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RESEARCH

INDEPENDENT INVESTMENT RESEARCH

Sheffield Resources Limited (ASX: SFX)

October 2018

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Note: This report is based on information provided by the company as at October 12, 2018

Investment Profile	
Share Price - October 12 2018	A\$1.09
12 Month L/H	A\$0.58/ A\$1.275
Base Case Per Share Valuation	A\$1.75
Issued Capital:	
Ordinary Shares	230.1 m
Unlisted Options	12.3 m
In The Money Options	10.7 m
Performance Rights	2.0 m
Diluted for in Money Options	240.8 m
Fully Diluted	244.4m
Market Capitalisation UD	A\$250.8 m
Cash June 30, 2018	A\$23.08 m
Cash on Option Conversion	A\$3.90 m

Board and Management	
Mr Will Burbury: Non-Executive Chairman	
Mr Bruce McFadzean: Managing Director	
Mr David Archer: Technical Director	
Mr Bruce McQuitty: Non-Executive Director	
Mr Stuart Pether: Chief Operating Officer	
Mr Mark Di Silvio: CFO/Company Secretary	
Mr Jim Netterfield: Project Manager	
Mr Neil Patten-Williams: Marketing Manager	

Major Shareholders	
Mr. W Yovich & Mrs J Yovich/ Mr. W Yovich (in two holdings)	10%
BlackRock Group	6%
Top 20	51%
Board and Management	12%



Senior Analyst – Mark Gordon

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THUNDERBIRDS ARE GO

Sheffield Resources (“Sheffield” or “the Company”), an ASX listed heavy mineral sands (“HMS”) developer, is now set to develop its Tier 1 Thunderbird Project (“Thunderbird” or “the Project”), located in the Dampier Peninsula of Western Australia, with first production from commissioning expected in late 2020, following a near two year construction period.

The Company has finalised all key permitting and financing aspects subsequent to our April 2017 note, with the final steps being the recent granting of the Mining Lease and Federal Government Environmental Approval - these follow on from the signing of a Coexistence Agreement with the Traditional Owners. Sheffield has already commenced preliminary site works, including upgrading of the access road and acquisition of an accommodation village.

Importantly, binding offtake agreements are in place for ~77% of the expected revenue of the four year Stage 1 output; this includes 100% of zircon products and 50% of the LTR ilmenite. Debt funding facilities totalling ~A\$340 million on reasonable terms are now largely in place (subject to pre-conditions being met); this includes US\$175 million of underwritten senior debt with Taurus Mining Finance (“Taurus”), and A\$95 million of long term concessional finance with the Commonwealth Government’s Northern Australia Infrastructure Fund (“NAIF”), with both including two tranches, and with the latter requiring approval from the Western Australian Government.

The Company has also continued work on the regional Dampier HMS Project, with strong results from the Night Train prospect near Thunderbird and 2017 drilling at Eneabba leading to a Resource expansion; Sheffield has also increased the portfolio of mineral sands properties.

Consistent with the focus on mineral sands, in late 2017 Sheffield successfully spun out its base and precious metals assets into Carawine Resources (ASX: CWX, “Carawine”), which raised A\$7 million through the issue of 35 million new shares at A\$0.20/share (now trading at A\$0.23/share); the IPO included the in-specie distribution of 20 million Carawine shares to Sheffield shareholders at a ratio of ~one CWX share for each 11.4 Sheffield shares held.

KEY POINTS

Robust, world class project: The 2017 BFS for Thunderbird highlights a project that will give excellent returns to shareholders over the projected 42 years of operation with the Project also expected to deliver a consistent supply of zircon and titanium products over the life of mine - there is also considerable scope for growing production both through expansions of the Thunderbird Resource and new discoveries/Resources - the latter includes the nearby Night Train discovery that has returned excellent drill results to date.

Excellent financial metrics: The estimated up-front Stage 1 capital cost of \$348 million is attractive when compared to the post-tax NPV₈ of A\$620 million as estimated in the 2017 BFS, with the Project over the first 10 years providing a revenue to costs ratio of around 2:1 – this is in the 2nd quartile of global mineral sands producers, making Thunderbird a globally competitive operation.

Improving HMS markets: Recent price increases and forecasts point towards continuing improving mineral sands markets since their nadir in 2016, with Sheffield ideally placed to take advantage of this - the Project’s value is strongly leveraged to mineral sands prices, with further price increases since completion of the BFS confirming the upside.

Strategic Asset: With expected shortages in supply for zircon in coming years, partly due to disruptions at Rio’s Richards Bay operations in South Africa (which historically has been one of the single largest producers of zircon globally), Thunderbird, by virtue of the expected consistent long life operation and location in a low sovereign risk jurisdiction with ready access to transport infrastructure, can be considered as a valuable and strategic asset.

Takeover or Acquisition Target? Our view is, by virtue of the fully permitted and strategic nature of Thunderbird, location in a stable jurisdiction, and the current deep discount in the value of Sheffield to the expected value of Thunderbird, that the Company or the Project make an attractive takeover or acquisition opportunity.

Valuation: We have a current base case value of A\$1.75/share for Sheffield, with the majority of this ascribed to our risked NPV₈ valuation of Thunderbird. Our per share valuation is based on a share structure diluted for equity raised for the development of Thunderbird.

HMS product pricing is that as used in the 2017 BFS, however we have seen significant price increases since that time and hence there is good upside in this value to ~A\$2.00/share using increased prices - there is also upside in the valuation with progress in the development of Thunderbird.

SWOT ANALYSIS

Strengths

- ◆ **Permitted and funded:** This is key, as the project has now been “packaged up,” with permitting, offtake and debt facilities largely in place; our modelling indicates that any equity funding required should not be too onerous or dilutive given the current market capitalisation.
- ◆ **Very attractive economics:** The results of the BFS have resulted in very attractive and robust economics for Thunderbird, including the NPV/capex ratio, revenue/cost ratio and providing a long life, cash generating operation that will comfortably absorb adverse movements in key inputs.
- ◆ **Quality products:** Metallurgical test work has demonstrated that the Project has the capability to produce highly marketable products over most of the range of commodities to be produced.
- ◆ **Proven mining destination with low sovereign risk:** Western Australia is a proven mining destination and host to a number of world class deposits, with well developed mining legislation.
- ◆ **Experienced people with skin in the game:** Company personnel have significant experience in the resources game as well as significant shareholdings.
- ◆ **Quality register:** With institutions such as BlackRock, Sprott and Colonial First State on the register, the Company is well supported.

Weaknesses

- ◆ **Reliance on trucked LNG:** The area is not served by the electricity grid or a gas pipeline, hence gas needs to be liquefied, and trucked over 900km to site for regasification - this makes power relatively expensive, however it is the same system as used by the towns of Derby and Broome. The Company is looking at lowering operating costs through plans to change this from a third party Build-Own-Operate (“BOO”) operation to an owner built and operated facility by virtue of the long term debt to be provided by the NAIF.

Opportunities

- ◆ **Forecast price increases:** A key opportunity is to take advantage of forecast increasing HMS prices – it appears that we may have seen the worst in the market and Sheffield’s timing will be ideal to take benefit from a projected supply deficit in a number of VHM products.
- ◆ **Resource expansion:** Exploration work in the broader Dampier HMS Project area surrounding Thunderbird has discovered new high grade mineralisation, highlighting resource expansion possibilities.
- ◆ **Other project development:** In addition to Thunderbird Sheffield has the earlier stage Eneabba and McCalls projects, which both have the potential to be developed into large scale operations.

Threats

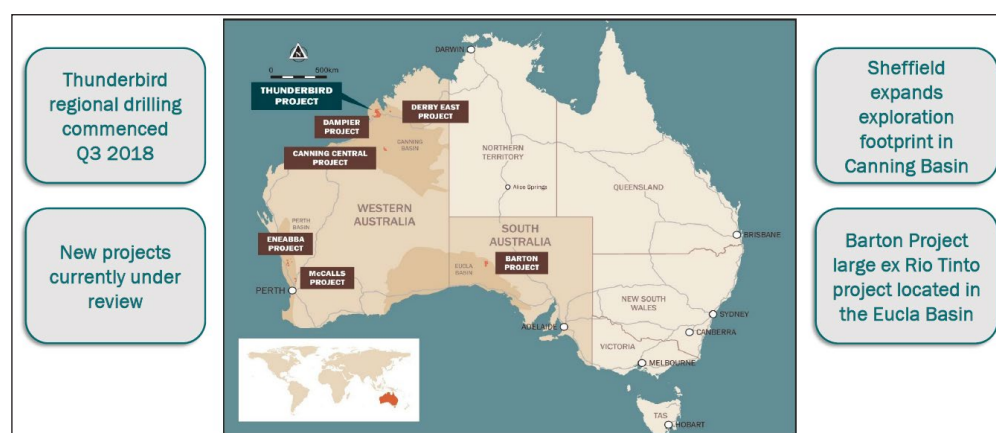
- ◆ **Prices and exchange rates:** These are threats facing any mining company, however the robust nature of Thunderbird somewhat shields it from these – the project is still viable when current spot prices are used in modelling.
- ◆ **Costs:** Again a factor to consider when assessing a resources company, however as for prices the robustness of Thunderbird largely shields it against adverse movements in costs – one key part here may be energy prices, with these making up some 35% of the total operating costs, and with gas having to be delivered to site for electricity production and use in the low temperature roaster (“LTR”).

OVERVIEW

STRATEGY AND PROJECT OVERVIEW

- ◆ The overall strategy is to grow the Company into a significant mineral sands producer, however the Company would consider other options that would return the significant value inherent in key projects to shareholders.
- ◆ Activities are largely concentrated on their Thunderbird HMS Project, a Sheffield discovery, located in the broader Dampier HMS Project in the Canning Basin of WA, with the Company also holding a number of other HMS projects as shown in Figure 1 which are possible future development opportunities.
- ◆ With permitting, offtake and financing now largely in place the Company is looking to commence development of Thunderbird, with the potential for first production in late CY2020.
- ◆ In line with the strategy to concentrate on mineral sands and return value to shareholders, the Company spun out non-core, non-mineral sands assets into Carawine Resources in late 2017; this also allows these other assets to get the attention that they deserve.

Figure 1: Project location map



Source: Sheffield

FINANCIAL POSITION

- ◆ As of June 30, 2018 the Company had A\$23.080 million in cash and no debt.
- ◆ Over the twelve months to June 30, 2018, the Company raised A\$32 million through two issues; a A\$30 million placement to sophisticated and professional investors, with the issue of 42.9 million shares at A\$0.70/share, and an SPP to existing shareholders to raise a further A\$2 million at the same price.
- ◆ Both the placement and SPP were heavily oversubscribed.
- ◆ Over the same period the Company spent \$9.898 million on exploration and development activities, and \$5.450 million on staff and administration costs.

RECENT ACTIVITIES

- ◆ Activities subsequent to our April, 2017 note have largely concentrated on offtake, financing permitting and project execution, with some exploration work also being completed at Eneabba, and over Thunderbird regional targets.

OFFTAKE AGREEMENTS

- ◆ The Company has successfully signed binding agreements for ~77% of the value of the planned Stage 1 production; this includes all of the zircon production and 50% of the LTR ilmenite, with negotiations ongoing for HiTi-88 and titanomagnetite - the latter two make up only an estimated 9% of total revenue.
- ◆ Premium zircon pricing under all agreements will be based on the prevailing USD\$ price, negotiated on a quarterly basis; those for zircon concentrate will include adjustments for the ZrO₂, TiO₂ and TREO contents of the concentrates.
- ◆ Take or pay provisions are also included for the minimum contracted volumes under the various agreements, and CIF terms have been agreed.

Table 1: Offtake summary

Offtake summary		
Product (% of BFS Revenue)	Binding Agreement (% of Stage 1 output)	Offtake Parties
Premium Zircon (42%)	100%	Sukaso, Ruby Ceramics, RZI, Qingyuan Jinsheng, Minchem, CFM. Others
Zircon Concentrate (19%)	100%	Hainan Wensheng, RZI
LTR Ilmenite	50%	Bengbu
HiTi-88 (5%)	In Progress	
Titano-magnetite	In Progress	

Source: Sheffield

DEBT FUNDING

- ◆ Sheffield has secured, or is close to securing US\$175 and A\$95 million of debt funding, with Taurus and the NAIF.
- ◆ Due diligence and final documentation is well advanced for the Taurus facilities, with non-binding term sheets agreed for the NAIF facilities; as the State of Western Australia will be the lender in the case of the NAIF funding the provision of funds will also be contingent upon approval by the State.

Table 2: Debt facilities summary

Debt facilities summary		
Facility	Amount	Details
Taurus Tranche 1	US\$75 m	Interest - US Libor + 4.5% Interest only 3.5 years Repayable - years 3.5 - 7 The Taurus facility includes a revenue royalty of 0.5% during Stage 1, and 0.75% from years 5 to 22.54
Taurus Tranche 2	US\$100 m	Interest - 8.5% Interest only 3.5 years Bullet payment year 7
NAIF Project Development	A\$30 m	Interest and fees - Customary for a facility of this nature Term - 15 years Interest only years 1 to 8 Straight line amortisation years 9 to 15 Additional cash sweep in certain circumstances
NAIF Infrastructure Development	A\$65 m	Interest and fees - Customary for a facility of this nature Term - 20 years Scheduled principal repayments after the earlier of satisfaction of the conditions precedent and the date that is 12 months after the date of Project Completion Additional cash sweep in certain circumstances

Source: Sheffield

- ◆ Part of the NAIF facilities will allow Sheffield to construct its own accommodation village and power generation facilities on site, for which the Company initially looked at outsourcing construction and operation on a Build-Own-Operate ("BOO") basis or similar; ownership, whilst not reducing up-front capex, will decrease operating costs with the removal of BOO recovery charges.
- ◆ As part of this the Company has already secured a 328 person village that is currently located close to Thunderbird.

PERMITTING

- ◆ Sheffield has now acquired all necessary permits required for development, including:
 - Both the State and Federal environmental approvals,
 - Granting of the Mining Lease and Miscellaneous Licences; and,
 - Signing of a Coexistence Agreement ("the "Agreement") with the Traditional Owner Negotiation Committee ("TONC") that represents the Mount Jowlaenga Polygon #2 Claimant Group.

- ◆ Part of the latter has included the provision of a royalty to be paid to the Traditional Owners (“TO”) - this is confidential however in our valuation we have used our estimate of 1%; the Company also has in place a policy of comprehensive engagement (including employment opportunities) with local communities.

PROJECT IMPLEMENTATION

- ◆ Sheffield is well advanced in the early stages of project implementation, with advances subsequent to our April 2017 note including:
 - Appointment of GR Engineering Services (ASX: GRE, “GRE”) as lead Engineering, Procurement and Construction (“EPC”) contractor,
 - Early stage site works, including access road upgrade; and,
 - The acquisition of a 328 person accommodation village in late 2017; this is located reasonably close to Thunderbird.

EXPLORATION

- ◆ Exploration activities undertaken include aircore drilling at the Robs Cross and Johnsons deposits at Eneabba, with this resulting in initial MRE’s for these deposits, and thus an overall increase in Eneabba Resources; and,
- ◆ A drilling programme over a number of targets in the regional Dampier HMS Project surrounding Thunderbird has resulted in strong results from Night Train, highlighting the potential of this high grade discovery, with more news flow from this drilling expected in the short term.

CARAWINE RESOURCES SPIN-OUT

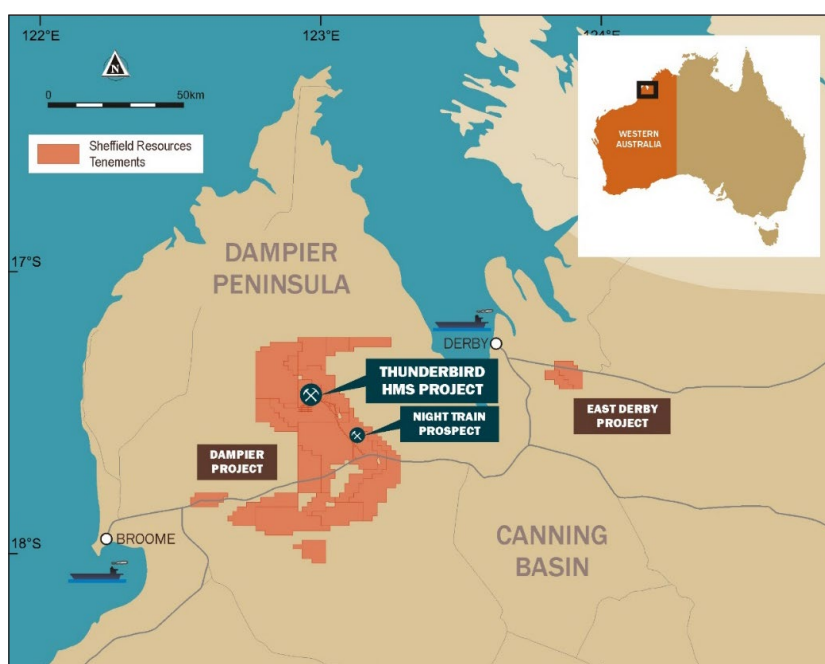
- ◆ In late 2017 the Company spun-out its non-HMS assets into Carawine Resources.
- ◆ This included the raising of A\$7 million through the issue of 35 million shares at A\$0.20/ share, and the in-specie of 20 million vendor shares to existing Sheffield shareholders on the basis of one Carawine share for every 11.4 Sheffield share held.
- ◆ At the time of writing Carawine is trading at A\$0.235/share.

THUNDERBIRD HMS PROJECT - SFX 100%

LOCATION AND TENURE

- ◆ Thunderbird is part of the Dampier HMS Project which includes one granted Mining Lease (“ML” 4,525ha), five granted Miscellaneous Licences (1,781ha) ten granted Exploration Licences (“EL” 2,440km²) and four EL applications (“ELA” 680km²), held 100% by Sheffield through Thunderbird Operations Pty Ltd; all granted tenements are in good standing.

Figure 2: Thunderbird tenement and resource map



Source: Sheffield

- ◆ The Project is located on the Dampier Peninsula, midway between the regional towns of Broome and Derby, accessible from the Great Northern Highway via a 30km access road that meets the highway halfway between both towns – the Project is located approximately 140km by road from either town.

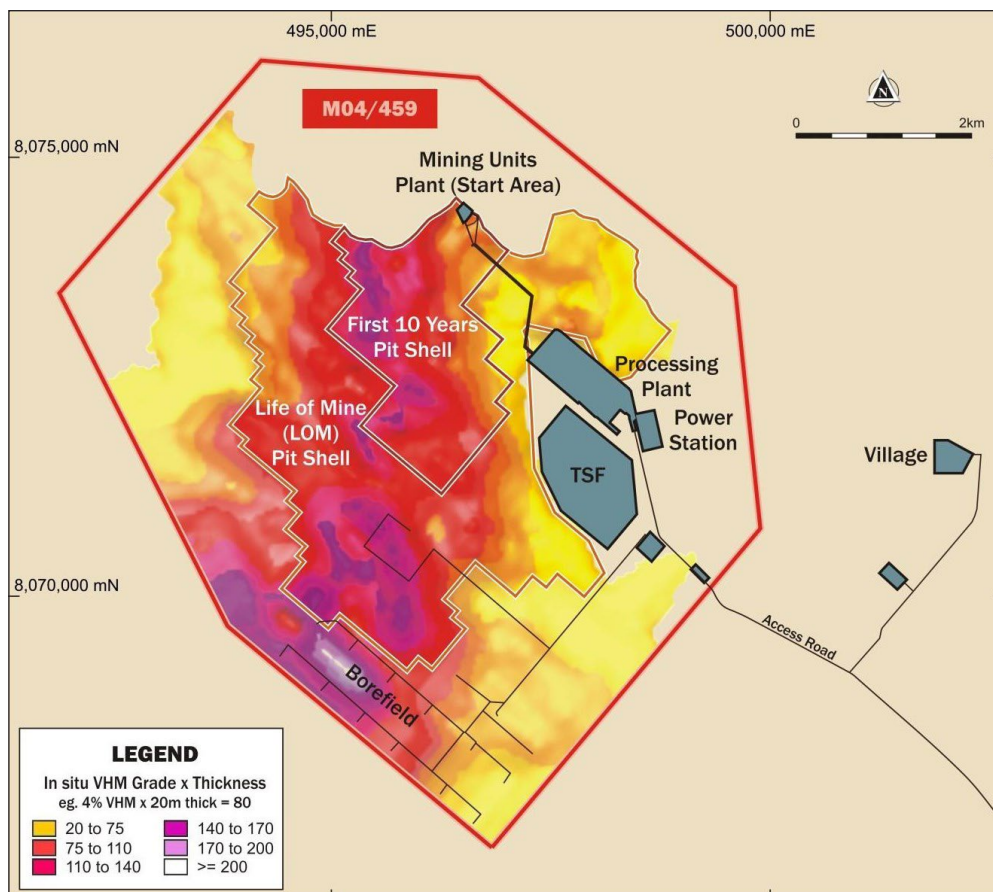
PROJECT HISTORY

- ◆ After applying for the EL over what is now the Thunderbird Project in 2010, the EL, E04/2083 was granted on September 7, 2011.
- ◆ Following the discovery of Thunderbird, Initial and follow up drilling was used in the initial Mineral Resource Estimate (“MRE”), which was announced on December 18, 2012 – ongoing drilling has continued to increase both the size and confidence in the resource with this now standing at 3.23Bt @ 6.9% HM.
- ◆ Sheffield completed a Scoping Study in early 2014, which envisaged a 20.8Mtpa, 32 year operation, with an up front capital cost of \$294 million.
- ◆ This led into a Pre-Feasibility Study (“PFS”), as released to the market in May 2015, and which resulted in a capital cost of \$367 million – this was updated in October 2015, with the updated study delivering significantly reduced capital costs of \$271.3 million, for a 40 year life staged operation, initially mining at 12mtpa and then increasing to 18mtpa.
- ◆ Subsequent work has been incorporated into the BFS, released in March 2017 and discussed later in this report.

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 HMS mineralisation largely occurs in a unit referred to as the Broome Sandstone, characterised by brown/orange loose sands up to 90m thick (these are generally free digging, but with some minor ripping required in the near surface material) – not all of the Broome Sandstone is mineralised however, with the mineralised part being locally referred to as the Thunderbird Formation.
- ◆ 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 the NW/SE strike (Figure 3).

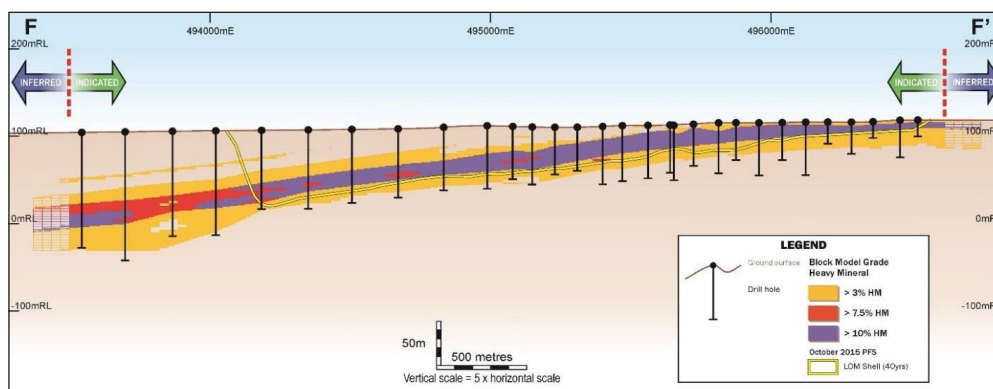
Figure 3: Thunderbird plan showing grade x thickness and proposed site layout



Source: Sheffield

- ◆ Structurally the basin units form a broad NW striking anticline, with stratigraphy being folded from flat to a very gentle 4° dip to the SW
- ◆ 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, 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 along strike and down dip.
- ◆ The dominant valuable heavy minerals include ilmenite (FeTiO_3), zircon (ZrSiO_4), leucosene (a weathering product of ilmenite, with higher but variable TiO_2 grades), rutile (TiO_2) and anatase (TiO_2).

Figure 4: Typical SW-NE cross section, Thunderbird



Source: Sheffield

RESOURCES AND RESERVES

- ◆ The most recent MRE was released to the market on July 5, 2016, with this presented in Table 3.
- ◆ This is shown at two cut-off grades – 3% total HM and 7.5% total HM, and provides two estimations – a global resource of 3,23Mt @ 6.9% HM and a high grade resource of 1.05Mt @ 12.2% HM.

Table 3: Thunderbird Mineral Resource Estimate

Thunderbird Mineral Resource Estimate										
Cut-off (HM%)	Category	Resource Tonnes (Mt)	In situ HMS (Mt)	HM (%)	Zircon (%)	HiTi Leuc (%)	Leuc (%)	Ilmenite (%)	Slimes (%)	Osize (%)
> 3%	Measured	510	45	8.9	0.71	0.2	0.19	2.4	18	12
	Indicated	2,120	140	6.6	0.55	0.18	0.2	1.8	16	9
	Inferred	600	38	6.3	0.53	0.17	0.2	1.7	15	8
	Total	3,230	223	6.9	0.57	0.18	0.2	1.9	16	9
>7.5%	Measured	220	32	14.5	1.07	0.31	0.27	3.9	16	15
	Indicated	640	76	11.8	0.9	0.28	0.25	3.3	14	11
	Inferred	180	20	10.8	0.87	0.27	0.26	3	13	9
	Total	1,050	127	12.2	0.93	0.28	0.26	3.3	15	11

Source: Sheffield

- ◆ The most recent Ore Reserve update was released to the market on March 16, 2017, with this completed as part of the BFS (Table 4).
- ◆ At 680.5Mt, including 35% in the Proved category, the Reserves are sufficient to carry the planned 42 year long life operation.
- ◆ In the BFS release, the Company has stated that the Reserves were calculated using a low value pit shell – the pit shell for the first 10 years of the proposed operation was based on product prices in the range of 50-55% of the weighted average of 2017 spot prices; that for the LoM is based on a range of 70-75% of the weighted average of 2017 spot prices.
- ◆ This is a conservative approach, and should prices increase and these be maintained there is the potential to significantly increase Reserves.

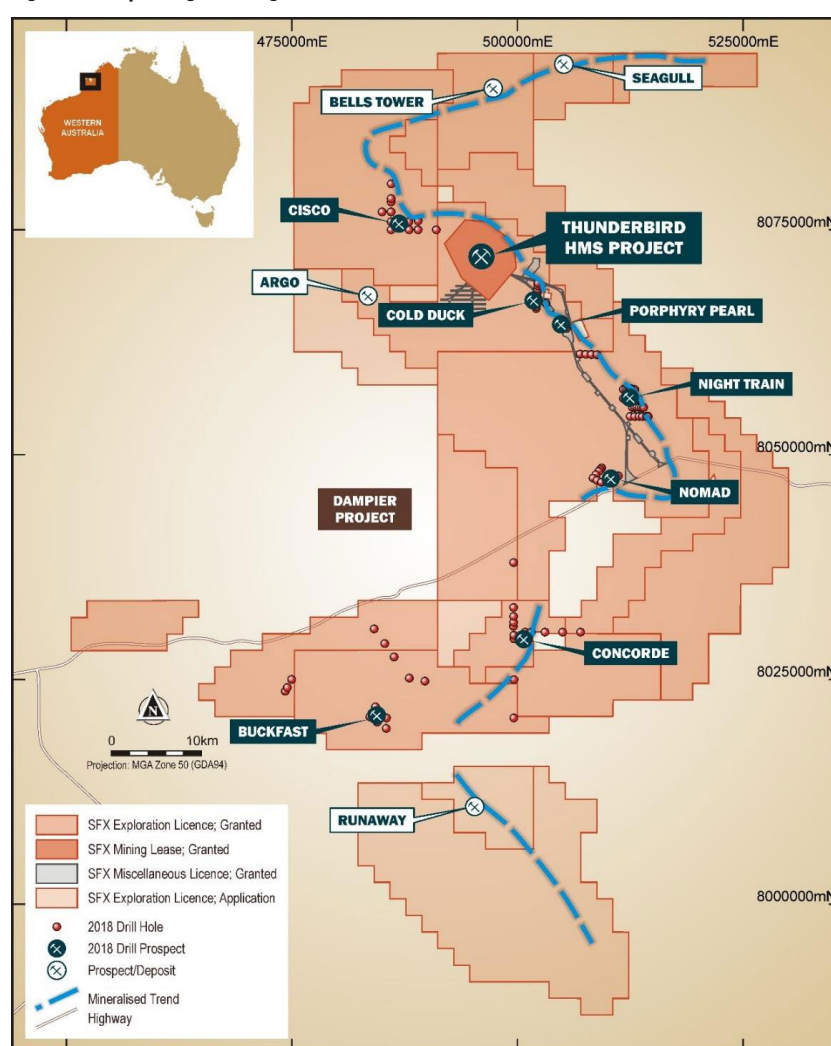
Table 4: Thunderbird Ore Reserves

Thunderbird Ore Reserves									
Category	Resource Tonnes (Mt)	Insitu HMS (Mt)	HM Grade (%)	Zircon (%)	HiTi Leuc (%)	Leuc (%)	Ilmenite (%)	Slimes (%)	Osize (%)
Proved	235.8	31.4	13.3	1	0.29	0.26	3.55	16.5	13.7
Probable	444.8	45.4	10.2	0.8	0.26	0.26	2.85	15.2	11
Total	680.5	76.8	11.3	0.87	0.27	0.26	3.1	15.7	12

Source: Sheffield

EXPLORATION POTENTIAL

- ◆ Work by Sheffield has highlighted the potential for the discovery of additional resources in the broader Dampier Project area.
- ◆ This includes the discovery of the Night Train deposit, located some 20km SE of Thunderbird, and within 2km of the planned site access road – the location is shown in Figure 5, a drilling plan in Figure 6 and a section in Figure 7.

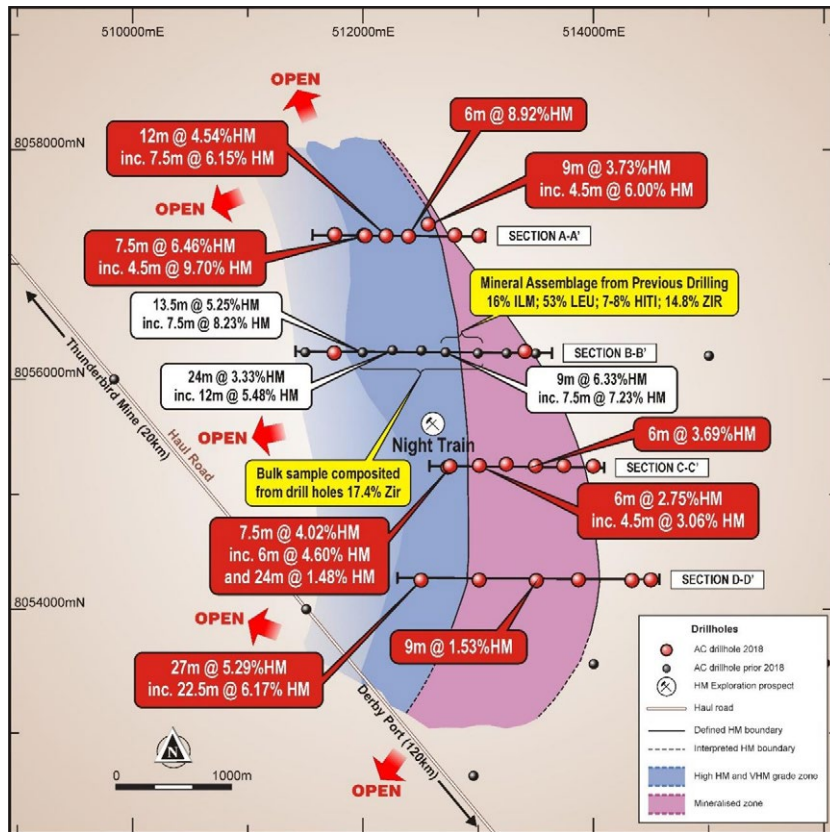
Figure 5: Dampier regional targets

Source: Sheffield

- ◆ First pass drilling resulted in some very positive results, with this highlighting thicknesses varying from 4m to 24m (average 11m), with a high value mineral assemblage – overall average grades from this work were 4.04% HM, with 92% of this being VHM, with an assemblage of 15% zircon, 53% leucoxene, 8% HiTi leucoxene and 16% ilmenite.
- ◆ Recently completed follow up drilling has reinforced the quality of the prospect, with selected results shown in Figures 6 and 7 - these include 27m @ 5.29% HM (including 22.5m @ 6.17% HMS) from 49.5m in hole DAAC114.
- ◆ Mineralisation, which has been defined for a strike length of 4.5 km and a width of 1.5 km is open to the north and south and down dip to the west.

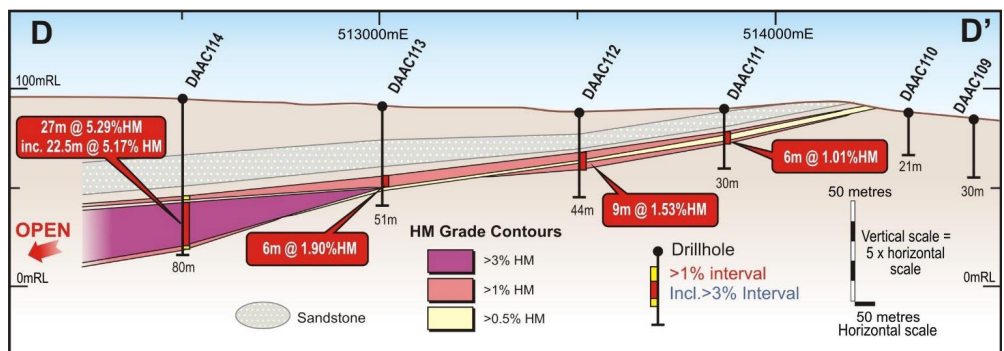
- ◆ This includes a coherent zone of high grade mineralisation (using a 3% HM cut-off) up to 25m thick (average 7.5m) covering an area of 4.5 km², and still open along strike and down dip, and also thickens down dip to the south/southwest.
- ◆ An initial appraisal of the samples from this latest drilling indicate a mineral assemblage consistent with that from the first phase - mineral assemblage test work will now be undertaken, with the results to be used in an initial MRE, scheduled for completion in 1Q19.
- ◆ Preliminary metallurgical test work undertaken on a 100kg drill sample composite in 2016 showed that high quality zircon that meets ceramic specifications can be produced.

Figure 6: Dampier regional targets



Source: Sheffield

Figure 7: Night Train Section D-D', looking north



Source: Sheffield

BANKABLE FEASIBILITY STUDY

- ◆ Sheffield has completed a BFS which was released to the market on March 24, 2017 – key financial metrics are provided in Table 5.
- ◆ The BFS has not been updated, however some changes over the 18 months since it was completed may affect inputs and results:
 - Recent months have seen higher than forecast rises in product prices, as well as the Australian Dollar falling against the US Dollar which, if it continues, will have a positive affect on revenue; and,

- By virtue of the loan with the NAIF, there will be some changes with regards to the development of some infrastructure, including the power generation and camp facilities - as mentioned earlier the Company will fund construction of these facilities rather than through a BOO model (the accommodation village has already been purchased) - this may increase upfront capex however should decrease operating costs (to which the Project is sensitive) through removal of the capital recovery charges.
- ◆ The BFS envisages an initial four year operation ramping up to a ~8.5Mtpa mining rate, then expanding to ~17Mtpa in the fifth year of operation, with this rate then continuing for the full proposed 42 year mine life – life of mine production is shown in Table 6.
- ◆ The study, which used prices as forecast by respected consulting group TZ Minerals International (“TZMI”), returned a pre-tax NPV₁₀ of A\$676 million (with an IRR of 24.9%), for an initial capital outlay of A\$348 million – this gives a robust NPV/capex ratio of 1.94.
- ◆ Using early 2017 spot prices the Project still returned a healthy NPV₁₀ of \$346, highlighting the robustness of the Project.
- ◆ We have used the Company’s inputs in our valuation of Thunderbird as detailed later.

Table 5: Financial results and metrics, Thunderbird 2016 BFS

Financial results and metrics, Thunderbird 2017 BFS			
\$Am, Real 2017 Prices	Financial Year 2019 – 2023	Financial Year 2024 – 2033	LOM 2018 - 2061
Revenue	854	3,875	13,560
Royalties	-50	-223	-781
Net Revenue	803	3,652	12,779
Opex: Mining	-104	-421	-1,828
Opex: Processing	-228	-1,024	-4,093
Opex: Logistics	-73	-288	-1,005
Opex: Site G&A	-59	-172	-707
Total Opex	-464	-1,905	-7,633
EBITDA	339	1,746	5,146
Ore Mined (Mt)	32	171	670
A\$ Site costs / tonne ore mined	14.65	11.11	11.40
A\$ Revenue / tonne ore mined	25.99	22.29	19.92
US\$ Site costs / tonne Premium Zircon equivalent	721	692	790
US\$ Revenue / tonne Premium Zircon equivalent	1,278	1,387	1,381
	Stage 1	Stage 2	LOM8
Capital Expenditure (\$Am)	348	195	543
Pre-Tax Project NPV (10% WACC)			675.6
Pre-Tax IRR %			24.9
Post-Tax Project NPV (8% WACC)			620.4
Post-Tax IRR %			20.6

Source: Sheffield

Table 6: Forecast production and commodity prices

Forecast production and commodity prices				
Production (Average tonnes per annum)	Financial Year 2019 – 2023	Financial Year 2024 – 2033	LOM 2018 - 2061	
Premium Zircon	51,500	88,700	76,100	
Zircon Concentrate	49,100	80,100	68,500	
LTR Ilmenite	264,500	481,600	387,800	
HiTi88	12,800	23,000	20,300	
Titano-magnetite	156,600	285,300	229,800	
Commodity Prices (US\$/tonne)	Financial Year 2019 – 20235	Financial Year 2024 – 2033	LOM 2018 - 2061	Early 2017 Spot Prices
Premium Zircon	1,282	1,387	1,381	1,050
Zircon Concentrate	659	677	676	580
LTR Ilmenite	183	183	183	180
HiTi88	500	500	500	400
Titano-magnetite	48	48	48	58

Source: Sheffield

- ◆ The Stage 1 capital cost breakdown, which was undertaken in-house is presented in Table 7 below - it is expected that the Stage 2 capex of \$195 million may be largely funded out of cash flow.
- ◆ Our view, in comparisons with the estimated capital cost of other mineral sands projects, is that the estimate is reasonable.

Table 7: Capital cost estimate, Thunderbird 2017 BFS

Capital cost estimate, Thunderbird 2017 BFS		
Description	US\$M	A\$M
Direct Costs		
Plant Area Concrete, Civils & Buildings, Process Water Systems	19	25.3
Wet Concentrator Plant (WCP)	43.5	58
Concentrate Upgrade Plant (CUP)	25.7	34.3
Zircon Processing Plant	59.2	78.9
Ilmenite Processing Plant	22.7	30.2
Low Temperature Roast (LTR)	32.6	43.4
Sub-Total	202.6	270.1
Non-Processing Infrastructure (NPI) Costs		
Site Preparation & Materials, Roads & Access	5	6.7
Tailings Dams, HV Distribution, Bore field Infrastructure	12	16
Derby Port Facilities	5	6.6
Sub-Total	22	29.3
Owners Costs		
Labour & Operational Readiness	6.7	8.9
Trial Pit, Mining Services, Mobilisation and Infrastructure	4.6	6.1
Accommodation Village Services and Infrastructure	3.9	5.2
Systems, Insurances, Administration & Services	3.2	4.2
Sub-Total	18.3	24.4
Contingency	18.1	24.2
TOTAL CAPITAL COST	260.9	347.9

Source: Sheffield

- ◆ Operating costs for the first 10 years and life of mine are presented in Table 8 – as for capital costs, when compared with other mineral sands operations these appear reasonable.

Table 8: Estimated operating costs, Thunderbird 2017 BFS

Estimated operating costs, Thunderbird 2017 BFS				
	Years 1-10	LOM	Years 1-10	LOM
	\$US/tonne of ore	\$US/tonne of ore	\$A/tonne of ore	\$A/tonne of ore
Mining	1.78	2.01	2.37	2.69
Processing	4.56	4.51	6.08	6.01
Product Logistics	1.36	1.11	1.82	1.48
Site G&A	0.88	0.78	1.17	1.04
Sustaining Capital	0.16	0.14	0.22	0.18
Total	8.74	8.55	11.65	11.4

Source: Sheffield.

- ◆ Details of the various production phases are given below.

Mining

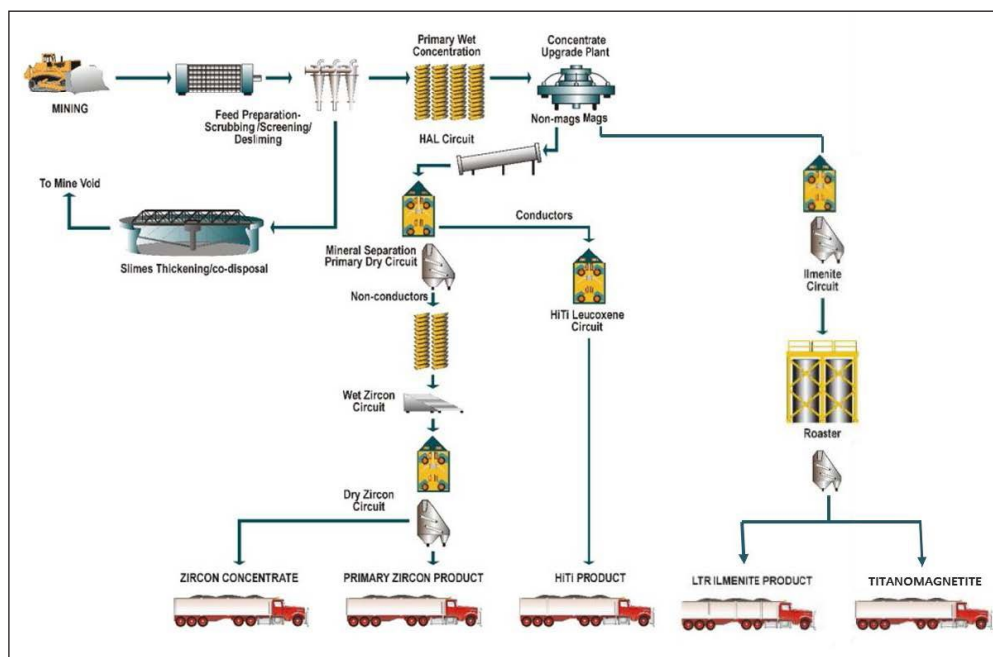
- ◆ Mining, will be largely free dig by industry standard dozer trap dry mining is planned to be contracted out.
- ◆ Soil and overburden will be removed and stockpiled using loaders and 100t off-highway trucks - ~6% of the overburden will require hard ripping.

- ◆ Ore, in the initial phase, will be fed through a dozer trap into a single in-pit mining unit plant ("MUP") – this will be expanded to two units in the second phase of operations, doubling the throughput.
- ◆ The MUP will then feed ore to the wet concentrator plant ("WCP") for the start of the beneficiation process.
- ◆ The pit will reach a maximum depth of up to 76m, with batter angles of 40° where rock layers are present and 34° elsewhere.
- ◆ The LoM stip ratio is 0.68:1.

Metallurgical Processing

- ◆ The proposed process route has been designed to produce high quality products using industry standard processes – this is shown schematically in Figure 8.

Figure 8: Proposed process route



Source: Sheffield

- ◆ This has been based on ongoing metallurgical test work as well as testing a 40 tonne bulk sample using full scale or scalable equipment – this also involved variability test work on three 5 tonne samples from various areas of the deposit, which largely followed the full design flowsheet, with the exception of the gravity separation stage.
- ◆ Material is scrubbed and screened in the MUP, with the -38µm material being disposed of to slimes, and the +2mm being rejected as oversize.
- ◆ The rejected material will be deposited in a tailings storage facility ("TSF") until such time as a suitable mine void is developed for tailings disposal – this is expected to take around 2.5-3 years.
- ◆ Ore material is then conveyed to the WCP and concentrate upgrade plant, which use a combination of gravity (spirals) and magnetic circuits to concentrate and then separate the magnetic (ilmenite) and non-magnetic (zircon, leucoxene) minerals for further processing.
- ◆ Ilmenite is further treated through an LTR plant – this reduces any Fe₂O₃, thus upgrading the product and also producing a product with consistent specifications across a range of feed grades.
- ◆ Following separation from leucoxene, zircon is treated through an attritioning and hot acid leach ("HAL") plant to produce two products – a premium zircon and a zircon concentrate.
- ◆ Recoveries for the various products are as follows:
 - Primary zircon – 56.1% (2.6% higher the PFS).
 - Zircon concentrate – 33.0% - overall zircon recovery of 89.1%.
 - Ilmenite to LTR ilmenite – 71% (1.6% higher than PFS).
 - Leucoxene to HiTi88 – 7.4%.
 - High titanium to HiTi88 – 35.3%.

Product Logistics

- ◆ Products are planned to be trucked to Derby to be loaded onto ships for export largely to Asian markets - a 20 year Derby Port Facility Agreement has now been executed, providing the Company with long term access.
- ◆ It is planned to ship both LTR ilmenite and titano-magnetite in bulk to Derby, where it will be stored in a purpose built shed for shipping – zircon concentrate will also probably be delivered in bulk.
- ◆ Derby has historically been used as a bulk terminal, using both direct loading and transshipment – the Company's activities will require refurbishment of the current ship loader and conveyor, with transshipment using barges to the customers' vessels.
- ◆ Given the relatively small volumes, it is planned to load premium zircon and HiTi-88 into 2,5 tonne "bulka bags" at the processing site, for truck transport to Broome for loading into ships holds in volumes as required by customers.

Infrastructure

- ◆ The location of various infrastructure facilities is shown in Figure 3.
- ◆ The Company was originally looking at supplying the expected 15.5MW of power through a BOO gas fired power station, with expected power costs of \$0.19/kWh - as discussed earlier the Company plans to construct and own this facility.
- ◆ Gas for the power station, as well as for the LTR plant, will be supplied by a "virtual" pipeline from the Pilbara gas supply centre at Karratha – it is expected that the LTR plant will use 45% of the LNG.
- ◆ It is planned to liquefy natural gas at the source, truck 923km to a storage facility on site for gasifying and use in the power plant and LTR facility – this is the same method that is used to supply gas to the Broome (40MW) and Derby (12MW) power stations - the Company also has access to storage facilities in Broome and Derby.
- ◆ Estimated gas requirements are 2,140TJ/annum, with a delivered unit price of \$15/GJ, with storage on site for 10 days use.
- ◆ Operations at the port facilities are expected to be supplied from the existing power infrastructure.
- ◆ The accommodation camp is planned to be located some 8km from the processing plant – this will be able to cater for 300 construction workers and 180 operations personnel; as for the power supply the Company is now planning to build and own this facility.
- ◆ The operation will be largely drive-in/drive-out ("DIDO") from regional towns and localities, with some key personnel on a fly-in/fly-out ("FIFO") roster.
- ◆ Water will be supplied from both mine dewatering and make-up bore fields adjacent to the mining void, however after 32 years it is expected that the dewatering volumes will exceed process water requirements, and thus will need to be injected back into the aquifer.
- ◆ Steady state operation water requirements are ~10.7GL/year, with the water being of good quality and low salinity.

Product Specifications and Marketing

- ◆ Expected product grades are presented in Table 9.

Table 9: Estimated product specifications, Thunderbird 2017 BFS

Estimated product specifications, Thunderbird 2017 BFS					
Item	TiO ₂ (%)	Fe ₂ O ₃ (%)	SiO ₂ (%)	ZrO ₂ (%)	ZrO ₂ +HfO ₂ (%)
Ilmenite	56.1	18.5	0.9	0.1	
Hi-Ti88	87.8	2.9	3.4	3.2	
Premium Zircon	0.14	0.08	32.5		66.3
Zircon Concentrate	20.1	0.9	23.3		43.7
Titano-magnetite	11.4	81.1	7.8		

Source: Sheffield.

- ◆ TZMI have carried out a product and marketing assessment of the potential Thunderbird products, with these largely meeting or exceeding acceptable specifications, and therefore being saleable.
- ◆ This has been supported in the case of the premium zircon with offtake MoU's recently being signed for 40% of proposed production.

- ◆ There are some potential issues with the HiTi88 product, however as this makes up only 4% of expected revenue this is not a critical issue – comments from TZMI are as follows:
 - The TiO₂ content of 87.7% is slightly lower than most product on the market, however chemically is comparable to MZI Resources (ASX: MZI) L88 product that has been accepted by a global chloride TiO₂ producer.
 - The fine average size of 71µm is considered low for western style chlorinators, however could potentially be used as a blending feedstock.
 - The other potential use is in the welding electrode market, although the P₂O₅ content of 0.16% is at the limit of generally acceptable industry specifications, and also this is a relatively small market.

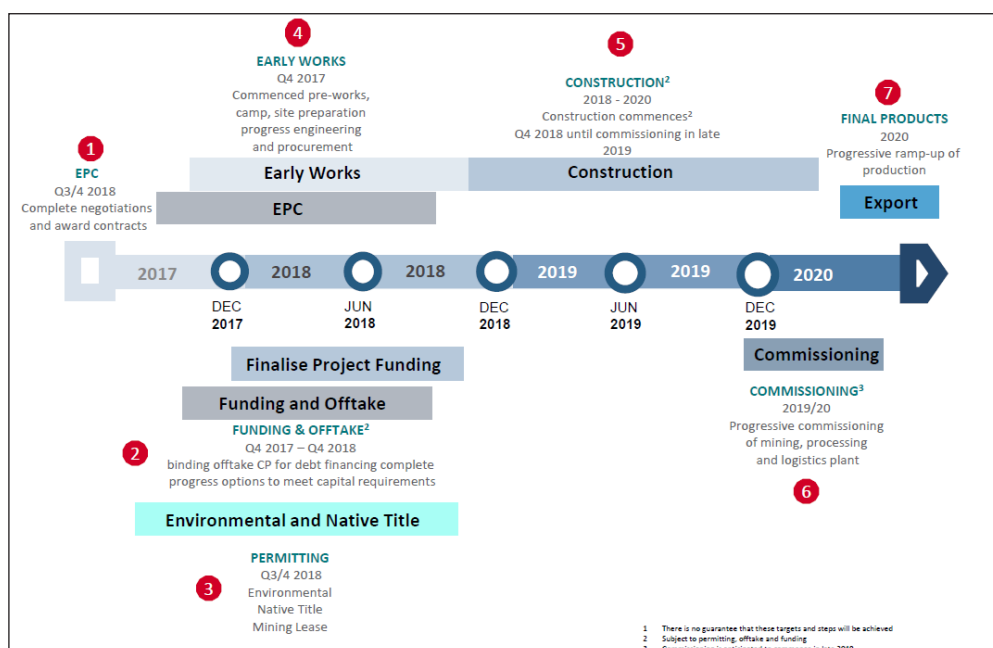
PERMITTING AND STAKEHOLDER ENGAGEMENT

- ◆ The Project is now fully permitted, with the Mining Lease and Miscellaneous Licences now granted, and both State and Federal Environmental Permits granted.
- ◆ The key stage to finalising the Mining Lease was the signing of the Co-existence Agreement (“the “Agreement”) with the Traditional Owner Negotiation Committee (“TONC”) that represented the Mount Jowlaenga Polygon #2 Claimant Group.
- ◆ The signing of the Agreement will allow the Kimberley Land Council to take it to an authorisation meeting, which will involve a wider group of Traditional Owners to consider authorising the Named Applicants to execute the Agreement.
- ◆ This is the final step in the process, with the meeting expected in late October/early November; however as a final agreement has been reached with the Named Applicants this should be a formality - this is also recognised by the grant of the Mining Lease.
- ◆ As part of the process, the Company undertook Aboriginal heritage surveys with the Traditional Owners – this has outlined some areas that the Company has been asked to avoid, however these are well outside the area of proposed operations.
- ◆ The Company has stated that the Project has strong community support - this is partly due to the closure and cancellation of a number of resource projects in the region.

CURRENT AND PLANNED ACTIVITIES

- ◆ The proposed Thunderbird time line is shown in Figure 9.
- ◆ Current activities are focussed on finalising funding, with preliminary site works (including upgrading of the access road and installation of the accommodation camp) already underway; the Company is looking to commence the main construction phase in early CY2019.
- ◆ The Company is also undertaking regional exploration, with drilling over Dampier regional targets commencing in August 2018, with, as mentioned above, results from Night Train being released, and with more results due in the near term.

Figure 9: Proposed Thunderbird timeline



Source: Sheffield

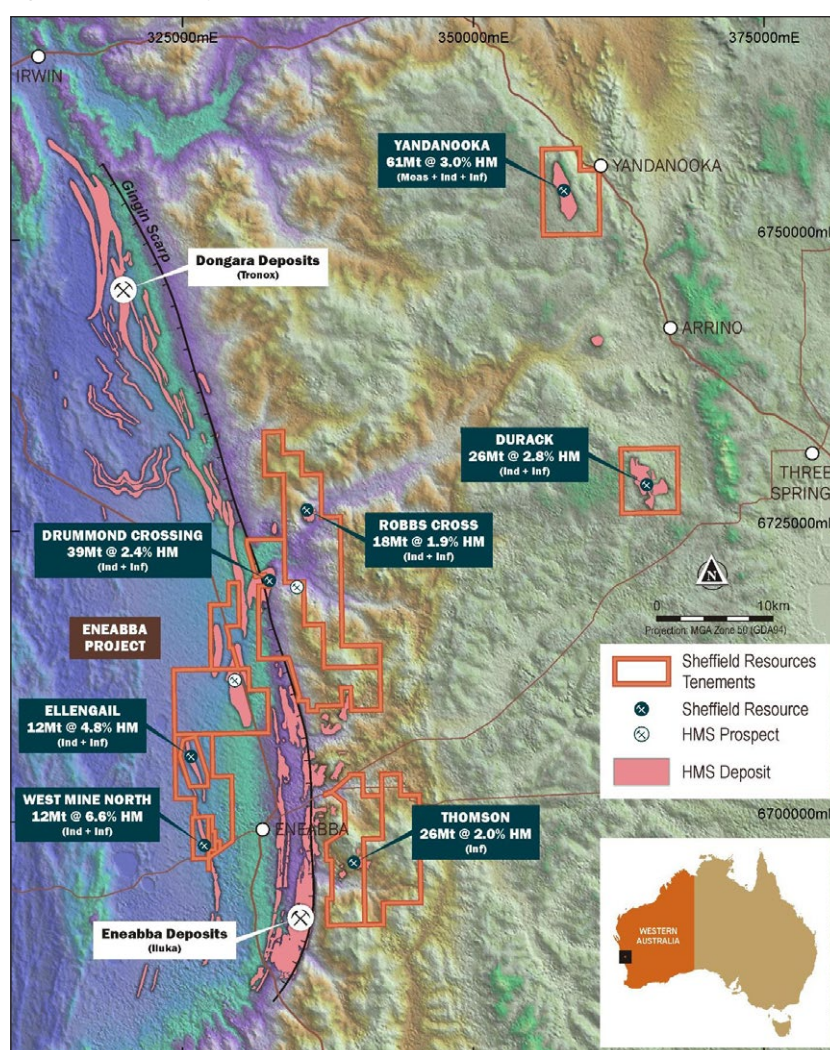
ENEABBA AND MCCALLS HMS PROJECTS – SFX 100%

- ◆ Sheffield holds two other HMS projects in WA, Eneabba and McCalls, with resources shown in Tables 10 and 11 and a map of Eneabba shown in Figure 10.

ENEABBA

- ◆ Eneabba is Sheffield's second mineral sands project, located in the Perth Basin centred approximately 140km south of Geraldton.
- ◆ The Eneabba Project, which comprises five defined dunal sand deposits, one dunal/strandline deposit (Ellengail) and one strandline deposit (West Mine North) as well as a number of other prospects is located near existing mineral sands operations in an area of world-class HMS mineralisation and is well connected by road and rail to Kwinana/Fremantle and Geraldton Ports.
- ◆ Sheffield's strategy is to build up a resource base of at least 10Mt of contained HMS, which will be amenable for sequential mining and treatment using a mobile plant – four new discoveries (Mount Adams, Robbs Cross, Ding Road and Thomson's) were made in 2015.

Figure 10: Eneabba Project



Source: Sheffield

- ◆ The deposits in the region are typically zircon and rutile rich, with ilmenite also generally being high grade (>60% TiO₂) and thus suitable for chloride pigment or synthetic rutile feedstock; mineralisation is broad and up to 20m thick.
- ◆ Deposits are also at surface and typically sit above the water table.
- ◆ Retention Licences were granted over Durack and Yandanooka in 2016.
- ◆ The most recent work was a 79 hole, 1,779m aircore drilling programme at Eneabba, with results being used in the Initial MREs for Robs Cross and Thomsons (Figure 10, Table 10).

McCALLS

- ◆ 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 – McCalls is located approximately 100km north of Perth.
- ◆ The mineral assemblage is dominated by ilmenite, and characterisation studies on one sample indicated TiO₂ 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.
- ◆ Sheffield's plan is to continue evaluation of the project as a large scale bulk mining operation, and is seeking a strategic alignments with chloride pigment off-take groups to progress McCalls.

Table 10: Eneabba Mineral Resources

Deposit (cut-off)	Category	Tonnage (Mt)	Grade (%)	Zircon (%)	Rutile (%)	Leuc (%)	Ilmenite (%)	Osize (%)	Slimes (%)
Yandanooka (>1.4% HM)	Measured	2.6	4.3	0.44	0.09	0.1	3.08	11.3	15
	Indicated	57.7	3	0.37	0.11	0.11	2.08	11.4	15
	Inferred	0.4	1.5	0.16	0.05	0.07	1.01	21.9	20
	Total	60.8	3	0.37	0.11	0.11	2.11	11.5	15
Durack (>1.4% HM)	Indicated	20.7	2.9	0.4	0.09	0.11	2.07	14.7	14
	Inferred	5.6	2.6	0.37	0.07	0.19	1.68	18.3	16
	Total	26.3	2.8	0.39	0.08	0.13	1.99	15.5	14
Drummond Crossing (>1.4% HM)	Indicated	35.5	2.4	0.33	0.24	0.08	1.26	7.7	14
	Inferred	3.3	2.3	0.26	0.21	0.06	1.31	7.2	12
	Total	38.8	2.4	0.33	0.24	0.08	1.26	7.7	14
Robbs Cross (>1.4% HM)	Indicated	14	1.9	0.27	0.24	0.09	0.88	6.2	6
	Inferred	3.8	2	0.29	0.22	0.08	1.02	8.1	6
	Total	17.8	1.9	0.28	0.23	0.09	0.91	6.6	6
Thomsons (>1.4% HM)	Inferred	26	2	0.38	0.28	0.11	0.85	6.9	18
	Total	26	2	0.38	0.28	0.11	0.85	6.9	18
West Mine North (>2.0% HM)	Measured	10.2	7.3	0.43	0.48	0.13	3.51	2.3	11
	Indicated	1.8	2.7	0.25	0.23	0.06	1.31	3	17
	Total	12	6.6	0.4	0.44	0.12	3.18	2.4	12
Ellengail (>2.0% HM)	Indicated	6.5	5.3	0.53	0.43	0.55	3.49	3.2	15
	Inferred	5.3	4.1	0.41	0.34	0.35	2.55	2.5	15
	Total	11.8	4.8	0.47	0.39	0.46	3.07	2.9	15
All Eneabba (various cutoffs)	Measured	2.6	4.3	0.44	0.09	0.1	3.08	11	15
	Indicated	144.6	3.1	0.37	0.19	0.12	1.92	9	14
	Inferred	46	2.4	0.36	0.24	0.14	1.21	8	16
	Total	193.3	3	0.36	0.2	0.13	1.77	9	14

Source: Sheffield

Table 11: McCalls Mineral Resources

Deposit	Category	Tonnage (Mt)	THM (%)	Zircon (%)	Rutile (%)	Leuco-xene (%)	Ilmenite (%)	Osize (%)	Slimes (%)
McCalls (>1.1% HM)	Indicated	1,630	1.4	0.07	0.05	0.04	1.1	1.1	21
	Inferred	1,980	1.2	0.06	0.05	0.04	1	1.1	26
	Total	3,600	1.3	0.07	0.05	0.04	1.05	1.1	24
Mindarra Springs (>1.1 HM)	Inferred	2,200	1.6	0.07	0.01	0.05	1.32	5.1	20
	Total	2,200	1.6	0.07	0.01	0.05	1.32	5.1	20
Total (>1.1% HM)	Indicated	1,630	1.4	0.07	0.05	0.04	1.1	1.1	21
	Inferred	4,180	1.5	0.07	0.03	0.05	1.17	3.2	23
	Total	5,800	1.4	0.07	0.03	0.04	1.15	2.6	22

Source: Sheffield

SHEFFIELD VALUATION

- ◆ Our updated base case valuation is presented in Table 12, and includes:
 - A risked, funded, post-tax valuation for Thunderbird, with this discussed more fully below - we have increased our risk weighting from 61% to 80% to take account of the significant progress made,
 - We have included head office costs of A\$5 million per annum in the Thunderbird valuation; the after tax NPV₈ of these costs is A\$50 million,
 - An indicative valuation of A\$20 million for other projects - this is as for our 2017 valuation,
 - Cash as of June 30, 2018; and,
 - Per share valuations are based on a share structure diluted for a \$175 million project equity raise at A\$1.00/share - this price is at a discount to the current price, and in fact may be higher at the time of a capital raise and thus lead to less dilution - the Company valuation is A\$1.91/share if an equity raising price of A\$1.25/share is used.
- ◆ We see upside in this valuation with progress with the development and hence further de-risking of Thunderbird, and also with improving HMS product prices - we have used average LoM product prices of US\$1,381/t zircon, US\$676/t zircon concentrate, US\$500/t HiTi-88, US\$183/t ilmenite and US\$48/t magnetite concentrate as used in the BFS.
- ◆ Mineral sands prices, particularly zircon, have risen significantly since the completion of the BFS, and using only modest increases of LoM prices to US\$1,400/t zircon, US\$700/t zircon concentrate, US\$500/t HiTi-88, US\$200/t ilmenite and US\$48/t magnetite concentrate increases the risked Sheffield per share valuation to A\$2.00/share; price changes have a significant effect in the first three years of production where the forecast prices used included US\$1,282/t zircon and US\$659/t zircon concentrate.

Table 12: Sheffield valuation

Sheffield valuation						
Item	Total	Total/Share	Risk Factor	Risked	Risked/Share	Notes
Thunderbird & Head Office	A\$832 m	A\$2.056	80%	A\$665 m	A\$1.645	NPV ₈ , funded, after tax
Other Properties	A\$20 m	A\$0.049	100%	A\$20 m	A\$0.049	Nominal
Cash	A\$22 m	A\$0.055	100%	A\$22 m	A\$0.055	June 30, 2018
Total	A\$874 m	A\$2.160		A\$707 m	A\$1.749	
Shares for Reporting		404,765,124				

Source: IIR analysis

THUNDERBIRD VALUATION

- ◆ Key inputs (including prices and costs) for our updated valuation are largely as those for our 2017 valuation, however with the following changes:
 - Our updated valuation for Thunderbird, given the debt facilities in place, is funded and after tax, with a per share value based on a share structure diluted for a A\$175 million equity raise at A\$1.00/share,
 - We have included debt funding of A\$225 million from the Taurus and NAIF debt draw down and repayment profiles as provided in Company releases; although no interest rates have been disclosed for the NAIF facilities, we have assumed 7.5%,
 - We have assumed equity raising costs of 5% and loan establishment fees of 2%,
 - We have allowed for ~A\$52 million working capital to cover pre-production working capital, fees, and opex for three months of production, bringing the total funding requirement to A\$400 million,
 - Our forecast product prices for our headline valuation are still those as used in the BFS, however we have adjusted the AUDUSD exchange rate to 0.72; and,
 - We have added the Taurus royalty, which if applied over total production, equates to 0.42% of revenue - this is in addition to the State Government Royalty of 5% and a royalty payable under the Coexistence Agreement (the amount of which is confidential) - we have used an estimate of 1%.

- ◆ We have taken no account of changes expected in capital and operating costs with the power plant and camp facilities now being owner built and operated; our view is that these may have only a minimal affect on the overall valuation, with an offset between additional capex and lower opex.
- ◆ A summary of key inputs and outputs is presented in Table 13.

Table 13: Thunderbird key inputs and outputs

Thunderbird key inputs and outputs			
Item	Units	Value	Notes
Mine Life	Years	42	
Total Ore Mined	Tonnes	680,580,810	
VHMS Produced	Tonnes	32,669,700	
Av VHMS Sales Price	A\$/tonne	\$434	Average across all products
Funded NPV, mid-year	A\$m	\$832 m	
IRR, Pre-Tax, Pre-Funding	%	25%	
Discount Rate	%	8%	Real
LoM Revenue	A\$m	\$14,163 m	
LoM Site Opex	A\$m	-\$7,757 m	
LoM HO and Misc	A\$m	-\$233 m	
Lom Royalties	A\$m	-\$910 m	
LoM EBITDA	A\$m	\$5,263 m	
LoM Capex	A\$m	-\$688 m	
Working Capital	A\$m	-\$52 m	
LoM FCF	A\$m	\$3,280 m	
Peak annual FCF	A\$m	\$266 m	
Average Annual EBITDA	A\$m	\$125 m	
5 x EBITDA Mult	A\$m	\$626.55	
Project Finance Debt	%	56%	
Debt Amount	A\$m	\$225 m	Taurus and NAIF, 67% of available facilities
Financing Term	Years	Various	
Interest Rate	%	Various	
Project Finance Equity	A\$m	\$175 m	
Equity Price	A\$/share	\$1.00	IIR estimate, possibly conservative
Diluted Shares on Issue	Million on Issue	405	
Exchange Rate	AUD:USD	0.72	Updated

Source: IIR analysis

- ◆ Forecast production and cash flow figures are presented in Table 14 - the capex profile has been adjusted from figures as presented in the BFS to suit a commencement of construction in the second half of FY2019.
- ◆ One figure of interest is the “revenue to cost” ratio – this is a factor commonly used in HMS operations given different product mixes, and figure of 1.8:1 and better from 2022 places Thunderbird in a very competitive position amongst global producers.

Table 14: Thunderbird production and cashflow profile

Thunderbird production and cashflow profile								
Year	2018	2019	2020	2021	2022	2023	2024	2025
Ore Mined	Mt	0.00	0.00	5.57	7.90	8.61	8.64	16.08
Waste Mined	Mt	0.00	0.00	0.13	5.38	5.36	5.36	2.22
Premium Zircon	tonnes	0	0	25,076	48,615	58,097	60,073	87,152
Zircon Concentrate	tonnes	0	0	30,460	48,597	51,736	53,140	87,891
LTR Ilmenite	tonnes	0	0	139,819	275,031	285,952	287,320	494,199
HiTi88	tonnes	0	0	5,906	11,901	15,166	14,854	20,565
Titano-magnetite	tonnes	0	0	82,794	162,850	169,441	170,156	292,652
Revenue	A\$ million	0.0	0.0	117.7	220.1	245.3	260.4	409.9

Thunderbird production and cashflow profile								
Year	2018	2019	2020	2021	2022	2023	2024	2025
Operating Costs (inc HO, fees)	A\$ million	-17.0	-6.3	-83.0	-115.6	-125.5	-126.0	-186.3
Royalties	A\$ million	0.0	0.0	-7.9	-14.9	-16.6	-17.6	-27.7
EBITDA	A\$ million	-17.0	-6.3	26.7	89.6	103.2	116.8	196.0
D and A	A\$ million	-1.1	-6.5	-8.3	-8.4	-8.5	-12.1	-14.0
EBIT	A\$ million	-18.1	-12.8	18.5	81.2	94.7	104.7	182.0
Interest	A\$ million	-6.5	-15.2	-15.2	-17.8	-16.5	-15.2	-13.7
EBT	A\$ million	-24.6	-28.0	3.3	63.4	78.2	89.6	168.2
Tax	A\$ million	7.4	8.4	-1.0	-19.0	-23.5	-26.9	-50.5
NPAT	A\$ million	-17.2	-19.6	2.3	44.4	54.7	62.7	117.8
Capex	A\$ million	-46.9	-233.2	-74.9	-7.0	-2.5	-138.7	-74.7
Revenue to Costs	X	0	0	1.42	1.90	1.95	2.07	2.20
Weighted Shares	million	331.8	404.8	404.8	404.8	404.8	404.8	404.8
EPS	A\$	-0.05	-0.05	0.01	0.11	0.14	0.15	0.29

Source: IIR analysis

- ◆ We have completed a sensitivity analysis, with this indicating that Thunderbird is most sensitive to Zr product prices, other revenue factors and operating costs – these are shown in Table 15.
- ◆ Table 16 presents the paired sensitivity of the risked per share value of Thunderbird to revenue factors and operating costs - this per share value can be treated as a proxy for the Company value per share.
- ◆ We have also analysed the sensitivity of the per share valuation to the assumed equity raising price, given that we may expect the share price to increase over coming months; using an equity raising price of A\$1.25/share results in a risked Company valuation of A\$1.91/share.
- ◆ Other revenue factors include mineralisation grade, recovery and exchange rates, with these all behaving approximately the same in any sensitivity analysis.
- ◆ Given the high expected operating cash flows the Project is least sensitive to capex.

Table 15: Un-risked, funded, after tax Thunderbird sensitivity analysis

Un-risked, funded, after tax Thunderbird sensitivity analysis					
Change	Zr Price	Ti Price	Revenue Factors	Site Costs	Capex
0%	A\$514 m	A\$658 m	A\$316 m	A\$1,115 m	A\$827 m
5%	A\$673 m	A\$745 m	A\$574 m	A\$974 m	A\$879 m
10%	A\$832 m	A\$832 m	A\$832 m	A\$832 m	A\$832 m
15%	A\$991 m	A\$919 m	A\$1,090 m	A\$691 m	A\$785 m
20%	A\$1,150 m	A\$1,006 m	A\$1,348 m	A\$549 m	A\$838 m

Source: IIR analysis

Table 16: Thunderbird risked per share sensitivity

Thunderbird risked per share sensitivity						
Change in Site Operating Costs						
		-20%	-10%	0%	10%	20%
Change in Revenue	20%	\$3.22	\$2.94	\$2.66	\$2.38	\$2.11
	10%	\$2.71	\$2.43	\$2.15	\$1.88	\$1.60
	0%	\$2.20	\$1.92	\$1.65	\$1.37	\$1.09
	-10%	\$1.69	\$1.41	\$1.14	\$0.86	\$0.57
	-20%	\$1.18	\$0.90	\$0.62	\$0.34	\$0.05

Source: IIR analysis

PEER GROUP ANALYSIS

- ◆ There are only a handful of ASX-listed mineral sands companies, as shown in Table 17 below, and ranked in decreasing order of EV.
- ◆ Resource figures are for 100% of all projects that the relevant companies have an interest in, and grades are for total potentially saleable zircon and titanium dioxide feedstock minerals.

Table 17: Sheffield peer group comparison

Sheffield peer group comparison							
Company	Key Project	Stage	Equity Share	EV ¹	Global Resources - All Deposits	Global Payable HM Grade ²	Contained Payable HM
Iluka Resources	Various	Producing	100%	\$3,790 m	3,144 Mt	4.44%	139.7 Mt
Base Resources	Kwale, Kenya	Producing	100%	\$331 m	1,004 Mt	4.57%	45.9 Mt
Sheffield Resources	Thunderbird, WA	Development	100%	\$227 m	7,003 Mt	2.00%	140.2 Mt
MZI Resources	Keysbrook, WA	Producing	100%	\$199 m	147 Mt	1.66%	2.4 Mt
Strandline Resources	Various, Tanzania	Exploration, resources estimated	100%	\$36.8 m	477 Mt	1.52%	7.2 Mt
Diatreme Resources	Cyclone, WA	PFS complete	100%	\$28.5 m	204 Mt	1.71%	3.5 Mt
Astron Corporation	Donald, Murray Basin Victoria	Optimisation of FS	100%	\$21.3 m	4,780 Mt	2.92%	139.7 Mt
Broken Hill Prospecting	Murray Basin	Exploration, resources estimated	100%	\$7.5 m	113 Mt	1.22%	1.4 Mt
Metallica Minerals	Point Urquart, Queensland	On hold	50%	\$5.6 m	3 Mt	2.01%	0.1 Mt

1: EV is defined as market capitalisation less cash plus debt – no allowance has been made for the value of non-HMS projects in the companies' portfolios

2: Payable grade is the published grade of valuable zircon and titanium dioxide minerals

3: Strandline's mineralisation includes the 308Mt Coburn deposit in Western Australia – activities however are focussed on Tanzania.

Source: IRESS, Company reports: Company reports

- ◆ Table 18 presents a range of published mineral sands resources with a theoretical in ground value based on AUD prices as given in the table footnotes - this is not exhaustive but provides a sample of the resources.
- ◆ The in ground value does not reflect potential realisable values – this will depend on other factors, including the metallurgy/recovery and marketability of the VHM's.
- ◆ This is intended as an indicative guide only, however shows the high relative value of Thunderbird and the potential at Night Train.

Table 18: HMS deposit comparisons

HMS deposit comparisons								
Coy	Project/Area	Deposit	Total Tonnage	HMS Grade	Ti Mins %	Zircon %	Total Potentially Payable HMS Grade	Value/t ¹
ILU	Murray Basin	West Balranald	36 Mt	32.99%	24.01%	3.58%	27.59%	\$142.45
ILU	Murray Basin	West Balranald	36 Mt	32.99%	24.01%	3.58%	27.59%	\$122.22
ILU	Murray Basin	All	189 Mt	16.83%	11.54%	1.81%	13.34%	\$62.74
SFX	Dampier, WA	Night Train	N/A - Average Drilling ³	6.40%	4.93%	0.93%	5.89%	\$32.04
SFX	Dampier, WA	Thunderbird HG	1,040 Mt	12.20%	3.96%	0.93%	4.88%	\$21.70
MuZi	Murray Basin	WIM150	1,650 Mt	3.72%	1.82%	0.77%	2.59%	\$17.65
ILU	Sri Lanka	All	690 Mt	8.16%	5.90%	0.29%	6.19%	\$17.57

HMS deposit comparisons								
Coy	Project/Area	Deposit	Total Tonnage	HMS Grade	Ti Mins %	Zircon %	Total Potentially Payable HMS Grade	Value/t ¹
MLM	Cape York	Urquart Point	3 Mt	5.94%	1.40%	0.61%	2.01%	\$15.80
Rele	Murray Basin	Magic	15 Mt	3.70%	2.89%	0.52%	3.40%	\$14.93
BSE	Toliara, Madagascar	Ranobe	857 Mt	6.19%	4.55%	0.34%	4.89%	\$13.88
DRX	Eucla Basin	Cyclone	204 Mt	2.28%	1.10%	0.62%	1.71%	\$13.28
SFX	Dampier, WA	Thunderbird	3,230 Mt	6.91%	2.30%	0.57%	2.88%	\$13.27
MuZi	Murray Basin	Mindarie All	244 Mt	3.09%	1.80%	0.52%	2.32%	\$12.14
MZi ²	Keysbrook, Perth Basin	Keysbrook	86 Mt	2.19%	1.80%	0.26%	2.06%	\$12.13
ILU	USA Atlantic	USA	118 Mt	4.43%	2.87%	0.49%	3.35%	\$12.07
BSE	Kenya	Kwale	147 Mt	3.52%	2.47%	0.21%	2.68%	\$10.75
ILU	Sierra Leone	Sierra Leone	720 Mt	2.00%	1.16%	0.08%	1.24%	\$10.69
SFX	Eneabba, WA	Eneabba All	163 Mt	2.92%	2.07%	0.37%	2.43%	\$10.66
BPL	Murray Basin	Jaws	63 Mt	1.90%	1.18%	0.19%	1.37%	\$10.13
STA	Tanzania	Fungoni	22 Mt	2.82%	1.30%	0.47%	1.77%	\$9.96
STA	Tanzania	Tajiri	147 Mt	3.10%	2.45%	0.12%	2.57%	\$8.04
BPL	Murray Basin	Gilligans	50 Mt	1.60%	0.88%	0.14%	1.02%	\$7.35
MZI	Keysbrook, Perth Basin	Yangedi	47 Mt	1.60%	1.27%	0.13%	1.40%	\$7.31
STA	Coburn	Coburn All	308 Mt	1.20%	0.72%	0.28%	1.00%	\$5.97
	Grande Cote, Senegal	Grande Cote	1,847 Mt	1.40%	1.08%	0.15%	1.23%	\$4.42
SFX	McCalls, WA	McCalls	3,610 Mt	1.29%	1.13%	0.06%	1.20%	\$3.42
SFX	McCalls, WA	Mindarra Springs	2,200 Mt	1.60%	1.16%	0.07%	1.23%	\$3.28

1: Values based on the following AUD prices per tonne: Zircon - \$1,400, Rutile \$1,200, High Ti leucoxene \$533, Low Ti Leucoxene \$400, Ilmenite \$225.

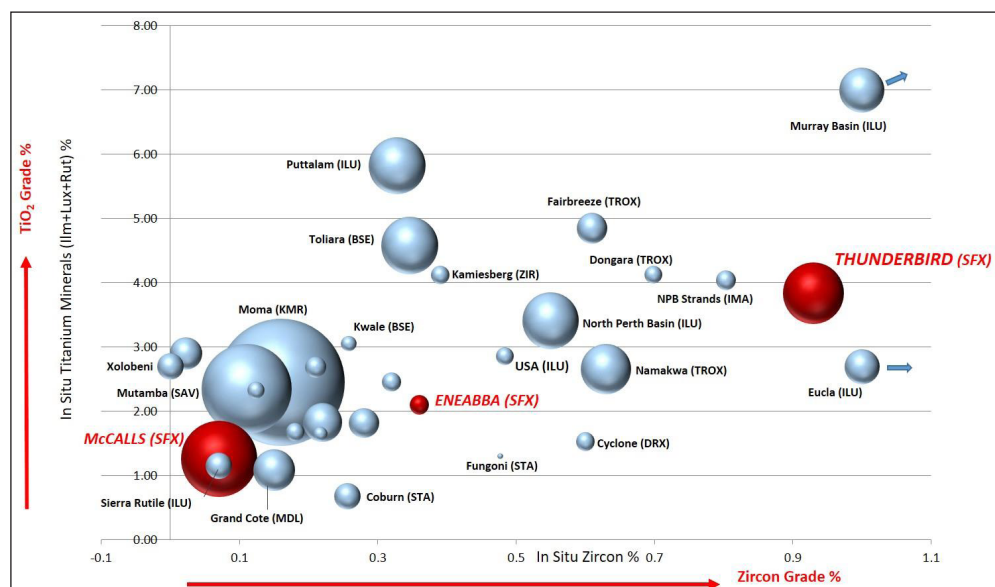
2: MuZi is Murray Zircon, now privately owned – this was previously Australian Zircon.

3: Night Train grades are based on numbers published on Sheffield's website – no resource has yet been published

Source: IRESS, Company reports: Company reports

- ◆ Figure 11 shows a comparison of zircon and titanium dioxide feedstock mineral grades in Ore Resources – this clearly shows the quality of Thunderbird.

Figure 11: Resource grades of HMS projects



Source: Sheffield

CAPITAL STRUCTURE

- ◆ Sheffield currently has 230.10 million shares, 12.27 million options (including employee options) and 2.01 million performance rights on issue.
- ◆ The top shareholders include the BlackRock Group (6.0%), Mr Walter and Mrs Jeanette Yovich (5.4%) and Mr Walter Yovich (4.9%) - the combined Yovich holdings total 10.3%.
- ◆ Total insiders interests are 11.9%, with the top 20 holding 51.2%
- ◆ The Company has ~1,575 shareholders.

RISKS

- ◆ **Project Implementation:** Delays and cost over runs are common in the construction of new projects, and also unforeseen issues are often uncovered in the commissioning phase of a project. This latter point is partly mitigated through Sheffield planning to use industry standard processing equipment and mining techniques.
- ◆ **Fine grain size:** This has caused some issues at other mineral sands deposits (particularly in the Wimmera), and also has 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 pilot scale, and that the slimes are readily handled.
- ◆ **Prices and exchange rates:** These are factors outside of a company's control, and can severely affect a project's viability – this is not as much an issue as at some other operations, with our modelling suggesting that the Project can handle 20% adverse movements in either and still remain viable.
- ◆ **Costs:** Again factors that can severely impact on the viability of a project, however given the robustness of Thunderbird it can absorb adverse movements in costs.

BOARD AND MANAGEMENT

- ◆ **Mr Will Burbury – Non-Executive Chairman:** Mr 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).
- ◆ **Mr Bruce McFadzean – Managing Director:** A qualified mining engineer with more than 35 years' experience in the global resources industry, Mr McFadzean has led the financing, development and operation of several new mines around the world and his skills will drive progress of Sheffield's world-class Thunderbird minerals sands project through to production.

Bruce McFadzean's professional career includes 15 years with BHP Billiton and Rio Tinto in a variety of positions and four years as Managing Director of successful Western Australia gold miner Catalpa Resources Limited (ASX:CAH). Under his management, Catalpa's market capitalisation grew from \$10 million to \$1.2 billion following the Evolution merger. He has raised in excess of A\$350 million in debt and equity from Australian and overseas markets
- ◆ **Mr David Archer – Technical Director:** 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.
- ◆ **Mr Bruce McQuitty – Non-Executive Director:** Mr McQuitty has over 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.

- ◆ **Mr Stuart Pether – Chief Operating Officer:** Mr Pether is a qualified mining engineer with over 25 years' experience in the resources industry, both in Australia and overseas. Stuart has extensive experience in project development, technical studies, mine operations and corporate management; including executive engagements as CEO of Kula Gold Limited, VP Project Development - Evolution Mining and COO at Catalpa Resources..
- ◆ **Mr Mark Di Silvio – CFO/Company Secretary:** Mr Di Silvio is a CPA with over 25 years' experience in the resources sector working across Africa and Australia. He has led financing and restructuring initiatives, holding senior finance and executive positions with RGC/Goldfields, Woodside Energy, Centamin and Mawson West.
- ◆ **Mr Jim Netterfield – Project Manager:** Mr Netterfield brings more than 20 years' experience in the resources industry to the role and has a proven track record in successfully managing mineral development projects through to production. He will take responsibility for delivering the definitive feasibility study (DFS) for Thunderbird, the world's best undeveloped mineral sands deposit.

Mr Netterfield's professional career includes 11 years with BHP Billiton and Rio Tinto in a variety of senior operations roles, including Vice President – Railway & Ports, Vice President Operations and Manager Operations, Dampier. He recently served for four years as acting CEO and Operations Director at Oakajee Port & Rail Pty Ltd, leading the feasibility studies for Mitsubishi's \$10 billion magnetite iron ore project. In addition, he has held senior operations roles with Minara Resources, Tomago Aluminium Company and Janus Consulting Australia.

- ◆ **Mr Neil Patten-Williams – Marketing Manager:** Mr Patten-Williams is a professional with over 18 years' experience in the resources industry, including five years as Sales and Marketing Manager for established mineral sands producer the Doral Group, where he was responsible for marketing, logistics and sales globally. Mr Patten-Williams has a strong background in both zircon and titanium mineral products. Prior to his appointment as Sales and Marketing Manager at Doral, he was Operations Manager of the Doral Fused Materials Plant in WA for five years responsible for all aspects of safety, operations and maintenance and also spent five years as the company's Zirconia Operations Manager. As a metallurgist with hands-on operational experience Mr Patten-Williams has a unique blend of commercial, global marketing and operational skills in the mineral sands industry.

BACKGROUND – THE MINERAL SANDS INDUSTRY

Introduction

- ◆ 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 2014 global production included 1.1Mt of zircon and 7.25Mt of titanium dioxide feedstock.

Zircon

- ◆ The zircon market is supplied by the one product, zircon.
- ◆ The major use for zircon is in ceramics, with this comprising some 50% of the 2014 global demand of 1.1Mt, with approximately 90% of the ceramics demand from 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%.
- ◆ China is the largest market, comprising 40% in 2014, with this region seeing significant growth, largely due to the rapid urbanisation during the 2000's driving increased demand for tiles and other ceramics – tiles comprise approximately 75% of all floor coverings in China (source: Iluka).
- ◆ Other major markets include Europe (20% in 2014) and North America (9% in 2014).
- ◆ 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 supplier globally, providing 38% of the world's production in 2017, with Iluka alone supplying 20% 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 lower prices prior to the pick up in prices in 2017.

Titanium Dioxide

- ◆ The majority (90%) of titanium dioxide is used in the pigment industry, being used in various products, including paints, coatings, paper and inks.

Table 19: Titanium dioxide products sold, 2014

Titanium dioxide products sold, 2014			
Product, approximate market share	TiO ₂ %	Notes	End Uses
Rutile – 10%	95-97	Mined product	Pigments, metal
Synthetic rutile – 3%	88-95	Upgraded from ilmenite in a furnace	Pigments
Ilmenite			
Sulphate – 42%	52-54	Processed to pigment - sulphate processing	Pigments
Chloride – 12%	8-62	Processed to pigment - chloride processing	
Slag			
Sulphate – 11%	80-85	Upgraded from sulphate ilmenite in a furnace	Pigments
Chloride – 19%	85-90	Upgraded from chloride ilmenite in a furnace	
Upgraded – 3%	95	Upgraded from ilmenite	

Source: Iluka

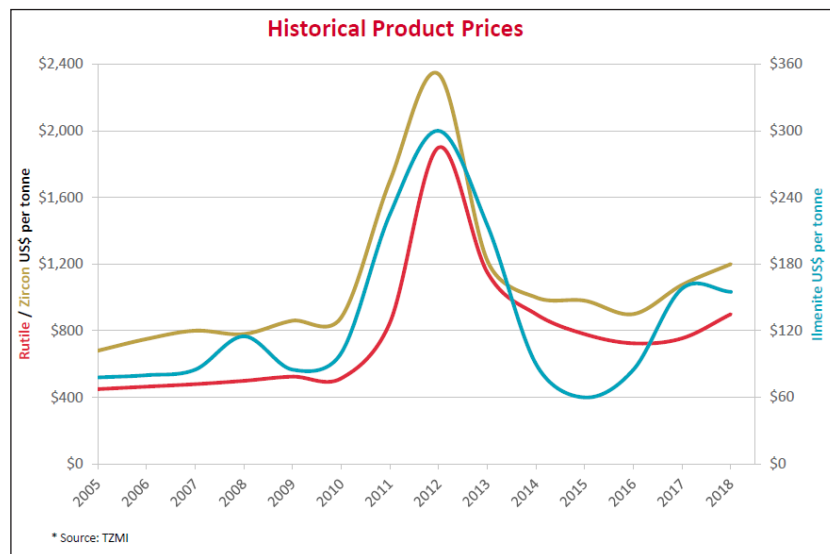
- ◆ It is a key white pigment in that it has a high refractive index (whiteness), provides UV protection and is non-toxic.
- ◆ Other uses include as a metal (military, aerospace and specialty applications) and for welding rod core wire.
- ◆ There are two main pigment production routes – chloride and sulphate, with chloride generally being cleaner and requiring higher grade feedstocks.
- ◆ The majority of Chinese capacity is for sulphate grade feedstock; western producers generally use the chloride process.
- ◆ In 2017 (total production 7.10Mt) the major titanium dioxide producers were South Africa and Australia (both with ~20%) and China (11%).
- ◆ Like zircon, Australian share of production had fallen from 24% of 6.5Mt in 2011 (1.6Mt) to 20% of 7.10Mt in 2017 (1.35Mt), again largely due to Iluka curtailing production and sales.
- ◆ Rio Tinto (20% in 2017) is the largest producer, with operations in South Africa (Richards Bay), QIT (Canada) and QMM (Madagascar), however is now encountering difficulties at Richards Bay.
- ◆ In 2017 Iluka was the second largest producer (10%), with operations in Australia and Sierra Leone.
- ◆ Unlike zircon, where the market is supplied by a single product, the 7.10Mtpa (2017) titanium dioxide market is fed by a number of products feeding the different processing routes.
- ◆ Key products sold by producers are shown in Table 18. What can be seen is that 36% of the products sold to end users and pigment manufacturers are upgraded products, with the remaining 64% being raw materials.
- ◆ In addition, approximately 52% of feedstocks are chloride grade and 48% sulphate grade.

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.
- ◆ Figure 12 presents the price performance of key HMS products over the past 13 years.
- ◆ The noticeable feature is the sharp decrease in prices in 2013, which continued into 2016 – this followed slowing in demand during 2012, largely due to weakening global economic conditions.

- ◆ Also apparent are significant price 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.

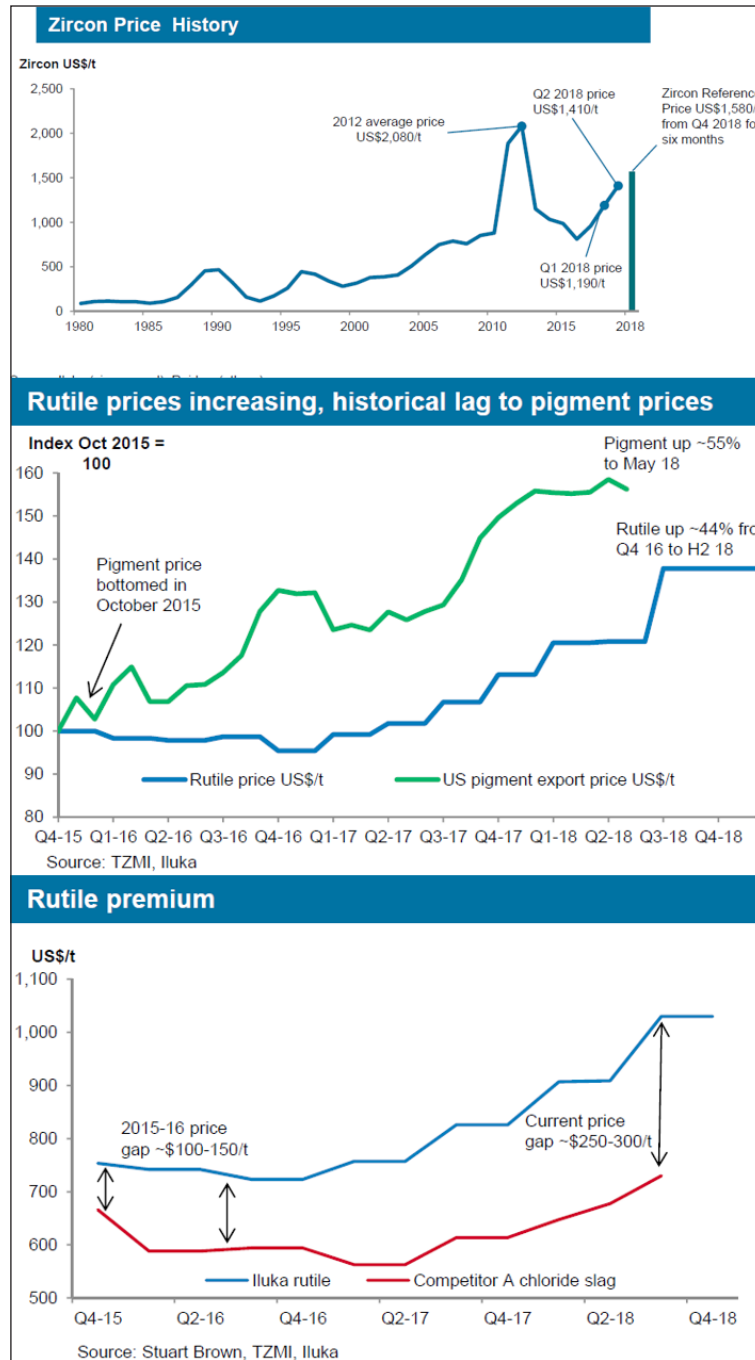
Figure 12: Zircon and Titanium Dioxide Prices



Source: Base Resources presentation

- ◆ 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%.
- ◆ Reduced prices in 2014-2016 saw curtailing of operations, and also, especially in the case of zircon, selling from stockpiles (particularly by Rio Tinto) which saw prices remain depressed.
- ◆ TZMI expect that in the case of sulphate ilmenite, feedstock inventories have peaked, and were depleted by early 2017, with this also coinciding with increasing demand, and with the possibility of no new operations coming on stream.
- ◆ They forecast that this will lead to a deficit of up to one million TiO_2 units (around 2 Mt of feedstock) by 2020-2021, with prices now increasing due to tightening markets.
- ◆ In addition, some Chinese supply has historically come as a by-product from domestic magnetite mines – with falling iron ore prices a number of these are closing and thus also affecting ilmenite supply.
- ◆ With regards to zircon, the forecast is for significant reduction in production from existing operations, with this pointing to a reduction in existing supply to ~750,000t by 2025 – this provides an excellent opportunity for new projects such as Thunderbird.
- ◆ This has followed a period where potential supply has been greater than demand due to overstocking and hence weighing on prices.
- ◆ Ongoing community unrest at Rio's Richard Bay Minerals operations are also causing supply disruption - in 2014 this produced some 16% of global zircon supply.
- ◆ Zircon and rutile prices, and the relative performance of pigment and rutile pricing are shown in Figure 13 - changes in ilmenite and leucoxene prices will reflect those of rutile, albeit at a lower levels.
- ◆ This highlights the recent recoveries in prices, particularly, with regards to Sheffield, in zircon prices - the 4Q18 reference price of US\$1,580/tonne is 13% above the long term price we have used in our modelling.
- ◆ This also highlights the strong performance for Zircon since 2000 when the price was ~US\$250/tonne - our analysis indicates a 8% CAGR price increase, not taking into account the 2012-2013 spike, which appears to be a sustainable growth.

Figure 13: Zircon and Titanium Dioxide Prices



Source: Iluka 1H18 Results presentation

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For further information, please contact IIR at: client.services@independentresearch.com.au



Independent Investment Research (Aust.) Pty Limited

SYDNEY OFFICE

Level 1, 350 George Street
Sydney NSW 2000
Phone: +61 2 8001 6693
Main Fax: +61 2 8072 2170
ABN 11 152 172 079

MELBOURNE OFFICE

Level 7, 20-22 Albert Road
South Melbourne VIC 3205
Phone: +61 3 8678 1766
Main Fax: +61 3 8678 1826

HONG KONG OFFICE

1303 COFCO Tower
262 Gloucester Road
Causeway Bay, Hong Kong

DENVER OFFICE

200 Quebec Street
300-111, Denver Colorado USA
Phone: +1 161 412 444 724

MAILING ADDRESS

PO Box H297 Australia Square