AUSTRALIAN
RESEARCH
INDEPENDENT INVESTMENT RESEARCH

Sheffield Resources Limited (ASX: SFX)

December 2019

INDEPENDENT
INVESTMENT RESEARCH

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INDEPENDENT INVESTMENT RESEARCH

Sheffield Resources Limited (ASX: SFX)

Comprehensive Update - December 2019

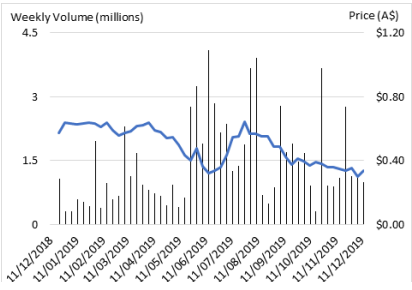
Note: This report is based on information provided by the company as at December 18, 2019

Investment Profile	
Share Price - Dec 18, 2019	A$0.30
12 Month L/H	A$0.285/ A$0.89
Base Case Per Share Valuation	$2.34
Issued Capital:	
Ordinary Shares	309.1 m
Unlisted Options	7.80 m
Performance Rights	9.34 m
Fully Diluted	326.1 m
Market Capitalisation UD	A$92.7 m
Cash September 30, 2019	A$10.63 m
September Placement T2 Remaining Cash	A$6.26 m

Board and Management
Mr Will Burbury: Non-Executive Chairman
Mr Bruce McFadzean: Managing Director
Mr David Archer: Technical Director
Mr Ian Mcliver: Non-Executive Director
Mr John Richards: Non-Executive Director
Mr Stuart Pether: Chief Operating Officer
Mr Jim Netterfield: GM, Engineering & Processing
Mr Mark Di Silvio: CFO/Company Secretary
Mr Neil Patten-Williams: Marketing Manager
Ms Vanessa Hughes: GM, People and Community

Major Shareholders	
Mr. W Yovich & Mrs J Yovich (in two holdings)	9.70%
BlackRock Group	7.63%
Mitsubishi UFG Finance	5.66%
Top 20	51%
Board and Management	5.98%

Share Price Performance



The investment opinion in this report is current as at the date of publication. Investors and advisers should be aware that over time the circumstances of the issuer and/or product may change which may affect our investment opinion.

DEVELOPMENT READY TIER 1 MINERAL SANDS PROJECT

Sheffield Resources ("Sheffield" or "the Company"), an ASX listed heavy mineral sands ("HMS") developer has recently completed a BFS Update ("BFSU") for it's Tier 1 Thunderbird Project ("Thunderbird" or "the Project"), located in the Dampier Peninsula of Western Australia. First production from commissioning could potentially be in 2022, following an estimated near two year construction period for what will be a globally significant producer of zircon and titanium products.

Major changes in the BFSU over the 2017 BFS include an accelerated two stage production profile, concentrating on the higher value zircon products; this also remove the low temperature roast ("LTR") ilmenite circuit, thus lowering capital and operating costs - these result in significantly enhanced economics for an already robust project, with a projected first quartile revenue to costs ratio, a key measurement of the profitability of HMS operations.

The Project is now fully permitted and is development ready, with the Company now in the process of attracting a strategic partner to fund the estimated ~A$143 million of equity. Our modelling has estimated that this may be done by selling a 30% stake in the Project at a value of 50% of the proportion of the NPV.

Importantly, binding offtake agreements are in place for ~100% of the planned stage one output - this includes a high value assemblage of primary zircon, zircon concentrate and primary 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 the latter requiring approval from the Western Australian Government.

The Company has also continued work on the regional Dampier HMS Project, with work to date identifying several targets over a 160 km strike length of prospective Canning Basin stratigraphy. One prospect is the Night Train deposit, for which an initial Mineral Resource Estimate ("MRE") of 130 Mt @ 3.30% HM was estimated in 2019 - Night Train is characterised by a high value mineral assemblage. The Company has also continued work on its Perth Basin projects, including Eneabba.

KEY POINTS

Robust, world class project: The 2019 BFSU for Thunderbird highlights a project that will give excellent returns to shareholders over the projected 37 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 - the latter includes the nearby 130 Mt Night Train deposit which hosts a high value mineral assemblage.

Excellent financial metrics: The estimated up-front Stage 1 capital cost of A$392 million is attractive when compared to the post-tax NPV_8 of A$980 million as estimated in the 2019 BFSU, with the Project over the first 10 years providing a revenue to costs ratio of over 2:1 – this is in the 1st quartile of global mineral sands producers, making Thunderbird a highly competitive operation globally.

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.

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$2.34/share for Sheffield, with the majority of this ascribed to our risked NPV_8 technical valuation of Thunderbird. Our per share valuation is based on Sheffield selling a 30% stake in the Project to fund the equity required for project funding. We see material progress in attracting an equity partner as a key catalyst for share price movement, and we also see upside in this with forecast improving product prices and the opportunity for production expansions.

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 the Company should be able to maintain a majority interest in the Project even with obtaining all required equity funding through attracting a development partner.
- **Very attractive economics:** The results of the BFSU have resulted in very attractive and robust economics for Thunderbird, including the NPV/capex ratio, revenue/cost ratio and providing a long life, strong 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 the range of commodities to be produced -- this has been confirmed by the offtake agreements in place. In addition the mineral assemblage is relatively high value when compared with peers (refer to Table 20)
- **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 and Mitsubishi Financial 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 900 km 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 an owner built and operated facility by virtue of the long term debt to be provided by the NAIF, rather than as a third party Build-Own-Operate ("BOO") operation as previously envisaged.

Opportunities

- **Forecast price increases:** A key opportunity is to take advantage of forecast increasing valuable heavy mineral ("VHM") 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

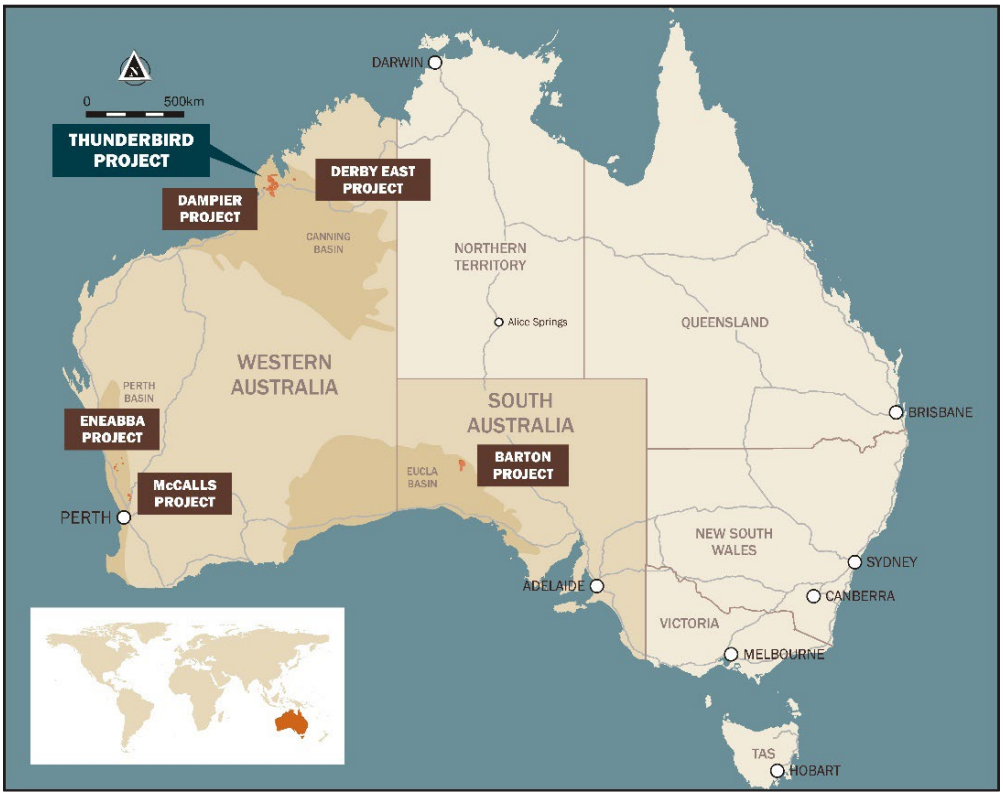
- **Prices and exchange rates:** These are threats facing any mining company, however the robust nature of Thunderbird somewhat shields it from these – the project should be able to readily absorb adverse movements in product prices.
- **Costs:** Again a factor to consider when assessing a resources company, however as for prices the robustness of Thunderbird largely shields it against adverse movements in costs.

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 the 100% owned 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 debt financing now in place the Company is now looking to attract a strategic partner to commence development of Thunderbird, with the potential for first production in CY2022 subject to finalisation of equity funding and a FID.
- 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 (ASX: CWX) in late 2017; this has allowed these quality exploration assets to get the attention that they deserve.
- Twenty million shares in Carawine that were received by Sheffield in the IPO were distributed to Sheffield shareholders through an in-specie distribution.

Figure 1: Project location map



Source: Sheffield

FINANCIAL POSITION

- As of September 30, 2019 the Company had A$10.630 million in cash and no debt.
- The Company has subsequently received the second tranche (A$6.26 million) of an A$18 million placement at A$0.39/share (before costs).
- This placement allowed the Company to withdraw from a US$10 million bridging facility with Taurus.
- In addition to the placement detailed above, over the twelve months to September 30, 2019, the Company raised A$16.231 million through the issue of 24.980 million shares at A$0.65/share, and A$0.661 million through an SPP to existing shareholders at the same price - there was a 20% take-up in the SPP.
- Over the same period the Company spent $24.608 million on exploration and development activities, and $5.564 million on staff and administration costs.

RECENT ACTIVITIES

- The Company has undertaken significant activities since our October 2018 note, with the key being the completion of the BFSU, as released to the market on July 31, 2019 (this is discussed in more detail later).
- The updates to the original BFS were made in response to changes in the mineral sands markets, and to improve project economics and decrease execution risk - key changes in the 2019 BFSU over the 2017 BFS include:
  - LTR ilmenite processing circuit removed, with primary ilmenite now to be sold instead of LTR ilmenite,
  - Zircon production increased by 39%; and,
  - Mine and wet concentrator throughput rates increased.
- The removal of the LTR plant has significantly decreased capital and operating costs, and will decrease project execution risk - the move from supplying LTR ilmenite to primary ilmenite has also come about from forecast high grade feedstock shortages for the chloride pigment sector - this has led to strong growth in chloride slag production and hence demand for ilmenite feedstock.

OFFTAKE AGREEMENTS

- The Company has now successfully signed binding agreements for ~100% of the value of the planned Stage 1 production; this includes all of the zircon production and approximately 100% of the primary ilmenite.
- 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 ZrO_2, TiO_2 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 (44%)	100%	Sukaso, Ruby Ceramics, RZI, Qingyuan Jinsheng, Minchem, CFM. Others
Zircon Concentrate (26%)	100%	Hainan Wensheng, RZI
Primary Ilmenite (30%)	~100%	Bengbu

Source: Sheffield

PROJECT FINANCING

- The Company has estimated total funding requirements of A$478 million for the development of Stage 1 of Thunderbird, and thus far has secured A$335 million (or ~70% of total) in debt funding as detailed below.
- This leaves ~A$143 million to be provided by equity funding, with the Company looking at options regarding this - as such Sheffield has engaged UBS to identify a third party to become a strategic partner in the development, either at the project or corporate level - this is the key activity at the present time.
- Such a project equity sale may be structured in such a way that will minimise (or reduce to zero) the amount of project finance equity that Sheffield will need to raise from existing shareholders.

Debt Funding

- Sheffield has now secured the US$175 million (Taurus project finance) and A$95 million (NAIF infrastructure funding) debt facilities as detailed in Table 2.
- 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.
- Finalisation of the debt is expected by the end of 2019.

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 the infrastructure facilities the Company has secured a 328 person village with part having now been installed at 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,
  - Approval of the Mining Proposal and Mine Closure Plant for Stage 1,
  - The Stage 1A and Stage 1B Works Approvals (Stage 1B is an amendment of the Stage 1A Works Approval); 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

- Early stage site works are now largely completed, with the main site access road and 52 rooms of on-site accommodation (and common areas/support infrastructure) now in place - the accommodation is part of the village as acquired by the Company in late 2017.
- These works are now on hold pending completion of the strategic partner process, however a residential roster is in place for the care and maintenance team.

EXPLORATION

- A drilling programme over a number of targets in the regional Dampier HMS Project surrounding Thunderbird has resulted in strong results from a number of prospects over a 160 km strike length of prospective stratigraphy.
- This has also resulted in the initial MRE for Night Train, which has a high value mineral assemblage.

CARAWINE RESOURCES SPIN-OUT

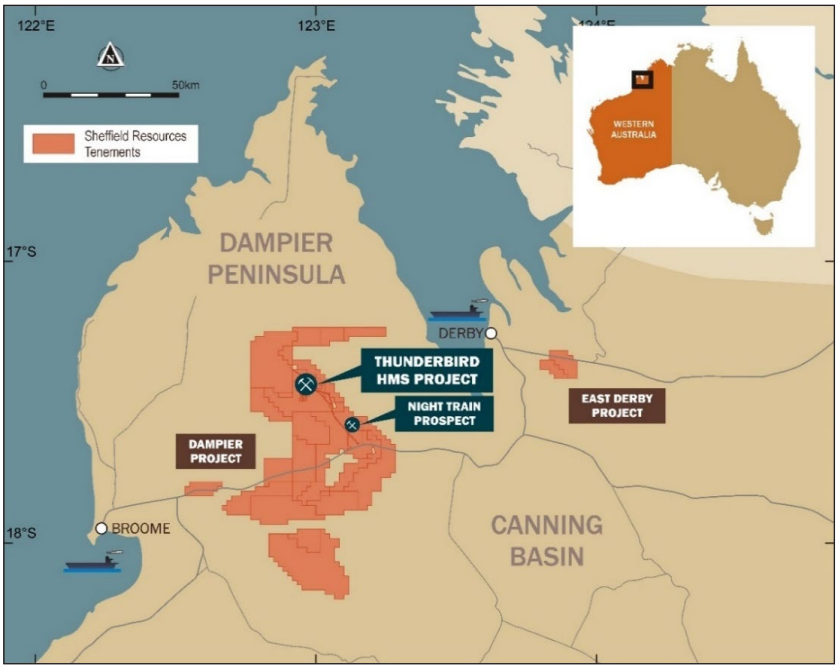
- In late 2017 the Company spun-out its non-HMS assets into Carawine Resources.
- This included the raising of A$7 million through the issue of 35 million shares at A$0.20/share, and the in-specie of 20 million vendor shares to existing Sheffield shareholders on the basis of one Carawine share for every 11.4 Sheffield shares held.
- At the time of writing Carawine is trading at A$0.26/share.

THUNDERBIRD HMS PROJECT - SFX 100%

LOCATION AND TENURE

- Thunderbird is part of the Dampier and East Derby HMS Project which includes one granted Mining Lease ("ML", 4,525 ha), seven granted Miscellaneous Licences (1,781 ha) 24 granted Exploration Licences ("EL", 2,595 km^2) and five EL applications ("ELA", 352 km^2), 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.

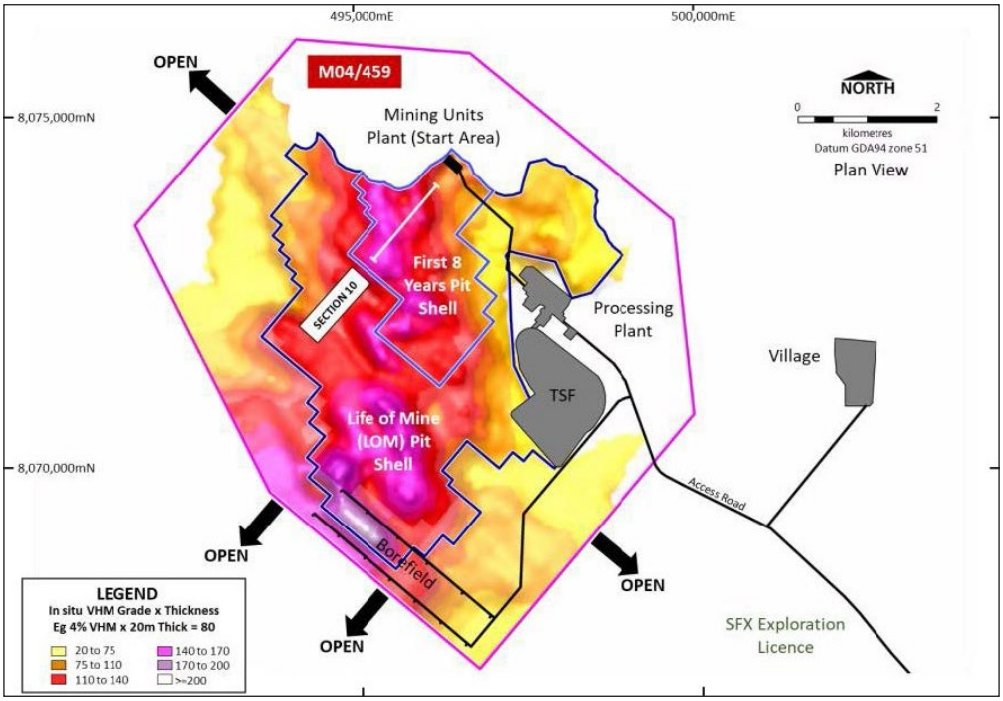
PROJECT HISTORY

- After applying for the EL over what is now the Thunderbird Project in 2010, the tenement, E04/2083 was granted on September 7, 2011.
- Following the discovery of Thunderbird, first pass 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 3.23 Bt @ 6.9% HM; in addition Night Trains has an MRE of 130 Mt @ 3.3% HM.
- Sheffield completed a Scoping Study in early 2014, which envisaged a 20.8 Mtpa, 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 12 mtpa and then increasing to 18 mtpa.
- Subsequent work was incorporated into the BFS, released in March 2017, with an updated BFS released in July 2019, and which is discussed in detail later.

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 90 m 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 2.5 km and 5.5 km down dip (NE/SW), and 8 km along the NW/SE strike (Figure 3).

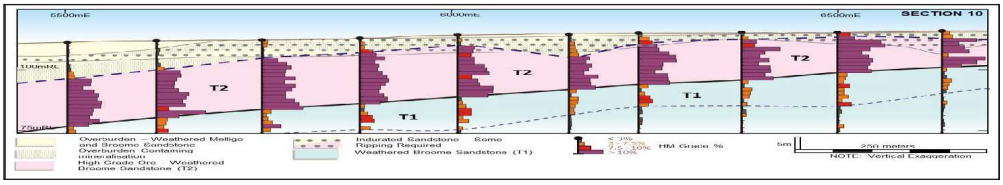
Figure 3: Thunderbird plan showing grade x thickness and proposed site layout



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 47 m, with an average depth to the top of 21 m - around 32% of the resource area is within 6 m of the surface, with the mineralisation being open along strike and down dip.
- The dominant valuable heavy minerals include ilmenite ($FeTiO_3$), zircon ($ZrSiO_4$), leucoxene (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 Annual MRER for Thunderbird was released to the market on September 24, 2019 - this incorporated the initial MRE for Night Train which was released to the market on January 31, 2019 - this is presented in Table 3.
- This is shown at high and low cut-off grades - at both Thunderbird and Night Train the high grade Resources form coherent zones within the broader deposits.

Table 3: Thunderbird Mineral Resource Estimate

Thunderbird Mineral Resource Estimate										
Cut-off (HM%)	Category	Resource Tonnes (Mt)	Insitu HMS (Mt)	HM (%)	Zircon (%)	HiTi Leuc (%)	Leuc (%)	Ilmenite (%)	Slimes (%)	Osize (%)
T'Bird >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**
Night Train >1.2%	Inferred	130	4.2	3.3	0.45	0.18	1.5	0.71	8.7	2.2
	Total	**130**	**4.2**	**3.3**	**0.45**	**0.18**	**1.5**	**0.71**	**8.7**	**2.2**
All Dampier (low cutoff grade)	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	730	42	5.8	0.51	0.17	0.43	1.6	13	7.2
	Total	**3,360**	**227**	**6.8**	**0.57**	**0.18**	**0.25**	**1.9**	**15**	**8.7**
T'Bird >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**
Night Train >2%	Inferred	50	3	5.9	0.82	0.33	2.9	1.06	10.2	2.2
	Total	**50**	**3**	**5.9**	**0.82**	**0.33**	**2.9**	**1.06**	**10.2**	**2.2**
All Dampier (high cutoff grade)	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	230	23	9.7	0.85	0.28	0.83	2.6	12	7.2
	Total	**1,090**	**130**	**11.9**	**0.92**	**0.29**	**0.38**	**3.2**	**14**	**11**

Source: Sheffield (note - rounding errors may occur)

- In addition to the MRE, and exploration target of 3.0 Mt to 4.0 Mt at 3.0% to 4.0% HM has been estimated at Night Train (Figure 6).
- The most recent Ore Reserve update was released to the market on July 31, 2019, with this completed as part of the BFSU (Table 4).
- At 748 Mt, including 30% in the Proved category, the Reserves are sufficient to carry the planned 37 year long life operation, with higher grade Proven Reserves more than sufficient to feed the first 10 years of the planned operation.

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	219	30	13.7	1.02	0.3	0.28	3.68	16.1	14
Probable	529	53.4	10.1	0.79	0.26	0.27	2.87	14.5	10.5
Total	748	83.8	11.2	0.86	0.27	0.27	3.11	15	11.6

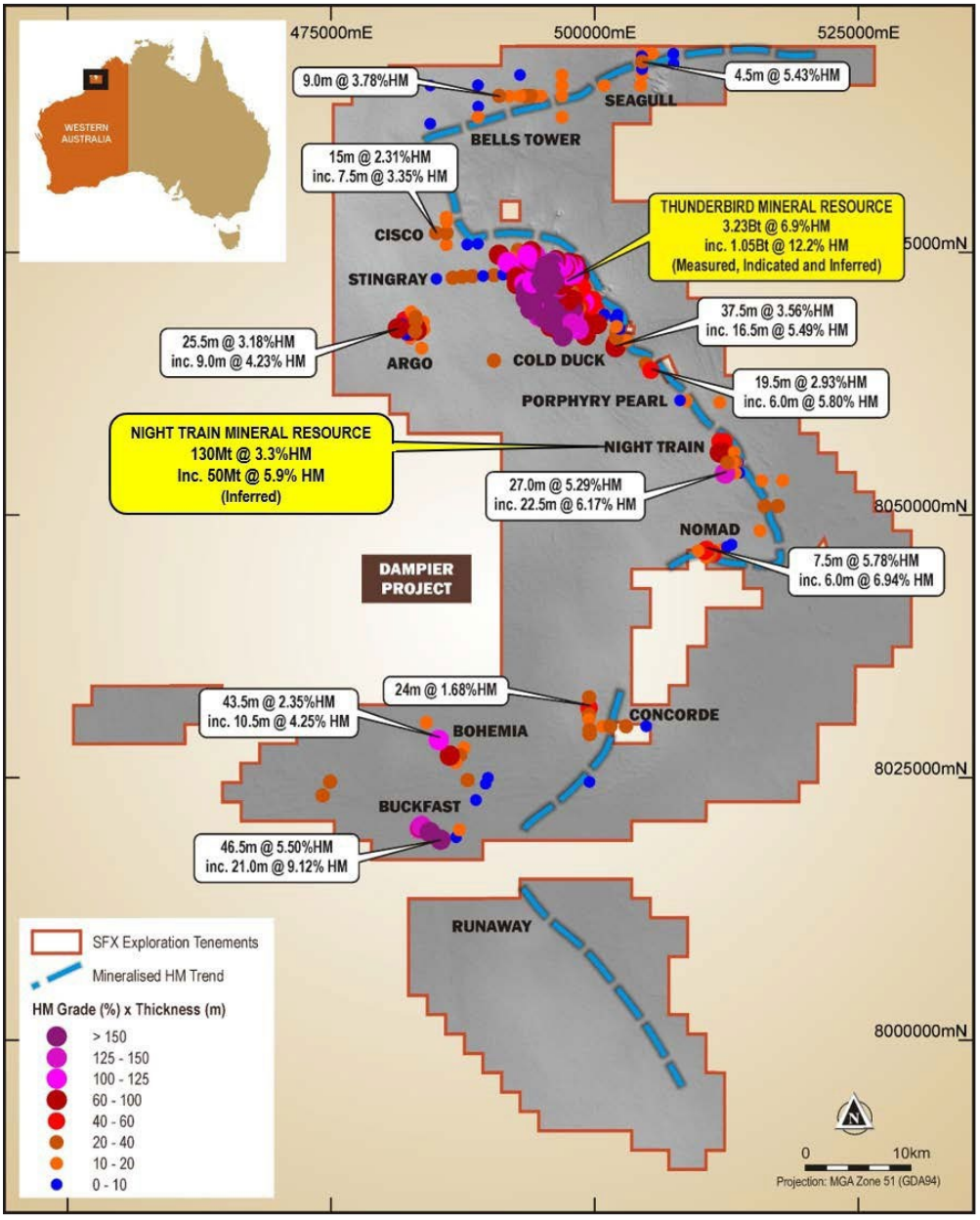
Source: Sheffield

EXPLORATION POTENTIAL

- Work by Sheffield has highlighted the potential for the Canning Basin to be a globally significant mineral sands province - work to date has identified 14 zones of mineralisation along a 160 km trend from Seagull in the north to Runaway in the south (Figure 5).
- This includes the Night Train deposit, located some 20 km SE of Thunderbird, and within 2 km 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.

- As mentioned previously the Company has published an initial MRE and exploration target for Night Train.

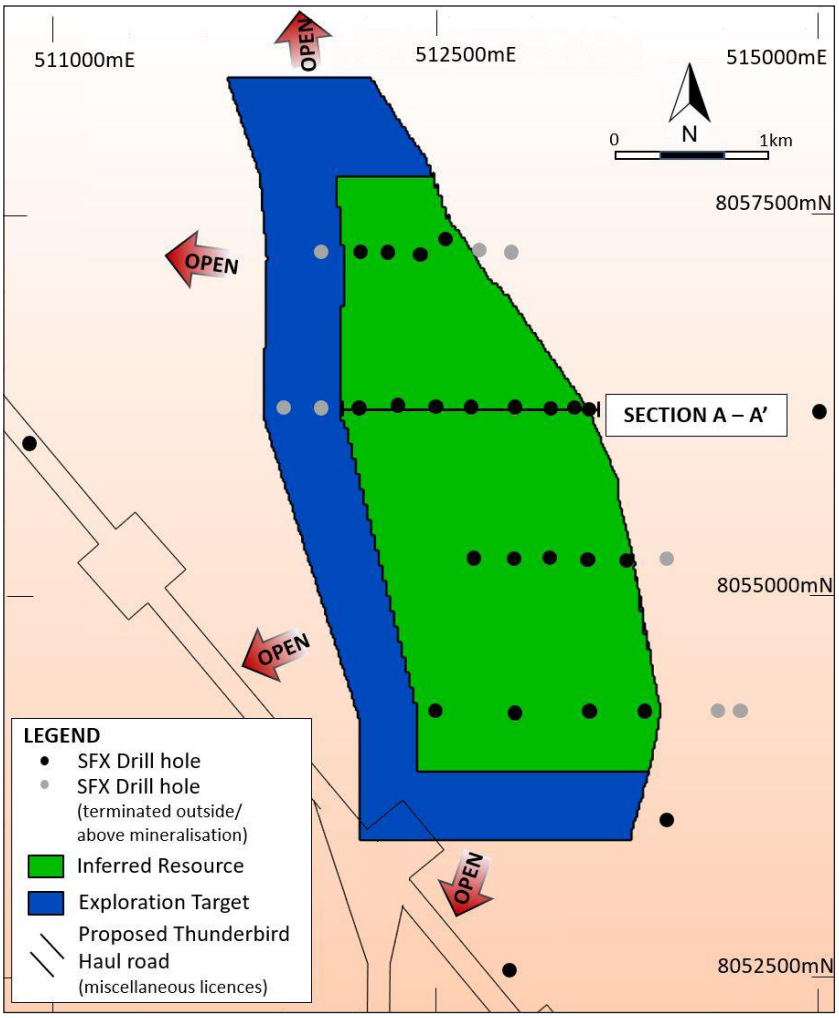
Figure 5: Dampier regional targets



Source: Sheffield

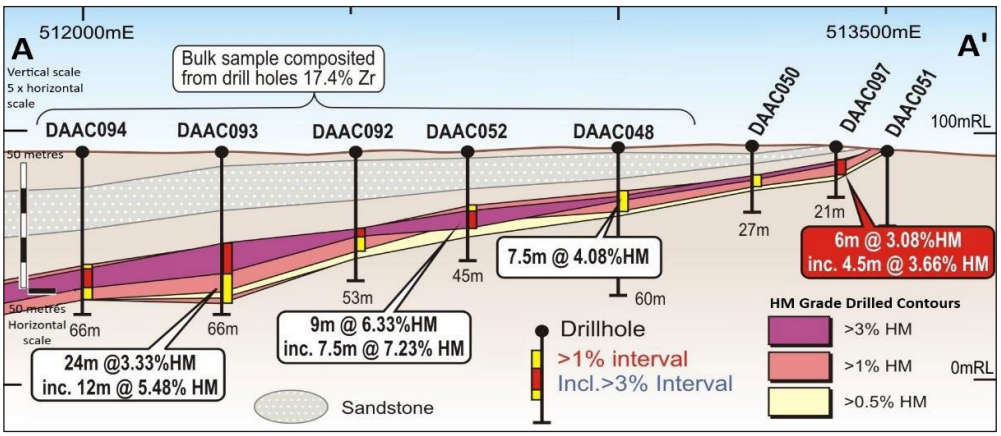
- Drilling has highlighted the quality of the prospect, with some results shown in Figure 7 - others include 27 m @ 5.29% HM (including 22.5 m @ 6.17% HMS) from 49.5 m in hole DAAC114, which occurs at the south-western extremity of the drilled portion of the deposit, highlighting the upside potential.
- Mineralisation, which has been defined for a strike length of over 5 km and a width of between 1.5 km and 2.0 km is open to the north and south and down dip to the west.
- Preliminary metallurgical test work undertaken on a 100 kg drill sample composite in 2016 showed that high quality zircon that meets ceramic specifications can be produced.
- Other prospects have also provided very encouraging intersections,

Figure 6: Night Train plan, showing Resource and exploration target areas



Source: Sheffield

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



Source: Sheffield

UPDATED BANKABLE FEASIBILITY STUDY

- Sheffield completed an original BFS which was released to the market on March 24, 2017 - this has subsequently been updated, with the BFSU released to the market on July 31, 2019 - inputs and outcomes are presented in Tables 5 and 6.
- The BFSU envisages a two stage operation;
  - Stage 1, mining at 10.4 dry Mtpa for years one to four; and,
  - Stage 2, mining at 20.8 dry Mtpa for years five to 37.
- Key outcomes from the BFSU over the original study include improved financial metrics, cutting up-front capital expenditure, reducing project execution risk and increasing the production of the high value primary zircon and zircon concentrate (Table 7).

- Changes in the proposed development which have resulted in the above objectives include:
  - Increased wet concentrator plant ("WCP") throughput to 1,085 dry tph feed, targeting annual zircon production (primary and concentrate) of 202 ktpa over the 37 year project life,
  - Removal of the LTR ilmenite circuit, which will lower capex as well as decrease project execution risk; and,
  - Sell primary ilmenite into the high growth chloride slag market - a binding offtake agreement is in place for 100% of the first seven years of production.
- A comparison of the initial BFS and BFSU is presented in Table 7.

Table 5: Financial results and metrics, Thunderbird 2019 BFSU

Financial results and metrics, Thunderbird 2017 BFS			
$A m, Real 2019 Prices	Financial Year 2022 – 2025	Financial Year 2026 – 2031	LOM
Revenue	1,082	2,979	15,129
Royalties	-73	-218	-1,089
Net Revenue	1,009	2,760	14,040
Opex: Mining	-137	-405	-2,522
Opex: Processing	-186	-497	-2,764
Opex: Logistics	-102	-258	-1,266
Opex: Site G&A	-60	-103	-619
Total Opex	-485	-1,262	-7,170
EBITDA	524	1,498	6,869
Ore Mined (Mt)	42.8	136	748
A$ Site costs / tonne ore mined	11.34	9.28	9.58
A$ Revenue / tonne ore mined	25.31	21.91	20.21
Revenue to C1 costs ratio	2.2	2.4	2.1
	Stage 1	Stage 2	LOM
Capital Expenditure ($Am, including sustaining)	392	237	760
Pre-Tax Project NPV (10% WACC)			1,130
Pre-Tax IRR %			30.1
Post-Tax Project NPV (8% WACC)			980
Post-Tax IRR %			24.0

Source: Sheffield

Table 6: Forecast production and commodity prices

Forecast production and commodity prices				
Production (Average tonnes per annum)	Financial Year 2022 – 2025	Financial Year 2026 – 2031	LOM 2022 - 2058	Total Production (tonnes)
Premium Zircon	55,000	111,000	92,000	3,404,000
Zircon Concentrate	77,000	128,000	110,300	4,070,000
Primary Ilmenite	660,000	1,258,000	961,000	35,557,000
Commodity Prices (US$/tonne)	Financial Year 2022 – 2025	Financial Year 2026 – 2031	LOM 2022 - 2058	Mid 2019 Spot Prices
Premium Zircon	1,520	1,469	1,472	~1,600
Zircon Concentrate	689	718	723	
Primary Ilmenite	102	94	95	

Source: Sheffield

Table 7: BFS and BFSU comparison

BFS and BFSU comparison			
Metric	**2019 BFSU**	**Previous Disclosures**	**Change**
Total Funding Requirement	A$478 m	A$579 m	A$101 m (17%)
Equity Requirement	A$143 m	A$251 m	A$108 m (43%)
Project Capital	A$392 m	A$463 m	A$71 m (15%)
Project Revenue	A$15.1 B	A$13.6 B	A$1.57 B (11%)
Project Operating Costs	A$7.21 B	A$7.63 B	A$0.42 B (6%)
NPV_{10} pre-tax	A$1.13 B	A$0.67 B	A$0.46 B (69%)

BFS and BFSU comparison			
Metric	**2019 BFSU**	**Previous Disclosures**	**Change**
NPV_8 post-tax	A$0.98 B	A$0.62 B	A$0.36 B (58%)
IRR pre-tax %	30.10%	24.90%	5.2% (21%)
Zircon Production (average '000tpa)	202	145	57 (39%)
Offtake	~100%	>75%	Full
LTR & Ilmenite Process Circuit	Not Required	Included in Stage 1	Removed
Process Rate (t/hr)	1,085	788	297 (38%)
Mine Life	37 years	42 years	-5 years (-12%)
Long Term Average FX Rate (A$/US$)	0.75	0.75	No change
Long Term Zircon Price (TZMI)	US$1,469	US$1,387	US$82 (6%)

Source: Sheffield

- The Stage 1 capital cost and total funding requirements breakdown is presented in Table 8 - it is expected that the Stage 2 capex of A$237 million may be largely funded out of cash flow - the capex estimates were undertaken by GR Engineering Services ("GRES") as part of completing an EPC agreement with Sheffield.
- Total sustaining capex requirements are estimated at A$17 million for Stage 1 and A$114 million for years 5 to 37.
- Our view, in comparisons with the estimated capital cost of other mineral sands projects, is that the estimate is reasonable.

Table 8: Capital cost estimate, Thunderbird 2019 BFSU

Capital cost estimate, Thunderbird 2019 BFSU		
Description	**A$M**	**Notes**
Direct Costs		
Wet Concentrator Plant (WCP)	52.9	
Concentrate Upgrade Plant (CUP)	22.0	
Hot Acid Leaching Plant	36.3	
Zircon Processing Plant	52.3	
Process Water Systems	11.4	
Sub-Total - Direct Costs	**174.9**	
Infrastructure		
Engineering and Project Management	22.8	
Site Construction, Commissioning, Mobilisation	70.2	
Power Reticulation and Other Non-Process Infrastructure	24.4	
Sub-Total - Infrastructure	**117.4**	
Owners Costs		
Power Station and Storage, Village and Port Facilities	66.5	Power and gas EPC contract funded by NAIF
Ops Readiness, Tailings Dams, Bore Field and Other	32.9	
Sub-Total - Owners Costs	**99.4**	
Total Stage 1 Upfront Capex	**391.7**	**Includes 7.5% contingency**
Other Funding Requirements		
Pre-operations Net Working Capital	1.5	Net operating cash flows during construction
Financing Costs	17.3	Includes fees, expert costs etc
Cost Overrun Facility	40.0	~10% on Stage 1 upfrant capex as reqd by lenders
Interest During Construction	26.9	LIBOR + facility margin
Sub-Total - Other Funding Requirements	**85.6**	
Total Uses	**477.4**	

Source: Sheffield

- Operating costs are presented in Table 9.

Table 9: Estimated operating costs, Thunderbird 2019 BFSU - A$/ROM tonne

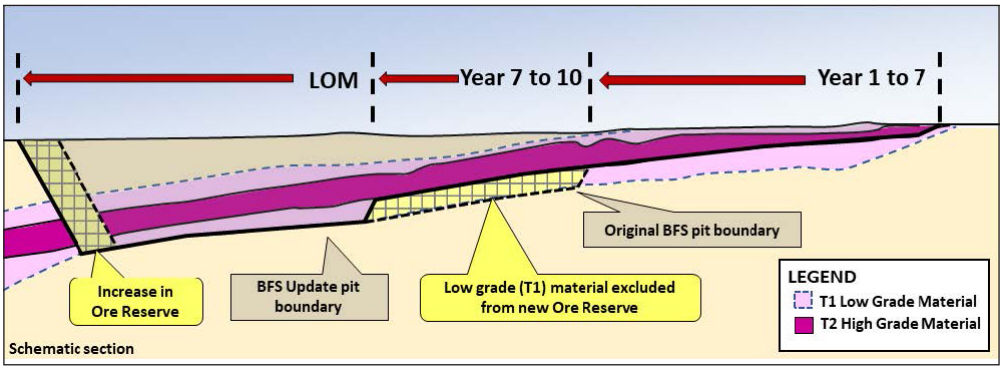
Estimated operating costs, Thunderbird 2019 BFSU - A$/ ROM tonne			
Area	**Stage 1**	**Stage 2**	**LOM**
Mining	3.19	2.98	3.37
Processing	4.36	3.65	3.69
Product Logistics	2.39	1.90	1.69
Site G&A	1.40	0.76	0.83
Total	**11.34**	**9.28**	**9.58**

Source: Sheffield.

Mining

- Mining, will be largely free dig by industry standard dozer trap dry mining and is planned to be contracted out.
- Soil and overburden will be removed and stockpiled using excavators and 100 t 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 planned average feed rate is 1,470 dry tph for each unit, well within the nameplate capacity of 1,800 dry tph
- The MUP will then feed ore to the wet concentrator plant ("WCP") for the start of the beneficiation process - the planned throughput for each WCP is 1,085 dry tph of -2 mm/-38 µm material - this is an increase of 38% to that envisaged in the 2017 BFS.
- The LoM strip ratio is 1.1:1, with the proposed schedule shown in Figure 8.

Figure 8: Schematic mining schedule



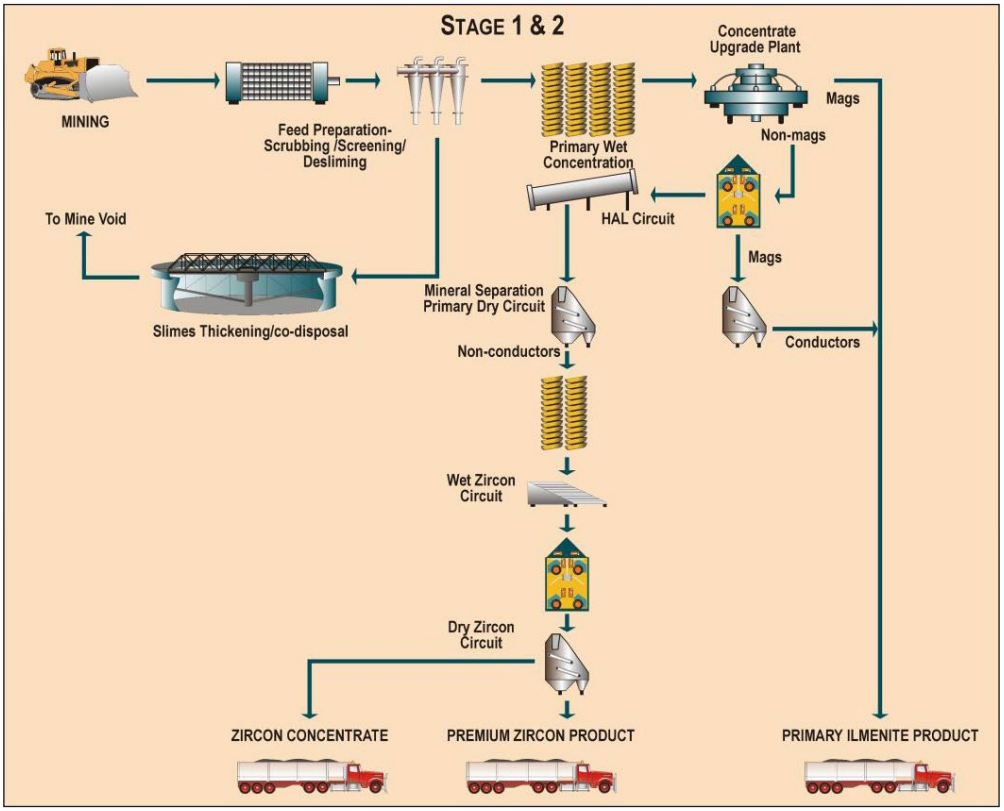
Source: Sheffield

Metallurgical Processing

- The proposed process route has been designed to produce high quality products using industry standard processes – this is shown schematically in Figure 9.
- This has been based on completed metallurgical test work which included 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.
- Material is scrubbed and screened via cyclones in the MUP, with the -38 µm material being disposed of to slimes, and the +2 mm being rejected as oversize.
- The rejected material will be deposited in a surface tailings storage facility ("TSF") until such time as a suitable mine void is developed for in-pit tailings disposal – this is expected to take around 2.5 to 3 years.
- Ore material is then pumped as slurry to the WCP and concentrate upgrade plant ("CUP"), 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.
- 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 shown in Table 10, with expected product grades presented in Table 11.

Figure 9: Proposed process route



Source: Sheffield

Table 10: Product recoveries

Product recoveries			
	Stage 1	Stage 2	LOM
Zircon to Premium Zircon	43.9%	53.0%	53.6%
Zircon to Zircon Concentrate	36.0%	33.3%	33.6%
Ilmenite to Ilmenite Products	76.7%	77.7%	78.7%

Source: Sheffield.

Table 11: Estimated product specifications, Thunderbird 2019 BFSU

Estimated product specifications, Thunderbird 2019 BFSU					
Item	TiO_2 (%)	Fe_2O_3 (%)	SiO_2 (%)	ZrO_2 (%)	ZrO_2+HfO_2 (%)
Primary Ilmenite	56.1	18.5	0.9	0.1	
Premium Zircon	0.14	0.08	32.5		+66%
Zircon Concentrate	~34%	`			~35%

Source: Sheffield

Product Logistics

- Products are planned to be trucked to either Derby or Broome 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 ilmenite and zircon concentrate in bulk to Derby, where it will be stored in a purpose built shed for shipping.
- Derby has historically been used as a bulk terminal, using transhipment – the Company's activities will require refurbishment of the current ship loader and conveyor, with transhipment using barges to the customers' vessels which will be moored 20 km to 30 km offshore.
- Given the relatively small volumes, it is planned to load premium zircon 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 15.5 MW of power through a BOO gas fired power station, with expected power costs of $0.15/kWh - as discussed earlier the Company plans to construct and own this facility, with funding provided by the NAIF.
- Gas for the power station will be supplied by a "virtual" pipeline from the Pilbara gas supply centre at Karratha.
- It is planned to liquefy natural gas at the source, truck 923 km to a storage facility on site for gasifying and use in the power plant – this is the same method that is used to supply gas to the Broome (40 MW) and Derby (12 MW) power stations - the Company also has access to storage facilities in Broome and Derby.
- Estimated gas requirements fro Stage 1 are 1,012 TJ/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 located some 8 km from the processing plant – when finalised this will be able to cater for 400 construction workers and 240 Stage 1 operations personnel (with a further 40 operations personnel based in Broome and Derby) - to date accommodation for 52 personnel has been installed.
- 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 ~10.7 GL/year, with the water being of good quality and low salinity.

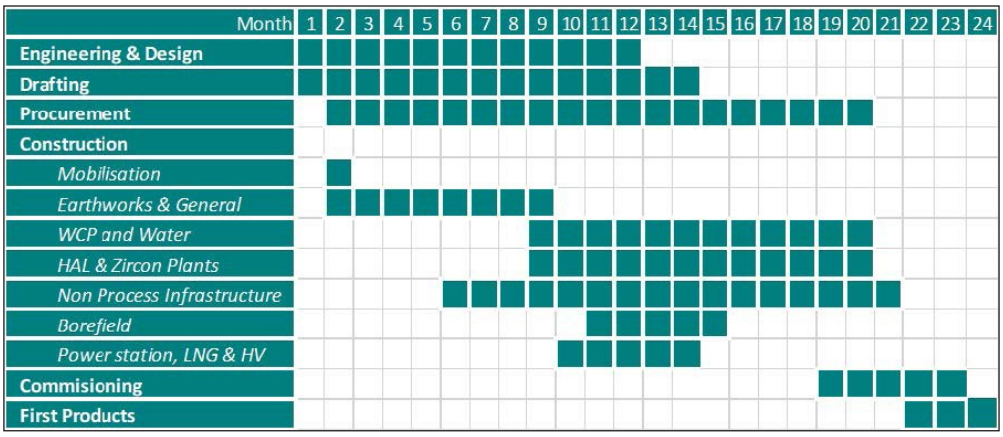
PERMITTING AND STAKEHOLDER ENGAGEMENT

- 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") by the Traditional Owner Negotiation Committee ("TONC") that represented the Mount Jowlaenga Polygon #2 Claimant Group after a successful Authorisation meeting with the wider group of Traditional Owners was held in October 2018.
- 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.
- 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 following a positive FID is shown in Figure 10 - this will be dependent upon successfully engaging a development partner.
- We expect that, given the recent placement, that the Company is fully funded to a FID.

Figure 10: 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 12 and 13 and a map of Eneabba shown in Figure 11.

ENEABBA

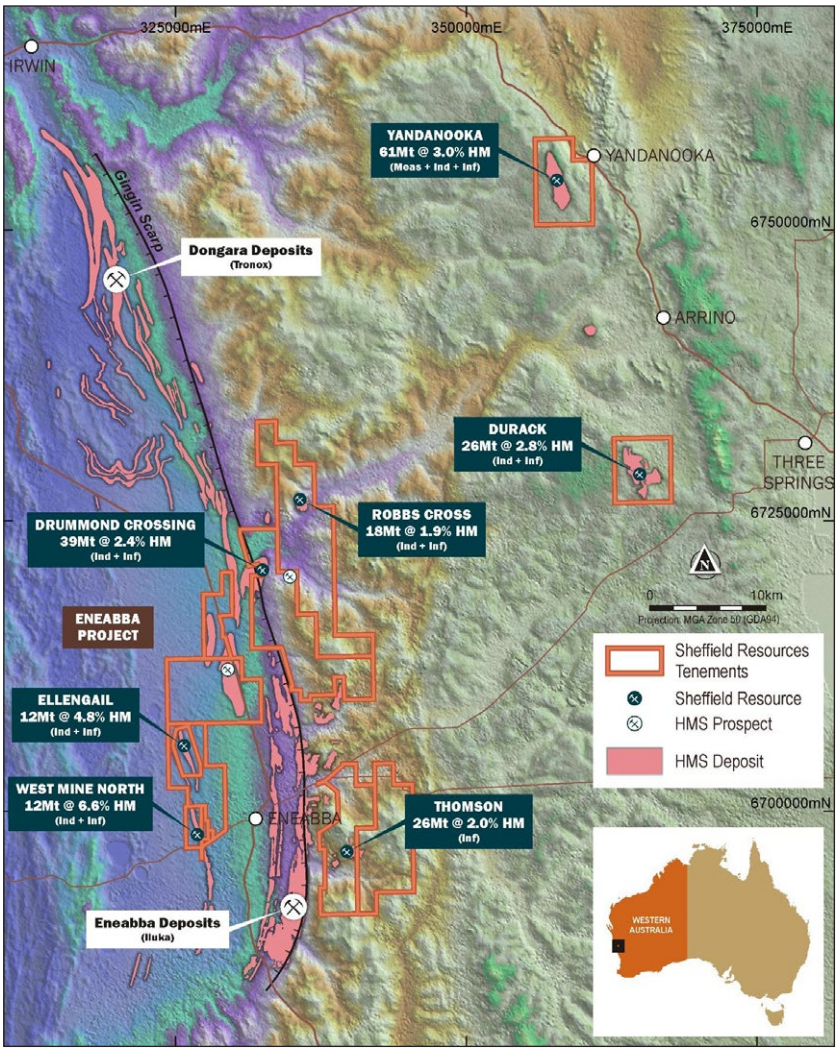
- Eneabba is Sheffield's second mineral sands project, located in the Perth Basin centred approximately 140 km south of Geraldton.
- Eneabba, which comprises five defined dunal sand deposits, one dunal/strandline deposit (Ellengail) and one strandline deposit (West Mine North) and several other prospects is located near existing mineral sands operations in an area of world-class HMS mineralisation and is well served by road and rail to Kwinana/Fremantle and Geraldton Ports.
- Sheffield's strategy is to build up a resource base of at least 10 Mt 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.

Table 12: Eneabba Mineral Resources

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

Figure 11: Eneabba Project



Source: Sheffield

- The deposits in the region are typically zircon and rutile rich, with ilmenite also generally being high grade (>60% TiO_2) 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 11, Table 12).

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 TiO_2 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 +40 Mt 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 13: 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 14, and includes:
  - A risked, funded, post-tax valuation for Thunderbird, with this discussed more fully below,
  - We have included head office costs of A$5 million per annum in the Thunderbird valuation; the after tax NPV_8 of these costs is A$50 million,
  - An indicative valuation of A$20 million for other projects - this is as for our previous valuations,
  - Cash is as of September 30, 2019 plus cash received post the end of the quarter from Tranche 2 of the September placement,
  - We have assumed that the A$150 million project equity we have used has been raised through the sale of 30% of the Project valued at 50% of the unfunded, post-tax NPV (A$1,038 million), and thus there is no requirement for further equity raisings at the Company level - as such we have calculated the per share valuation using the current share structure.
- We have used the product prices as in the BFSU in our model - these are reasonable, and there is upside with improving prices.

Table 14: Sheffield valuation

Sheffield valuation							
Item	**Total**	**Equity Stake**	**Equity Value**	**Tech Risk Factor**	**Risked**	**Risked/ Share**	**Notes**
Thunderbird & Head Office	A$1,223 m	70%	A$856 m	80%	A$685 m	A$2.21	NPV_8, funded, after tax
Other Properties	A$20 m	100%	A$20 m	100%	A$20 m	A$0.07	Nominal
Cash	A$17 m	100%	A$17 m	100%	A$17 m	A$0.06	Sept 30, 2018
Total	**A$1,260 m**	**71%**	**A$893 m**	**81%**	**A$722 m**	A$2.34	
Shares for Reporting			308,959,220				

Source: IIR analysis

THUNDERBIRD VALUATION

- Key inputs are those as in the BFSU.
- A summary of key inputs and outputs is presented in Table 15.

Table 15: Thunderbird key inputs and outputs

Thunderbird key inputs and outputs			
Item	**Units**	**Value**	**Notes**
Mine Life	Years	37	
Total Ore Mined	Tonnes	749,000,000	
VHMS Produced	Tonnes	43,063,000	

Thunderbird key inputs and outputs			
Item	**Units**	**Value**	**Notes**
Av VHMS Sales Price	A$/tonne	$352	Average across all products
Funded NPV, mid-year	A$m	$1,223 m	
IRR, Pre-Tax, Pre-Funding	%	30%	
Discount Rate	%	8%	Real
LoM Revenue	A$m	$15,146 m	
LoM Site Opex	A$m	-$7,037 m	
LoM HO and Misc	A$m	-$209 m	
Lom Royalties	A$m	-$982 m	
LoM EBITDA	A$m	$6,918 m	
LoM Capex	A$m	-$779 m	
Working Capital	A$m	-$86 m	
LoM FCF	A$m	$4,306 m	
Peak annual FCF	A$m	$215 m	
Average Annual EBITDA	A$m	$187 m	
5 x EBITDA Mult	A$m	$934.85	
Project Finance Debt	%	69%	
Debt Amount	A$m	$328 m	Taurus and NAIF facilities
Financing Term	Years	Various	
Interest Rate	%	Various	
Project Finance Equity	A$m	$150 m	
Exchange Rate	AUD:USD	0.75	Updated

Source: IIR analysis

- Forecast production and cash flow figures are presented in Table 16.
- 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 better than 2:1 from 2023 places Thunderbird in a very competitive position amongst global producers.

Table 16: Thunderbird production and cashflow profile

Thunderbird production and cashflow profile								
Year	**Unit**	**FY2020**	**FY2021**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**
Ore Mined	Mt	0.00	0.00	8.00	11.00	11.00	12.00	23.00
Waste Mined	Mt	0.00	0.00	3.00	8.00	8.00	4.00	8.00
Premium Zircon	tonnes	0	0	39,130	63,245	72,345	67,340	105,105
Zircon Concentrate	tonnes	0	0	46,870	75,755	86,655	80,660	125,895
Primary Ilmenite	tonnes	0	0	467,000	688,000	752,000	735,000	1,228,000
Revenue	A$ million	0.0	0.0	185.9	291.3	328.5	310.5	495.7
Operating Costs (inc HO, fees)	A$ million	-17.1	-6.9	-95.7	-129.7	-129.7	-141.1	-218.4
Royalties	A$ million	0.0	0.0	-12.5	-19.7	-22.2	-21.0	-33.5
EBITDA	A$ million	-17.1	-6.9	77.6	141.9	176.6	148.5	243.8
D and A	A$ million	-5.0	-10.2	-10.2	-10.3	-10.3	-17.4	-17.5
EBIT	A$ million	-22.1	-17.1	67.4	131.7	166.2	131.1	226.3
Interest	A$ million	-9.4	-22.2	-22.2	-26.0	-24.1	-22.2	-20.1
EBT	A$ million	-31.6	-39.3	45.2	105.7	142.1	108.9	206.2
Tax	A$ million	9.5	11.8	-13.6	-31.7	-42.6	-32.7	-61.9
NPAT	A$ million	-22.1	-27.5	31.6	74.0	99.5	76.3	144.3
Capex	A$ million	-195.9	-195.9	-1.6	-2.2	-2.2	-239.4	-4.6
Revenue to Costs	X	0	0	1.94	2.25	2.53	2.20	2.27
Weighted Shares	309.0	309.0	309.0	309.0	309.0	309.0	309.0	309.0
EPS	-0.07	-0.09	0.10	0.24	0.32	0.25	0.47	0.49

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 17.
- Table 18 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.
- 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 17: Un-risked, funded, after tax Thunderbird sensitivity analysis, 100% basis

Un-risked, funded, after tax Thunderbird sensitivity analysis, 100% basis					
Change	Zr Price	Ti Price	Revenue Factors	Site Costs	Capex
-20%	A$792 m	A$1,030 m	A$599 m	A$1,518 m	A$1,278 m
-10%	A$1,007 m	A$1,127 m	A$911 m	A$1,371 m	A$1,252 m
0%	A$1,223 m	A$1,223 m	A$1,223 m	A$1,223 m	A$1,223 m
10%	A$1,438 m	A$1,319 m	A$1,535 m	A$1,075 m	A$1,191 m
20%	A$1,654 m	A$1,416 m	A$1,846 m	A$928 m	A$1,155 m

Source: IIR analysis

Table 18: Thunderbird risked per share sensitivity, company equity basis

Thunderbird risked per share sensitivity, company equity basis						
		Change in Site Operating Costs				
		-20%	-10%	0%	10%	20%
Change in Revenue	20%	$3.88	$3.61	$3.35	$3.08	$2.81
	10%	$3.32	$3.05	$2.78	$2.51	$2.25
	0%	$2.75	$2.48	$2.21	$1.95	$1.68
	-10%	$2.19	$1.92	$1.65	$1.38	$1.12
	-20%	$1.62	$1.35	$1.09	$0.82	$0.55

Source: IIR analysis

PEER GROUP ANALYSIS

- There are only a handful of ASX-listed mineral sands companies, as shown in Table 19 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 20 presents a range of published mineral sands Resources and Reserves for Australian companies with a theoretical in ground value based on USD 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 19: 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%	$4,096.4 m	2,351 Mt	5.46%	128.4 Mt
Base Resources	Kwale, Kenya	Producing	100%	$229.8 m	1,440 Mt	3.50%	50.5 Mt
Sheffield Resources	Thunderbird, WA	Development	100%	$75.7 m	9,333 Mt	1.83%	170.9 Mt
Strandline Resources	Various, Tanzania	Development ready	100%	$34.8 m	1,896 Mt	1.18%	22.3 Mt
Astron Corporation	Donald, Murray Basin Victoria	Optimisation of FS	100%	$19.7 m	4,780 Mt	2.92%	139.7 Mt
Diatreme Resources	Cyclone, WA	PFS complete	100%	$14.7 m	204 Mt	1.71%	3.5 Mt
Metallica Minerals	Point Urquart, Queensland	On hold	50%	$2.6 m	3 Mt	2.01%	0.1 Mt
Broken Hill Prospecting	Murray Basin	Exploration, MRE	100%	$2.4 m	113 Mt	1.22%	1.4 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 308 Mt Coburn deposit in Western Australia – activities however are focussed on Tanzania.

Source: IRESS, Company reports: Company reports

Table 20: HMS deposit comparisons

HMS deposit comparisons								
Coy	**Project/ Area**	**Deposit**	**Total Tonnage (Mt)**	**HMS Grade**	**Ti Mins %**	**Zircon %**	**Total Potentially Payable HMS Grade**	**Value/ ore tonne[1]**
ILU	Murray Basin	West Balranald - Resources	36	32.99%	24.01%	3.58%	27.59%	$109.93 /t
ILU	Murray Basin	Murray - Resources	195	16.81%	11.49%	1.80%	13.29%	$57.10 /t
ILU	Eucla Basin	Eucla - Resources	377	5.40%	2.91%	1.58%	4.49%	$27.88 /t
SFX	Dampier, WA	Night Train HG - Resources	50	5.90%	4.29%	0.82%	5.11%	$26.65 /t
Rele	Murray Basin	Kopi North - Resources	12	6.86%	5.28%	0.79%	6.07%	$25.53 /t
SFX	Dampier, WA	Thunderbird HG - Resources	1,040	12.20%	3.96%	0.93%	4.88%	$19.93 /t
SFX	Dampier, WA	Thunderbird - Reserves	748	11.93%	3.83%	0.91%	4.74%	$19.50 /t
ILU	Eucla Basin	Ambrosia - Resources	149	2.23%	0.28%	1.11%	1.39%	$17.77 /t
MuZi	Murray Basin	WIM150 - Resources	1,650	3.72%	1.82%	0.77%	2.59%	$17.50 /t
ATR	Murray Basin	Donald - Resources	4,780	3.70%	2.22%	0.70%	2.92%	$17.48 /t
MLM	Cape York	Urquart Point - Resources	3	5.94%	1.40%	0.61%	2.01%	$15.81 /t
DRX	Eucla Basin	Cyclone - Reserves	138	2.60%	1.13%	0.72%	1.85%	$15.30 /t
SFX	Dampier, WA	Night Train - Resources	130	3.30%	2.39%	0.45%	2.84%	$14.39 /t
ILU	Perth Basin	Perth Basin - Resources	999	5.60%	3.42%	0.55%	3.97%	$13.95 /t
SFX	Eneabba, WA	West Mine North HG - Resources	12	6.61%	3.74%	0.40%	4.15%	$13.93 /t
DRX	Eucla Basin	Cyclone - Resources	204	2.28%	1.10%	0.62%	1.71%	$13.66 /t
Rele	Murray Basin	Magic - Resources	15	3.70%	2.89%	0.52%	3.40%	$13.63 /t
ILU	Sri Lanka	Sri Lanka - Resources	690	8.15%	5.89%	0.29%	6.18%	$13.48 /t

HMS deposit comparisons

Coy	Project/ Area	Deposit	Total Tonnage (Mt)	HMS Grade	Ti Mins %	Zircon %	Total Potentially Payable HMS Grade	Value/ ore tonne[1]
STA	Tanzania	Fungoni - Reserves	12	3.89%	1.80%	0.67%	2.47%	$13.23 /t
MZI	Keysbrook, Perth Basin	Keysbrook - Resources	86	2.19%	1.80%	0.26%	2.06%	$12.39 /t
SFX	Dampier, WA	Thunderbird - Resources	3,230	6.91%	2.30%	0.57%	2.88%	$12.32 /t
MuZi	Murray Basin	Mindarie All - Resources	244	3.09%	1.80%	0.52%	2.32%	$11.53 /t
ILU	Sierra Leone	Sierra Leone - Resources	720	2.00%	1.16%	0.08%	1.24%	$10.67 /t
ILU	USA Atlantic	USA - Resources	90	4.79%	3.09%	0.50%	3.58%	$10.67 /t
BSE	Kenya	Kwale - Reserves	62	3.74%	2.64%	0.22%	2.87%	$10.19 /t
BPL	Murray Basin	Jaws - Resources	63	1.90%	1.18%	0.19%	1.37%	$10.17 /t
SFX	Eneabba, WA	Eneabba All - Resources	163	2.92%	2.07%	0.37%	2.43%	$9.66 /t
STA	Tanzania	Fungoni - Resources	22	2.82%	1.30%	0.47%	1.77%	$9.53 /t
BSE	Toliara, Madagascar	Ranobe - Resources	1,156	4.88%	3.63%	0.26%	3.88%	$8.40 /t
MZI	Keysbrook, Perth Basin	Yangedi - Resources	47	1.60%	1.27%	0.13%	1.40%	$7.45 /t
BPL	Murray Basin	Gilligans - Resources	50	1.60%	0.88%	0.14%	1.02%	$7.37 /t
BSE	Kenya	Kwale - Resources	284	2.82%	1.80%	0.15%	1.95%	$7.00 /t
STA	Tanzania	Tajiri - Resources	268	3.30%	2.17%	0.12%	2.30%	$5.79 /t
STA	Coburn	Coburn All - Resources	1,606	1.21%	0.72%	0.26%	0.98%	$5.51 /t
STA	Coburn	Coburn All - Reserves	523	1.12%	0.66%	0.25%	0.91%	$5.24 /t
MDL	Grande Cote, Senegal	Grande Cote - Resources	1,847	1.40%	1.08%	0.15%	1.23%	$3.78 /t
MDL	Grande Cote, Senegal	Grande Cote - Reserves	1,765	1.44%	1.06%	0.15%	1.20%	$3.68 /t
SFX	McCalls, WA	McCalls - Resources	3,610	1.29%	1.13%	0.06%	1.20%	$2.66 /t
SFX	McCalls, WA	Mindarra Springs - Resources	2,200	1.60%	1.16%	0.07%	1.23%	$2.48 /t
MZI	Keysbrook, Perth Basin	Railway - Resources	14	2.20%	0.00%	0.00%	0.00%	$0.00 /t

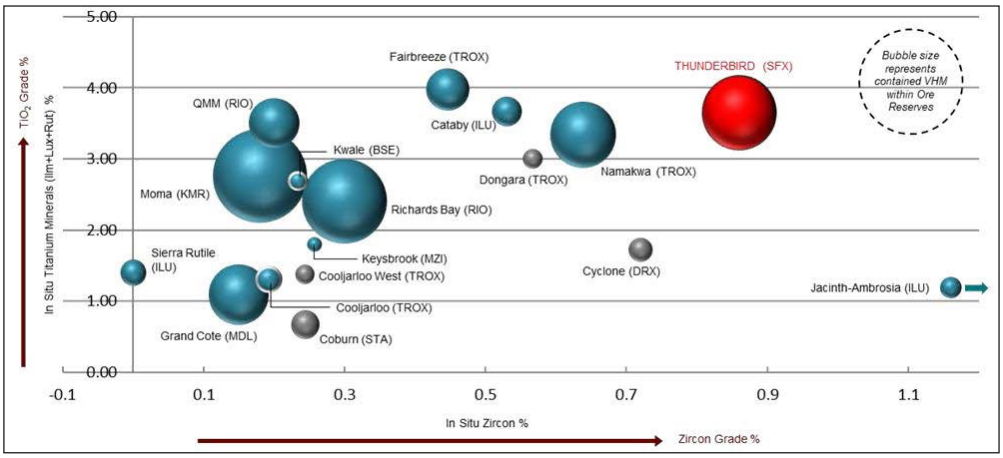
1: Values based on the following USD prices per tonne: Zircon - $1,500, Rutile $900, High Ti leucoxene $500, Low Ti Leucoxene $400, Ilmenite $104. Metallurgical recoveries have not been taken into account.

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

Source: IRESS, Company reports: Company reports

- Figure 12 shows a comparison of zircon and titanium dioxide feedstock mineral grades in Ore Resources – this clearly shows the quality of Thunderbird.

Figure 12: Resource grades of HMS projects



Source: Sheffield

CAPITAL STRUCTURE

- Sheffield currently has 308.96 million shares, 7.795 million options (including employee options) and 9.34 million performance rights on issue.
- The top shareholders include Mr Walter/Mrs Jeanette Yovich and Mr Walter Yovich with combined holdings of 9.70%, Blackrock with 7.63% and Mitsubishi UFJ Financial Group holding 5.66%.
- Total insiders interests are 5.98%, with the top 20 holding 51%
- 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, and the company has used appropriate recovery assumption in their financial models
- **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 Ian Mcliver - Non-Executive Director:** Mr Macliver is the Executive Chairman of Grange Consulting Group Pty Ltd and Grange Capital Partners (Grange). Prior to establishing Grange, he held positions over nine years in a general manager or executive director

position for various listed and corporate advisory companies. His experience covers all areas of corporate activity including capital raisings, acquisitions, divestments, takeovers, business and strategic planning, debt and equity reconstructions, operating projects and financial reviews and valuations. Ian has established contacts with many venture capital and broking institutions.

Mr Macliver is the Non-Executive Chairman of nickel miner Western Areas Ltd and is also Non-Executive Director of oil and gas company Otto Energy Ltd

- **Mr John Richards - Non-Executive Director:** Mr Richards is an Independent Non-Executive Director. He has previously held positions including Group Executive - Strategy and Business Development at Normandy Mining Ltd, Head of Mining and Metals Advisory (Australia) at Standard Bank, Managing Director at Buka Minerals Ltd and Operating Partner at Global Natural Resources Investments.

  Mr Richards is an economist with more than 35 years' experience in the resources industry. During this time, he has held strategy and business development positions within mining companies as well as in investment banks and private equity groups. He has been involved in a wide range of mining M&A transactions in multiple jurisdictions. Mr Richards joined the Saracen Mineral Holdings Ltd Board in 2019 as a Non-Executive Director and is the Chair of the Audit Committee and a member of the Remuneration & Nomination Committee.

- **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 (BFS) 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 2017 global demand of 1.2 Mt, 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.
- It is a key white pigment in that it has a high refractive index (whiteness), provides UV protection and in 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 7.10 Mt) the major titanium dioxide producers were South Africa and Australia (both with ~20%) and China (11%).

Table 21: Titanium dioxide products sold, 2017

Titanium dioxide products sold, 2017			
Product, approx 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

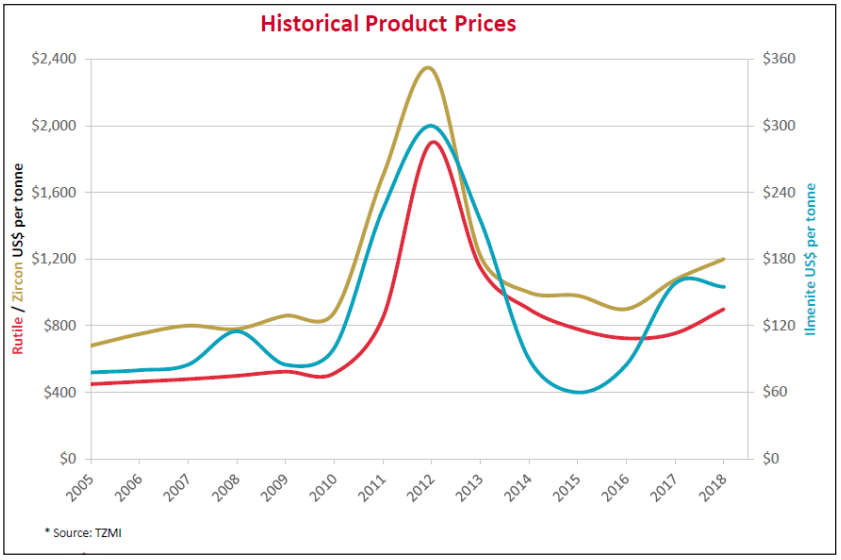
- Like zircon, Australian share of production had fallen from 24% of 6.5 Mt in 2011 (1.6 Mt) to 20% of 7.10 Mt in 2017 (1.35 Mt), again largely due to Iluka curtailing production and sales.
- Rio Tinto (20% in 2017) is the largest producer, with operations in South Africa (Richards Bay), QIT (Canada) 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 7.10 Mtpa (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 13 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 13: Zircon and Titanium Dioxide Prices

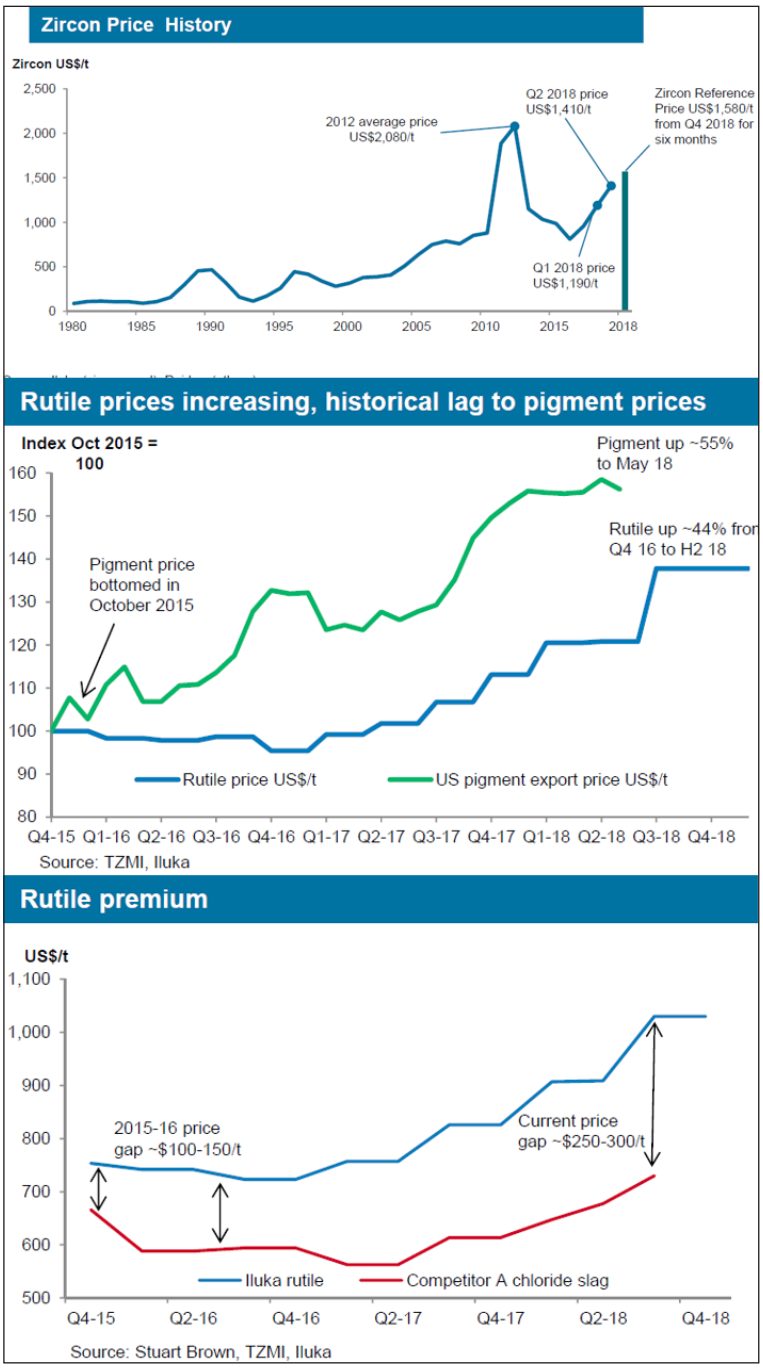


Source: Base Resources presentation

- 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 a 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 14: Zircon and Titanium Dioxide Prices



Source: Iluka 1H18 Results presentation

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