing completed
<b>Sheffield Resources</b>	T 'Bird high grade only	\$119	740	4.90%	36.23	\$3.28	PFS
<b>Diatreme Resources</b>	Eucla Basin, SA	\$4	243	0.89%	2.15	\$1.82	DFS on Cyclone
<b>Australian Zircon<sup>3</sup></b>	Wimmera, Victoria	\$40	1,650	2.59%	34.17	\$1.17	BFS completed
<b>Gunson Resources</b>	Coburn, WA	\$4	308	1.00%	3.07	\$1.14	Looking for partner
<b>Sheffield Resources</b>	Various, WA	\$119	7,353	1.74%	128.02	\$0.93	Various
<b>World Titanium</b>	SW Madagascar	\$27	959	4.88%	46.85	\$0.58	DFS Underway
<b>Astron Corporation</b>	Victoria	\$11	2,630	3.74%	98.40	\$0.27	DFS completed

1: Company share is the equity share of the total resource

2: EV is enterprise value – market capitalization less cash plus debt – the value of non-HMS projects have not been deducted from the EV in this case

3: AZC is suspended – funding is being provided by a third party

Source: IRESS, Company reports, EV as at close of trade April 24, 2014



We have also compared indicative in-ground values of a number of resources (both overall and individual deposits) – given the variability of valuable mineral assemblages it is misleading comparing resources on overall VHM grades alone, and thus the potential in-ground values need to be compared to give a more reasonable basis of comparison than on overall grades alone.

The table below shows the relatively high value of the Thunderbird high grade resource (Sheffield's flagship project), as well as the West Mine North high grade at Eneabba (which Sheffield envisages as being part of a sequential, multi-deposit operation at Eneabba using mobile plant).

#### HMS Deposits - Metrics

*Thunderbird has a relatively high in-ground value per tonne of mineralisation, comparable with current producers*

Co	Project/ Area	Deposit	Resource Tonnage	Total HM Grade	Total Ti	Zircon	Ti + Zr	Value/t resource <sup>1</sup>
ILU	Murray Basin	All	217	16.50%	11.17%	1.77%	12.94%	\$69.49
SFX	Eneabba	West Mine North HG	10	7.70%	5.83%	0.61%	6.44%	\$30.91
ILU	Eucla Basin	Jacinth-Ambrosia	239	4.00%	1.14%	1.92%	3.06%	\$29.36
ILU	Eucla Basin	All	445	4.86%	2.63%	1.36%	3.99%	\$25.69
ATR	Murray Basin	Donald	2630	5.28%	2.76%	0.98%	3.74%	\$24.24
SFX	Dampier	T 'Bird HG	740	12.13%	3.97%	0.92%	4.90%	\$23.10
AZC	Murray Basin	WIM150	1650	3.72%	1.82%	0.77%	2.59%	\$19.15
ILU	Sri Lanka	All	688	8.17%	5.74%	0.33%	6.07%	\$18.91
BSE	Kenya	Kwale	146	4.89%	3.23%	0.28%	3.52%	\$16.94
MZI	Keysbrook	Keysbrook	79	2.43%	1.80%	0.36%	2.16%	\$16.78
ILU	Perth Basin	All	1112	5.34%	3.32%	0.51%	3.83%	\$15.41
WTR	Toliara	Ranobe	959	6.10%	4.54%	0.34%	4.88%	\$15.28
DRX	Eucla Basin	Cyclone	137	2.19%	0.91%	0.66%	1.57%	\$15.00
SFX	Dampier	T 'Bird all	2620	6.52%	2.21%	0.54%	2.75%	\$13.53
ILU	USA Atlantic	USA	128	4.38%	2.84%	0.52%	3.35%	\$12.91
SFX	Eneabba	West Mine North	42	2.77%	2.10%	0.20%	2.30%	\$10.97
SFX	Eneabba	All	302	2.23%	1.66%	0.26%	1.91%	\$ 8.53
GUN	Coburn	Coburn	308	1.20%	0.72%	0.28%	1.00%	\$ 6.50
MDL	Senegal	Grande Côte	1030	1.73%	1.14%	0.15%	1.29%	\$ 4.48
MZI	Bathurst Island	Kilimiraka	56	1.60%	0.97%	0.18%	1.15%	\$ 4.46
SFX	Perth Basin	McCalls	4431	1.2%	1.05%	0.08%	1.13%	\$3.57

1: Values based on the following prices per tonne: Zircon - \$1,400, Rutile \$1,200, High Ti leucosene \$800, Low Ti Leucosene \$400, Ilmenite \$200.

Source: IRESS, Company reports

#### Risks

As with any resources projects there are risks involved.

*Prices, exchange rates and marketing are key risks for Thunderbird*

Our view is that the key risk for most resources projects are prices and exchange rates. This is the same for Thunderbird, although given the relatively high in-ground value of the resource used for the Scoping Study this is somewhat mitigated. Our indicative modelling and sensitivity analysis indicates that the project can comfortably absorb Australian denominated price falls of 20% from the figures used in the study. Prices are also a proxy for exchange rates.

Another key issue with mineral sands is marketing and obtaining offtake agreements for



the products. Work done by Sheffield however has targeted producing marketable products, thus potentially mitigating this risk.

The zircon and ilmenite products should be readily marketable, with large global markets for both products. The markets for the Company's fine grained HiTi80 leucoxene product are more restricted, and include the ~150,000tpa welding rod market or as a blend for the slagging market. Given the anticipated relatively minor amount of production of this, marketing and offtake again should not pose any major issues.

*Although fine-grained material has caused some issues at other operations, this should not be the case at Thunderbird*

Fine grain size has caused some issues at other mineral sands deposits (particularly in the Wimmera), and also have negative perceptions with some investors, however testwork done to date at Thunderbird indicates that the fine to medium grained material is readily treated at a bench scale, and the Company and metallurgical consultants are confident that it will scale up successfully to commercial volumes, using readily available technology. Testwork was done on balancing recoveries and producing marketable products.

Resource wise the project is largely de-risked – a large robust resource has been defined, sufficient for a company making mine life. This resource is also open in all directions, and there is additional exploration potential in the Dampier Project area.

*Resource wise Thunderbird is largely de-risked*

The Thunderbird Project is close to infrastructure, however will have to rely on its own power generation, either diesel or gas. This will result in potentially relatively high power costs. It is within 140km of both Broome and Derby ports, both of which have been flagged as potential export points.

We are aware that port studies are yet to be undertaken, but note that Broome does not have bulk loading facilities at the current wharf, which is used for both freight and cruise ships. Again infrastructure will be addressed with the ongoing studies.

There is the potential for significant additional capital expenditure requirements above those estimated in the Scoping Study for port facilities.

Further down the track permitting is always a risk with resources projects; however the project is in a relatively mining friendly jurisdiction, with well understood permitting processes. The Company has recently employed a Sustainability Manager, with extensive experience in project (including mineral sands project) permitting. The Company is also relatively well advanced in baseline environmental studies that will be required for permitting.

The key technical risk at McCalls is grade – we realise however that this is a global resource, and may contain higher grade areas of sufficient size to support any potential operation. Testwork done to date at McCalls indicates that the mineralisation is relatively coarse grained. We note that McCalls is of a similar grade and VHM assemblage to Mineral Deposits' Grande Côte Project in Senegal that has recently started production.

Given the stage of the projects, exploration risk is the main risk at Red Bull and the Pilbara iron ore projects; however results to date from both projects have been very encouraging.





## Project Review

### Introduction

*Sheffield has a diverse portfolio of 100% held projects in WA, with the Dampier HMS and Red Bull Ni-Cu being the key assets*

Sheffield has a portfolio of 100% held projects in Western Australia, with the key projects being the Dampier HMS and Red Bull Ni-Cu projects. The Company is currently concentrating activities on these projects, with both returning excellent results.

### Project Locations



Source: Sheffield

### Dampier HMS Project

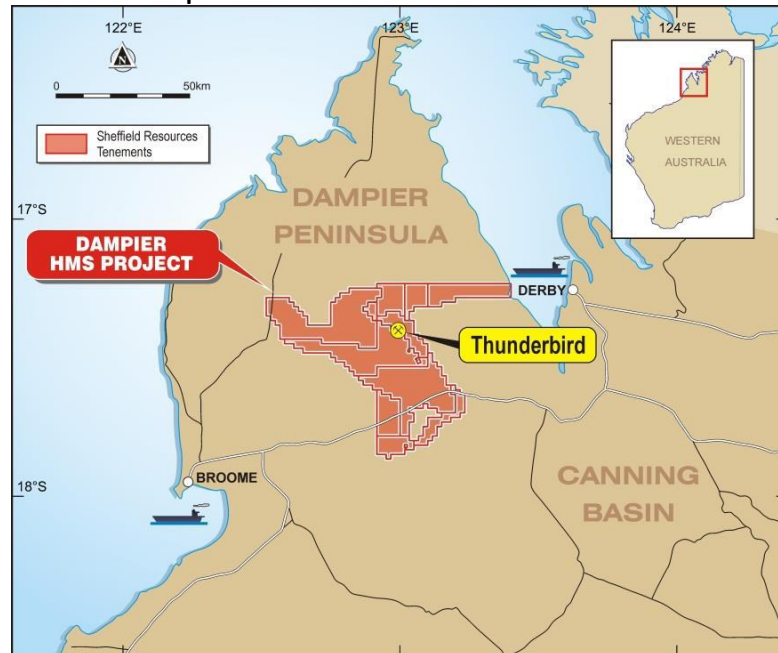
*The Dampier HMS Project is Sheffield's headline project, and includes the world class Thunderbird discovery*

This is Sheffield's headline project, and is located midway between Broome and Derby in northern WA. The project includes the world class Thunderbird deposit, a Sheffield discovery, and which has recently returned very robust Scoping Study results.

The Dampier Project covers nine granted exploration tenements totalling 2,500km<sup>2</sup>, held 100% by Sheffield.



## Thunderbird Deposit Location



Source: Sheffield

*Thunderbird is located midway between Broome and Derby*

## Geology and Mineralisation

The tenements are located over deeply weathered units of the Cretaceous Canning Basin, which in the vicinity of Thunderbird dip very gently to the southwest.

*The mineralisation occurs in loose Cretaceous sediments of the Canning Basin*

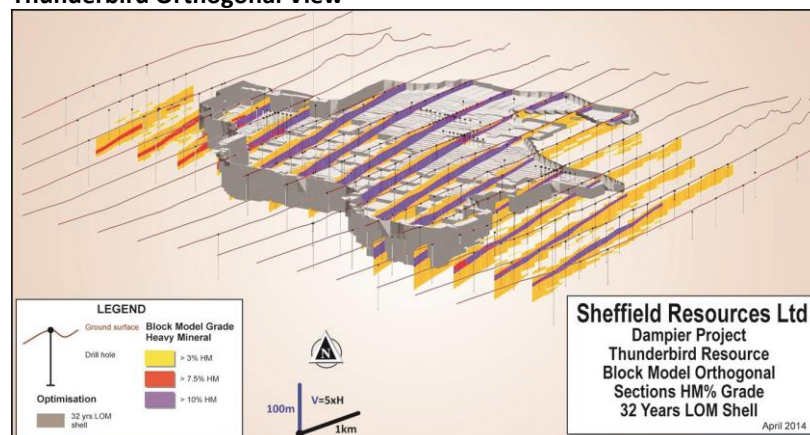
The HMS mineralisation largely occurs in a unit referred to as the Thunderbird Formation, characterised by brown/orange loose sands (free diggable) up to 90m thick. The mineralised horizon occurs as a laterally extensive, thick sheet like body, and has been defined for a distance of between 2.5km and 5.5km down dip (NE/SW), and 8km along strike (NW/SE).

The deposit properties, including morphology and grade are interpreted to indicate a potential off-shore, sub-wave base depositional environment.

*The average thickness of the mineralisation is 47m, and it forms a large, very gently dipping coherent sheet*

The average thickness of the mineralisation is 47m, with an average depth to the top of 21m. Around 32% of the resource area is within 6m of the surface, with the mineralisation being open in all directions.

## Thunderbird Orthogonal View



Source: Sheffield

To date Sheffield has completed 441 aircore holes for 25,953m of drilling at the project, with some spectacular intersections.



## Resources

Sheffield has defined a world class resource at Thunderbird, with a total resource of 2.62Bt @ 6.5% HM (including 2.73% valuable HM) at a 3% HM cut-off. This includes a coherent higher grade portion of 740Mt @ 12.1% HM (including 4.86% valuable HM), using a 7.5% HM cut-off. VHM comprise around 4-45% of the total HM content.

### Thunderbird HMS Resource

Overall resource of 2.62Bt @ 2.73% valuable HM at Thunderbird, including a coherent high grade component of 740Mt @ 4.86% valuable HM

Category	HM Cut Off	Tonnage Mt	Total HM	Slimes	Zircon	HiTi Leucoxene	Leucoxene	Ilmenite
<b>Measured</b>	3.0%	75	7.50%	19%	0.68%	0.20%	0.18%	2.20%
<b>Indicated</b>	3.0%	1,805	6.80%	17%	0.56%	0.19%	0.20%	1.90%
<b>Inferred</b>	3.0%	740	5.70%	15%	0.49%	0.17%	0.20%	1.60%
<b>Total</b>	<b>3.0%</b>	<b>2,620</b>	<b>6.50%</b>	<b>17%</b>	<b>0.55%</b>	<b>0.18%</b>	<b>0.20%</b>	<b>1.80%</b>
<b>Measured</b>	7.5%	30	12.20%	18%	1.10%	0.32%	0.26%	3.60%
<b>Indicated</b>	7.5%	545	12.50%	16%	0.94%	0.29%	0.25%	3.50%
<b>Inferred</b>	7.5%	165	10.90%	17%	0.84%	0.27%	0.24%	3.20%
<b>Total</b>	<b>7.5%</b>	<b>740</b>	<b>12.10%</b>	<b>16%</b>	<b>0.92%</b>	<b>0.29%</b>	<b>0.25%</b>	<b>3.40%</b>

Source: Sheffield

For the Scoping Study the Company has used a pit optimised resource of 669Mt @ 10.2% HM, using Measured and Indicated resources only, with in-situ grades of 0.83% zircon, 0.27% HiTi leucoxene, 0.26% leucoxene and 2.9% ilmenite.

### Scoping Study Parameters and Outcomes

The following table presents the Scoping Study inputs and outcomes as announced to the market on April 14, 2014.

### Scoping Study Parameters and Outcomes

Metric	Value
Mining Rate	20.8 Mtpa
Mine Life	32 years
LOM Revenue	A\$10,010 m
Average operating cash flows (first 10 years) (excluding taxes, royalties)	A\$204 mpa
Average operating cash flows (LOM) (excluding taxes, royalties)	A\$156 mpa
Average revenue per year	A\$313m
Strip Ratio – LOM/First 10 years	0.6:1/0.2:1
Production – Zircon	118.2ktpa
Production – HiTi80	21.7ktpa
Production – Ilmenite	545ktpa
LOM combined production	22Mt
Prices Zircon/Ilmenite/HiTi80 per tonne	US\$1,475/185/870
AUD: USD exchange rate	0.90
Average Revenue/ tonne of product	A\$457
Unit Cash Cost LOM	A\$230
Royalties (@ 5% of revenue)	A\$22.8
Upfront Capex	A\$294 million
LOM Sustaining Capex	A\$158 million
LOM Capex/tonne of product	A\$21
EBIT Margin/tonne of product	\$183
Payback Period	2 years

Source: Sheffield

The recently completed Scoping Study has indicated a robust, long term project





## Mining

*Mining will be free dig by dozers and scrapers*

The Scoping Study envisages dry free dig mining using large bulldozers and scrapers, with an annual ore mining rate of 20.8Mtpa over a 32 year mine life. LOM strip ratios are 0.6:1 on a bcm basis, with this being 0.2:1 in the first 10 years.

## Metallurgy and Processing

Metallurgical testwork to date has concentrated on balancing recoveries and the production of marketable products, and results have been very positive, indicating that the mineralisation can be readily upgraded into saleable products. There is also the potential for future optimisation testwork to increase recoveries. Testwork was carried out on an 11 tonne bulk sample.

Although the Company does not state recoveries, data from the Scoping Study indicate ilmenite recoveries in the order of 75% and zircon recoveries in the order of 70% from the pit optimised resource. HiTi leucoxene recoveries are lower at around 40%.

*Metallurgical testwork to date has been very positive, with the potential to produce marketable zircon and titanium dioxide products*

Testwork has indicated fine to medium grained heavy minerals, with a median grainsize in the order of 75-90 microns. Sliming characteristics are okay, with the slimes fraction having low clay content and exhibiting high settling rates. Assessment by industry experts TZMI and Chinese marketing group Ruidow Information Technology Co Ltd confirmed the marketability of the products obtained from the testwork.

The key products include:

- Zircon – meets the premium specification for the 1.3Mtpa (2012) ceramic zircon sector
- Ilmenite – the primary product is suitable for the 2.6Mtpa (2012) sulphate-route TiO<sub>2</sub> pigment process, which requires TiO<sub>2</sub> concentrate grades of 50-54%, or the titanium sulphate and chloride slag upgrading processes
- HiTi80 Leucoxene – this is an 80% TiO<sub>2</sub> combination of the minor components of rutile, secondary ilmenite and high titanium leucoxene, and is suitable for the niche welding rod market, with forecast demand in the order of 150,000tpa, and also the potential to use as a blend in the slagging market.

Key product specifications are presented below.

### Zircon Specifications

ZrO <sub>2</sub> %	Fe <sub>2</sub> O <sub>3</sub> %	TiO <sub>2</sub> %	Al <sub>2</sub> O <sub>3</sub> %	P <sub>2</sub> O <sub>5</sub> %
66.2	0.05	0.09	0.10	0.14

Source: Sheffield

### Primary Ilmenite Specifications

TiO <sub>2</sub> %	FeO%	Fe <sub>2</sub> O <sub>3</sub> %	SiO <sub>2</sub> %	Al <sub>2</sub> O <sub>3</sub> %	Cr <sub>2</sub> O <sub>3</sub> %	MgO%	MnO%	ZrO <sub>2</sub> %	CaO%
50.1	8.0	36.4	1.6	0.3	0.05	0.2	1.5	<0.01	<0.10

Source: Sheffield

Testwork indicated a standard processing route, including a primary processing plant, producing a heavy mineral concentrate through standard gravity separation methods, following by a concentrate upgrade plant utilising magnetic and gravity circuits to separate the different products.



*Testwork indicates a standard processing circuit*

The circuit as proposed in the Scoping Study includes:

- Screening and pumping as a slurry from portable Mining Unit Plants (“MUP”) to Wet Concentrator Plants (“WCP”) for initial concentrating and desliming
- Heavy Mineral Concentrate (“HMC”) from the WCP will be pumped to a Concentrate Upgrade Plant (“CUP”), where magnetic (ilmenite bearing) and non-magnetic (HiTi80 and zircon bearing) minerals will be separated
- Final products will be produced at a standard Mineral Separation Plant (“MSP”).

### **Transport and Infrastructure**

*The project is located within 140km of the ports of Broome and Derby. The Company is yet to undertake port studies however*

The Company is investigating the possibility of shipping concentrate out through the Port of Broome, or the Port of Derby. Both ports will involve trucking products approximately 140km from the mine site. Broome has the capacity to handle “Handy” size carriers (<40,000t DWT), however does not currently have bulk loading facilities.

The Company has included a figure of \$19 million for off-site infrastructure.

Power will need to be provided on site, either through a leased diesel or gas powered plant. There is the future potential to use locally sourced gas from recently discovered gasfields, which will have the potential to lower operating costs.

Other infrastructure included in the scoping study includes a 35km access road to the Great Northern Highway and an accommodation camp for 145 personnel.

### **Capital and Operating Costs**

A summary of capital costs is presented below.

#### **Scoping Study Capital Costs**

	AUD \$ millions
Local site infrastructure	\$43.05
Mining units	\$22.9
Wet concentrator plant	\$39.8
Concentrate upgrade plant	\$8.8
Mineral separation plant	\$47.6
Process water system	\$22.9
Off-site infrastructure	\$19.0
Labour indirects	\$4.5
EPCM	\$37.8
Contingency (15%)	\$36.9
Other costs	\$10.9
<b>TOTAL</b>	<b>\$294.15</b>

*Source: Sheffield*

*Capital and operating costs are on par with those for recent feasibility studies on other projects*

The table below presents a breakdown of the operating costs as presented in the study

#### **Scoping Study Operating Costs**

Item	A\$ unit costs - SFX release	A\$/tonne of product (Breakaway calculation)
Mining	\$3.67/bcm	\$86.00
Mining unit plants	\$13.25/t HMC	\$29.00
Processing	\$72.36/t product	\$72.36
Transport, storage, ship loading	\$21.46/t product	\$21.46
Mine administration	\$0.61/t MUP feed	\$18.50
<b>TOTAL</b>		<b>\$227.32</b>

*Source: Sheffield*



## Ongoing Activities

Sheffield has now commenced a Pre-feasibility Study for Thunderbird, which they expect to complete by Q1, 2015. The expected cost for this study is \$5 million.

Work will include:

- Infill and step out drilling, with a planned resource update by Q4 2014
- Hydrological study and water drilling programme
- Geotechnical drilling and analysis
- Port and infrastructure studies
- Ongoing environmental (including baseline) studies – Level 2 flora and fauna studies have already been completed
- Flowsheet optimisation

*The Company has commenced a PFS, due for completion by Q1, 2015. This will lead into a DFS, and the Company is aiming for production by 2017*

Following completion of a positive PFS the Company will then move into a Definitive Feasibility Study in 2015 (expected cost ~\$10 million), construction in 2016 and initial production in 2017.

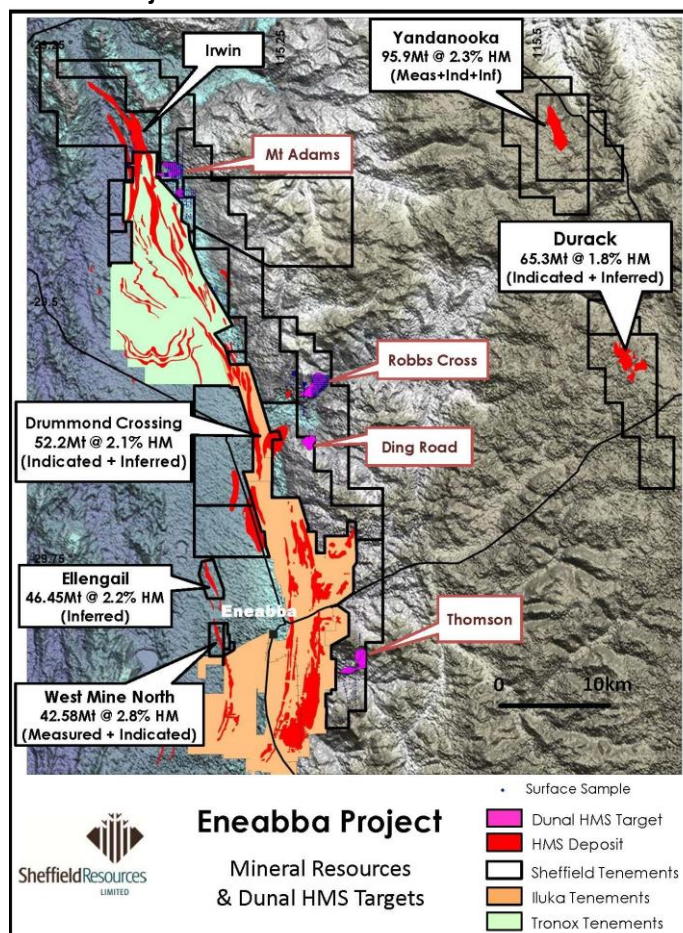
## Eneabba and McCall's Mineral Sands Projects

Eneabba is Sheffield's second mineral sands project, located in the Perth Basin centred approximately 140km south of Geraldton. The project includes six advanced exploration projects, located near existing operations of Tronox and Iluka and near existing road, rail and power infrastructure.

*The Company has 100% interests in two other HMS projects – Eneabba (in a proven mining district) and McCall's*

The region has been an important mineral sands producer since the 1970's.

### Eneabba Project



Source: Sheffield



*Eneabba is being evaluated as a sequential mining operation using mobile plant*

The Company is evaluating the Eneabba Project area as a sequential mining operation over a number of deposits, whilst exploring for other deposits. Previous optimisation work at West Mine North (part of a Scoping Study completed in 2012), has identified a high grade component of 10.09Mt @ 7.7% HM, containing 779kt of HM, with the assemblage comprising 7.9% zircon, 10.1% rutile, 59.2% ilmenite and 6.4% leucoxene. The ilmenite contains +60% TiO<sub>2</sub>, thus making it potentially suitable for chloride processing or synthetic rutile production.

The Company has recently identified four dunal additional style exploration targets at Eneabba as shown in the figure above.

*McCalls, although low grade, has one of the largest accumulations of chloride grade ilmenite in the world*

Large tonnage, low grade mineralisation was identified in the McCalls area by BHP in the 1970's, with Sheffield announcing a maiden resource in 2012. The mineral assemblage is dominated by ilmenite, and characterisation studies on one sample indicated TiO<sub>2</sub> grades of 60-68%, making it potentially a high grade chloride feedstock. In addition grainsize is relatively coarse at 125 microns. The contained chloride ilmenite tonnage of +40Mt makes it one of the largest concentrations of this material in the world.

The area is close to existing infrastructure, and the Company is carrying out further QEMSCAN mineral assemblage determination work. McCalls is a potential dredging operation, and is similar in grade and assemblage to MDL's Grande Côte Project.

#### Eneabba and McCall's Resources

Deposit	Category	Cut Off	Tonnage	HM %	Slimes %	O'size %	Insitu HM (Mt)	Zircon %	Rutile %	Leuc. %	Ilm. %
Yandanooka	Measured	0.9	3	4.1	15	14	0.1	11	1.9	2.2	72
Yandanooka	Indicated	0.9	90	2.3	16	15	2.1	11	3.9	3.9	69
Yandanooka	Inferred	0.9	3	1.2	18	21	0.03	11	3.9	4.6	68
Yandanooka	All	0.9	96	2.1	16	15	2.25	11	3.8	3.9	69
Durack	Indicated	0.9	50	2	15	21	1	14	2.8	5.1	69
Durack	Inferred	0.9	15	1.2	14	17	0.2	14	2.5	7.2	66
Durack	All	0.9	65	1.8	15	20	1.2	14	2.8	5.6	68
Drummond	Indicated	1.1	49	2.1	16	9	1	14	10	3.6	53
Drummond	Inferred	1.1	3	1.5	16	8	0.05	13	10	2.8	53
Drummond	All	1.1	52	2.1	16	9	1.1	14	10	3.5	53
Ellengail	Inferred	0.9	46	2.2	16	2	1	8.9	8.7	1.9	64
Ellengail	All	0.9	46	2.2	16	2	1	8.9	8.7	1.9	64
West Mine North	Measured	0.9	6	5.6	15	1	0.4	4.9	9.1	12	55
West Mine North	Indicated	0.9	36	2.3	13	3	0.8	8.4	10	5.4	60
West Mine North	All	0.9	43	2.8	13	3	1.2	7.9	10	6.4	59
Total Eneabba	Measured	Var.	9	5.2	15	5	0.5	6.7	6.8	8.7	60
Total Eneabba	Indicated	Var.	225	2.2	15	13	5	12	6	4.4	64
Total Eneabba	Inferred	Var.	68	1.9	15	6	1.3	10	7.2	3.2	64
Total Eneabba	All	Var	302	2.2	15	11	6.8	12	6.3	4.2	64
McCalls	Inferred	0.9	4,431	1.2	27	1.4	53	6.6	2	4.9	81
Total McCalls	All	0.9	4,431	1.2	27	1.4	53	6.6	2	4.9	81

Source: Sheffield

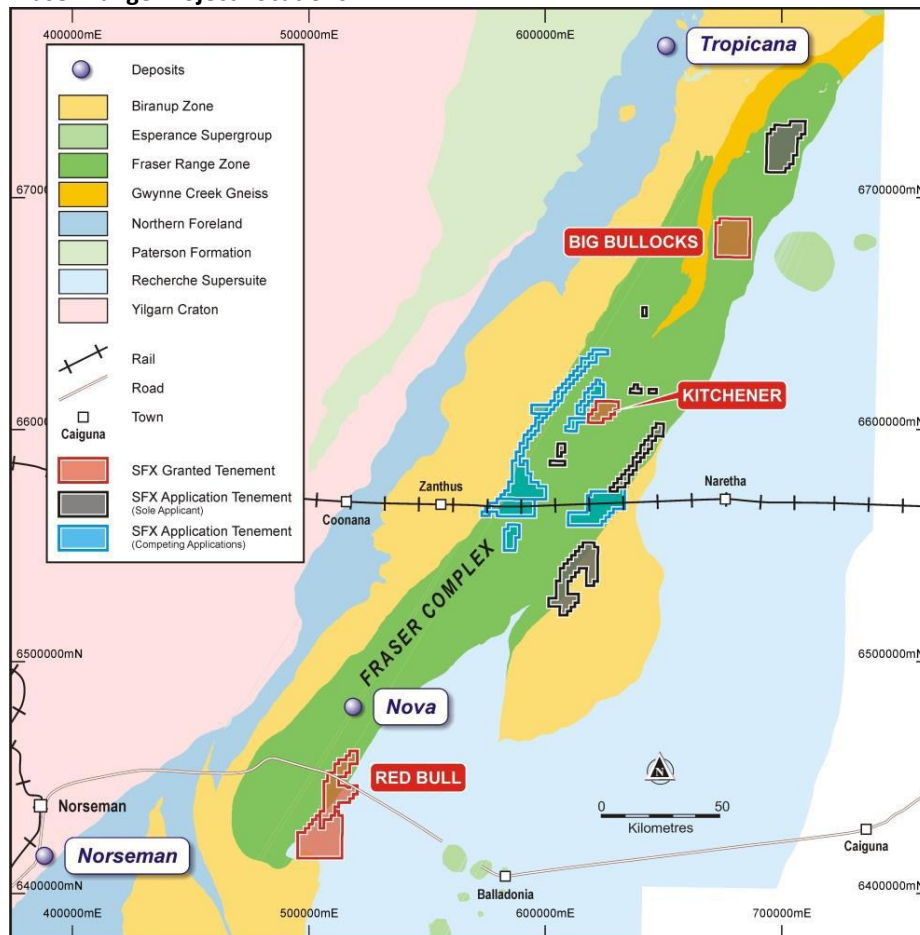


## Fraser Range Nickel-Copper Tenements

Sheffield is actively exploring its Fraser Range tenements, with the Red Bull Ni-Cu Project, the most advanced, being located 20km from Sirius' Nova-Bollinger discovery. Landholdings cover 2,420km<sup>2</sup>, which include six granted tenements and 11 applications, some of which are competing and likely to be chosen by ballot.

*The Fraser Range nickel tenements have returned excellent exploration results to date*

**Fraser Range Project Locations**



Source: Sheffield

Field work at Red Bull commenced in late 2012, following up VTEM anomalies outlined from an airborne survey. Work has included soil sampling, aircore and limited diamond drilling. The Company is targeting layered intrusive hosted massive nickel-copper-PGE sulphide mineralisation, and we consider that the results of work to date demonstrate the potential of the project area.

*Aircore drilling has defined a number of Ni-Cu anomalies that require follow up work*

The most recent work has included 2 phases of aircore drilling, which have outlined a number of promising Ni-Cu-Co anomalies as shown in the figure below

In addition to the aircore results, petrological work has identified trace amounts of chalcopyrite and the supergene nickel mineral violarite. Lithogeochemical work has identified a number of new target areas within the tenements.

*Diamond drilling has also intersected thick sequences of graphite*

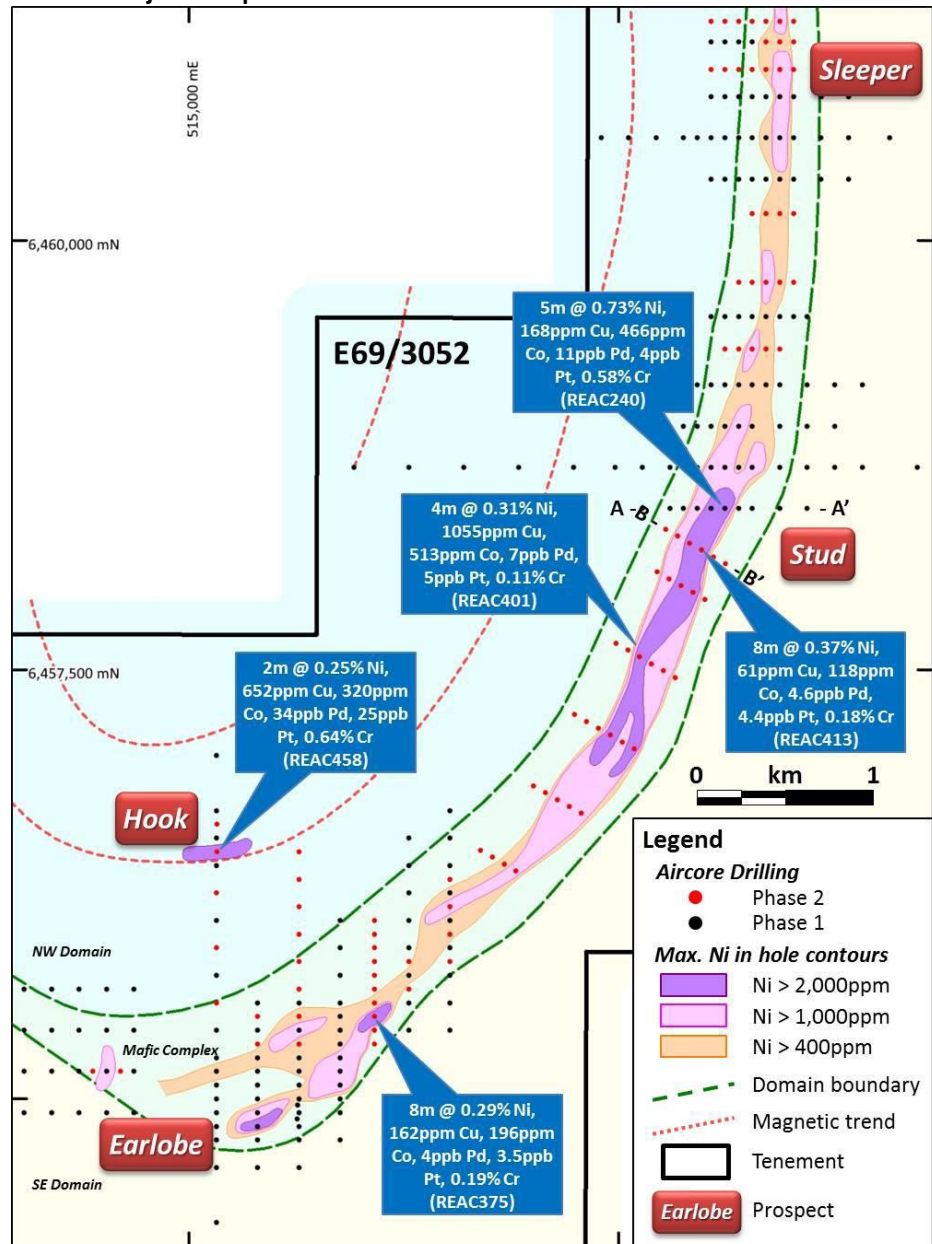
During 2013 three diamond holes were drilled targeting VTEM anomalies. Although these did not intersect base metal sulphides, they did intersect graphite, which was determined to be the conductive source for the VTEM anomalies. The highest grade result, which is considered significant, was 48.8m @ 4.6% total graphitic carbon.

Sheffield is considering the next steps with regards to the graphite.



The Company is planning further infill aircore drilling and ground EM, concentrating on the Hook and Stud prospects, and this work is anticipated to commence in Q2, 2004.

#### Red Bull Project Prospects and Results



Source: Sheffield

#### Pilbara Iron Project

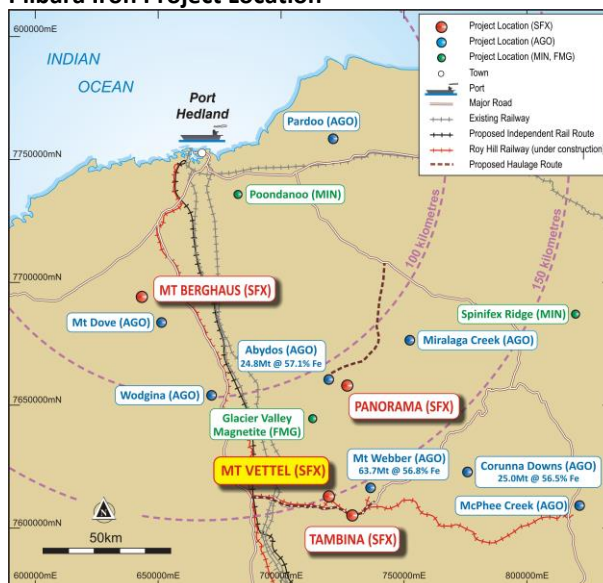
Sheffield is undertaking exploration work over four tenements considered prospective for DSO iron ore in the Pilbara. This work is early stage, with bedded iron being identified at MT Vettel, which is located 20km to the west of Atlas Iron's Mt Webber Project, and potentially within trucking distance of Port Hedland.

Mineralisation at Mt Vettel outcrops over a strike length of 1km, with widths of between 15m and 130m (averaging 50m). Rock chips have returned grades of up to 61.2% Fe, with low contaminants. The Company has planned an RC drilling programme, and is awaiting approval of the programme of work before commencement.

*First pass exploration over the Mt Vettel iron ore project has provided good results – the Company is now looking to drill*



## Pilbara Iron Project Location



Source: Sheffield

## Other Projects

*Other projects include the Oxley unconventional potash and Moora talc projects*

Sheffield is targeting unconventional hard rock potash at the Oxley Project, located near Morowa in the mid-west of Western Australia. The mineralisation is hosted in a high sanidine feldspar micro-syenite, and drilling has returned intervals of up to 36m @ 8.4% K<sub>2</sub>O.

Current activities include preliminary metallurgical testwork to evaluate a suitable extractive process.

At Moora, the focus is on the Fowlers talc deposit, which has an exploration target of 5-8Mt of talc. The Company is currently undertaking beneficiation testwork with the aim to lower the iron content and raise the brightness, which are currently out of marketable specifications for most commercial uses.

## Breakaway's View

In their Thunderbird discovery, Sheffield has a potentially robust world class mineral sands project. Deposit grades and mineral assemblages (and hence unit values) are comparable with current Australian operations; however Sheffield is differentiated by the size of the Thunderbird deposit, which has the potential to grow larger through additional drilling. The current high grade portion of the resource is large enough to support a long life operation.

Metallurgical testwork has shown the potential to produce readily marketable products at acceptable recoveries, and although the grain size is fine to medium, work to date indicates that the Thunderbird mineralisation will be readily treatable at a commercial scale using commercially available plant.

Our indicative financial analysis supports the robustness of the project and Sheffield's results.

The project is close to infrastructure, thus helping lower capital and transport costs, and being in Western Australia is in a relatively friendly mining jurisdiction. Further work needs to be done on the ports, however this is understandable given the stage the project is at, and the Company will now be undertaking the port studies.



The second key project, Red Bull, is in an excellent location in the emerging Fraser Range nickel province, and early stage exploration to date has produced very encouraging results with coincident nickel and copper anomalism and the right geology. This project has the right address, being within 20km of Sirius' Nova discovery.

We see considerable option value in the other projects, particularly the Eneabba and McCall's mineral sands projects, which both have the potential to be standalone operations.

*We rate Sheffield as a  
Speculative Buy*

Given the above we rate Sheffield as a **Speculative Buy**. We see the current momentum in price continuing, and see medium to long term price drivers being progress and eventual development of the Thunderbird deposit, with the shorter term sizzle being in exploration success at Red Bull.



## The Mineral Sands Industry

*The mineral sands industry is the key supplier of zircon and titanium dioxide minerals*

The mineral sands industry is the key supplier of zircon and titanium dioxide minerals worldwide. These are key feedstocks for industrial uses, with Australia being a major global producer, particularly of zircon.

In 2012 global production included 1.3Mt of zircon (down from 1.4Mt in 2011) and 7.1Mt of titanium dioxide feedstocks (up from 6.5Mt in 2011).

### Zircon

The zircon market is supplied by the one product, zircon.

*The major use for zircon is ceramics, which comprise some 50% of demand*

The major use for zircon is in ceramics, with this comprising some 50% of the 2012 global demand of 1.3Mt. Approximately 90% of the ceramics demand is in tile manufacture. Other uses include chemicals (21%) and in refractory products (17%). The chemical demand is currently the largest growing, with a 10 year CAGR of 11%.

*At 41% of demand in 2011 China is the largest market for zircon*

China is the largest market, comprising 41% in 2011. This region has seen significant growth, largely due to the rapid urbanisation during the 2000's seeing increased demand for tiles and other ceramics – tiles comprise approximately 75% of all floor coverings in China (source: Iluka). Other major markets include Europe (25% in 2011) and North America (8% in 2011).

Urbanisation is seen to be the key driver of zircon demand, largely due to increasing demand for tiles and other ceramic products.

*Australia is the largest producer of zircon, at 37% in 2012*

Australia is the largest supplier globally, providing 37% of the world's production in 2012, with Iluka alone providing 28% of the global demand. Australia's (and Iluka's) shares of global production were significantly down on the 2011 figures (50% and 38% respectively), largely due to weakening demand and prices in the second half of the year leading to curtailment of production.

### Titanium Dioxide

*The titanium dioxide market is fed by a number of products*

Unlike zircon, where the market is supplied by a single product, the 7.1Mtpa (2012) titanium dioxide market is fed by a number of products, with a number of processing routes. The two key pigment production processes are chloride and sulphate.

Key products sold by producers are shown in the table below. What can be seen is that almost 50% of the products sold to end users and pigment manufacturers are upgraded products, with the remaining 50% being raw materials. In addition, approximately 50% of feedstocks are chloride grade and 50% sulphate grade.

#### Titanium Dioxide Products Sold, 2012

Product, approximate market share	TiO <sub>2</sub> %	Notes	End Uses
Rutile – 10%	95-97	Mined product	Pigments, metal
Synthetic rutile – 8%	88-95	Upgraded from ilmenite in a furnace	Pigments
Ilmenite			
• Sulphate – 37%	52-54	Processed to pigment - sulphate processing	Pigments
• Chloride – 6%	8-62	Processed to pigment - chloride processing	
Slag			
• Sulphate – 13%	80-85	Upgraded from sulphate ilmenite in a furnace	Pigments
• Chloride – 20%	85-90	Upgraded from chloride ilmenite in a furnace	
• Upgraded – 6%	95	Upgraded from ilmenite	

Source: Iluka



*90% of titanium dioxide is used in pigments*

*Other uses are as metal and welding rod core wire*

*The pigment market is dominated by few countries and producers*

*Four countries provide two thirds of world supply*

*The mineral sands market is relatively opaque, with pricing set between sellers and buyers*

The majority (90%) of titanium dioxide is used in the pigment industry. It is used in various products, including paints, coatings, paper and inks. It is a key white pigment in that it has a high refractive index (whiteness), provides UV protection and is non-toxic.

Other uses include as a metal (military, aerospace and specialty applications) and for welding rod core wire.

The pigment market is dominated by Australia (28%), Western Europe (22%) and China (21%), with five major producers accounting for over half of global production. The majority of Chinese capacity is for sulphate grade feedstock, in Australia plants are entirely chloride process plants, with the rest of global capacity split between the two.

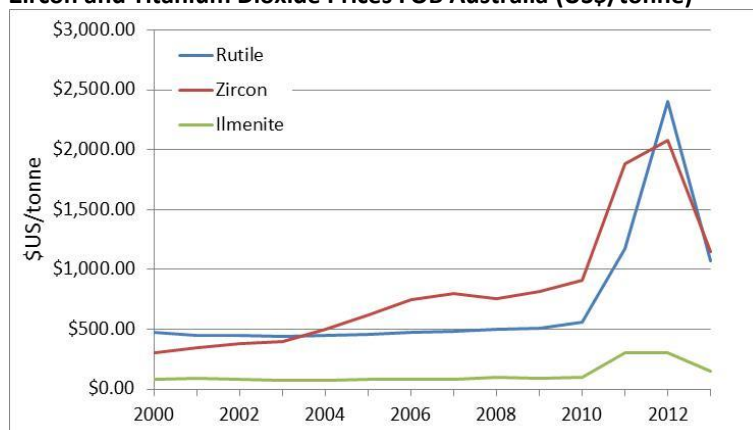
In 2012 (total production 7.1Mt) the major titanium dioxide producers were China (18%), Australia (17%), South Africa (17%) and Canada (15%). Like zircon, Australian share of production had fallen from 24% of 6.5Mt in 2011 (1.6Mt) to 17% of 7.1Mt in 2012 (1.2Mt), again largely due to Iluka curtailing production and sales.

### **Pricing**

The mineral sands market is relatively opaque – prices are generally fixed between the producer and buyer, and until 2009-2010 were largely on long term contracts, leading to relatively stable prices. More recently, changes in demand and supply have led to contracts more commonly being negotiated quarterly or half yearly.

Indicative product prices are shown below – rutile and zircon prices largely are as published in Iluka reports, ilmenite prices are derived from various sources.

**Zircon and Titanium Dioxide Prices FOB Australia (US\$/tonne)**



Source: Iluka, various public documents

The noticeable feature is the sharp decrease in prices in 2013 – this followed slowing in demand during 2012, largely due to weakening global economic conditions. Also apparent are significant increases in all commodities starting in 2010. As mentioned, this was as a result of supply constraints enabling producers to renegotiate prices away from long term contracts, which were a disincentive on bringing on new production.

*Zircon demand and pricing has largely been driven by urbanisation in China*

The steady increase in zircon price from 2000 to 2010 of around 12% CAGR was largely due to the rapid urbanisation in China driving demand for ceramics, and hence zircon. There was a minor blip during the GFC, largely due to non-Chinese factors.

Until 2010 price increases in the titanium dioxide products tended to follow annual GDP growth of around 3%.





## **Board and Management**

---

### *Executive Chairman*

#### **Will Burbury**

**Will Burbury** practised as a corporate lawyer with a leading Australian law firm prior to entering the mining and exploration industry in 2003. During his career, he has been actively involved in the identification and financing of many Australian and African resources projects. He has held senior management positions and served on the boards of several private and publicly listed companies. Mr Burbury was previously Chairman of Warwick Resources Limited prior to its merger with Atlas Iron Limited in 2009. He was also formerly a director of Lonrho Mining Limited (ASX: LOM) and an executive of Nkwe Platinum Ltd (ASX: NKP).

### *Managing Director*

#### **Bruce McQuitty**

**Bruce McQuitty** has 30 years' experience in the mining and civil construction industries and was previously Managing Director of Warwick Resources Limited prior to its merger with Atlas Iron Limited in 2009. Prior to that he held senior positions with Consolidated Minerals Limited, Renison Goldfields Consolidated Limited and Gympie Gold Limited. Mr McQuitty has significant technical expertise in exploration, project generation, feasibility, underground mining and engineering geology and has managed exploration teams in Australia and overseas. Mr McQuitty holds a Masters of Economic Geology and a Bachelor of Science.

### *Technical Director*

#### **David Archer**

**David Archer** is a geologist with 24 years' experience in exploration and mining in Australia. He has held senior positions with major Australian mining companies, including Renison Goldfields Consolidated Limited, and has spent the last ten years as a director of Archer Geological Consulting specialising in project generation, geological mapping and project evaluation. Mr Archer was a consultant to Atlas Iron Limited (ASX: AGO) and Warwick Resources Limited and was responsible for significant iron ore discoveries for both companies in the Pilbara. He was also involved in the discovery of the Magellan lead mine and the Raleigh and Paradigm gold mines.

### *Exploration Manager*

#### **David Boyd**

Prior to joining Sheffield Resources in December 2010, **David Boyd** was General Manager of Geology at Consolidated Minerals where he managed exploration and resource development across that company's manganese, chromite and iron ore projects. David has a first class honours geology degree from University of Western Australia and his 20 year career includes senior positions with leading mining houses such as RGC/Goldfields, Placer Dome and Barrick.

### *Project Development Manager*

#### **Mark Teakle**

**Mark Teakle** is a geologist with extensive experience in the mineral sands sector. During his 32 year career, Mark has held senior management positions with Aberfoyle Resources Ltd and Australian Zircon NL and was Executive Director at Mineral Sands Ltd (now Corvette Resources Ltd). Mr Teakle has been involved in the discovery and economic evaluation of mineral sands deposits in the Murray and Eucla Basins. Mark has provided consulting services to Sheffield since the Company's ASX listing.

### *Sustainability Manager*

#### **Wayne Groeneveld**

**Wayne Groeneveld** has over 30 years' experience in the mining industry, including senior positions with RGC Ltd, Pancontinental Mining Ltd, Goldfields Ltd, Placer Dome Australia Ltd and St Barbara Ltd. Most recently, Mr Groeneveld was General Manager – Sustainable Development at Xstrata Nickel where his portfolio covered a number of areas including permitting, environmental management, corporate and community relations. During his time with RGC Ltd (the forebear of Iluka Resources), Mr Groeneveld successfully negotiated land access agreements with landholders for a number of mineral sands operations, and has also built lasting relationships with Native Title claimants in the Goldfields region of Western Australia.



### **Analyst Verification**

We, Grant Craighead and Mark Gordon, as the Research Analysts, hereby certify that the views expressed in this research accurately reflect our personal views about the subject securities or issuers and no part of analyst compensation is directly or indirectly related to the inclusion of specific recommendations or views in this research.

### **Disclosure**

Breakaway Investment Group (AFSL 290093) may receive corporate advisory fees, consultancy fees and commissions on sale and purchase of the shares of Sheffield Resources and may hold direct and indirect shares in the company. It has also received a commission on the preparation of this research note.

### **Disclaimer**

Any observations, conclusions, deductions, or estimates of figures that have been made by Breakaway Research and the Breakaway Investment Group in this report should not be relied upon for investment purposes and the reader should make his or her own investigations. This publication has been issued on the basis that it is only for the information and exclusive use of the particular person to whom it is provided. Any recommendations contained herein are based on a consideration of the securities alone. In preparing such general advice no account was taken of the investment objectives, financial situation and particular needs of a particular person. Before making an investment decision on the basis of this advice, investors and prospective investors need to consider, with or without the assistance of a securities adviser, whether the advice is appropriate in light of the particular investment needs, objectives and financial circumstances of the investor or the prospective investor. Although the information contained in this publication has been obtained from sources considered and believed to be both reliable and accurate, no responsibility is accepted for any opinion expressed or for any error or omission that may have occurred therein.

#### **Breakaway Investment Group**

AFSL 290093 ABN 84127962387

T+61293928010

F+61292792727

PO Box H116 Australia Square

Sydney, NSW 2001

Suite 505, 35 Lime Street,

Sydney, NSW 2000