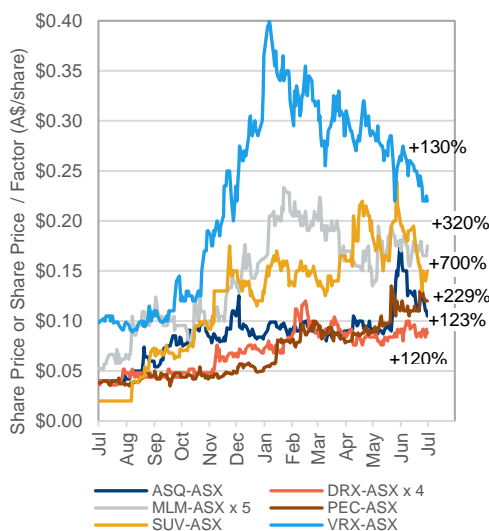
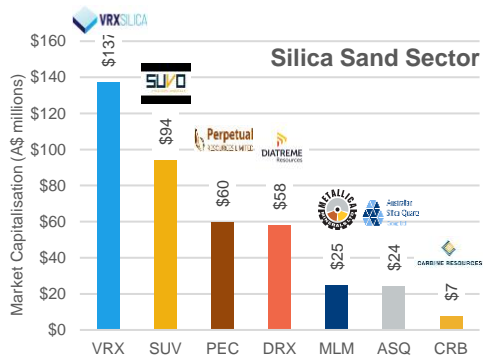


## Sector Research

26<sup>th</sup> July 2021



**Australian Silica Quartz Group Ltd (ASQ)** holds a number of hard rock quartz and high grade silica sand projects at various stages of development in WA. ASQ also owns an exploration licence prospective for Ni-Cu-PGE along strike the Julimar discovery and some bauxite projects in the Darling Range, WA.

**Diatreme Resources Ltd (DRX)** is an emerging producer of mineral and silica sands. Key projects comprise the Galalar silica sand project in Far North Queensland, located next to the world's biggest silica sand mine, together with the Cyclone zircon project in Western Australia's Eucla Basin.

**Metallica Minerals Ltd (MLM)** explores for silica sands, bauxite, copper, gold, graphite, and limestone projects. The company holds interests in the Cape Flattery silica sands project covering an area of approximately 56 km<sup>2</sup> located in Far North Queensland; Urquhart bauxite project situated on the Cape York; Esmeralda graphite project located near Croydon; and Fairview limestone projects.

**Perpetual Resources Ltd (PEC)** is an emerging silica sand producer with three projects prospective for high purity silica and construction sand products – all located proximal to established infrastructure in Western Australia.

**Suvo Strategic Minerals Ltd (SUV)** is a dual commodity Australian mining company focused on the development of its White Knight kaolin project located in the Yilgarn Craton and its Nova silica project located near the township of Eneabba, Western Australia. It also operates the Pittong kaolin mine and processing plant near Ballarat in Victoria.

**VRX Silica Ltd (VRX)** is wholly focused on becoming a global high quality silica sand producer and exporter. It owns silica sand projects at Arrowsmith, located 270km north of Perth, at Muchea, 50km north of Perth, and Boyatup, 100km east of Esperance. All locations benefit from adjacent rail lines connecting to ports in Geraldton (Arrowsmith), Kwinana (Muchea) and by road to the port at Esperance (Boyatup).

## AUSTRALIAN SILICA SAND SECTOR

J-François Bertincourt

**Booming demand and finite resource:** Silica is found in nature in the form of hard rock quartz and naturally weathered sand. It is one of the most plentiful naturally occurring minerals on the Earth. High grade silica sand is, however, relatively rare and it is experiencing booming demand. This is because high purity sand is required for making both flat glass and container glass as impurities such as sulphides and iron will cause imperfections. High-tech applications such as fibre-optics, LCD panels, LED lights and solar panels require ultra-clear glass produced with high purity silica sand. Supply is becoming an issue to the point where illegal mining is widespread in some countries.

Market research firm IMARC Group previously estimated the global silica sand market could grow from \$US7 billion in 2018 to \$US20 billion in 2024.

**Australia, again the lucky country:** Australia has several quality silica sand projects that are either in production or progressing through the exploration and development process.

In northern Queensland, Mitsubishi currently produces sand from its Cape Flattery Silica Sands (CFSS) mine. Adjacent to this mine, both Diatreme Resources Ltd and Metallica Minerals (ASX: MLM) have exploration tenure and have delineated high purity silica sands resources comparable to CFSS. In Western Australia, Australian Silica Quartz Group Ltd (ASX: ASQ) has secured three silica sand projects in the areas of Albany, Gingin and Esperance.

Also in Western Australia, Suvo Strategic Minerals Ltd (ASX: SUV) is working towards delineating a maiden mineral resource at the Nova silica sand project close to Eneabba and Carbine Resources Ltd (ASX: CRB) has acquired the Muchea West silica sand project (directly west of the VRX's Muchea project).

Finally in the same region between Dongarra and Eneabba, Perpetual Resources Ltd (ASX: PEC) with its Beharra project (PFS Mar 2021) and VRX Silica Ltd (ASX: VRX) with its Arrowsmith project (BFS Aug 2019) appear to be the closest to start delivering products to market.

**Path to Production:** Beyond progressing the technical and financial studies, the environmental and regulatory approvals are key to start production and export to the Asian markets, among the various players, PEC and VRX are currently the most advanced companies.

Company	VRX Silica	Perpetual	Diatreme	Metallica	Silica Quartz	Suvo
Code	VRX	PEC	DRX	MLM	ASQ	SUV
Key project	Arrowsmith	Beharra	Galalar	Flattery	White Hill	Nova
Mineral Resource	771 Mt	139 Mt	31 Mt	38 Mt	12 Mt	-
Ore Res./ Mining Inventory	204 Mt	64 Mt	14 Mt	-	-	-
Scoping Study	↓	↓	Sep-19	↓	Q3 2021	-
PFS	Sep-19	Mar-21	Q4 2021	Q3 2021	Q3 2021	-
DFS	✓	in progress	Q4 2021	Q1 2022	Q3 2021	-
Mining Lease Approval	✓	in progress	in progress	in progress	in progress	-
Environmental Approvals	in progress	in progress	in progress	in progress	in progress	-
Initial Capex	A\$26m	A\$39m	A\$24m	-	<A\$5m	-
Throughput/Production	2 Mtpa	1.5 Mtpa	0.95 Mtpa	-	0.5-1.0	-
Gearing	ungeared	40%	n/a	-	-	-
Silica Sand Price (FOB)	A\$50-66/t	A\$67/t	US\$107/t	-	-	-
Cash Cost (FOB)	A\$28/t	A\$43/t	A\$58/t	-	-	-
Post-tax NPV (or pre-tax)	148	236	231	-	-	-
Post-tax IRR (or pre-tax)	60%	77%	150%	-	-	-
Mine Life (years)	25	32	15	-	-	-
		2 MOU	MOU	-	-	-
Off-take Agreements	in progress	(0.4+0.6 Mt)	(0.25 Mt)	-	-	-

Source: company announcements. NPV and IRR are pre-tax for DRX. NPV for VRX used a 20% discount rate.

**Valuation:** All the listed companies in the silica sand sector have experienced significant share price appreciation over the last twelve months. Subject to delivering key milestones and completing the construction of their project in a reasonable timeframe, all companies should continue to perform well.

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All currencies are in Australian dollars unless otherwise specified.

## 1. Path to Production

### Technical Development

Compared to base and precious metals, the development path to production of silica sand projects appears relatively straight forward technically and can be progressed quickly:

- Drilling consists of shallow holes
- Resource modelling benefit from low variability across a deposit
- Substantial mineral resource can be delineated quickly
- Processing flow charts typically consist of screening, desliming, gravity, magnetic and physical separation with no chemical reagents involved.

As for other specialty minerals, one of the keys is to produce consistently a silica sand according to the specifications of the off-taker.

### Permitting

On the other hand, the permitting process remains similar to any mining projects. It includes running both the Mining Licence approval process (including negotiation with the Traditional Land Owners) and the environmental approvals in parallel.

Table 1.1 summarises the key dates and milestones achieved by DRX, MLM, PEC and VRX with regard to permitting.

**Table 1.1 – Environmental and Regulatory Approval Processes**

Process		Announcement Date to ASX			
WA Department of Mines, Industry, Regulation and Safety (DMIRS)		VRX	PEC	DRX	MLM
Mining Lease Application for Arrowsmith North		24-Dec-18			
Mining Lease Application for Muchea		17-Jan-18			
Mining Lease Application for Arrowsmith Central		14-Feb-19			
Native Title Mining Project Agreement signed for Muchea		31-Jan-20			
Mining Lease granted for Muchea		29-Oct-20			
Aboriginal Heritage Clearance for Arrowsmith North and Central		06-Nov-20			
Mining Lease granted for Arrowsmith North and Central		17-Nov-20			
Mining Lease Application lodged for Beharra			08-Apr-21		
Queensland Department of Resources					
Mining Lease Application lodged for Nob Point				10-Jun-21	
Mining Lease Application lodged for Cape Flattery					15-Jun-21
Environmental Protection Authority		VRX	PEC	DRX	MLM
Stage 1	Referral of a proposal to the EPA (s. 38)	18-Mar-21			
Stage 2	EPA decides to assess the referred proposal under s. 39A(1)	25-May-21			
Stage 3	Assessment of proposals (s. 40 to s. 43A)				
Stage 4	EPA report on the assessment of a proposal (s. 44)				
Stage 5	Decision on proposal and implementation of proposals (s. 45 to s. 48)				

Source: company announcements

The 25<sup>th</sup> May 2021 VRX announcement indicates that “the EPA will assess the proposal under s39A(1) of the Environmental Protection Act 1986 at a Public Environmental Review (PER) level of assessment for a 4 week period, which commenced on 18<sup>th</sup> May 2021.”

As part of the PER, VRX “will prepare an Environmental Scoping Document (ESD) which details the environmental studies that are required to inform the assessment of the project. Additional studies may include:

- Cultural and Heritage Assessment
- Greenhouse Gas Estimate
- High Level Air Quality Assessment”

VRX “has already commenced there studies and will finalise prior to the end of the PER period.”

We note that the PER period has passed with no further update on permitting from VRX at this time.

DRX, MLM and PEC have lodged Mining Lease Applications for their respective flagship project all in second quarter of 2021.

**Table 1.2 – Comparative Analysis**

Company	Silica Qtz	Diatreme	Metallica	Perpetual	Suvo	VRX Silica
Code	ASQ	DRX	MLM	PEC	SUV	VRX
Flagship Project	White Hill	Galalar	Flattery	Beharra	Nova	Arrowsmith
Resource (Mt)	11.6	61.9	38.3	139.0	x	771.0
Ore Reserve (Mt)	x	-	x	64.1	x	204
PFS			Q3 2021	Mar 2021		
DFS		Q4 2021	Q1 2022			Aug 2019
Market Capitalisation	\$25m	\$57m	\$19m	\$60m	\$88m	\$137m
Cash (31 Mar 2021)	\$5.9m	\$4.1m	\$1.9m	\$3.8m	\$5.8m	\$8.8m
Enterprise Value	\$19m	\$53m	\$17m	\$56m	\$82m	\$128m

Source: Company announcements.

## 2. Silica Sands

### What are Silica Sands?

Silica sands is quartz that over time, through the work of water and wind, has been broken down into tiny particles. The purity of silica sands varies from location to location due to environmental factors and as a result high purity sand is much sort after by end users.

At present, there is a global shortage of silica sand, owing to a number of export bans and the increased demand for sourced sand which is both environmentally and socially responsible. Sands found in deserts are unsuitable for the purposes the market requires, as it is shaped by wind rather than water (causing the grain to be round rather than angular) resulting in a further lack of supply.

### Use of Silica Sands

Silica sand is the primary component of all types of standard and specialty glass. It provides the essential SiO<sub>2</sub> component of glass formulation, silica represents over 70% of the final glass weight; its chemical purity is the primary determinant of colour, clarity and strength in glass.

The use of silica sands varies greatly but is used in production of:

- glass products: architectural, smartphones, tablets, automotive, fiberglass, solar panels;
- building products: quartz surfaces, roofing shingles;
- foundry sand; automotive and manufacturing, into foundry sand markets; and
- fillers and extenders, chemicals and construction sands.

Quartz (also known as silica) is produced commercially from a wide variety of deposits including unconsolidated sand, sandstone, quartzite, granite, aplite, and pegmatite. Silica sand and quartz are economical sources of SiO<sub>2</sub> used in glass and ceramics manufacture, for which key deleterious elements include iron and titanium.

## Markets

### Glass and Ceramics

In the production of glass, there is both the need and requirement for silica to be chemically pure (composed of over 98%  $\text{SiO}_2$ ), of the appropriate diameter (e.g. a grain size of between approximately 0.1 mm and 0.4 mm and with low iron content (less than approximately 0.04%  $\text{Fe}_2\text{O}_3$ ))

**Table 2.1– Silica chemical specifications for glass and ceramics markets**

Market	$\text{SiO}_2$ % Min	$\text{Al}_2\text{O}_3$ % Max	$\text{Fe}_2\text{O}_3$ % Max
Flat glass	99.5	0.3	0.04
Container flint glass	98.5	0.5	0.035
Insulation fibre glass	95.5	2.2	0.3
Porcelain	97.5	0.55	0.2
Enamels	97.5	0.55	0.02

Source: VRX, modified from Sinton (2006)

**Table 2.2– Physical size specifications for glass sand**

Sieve size	Mesh size	Flat glass	Flint container glass
mm	Openings per inch	Cum. % retained	Cum. % retained
1.18	14	0.0	0.0
0.85	18	<0.01	0.0
0.425	36	<0.1	<4
0.106	150	>92	>25
0.075	200	>99.5	>95

Source: VRX, modified from Herron (2006)

### Foundry Sand

Silica sand is used in the production of sand moulds for casting of metals; this product is described generically as 'foundry sand'. Although other types of sand e.g. olivine, zircon, aluminosilicate or chromite sands can be used to make moulds, silica sand is used primarily because it is globally available and relatively inexpensive.

There are different size specifications depending on the foundry application. Foundry sands are commonly bonded using bentonite clay and water, or resin, depending on the application. Milled coal is commonly added to create a reducing environment and to improve the casting finish by depositing a lustrous carbon layer at the sand/casting interface.

It is preferable to have rounded to sub-rounded silica grains with medium to high sphericity, as this improves flowability of the mould during formation and allows for higher permeability after the metal has been poured. More angular sands don't pack as well and require higher binder additions.

Most foundry sands fall into the range of ~0.1mm to 0.5mm and they are produced to meet specific size distributions which are commonly described by a number known as the 'AFS number'. The higher the AFS number, the finer the sand.

The global silica sand market could grow from US\$7 billion in 2019 to US\$20 billion in 2024 (source: IMARC Group), while the global solar PV glass market is estimated to reach US\$48.2 billion by 2025, up from US\$3.3 billion in 2016 (source: Bizwit Research & Consulting).

According to industry research firm IMARC Group, high-purity silica sands are becoming more sought after, with the global market growing at a

compound annual growth rate (CAGR) of around 6% between 2010 and 2017. In 2017, a total of 188 Mt of silica sand was produced globally.

This growth has been driven by silica sand's applications across a broad range of industries including glass-making, foundry casting, water filtration, chemicals and metals, hydraulic fracturing and an increasing number of hi-tech products, including solar panels.

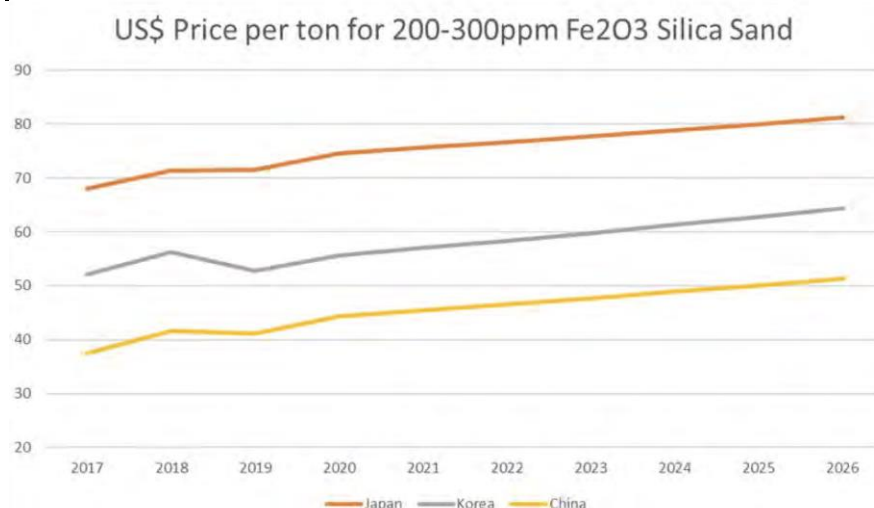
### Pricing

Unlike construction sands, which are used for their physical properties alone, high-grade silica sands are valued for a combination of chemical and physical properties.

Glass manufacturing product specifications are centred around the silica dioxide content of the silica sand, with consideration specifically attributed to other contained elements such as iron, titanium, aluminium and calcium, all of which affect the quality of the final glass products. Foundry industry product specifications are mostly centred around the size and shape of the silica sand grains.

Pricing ranges from country to country and is determined mostly by impurity levels (with a focus on  $\text{Fe}_2\text{O}_3$ ), once a base level of silica has been achieved (typically  $> 99.5\% \text{SiO}_2$ ).

**Figure 2.1 – Regional APAC silica sand pricing for 200-300ppm  $\text{Fe}_2\text{O}_3$**



Source: IMARC Group (Asia Pacific Silica Sand Market)

## 3. Australian Silica Quartz Group Limited

### Albany White Hill Silica Sand Project

The Albany Silica Sand Project consists of three granted exploration licences and four application exploration licences within 10-80 km of the Port of Albany.

ASQ has entered into an Exploration and Mining Access agreement ("Access Agreement") on a private freehold property located 70km east of Albany. This property has been selected following extensive desktop assessment and roadside reconnaissance.

The Access Agreement covers an area of 189 ha located on ASQ's 100% owned exploration licence E70/5262 and covers access for both exploration and also for mining should the project progress to



development. The project area is currently used for tree farming and has been previously cleared of native vegetation.

### Mineral Resource

ASQ has completed a Mineral Resource Estimate totalling 11.6 Mt with >99.9% SiO<sub>2</sub> + LOI and <50 ppm Fe<sub>2</sub>O<sub>3</sub> and extends over a strike length of 1,650m and has a maximum width of 1,565m.

**Table 3.1– Albany White Hill Silica Sand Deposit Inferred Mineral Resource – Jan 2021**

Size Fraction	Tonnes	Yield	SiO <sub>2</sub> + LOI	Al <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>
Fine	8.2 Mt	70.6%	99.93%	145 ppm	410 ppm	46 ppm
Coarse	3.4 Mt	29.1%	99.91%	137 ppm	668 ppm	43 ppm
<b>Total</b>	<b>11.6 Mt</b>		<b>99.92%</b>	<b>143 ppm</b>	<b>486 ppm</b>	<b>45 ppm</b>

Source: ASQ

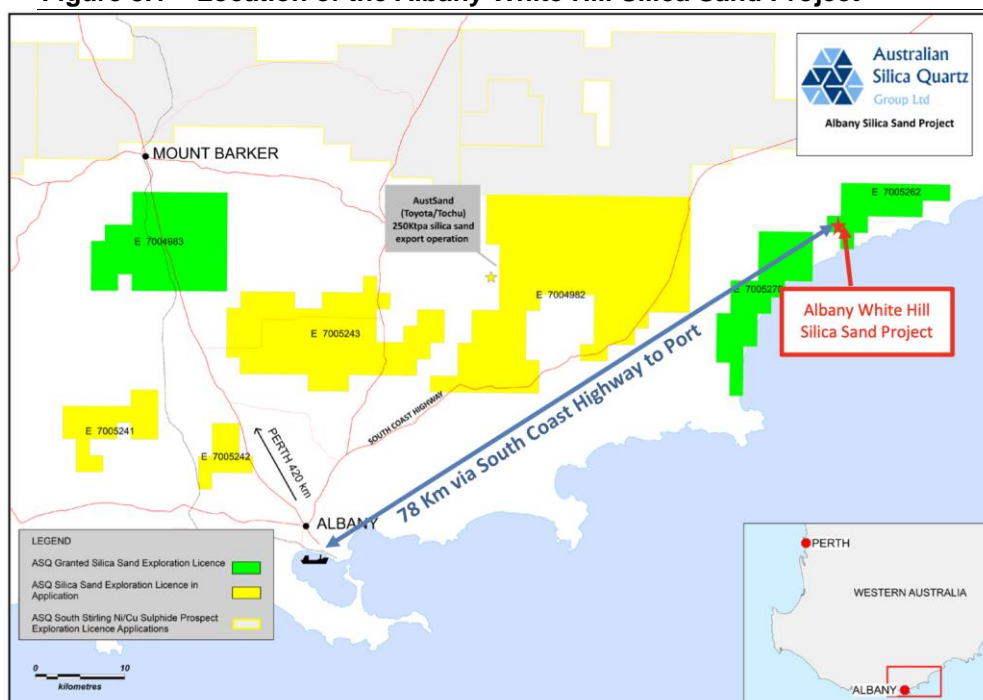
The mineral resource combines SiO<sub>2</sub> and LOI figures, which is unusual and results in biased SiO<sub>2</sub> grades reported by ASQ.

### Development

A Scoping Study looking at the suitability of the deposit for development into a 0.5 – 1.0 Mtpa export operation is progressing. The study includes stakeholder consultation, preliminary engineering design, environmental assessment, logistics and market assessments along with operational and capital expenditure estimates and financial modelling.

ASQ aims to be able to report the results of the Scoping Study and commence a feasibility study by Q3 2021.

**Figure 3.1 – Location of the Albany White Hill Silica Sand Project**



Source: ASQ. ASQ South Stirling Ni-Cu sulphide tenements shown for context

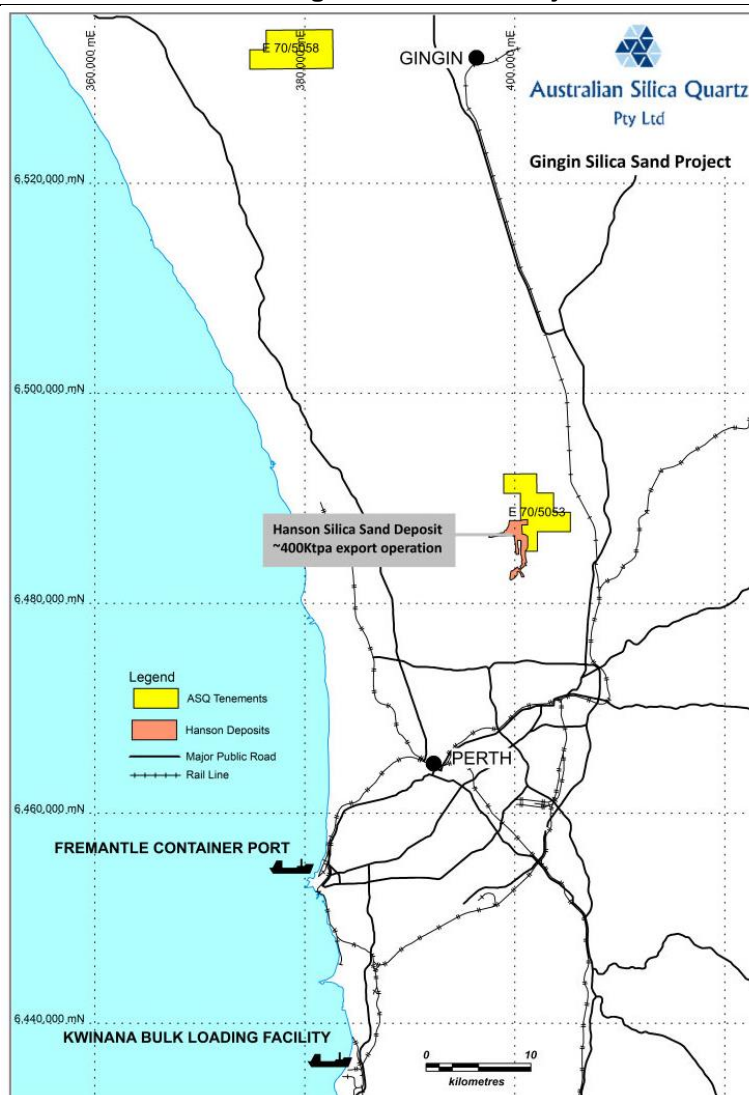
### Gingin Silica Sand Project

The Gingin Silica Sand Project consists of one application exploration licence located 20km north of Perth.

Historical sampling of the sand resources in the area demonstrate high grade silica sand with a silica content in excess of 99%, (Silica Sales Pty Ltd drilled 600 holes with sample grades ranging between 99.3% and 99.7%). The high-grade silica sand consists of almost pure quartz with only traces or no impurities of heavy minerals such as rutile and ilmenite. The sand grains were well rounded with a grain size within the range of 0.15 - 0.6mm.

The high grade silica sands in the Gingin project area are slightly coarser than the sands in the two southern projects at Albany and Esperance and the SiO<sub>2</sub> content of the sand is slightly higher.

**Figure 3.2 – Location of the Gingin Silica Sand Project**



Source: ASQ

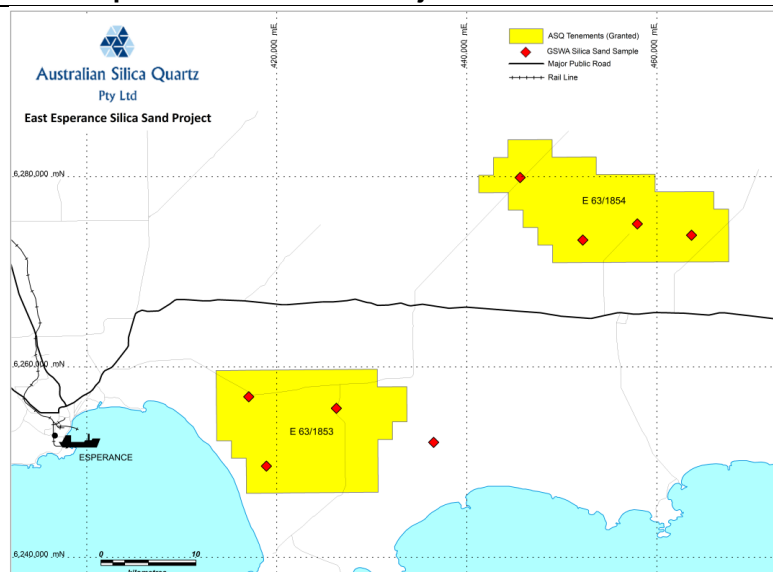
### Esperance Silica Sand Project

The Esperance Silica Sand Project consists of two granted and 100% owned exploration licences, totalling 522 km<sup>2</sup>, 15-50 km East of the Port of Esperance.

The company is currently advancing the project by way of obtaining land access and assessing the sand deposits and road, port and shipping logistics for potential export of high grade silica sand from these locations.



**Figure 3.3 – Esperance Silica Sand Project Areas**



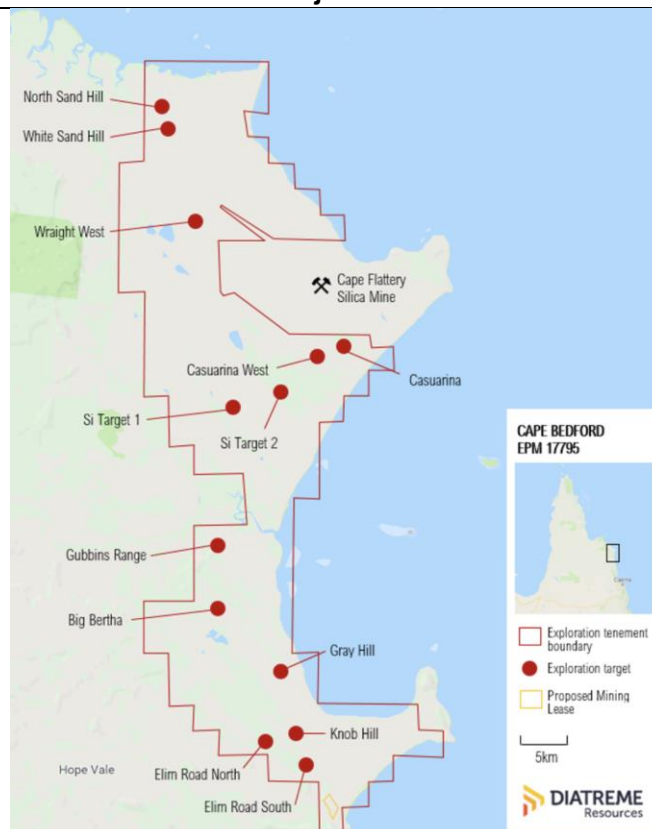
Source: ASQ

#### 4. Diatreme Resources Limited

##### Galalar Silica Project

Located around 200km north of Cairns and 20km north of the port of Cooktown, the Galalar Silica Project (EPM 17795) lies within the same sand dune system and in close proximity to the world's largest operating silica sand mine at Cape Flattery. The Cape Flattery silica sand product is recognised as a global benchmark for quality silica sand and is widely used for industrial purposes throughout Asia.

**Figure 4.1 – Galalar Silica Sand Project Areas**



Source: DRX

## Mineral Resource

DRX has completed a Mineral Resource Estimate totalling 61.6 Mt with 99.24% SiO<sub>2</sub>.

**Table 4.1– Galalar Silica Sand Deposit Mineral Resource – March 2021**

Category	Tonnes	Cut-off	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>	LOI
Inferred	5.8 Mt	98.5	99.21%	500 ppm	900 ppm	500 ppm	0.14%
Indicated	20.6 Mt	98.5	99.20%	500 ppm	700 ppm	500 ppm	0.14%
Measured	35.5 Mt	98.5	99.27%	900 ppm	1,000 ppm	900 ppm	0.10%
<b>Total</b>	<b>61.6 Mt</b>		<b>99.24%</b>	<b>1,020 ppm</b>	<b>891 ppm</b>	<b>729 ppm</b>	<b>0.12%</b>

Source: DRX

## Development

DRX has lodged a Mining Lease Application and is progressing environmental studies with the aim of fast-tracking development, targeting Asia's fast-growing solar PV and other markets.

DRX is targeting receiving the necessary environmental approvals and Mining Lease in the fourth quarter of 2021 and potential first production in 2022. This appears optimistic in our view.

Recent meetings with key stakeholders in Hope Vale together with key federal government ministers in Canberra (refer ASX release 23 February 2021) have highlighted the community support for the project, with affected native title holders having a direct 12.5% stake in the project.

## 5. Metallica Minerals Limited

### Cape Flattery Silica Sands Project

Metallica's 100% owned Cape Flattery Silica Sands (CFSS) project is adjacent to the world class Cape Flattery Silica Sand mining and shipping operation owned by Mitsubishi. Exploration drilling to date has now confirmed that the sand dunes within EPM 25734 contain high purity silica sands with an *in situ* quality, which is understood to be comparable to Mitsubishi's Cape Flattery Silica Mine.

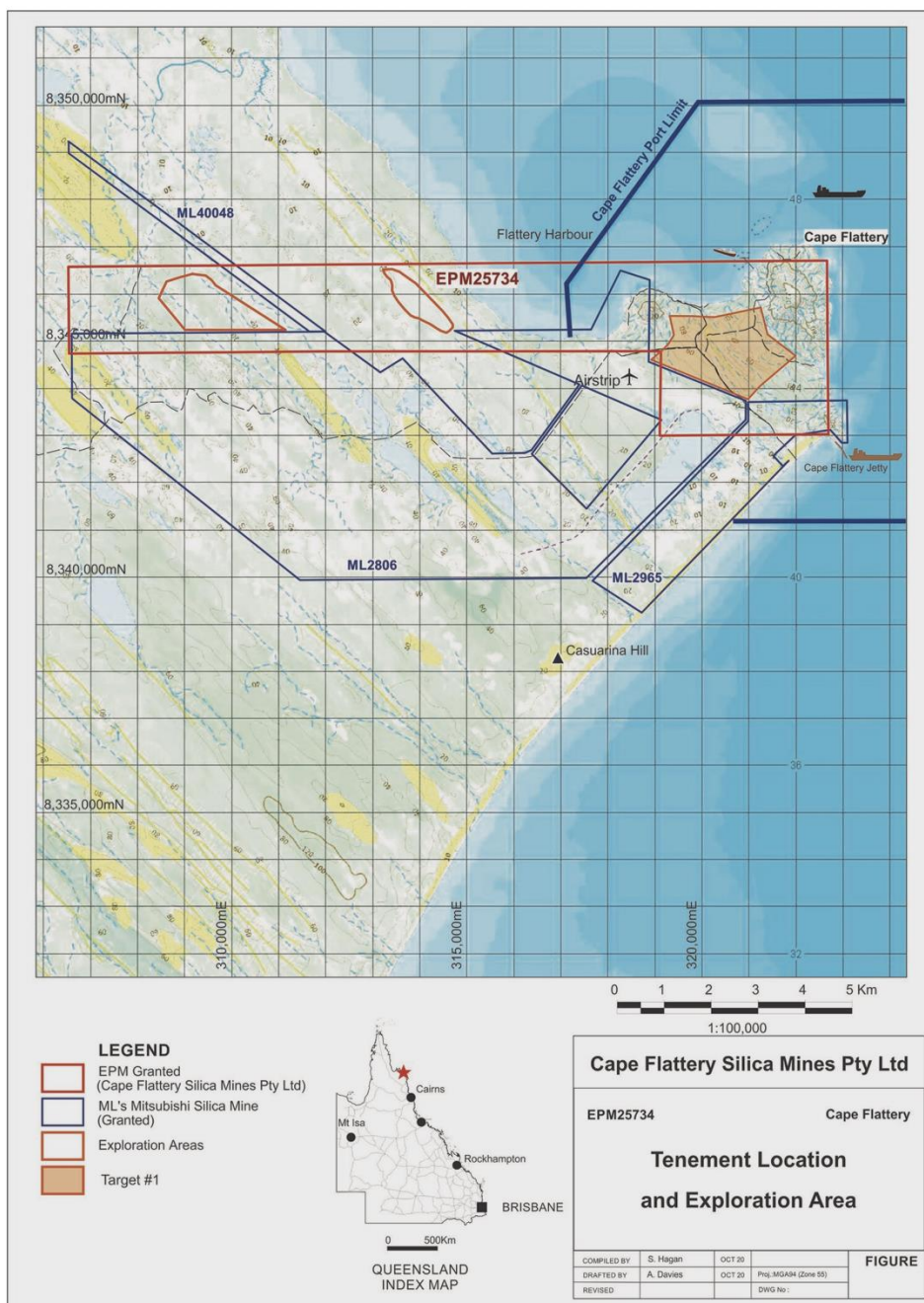
In mid-April it was announced that the 5 Water Monitoring Bores (WMB) had been installed within the main target area on its 100% owned Cape Flattery Silica Sand project.

The purpose of this program is to analyse the existing water table that lies within the planned development area and the potential impact, if any, on the existing aquifers.

The water bores have been installed on existing tracks within EPM 25734 and are specifically located in the key area of focus for the potential mine location (see map above). In preparing for the installation of the water bores, cultural clearance was completed with the key aboriginal stakeholders, namely Hopevale Congress Aboriginal Corporation and Walmbaar Aboriginal Corporation.

In addition to the water bore installation, a wet season flora and fauna environmental study has been undertaken. A team of environmental consultants from Epic Environmental completed a baseline ecological assessment and these preliminary findings will be used in the preparation for meetings with key Queensland Government departments and future Environmental Approval applications.

**Figure 5.1 – Cape Flattery Silica Sand Project**



Source: MLM

## Mineral Resource

On 2<sup>nd</sup> March 2021, MLM released an upgraded resource in the CFSS Eastern Resource Area.

**Table 5.1– Cape Flattery Silica Sand Deposit Mineral Resource – March 2021**

Category	Tonnes	SiO <sub>2</sub> Cut-off	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>	LOI
Inferred	5.4 Mt	98.5%	99.1%	400 ppm	1,300 ppm	900 ppm	0.14%
Indicated	32.9 Mt	98.5%	99.0%	700 ppm	1,500 ppm	1,200 ppm	0.14%
<b>Total</b>	<b>61.6 Mt</b>		<b>99.0%</b>	<b>600 ppm</b>	<b>1,500 ppm</b>	<b>1,200 ppm</b>	<b>0.12%</b>

Source: MLM

## Development

Metallica is progressing the following activities to advance the Cape Flattery Silica project:

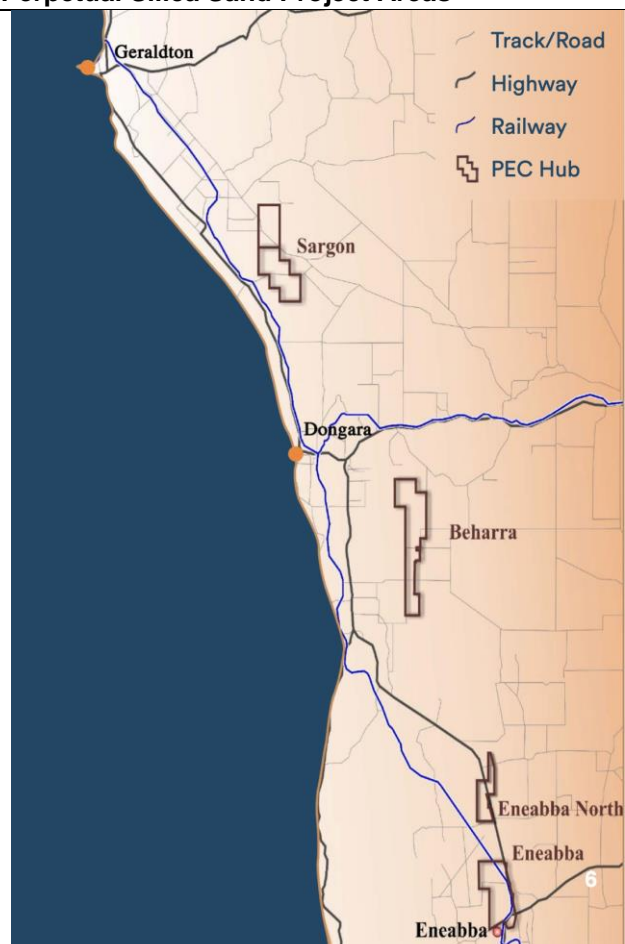
- Complete the metallurgical testwork on a representative silica sand bulk sample to determine processing requirements and assist in understanding the marketability of a premium sand product
- Continue environmental studies and field work
- Progress key agreements with the Traditional Land Owners including Aboriginal Cultural Heritage Agreements
- Continue discussions with the neighbouring silica mine and other tenement holders on the potential for synergies between projects
- Commence an internal project Scoping Study to determine high-level financial metrics
- Continue work towards lodging a Mining Lease Application.

## 6. Perpetual Resources Limited

### Beharra Silica Sands Project

Perpetual's flagship asset, the Beharra Project is located 300km north of Perth and is 96km south of the port town of Geraldton in Western Australia covering an area of about 49 km<sup>2</sup>. Access to the Project from Geraldton (to the north) and Perth (to the South) is via the sealed Brand Highway, thence the Mt Adams unsealed road providing access to the centre of the tenure.

**Figure 6.1 – Perpetual Silica Sand Project Areas**



Source: PEC

## Mineral Resource

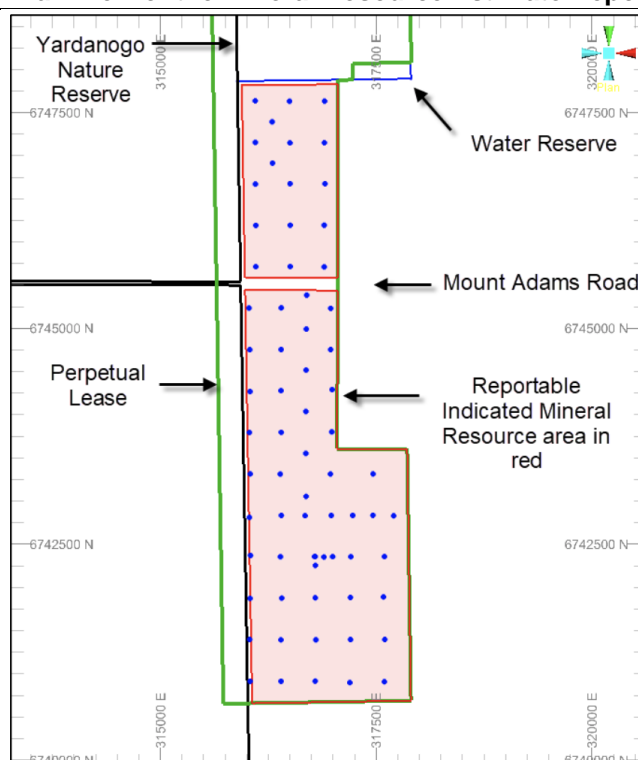
On 9<sup>th</sup> March 2021, PEC released an upgraded mineral resource estimate for the Beharra project.

**Table 6.1– Beharra Silica Sand Deposit Indicated Mineral Resource – March 2021**

Sand	Tonnes	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>	LOI
Yellow	13.2 Mt	98.2%	5,000 ppm	2,300 ppm	2,300 ppm	0.51%
White	125.8 Mt	98.6%	4,100 ppm	3,600 ppm	2,300 ppm	0.21%
<b>Total</b>	<b>139.0 Mt</b>	<b>98.6%</b>	<b>4,200 ppm</b>	<b>3,500 ppm</b>	<b>2,300 ppm</b>	<b>0.24%</b>

Source: PEC

**Figure 6.2 – Plan View of the Mineral Resource Estimate Reporting Area**



Source: PEC

## Ore Reserve

On 17<sup>th</sup> March 2021, PEC released a maiden ore reserve at Beharra.

**Table 6.2 – Beharra Silica Sand Deposit Probable Ore Reserve – March 2021**

Sand	Tonnes	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>	LOI
In situ	64.1 Mt	98.2%	4,240 ppm	3,460 ppm	1,950 ppm	0.235%
<b>Saleable Product</b>	<b>47.6 Mt</b>	<b>99.6%</b>	<b>1,789 ppm</b>	<b>369 ppm</b>	<b>276 ppm</b>	<b>0.10%</b>

Source: PEC. The Saleable Product is a portion of the in situ sand tonnage

## Flowsheet and Capital Costs

The mineral processing flowsheet and plant design follow industry standard processes of screening and desliming, gravity, magnetic and physical separation and commonly seen equipment used in the mineral sands industry. A summary of the capital costs for a packaged plant and turnkey solutions is presented in Table 6.3. Accuracy of capital costs is +/-25%.

**Table 6.3 – Beharra Project Capital Cost Estimate – March 2021**

Item	Amount (A\$'000)
Process plant including water distribution	19,287
Services and onsite infrastructure	3,537
Offsite infrastructure	9,272
Indirect, PCM and site office costs	2,338
Total development capital	34,434
Owners' costs	1,343
Contingency (10%)	3,443
Pre-production capital	39,220

Source: PEC

## Operating Costs

Operating costs were derived from contractor budget pricing, market quotations and bottom-up estimates based on 32-year LOM. Operating costs estimates are summarised in Table 6.4.

**Table 6.4 – Beharra Silica Sand Deposit Probable Ore Reserve – March 2021**

Opex	Cost p.a. A\$m	A\$/t ore	A\$/t saleable product
Mining (Run of Mine & overburden)	10.6	5.18	6.97
Processing	5.0	2.46	3.31
Reject haulage	0.6	0.29	0.36
Administration	2.4	1.18	1.58
Transport to port / Ship loading	39.4	19.40	26.09
Rehabilitation	1.8	0.43	0.58
Contingency	2.8	1.40	1.88
Royalty	3.5	1.71	2.30
Total operating costs	66.1	32.05	43.07

Source: PEC



## 7. Suvo Strategic Minerals Limited

### Nova Silica Sands Project

The 100% owned Nova Silica Sands Project is located 300km north of Perth, Western Australia. The project comprises four granted exploration licences (E70/5001, E70/5322, E70/5323 and E70/5324) for 169km<sup>2</sup>.

Access to the project is by the Brand Highway approximately 15km south of Eneabba. Numerous well established tracks that service the Dampier to Bunbury Natural Gas pipeline cross the tenure.

**Figure 7.1 – Nova Project Location Map**



Source: SUV

### Exploration

In the year period to 30<sup>th</sup> March 1993, colour aerial photography was captured for the area and areas of yellow sand were delineated. These areas were confirmed with a site visit.

Drilling was conducted on the areas of yellow sand with vertical air-core holes nominally spaced along the line at 120m. Holes were drilled with a Mantis 75 air-core drilling rig with samples taken at two metre intervals, panned and logged on site. Samples with a visual heavy mineral estimate greater than 2% were submitted to RGCMS Nangulu Laboratory for assay.

Suvo will twin several RGC drill holes to possibly allow the inclusion of this data into upcoming resource estimates that will be completed at Nova.

### Production Samples

Upcoming production samples will have the sand fraction sized into two different fractions +75µm to -150µm representing silica flour, and silica sand +150µm -1000µm.

Silica flour is a very specialised product with a required size range difficult to produce in any quantity by natural means and is usually produced by grinding of coarser silica sand. Silica flour is used as a filler or in cements for well capping's in oil and gas drilling. For example, silica flour helps oilwell cement maintain low permeability and high compressive strength under high-temperature conditions. This is a high value product compared to other silica sand applications.

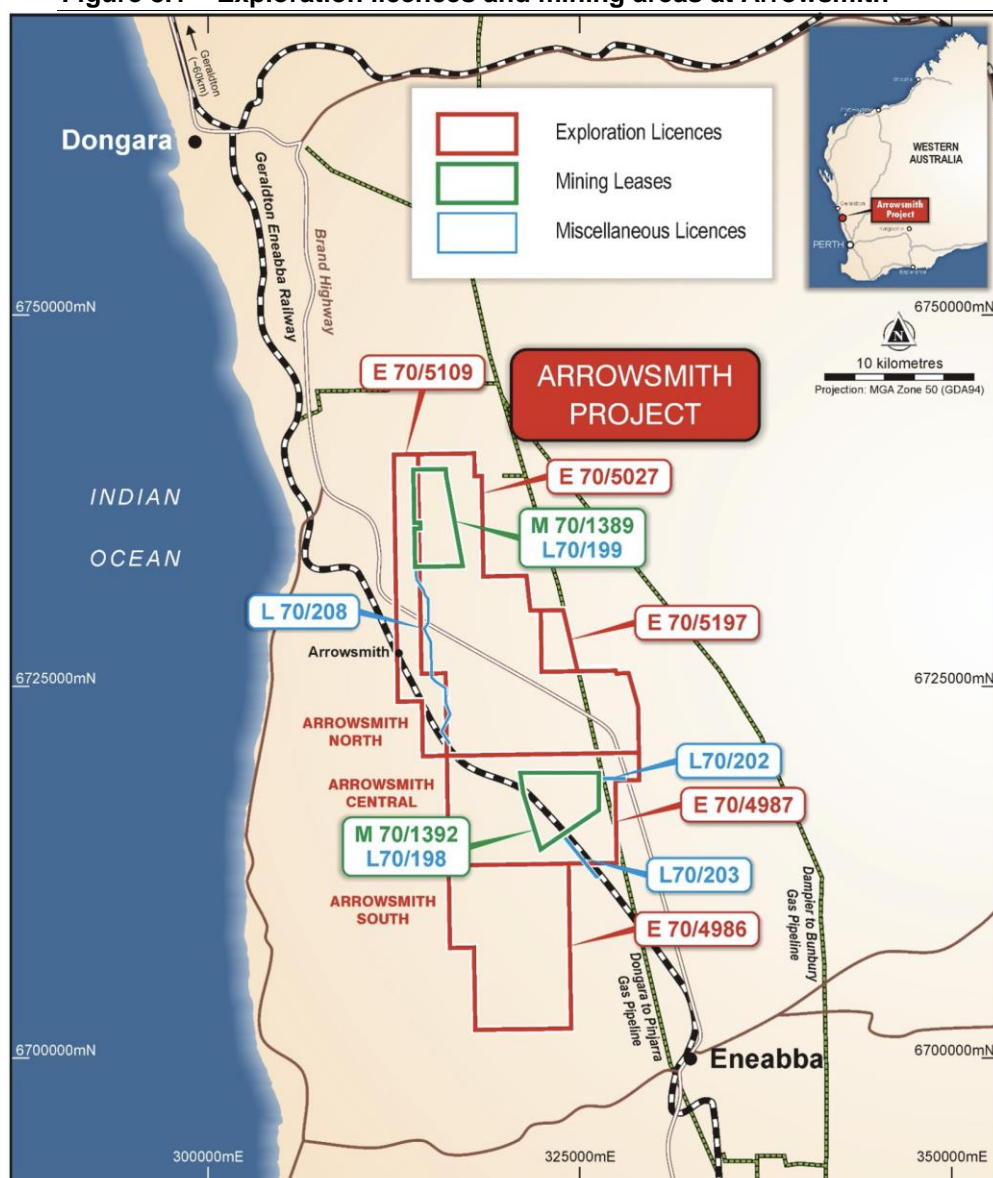
## 8. VRX Silica Limited

### Arrowsmith Silica Sand Project

In October 2017, VRX Silica announced the acquisition of the Arrowsmith Silica Sand Project, located 270 km north of Perth in WA. The project sits across five exploration licences, two mining leases and five miscellaneous leases totalling approximately 377 km<sup>2</sup> adjacent to the Brand Highway and the rail connection to Geraldton Port, which is suitable for bulk shipping.

Work to date at the Arrowsmith Project has identified a Mineral Resource in excess of 847mt and Ore Reserves of 241.9mt of silica sand suitable for use in both glassmaking and foundry work.

**Figure 8.1 – Exploration licences and mining areas at Arrowsmith**



Source: VRX

### Mineral Resources

The updated Mineral Resource estimate (MRE) for the Arrowsmith North deposit comprises 771 Mt @ 98% SiO<sub>2</sub> reported in accordance with the JORC Code.

**Table 8.1 – Arrowsmith North Mineral Resource Estimate (Indicated + Inferred) – Aug 2019**

Sand	Tonnes	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>	LOI
White	313 Mt	98.8%	5,400 ppm	1,800 ppm	1,500 ppm	0.24%
Yellow	458 Mt	97.6%	10,800 ppm	1,700 ppm	4,000 ppm	0.52%
All Sand	771 Mt	99.6%	8,600 ppm	1,700 ppm	3,000 ppm	0.41%

Source: VRX

## Ore Reserve

**Table 8.2 – Arrowsmith North Probable Ore Reserve Estimate – Aug 2019**

Product	ML 70/1339	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>	LOI
N20	54 Mt	99.7%	2,000 ppm	350 ppm	500 ppm	0.1%
N40 / NF400	136 Mt	99.7%	2,000 ppm	350 ppm	500 ppm	0.1%
Local market	14 Mt					
All Sand	204 Mt					

Source: VRX

## Regulatory Approvals

VRX has some Mining Leases granted for the Muchea and Arrowsmith North and Central projects.

VRX is now focussed on progressing the environmental approval process with both State and Federal Government authorities and completing additional requisite studies necessary for the grant of a Mining Permit.

## 9. Investment Risks

All companies are exposed to a number of risks including:

- **Geological risk:** the actual characteristics of a deposit may differ significantly from initial interpretations.
- **Resource risk:** all resource estimates are expressions of judgement based on knowledge, experience and industry practice. Estimates, which were valid when originally calculated may alter significantly when new information or techniques become available. In addition, by their very nature, resource estimates are imprecise and depend to some extent on interpretations, which may prove to be inaccurate.
- **Commodity price risk:** revenues derived through the sale of silica sand are exposed to commodity price risk. The price of silica sand fluctuates and is affected by many factors beyond the control of the operator. Such factors include supply and demand fluctuations, technological advancements and macro-economic factors.

- **Exchange Rate risk:** revenues derived from the sale of silica sand are exposed to exchange rate risk. International prices of silica sand are denominated in United States dollars, whereas the financial reporting currency of companies in the sector is the Australian dollar, exposing the companies to the fluctuations and volatility of the rate of exchange between the USD and the AUD as determined by international markets.
- **Mining risk:** A reduction in mine production would result in reduced revenue.
- **Processing risks:** A reduction in plant throughput would result in reduced revenue. In all processing plants, some mineral is lost rather than reporting to the valuable product. If the recovery of mineral is less than forecast, then revenue will be reduced.
- **Operational cost risk:** an increase in operating costs will reduce the profitability and free cash generation of the project.
- **Management and labour risk:** an experienced and skilled management team is essential to the successful development and operation of mining projects.

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