Bankable Feasibility Study Update

Arrowsmith North

Silica Sand Project

March 2024

Contents

Figures

Tables

1. Overview

VRX Silica Limited (**VRX** or **Company**) is an ASX-listed silica sand exploration and development company (ASX: VRX). VRX is focused on developing silica sand assets in Western Australia.

This Bankable Feasibility Study update (**BFS**) details the project and financial attributes supporting the development of VRX's Arrowsmith North Silica Sand Project (**Arrowsmith North** or **Project**). It updates the Bankable Feasibility Study for the Project prepared in August 2019 (**2019 BFS**).

Arrowsmith North is one of three separate but contiguous silica sand projects held by the Company and known as the Arrowsmith Silica Sand Projects. The other two projects are Arrowsmith Central and Arrowsmith Brand. This BFS is solely for Arrowsmith North.

The Company is proposing to mine and process raw sand from Arrowsmith North. The raw sand can be processed to a quality suitable for the glass making and foundry industries.

The silica sand Probable Ore Reserve is considerable and World class. This will support a very long-life mining and processing project with substantial benefits to the region and Western Australia generally.

Silica sand products will be transported by truck initially and ultimately by rail from Arrowsmith North to the Geraldton Port for export to Asian glass manufacturing and foundry industries.

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, size range and shape of the silica sand grains and less dependent on the mineralogy.

Arrowsmith can produce saleable products that meet the required specifications for both industries.

The cost structure analysis of silica sand production involves understanding the various components that contribute to the overall cost of production and supply. While specific cost factors may vary depending on the throughput and products the fundamental operations remain the same.

Raw Materials: The cost of raw materials is a significant factor in the cost structure of silica sand production. This includes the cost of extracting and processing quartz-containing minerals from the mine. Additionally, any other materials used in the production process, such as chemicals or additives, are considered.

Labour Costs: Labour costs encompass the wages, on-costs, benefits, and other expenses associated with the workforce involved in silica sand production. This includes personnel engaged in mining, processing, quality control, maintenance, and other related tasks.

Energy and Utilities: The energy and utilities required for silica sand production, such as electricity, gas, fuel, and water, contribute to the overall cost structure.

The cost of energy can vary based on the region, production processes, and efficiency of the equipment used.

Equipment and Machinery: The cost of acquiring and maintaining equipment and machinery used in silica sand processing is factored in. This includes costs associated with purchasing, leasing, operating, and maintaining mining machinery, processing equipment, transportation vehicles, and any specialised technology.

Transportation and Logistics: The cost of transporting silica sand from the production site to the port is considered. This includes expenses related to loading and unloading, storage and port facility costs.

Quality Control Costs: Cost of maintaining contract compliance in regard to quality and quantity of product standards at point of ship loading.

Overhead and Administrative Costs: Overhead costs, such as tenement rents and rate, office expenses, insurance, salaries and wages, are accounted for in the overall cost structure. These costs are not directly tied to production throughput but are necessary for running the business.

The Company has received enquiries and expressions of interest from organisations and also agents across Asia for these products and holds signed letters of intent for substantial tonnages. Subject to completion of the approvals process for mining, offtake agreements will be finalised before the Company makes a decision to proceed to mine.

VRX's wholly-owned subsidiary, Ventnor Mining Pty Ltd, has a granted Mining Lease for the Project. The Environmental Approval process is well advanced and a Mining Approval Application has been submitted, which approval will be subject to the Environmental Approval.

The Environmental Approval application under the EPBC Act has been assessed by the Federal Department of Climate Change, Energy, the Environment and Water (DCCEEW) as a Controlled Action and will accept an accredited assessment by the State Department of Water and Environmental Regulation (DWER).

Details of the work undertaken on the Project by the Company to-date and an economic evaluation that supports development of a mining operation follows.

Figure 1 Arrowsmith North Typical Vegetation

2. Project Background

2.1. Project Location

Arrowsmith North is located 270 km north of Perth, WA and is between the regional towns of Dongara and Eneabba, WA with mining and processing wholly within M70/1389 and access within L70/208.

The Project is located adjacent to the Brand Highway and the Geraldton-Eneabba Railway, with a road and rail connection direct to Geraldton Port.

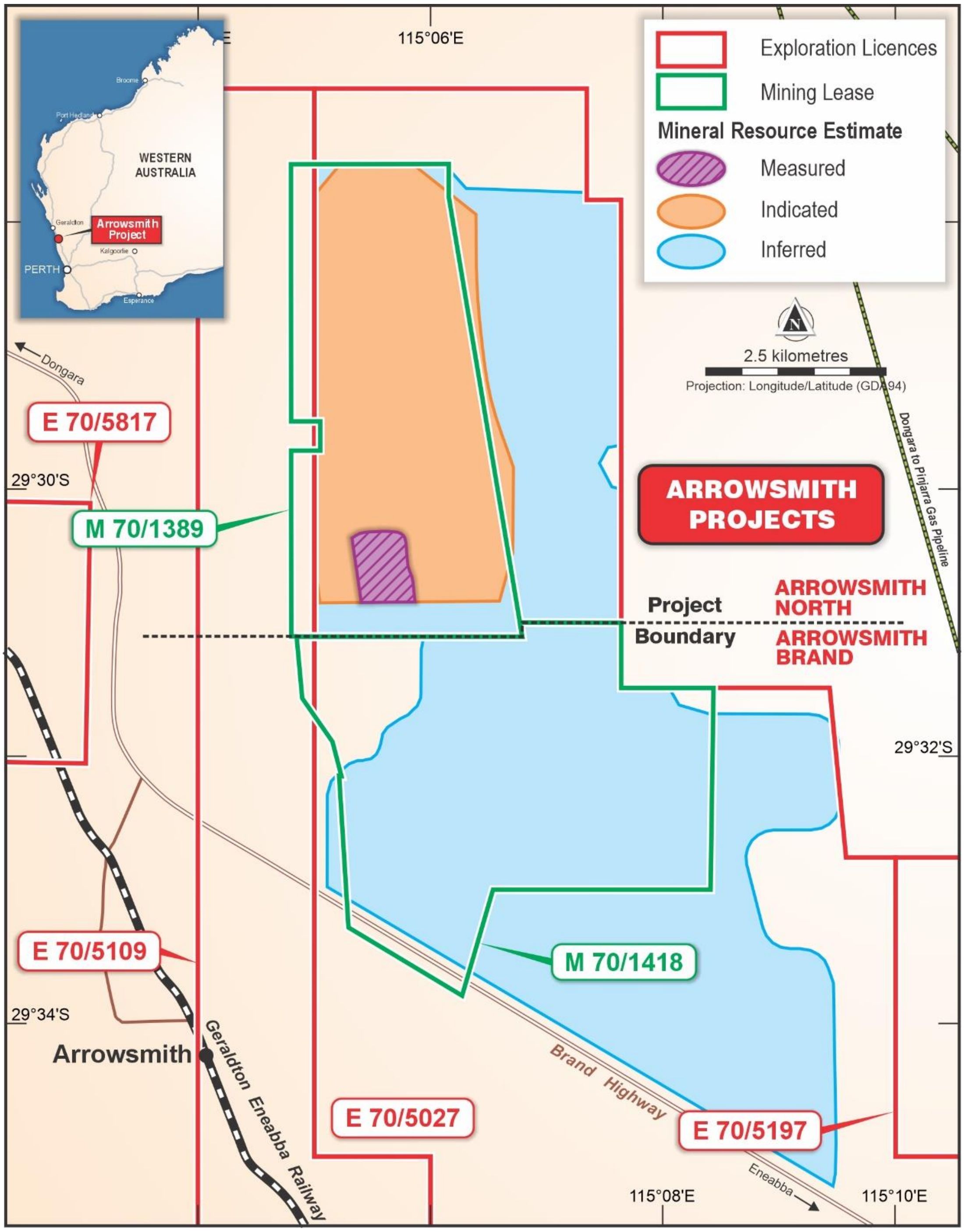


Figure 2: Arrowsmith North project and tenement location map

2.2. Environmental Data

Arrowsmith North is located on the Lesueur Sandplain subregion.

The climate is warm Mediterranean with a hot, dry summer and a cool, wet winter. Median and mean annual rainfall in this region are 481 mm and 489 mm respectively. The Lesueur Sandplain is dominated by proteaceous heath on sand over deeper limestone; the dominant land uses are dryland agriculture, conservation and crown reserves.

Vegetation over the Project area primarily consists of scattered eucalypts over mixed kwongan shrubland on sand. There is a seasonal drainage line running through the southern part of the Project area.

Fauna assemblage is typical of the Lesueur Sandplains subregion and is moderately rich, but incomplete with some species locally extinct. The area is notable for a rich reptile assemblage and high proportion of non-resident birds, many of which are nectarivorous and exploit seasonal abundance of nectar and pollen from the species-rich flora. Few species of high conservation significance are present or expected, but the Carnaby's Black-Cockatoo is important, with known roost sites nearby and the species very likely to be a regular foraging visitor to the Project area.

2.3. Site Topography and Drainage

The Project area lies within the northern Perth Basin, containing a succession of Quaternary to Permian age deposits up to a total of 12,000 m thick. It comprises a topographic high atop an aeolian sand dune system up to 15 m thick from the western edge of the deposit with a gentle west and east sloping erosional surface from 80mRL to 60mRL.

The surface is leached loose sand with very high transmissivity and drains from the centre of the Project to the west and east. To the west is the seasonal Arrowsmith River and Lake which flows only during very high rainfall events and to the east are low land swamps.

2.4. Existing Infrastructure

Aside from road and rail, there is limited infrastructure in or around the Project area.

There are no established power, water or sewerage services and the Company will have to install all of its required services.

To the south is access from the Brand Highway. South of Brand Highway is the Eneabba–Geraldton Railway line.

Employees will be stationed at Eneabba and Dongara and there will be no requirements for site accommodation.

2.5. Ownership and Leases

Land in the Arrowsmith North area is vacant, Unallocated Crown Land with the State and Indigenous Land holders the only stakeholders.

The entire Arrowsmith Silica Sand Projects area (incorporating Arrowsmith North and VRX's other silica sand projects adjacent to the Project, namely Arrowsmith Brand and Arrowsmith Central) has five granted exploration licences covering 420 km^2 and a granted Mining Lease (M70/1389) which covers the Arrowsmith North Mine MDE. Adjacent to the Arrowsmith North Silica Sand Project is the Arrowsmith Brand Silica Sand Project and granted Mining Lease M70/1418.

The granted tenements are held in a VRX 100% owned subsidiary, Ventnor Mining Pty Ltd, and comprise E70/5027 (Arrowsmith North), E70/4987 (Arrowsmith Central), E70/4986 (Arrowsmith South), E70/5109 adjacent to the west of Arrowsmith North and E70/5197 adjacent to the east of Arrowsmith North. All tenement holdings are contiguous with combined reporting status.

The Company also has Miscellaneous Licenses, one for the Search for Water over the Mining Lease area and the second for an access route south from the Mining Lease area to a location adjacent to the rail line reserve via the Brand Hwy L70/208.

Table 1 below sets out tenement details for the Arrowsmith Silica Sand Projects.

Tenement	Holders	Grant date	Expiry date	Area (km^2)
E70/5027*	Ventnor Mining Pty Ltd	14/06/2018	13/06/2028	179.2
E70/4987	Ventnor Mining Pty Ltd	06/04/2018	05/04/2028	92.8
E70/4986	Ventnor Mining Pty Ltd	06/04/2018	05/04/2028	86.4
E70/5109*	Ventnor Mining Pty Ltd	14/08/2018	13/08/2028	35.9
E70/5197*	Ventnor Mining Pty Ltd	07/06/2019	06/06/2029	25.6
E70/5817	Ventnor Mining Pty Ltd	17/08/2021	16/08/2026	12.8
M70/1389*	Ventnor Mining Pty Ltd	16/11/2020	15/11/2041	17.3
M70/1318	Ventnor Mining Pty Ltd	18/07/2023	17/02/2044	19.9
L70/199*	Ventnor Mining Pty Ltd	11/07/2019	10/07/2040	1.7
L70/208*	Ventnor Mining Pty Ltd	16/11/2020	15/11/2041	0.2

Table 1: Arrowsmith tenement details

* Arrowsmith North tenements

2.6. Political Overlay

The location of Arrowsmith North is within the jurisdiction of Western Australia and the Commonwealth of Australia.

Current Government positions relevant for the Project area and operations include:

Federal Minister: Melissa Price; MHR Durack

State Ministers

Premier; Roger Cook; State and Industry Development, Jobs and Trade; Public Sector Management. MLA for Kwinana

Deputy Premier; Rita Saffioti; Treasurer; Minister for Transport; Tourism; MLA for West Swan.

Minister for Energy; Mines and Petroleum; Industrial Relations; David Michael; MLA for Balcatta

Minister for Environment; Climate Action; Racing and Gaming; Reece Whitby MLA for Baldivis

State MPs

MLA for Moore; Shane Love

MLA for Geraldton; Lara Dalton

MLC for the Agricultural Region; Darren West

Government Departments

Department of Transport (Includes Ports); Peter Worozow; Director General

Department of Mines, Industry Regulation and Safety (DMIRS); Richard Sellers; Director General

Department of Jobs, Tourism, Science and Innovation (includes State Development) (DJTSI); Rebecca Brown; Director General

Department of Water and Environmental Regulation (DWER); Michelle Andrews; Director General

Environmental Protection Authority; Chairman Prof. Matthew Totts

Local Groups

Mid-West Development Commission; Chief Executive Officer; Nils Hay

Midwest Chamber of Commerce & Industry; Chief Executive Officer; Joanne Fabling

Mid-West Ports Authority; Chief Executive Officer; Damian Tully

Local Government

Shire of Chittering; Chief Executive; Melinda Prinsloo

Chittering Chamber of Commerce; President; Trish Murrell

Shire of Carnamah; Chief Executive Officer; Robert Paull

Shire of Irwin; Executive; Shane Ivers

City of Greater Geraldton; Chief Executive Officer; Ross McKim

2.7. Native Title and Aboriginal Heritage

The Mining Lease area lies within the Yamatji Nation Native Title Determination (WCD2020/001)(Yamatji Nation). The formation of the Yamatji Nation consolidated the existing four native title determinations, being, Mullewa Wadjari, Southern Yamitji, Hutt River and Widi Mob. The WA State Government then entered into an Indigenous Land Use Agreement (ILUA) with the Yamitji Nation thereby resolving the State Government's native title compensation liability in relation to the area covered by the ILUA. The Yamatji Southern Regional Corporation Ltd (YSRC) was established to act as the Regional Entity to manage the benefits of the ILUA.

The Company enjoys a strong relationship with, and continues to engage with, the Yamitji Nation and the YSRC on Heritage, contracting and employment opportunities and assistance in establishing a regional Ranger program. All Heritage surveys have been conducted with assistance from the YSRC representatives.

Heritage Surveys

The Company is a signatory to a Yamatji Standard Heritage Agreement which covers all of the Company's tenure at Arrowsmith North.

The Company has conducted three Aboriginal Heritage and Ethnographic Surveys over all disturbance that is being proposed. In 2023 an additional Aboriginal Heritage survey was undertaken on a potential route for a powerline from the Beharra Springs gas wellhead to the proposed processing plant site.

No aboriginal heritage sites, other heritage places, isolated artefacts or previously unrecorded suspected Aboriginal archaeological sites were recorded during any of the field surveys that have been conducted.

Existing Registered Aboriginal Sites

There are no Registered Aboriginal Sites within the proposed area of operation. The nearest is the Arrowsmith River, to the south of Brand Highway, Registered Site 30068, which is an unrestricted mythological unprotected site and north of Brand Highway and the Beharra Springs artefact scatter site.

Community

The Project is located on vacant, Unallocated Crown land.

The closest communities are Dongara, 40 km by bitumen road to the north and Eneabba, 42 km by bitumen road to the south. Both towns are expected to be the main source of personnel for mining and processing operations.

Dongara is located at the mouth of the Irwin River, contiguous with the town of Port Denison and is in the seat for the Shire of Irwin. It has a population of approximately 2,800 people. The main industries are the rock lobster fishery and agriculture (broadfield grain production).

Eneabba is the centre of what was once an extensive mineral sand industry. Major mineral sand operators still in the district are Iluka Resources and Tronox Holdings. The sand plains to the east of Eneabba are used predominately for agricultural purposes.

Iluka is in the process of establishing a Rare Earth cracking plant at Eneabba with a stated aim to process stockpiles of Monazite from previous Mineral Sands production.

3. Geology and Mineral Resources

3.1. Geology

Most economically significant silica sand deposits in Western Australia are found in the coastal regions of the Perth Basin, and the targeted silica sand deposits are the aeolian sand dunes that overlie the Pleistocene limestones and paleo-coastline, which also host the regional heavy mineral deposits.

Within the Project area, data obtained from the Department of Agriculture soil mapping shows there are pale and yellow deep sands predominating with lesser swampy areas and occasional ironstone ridges, Figure 3.

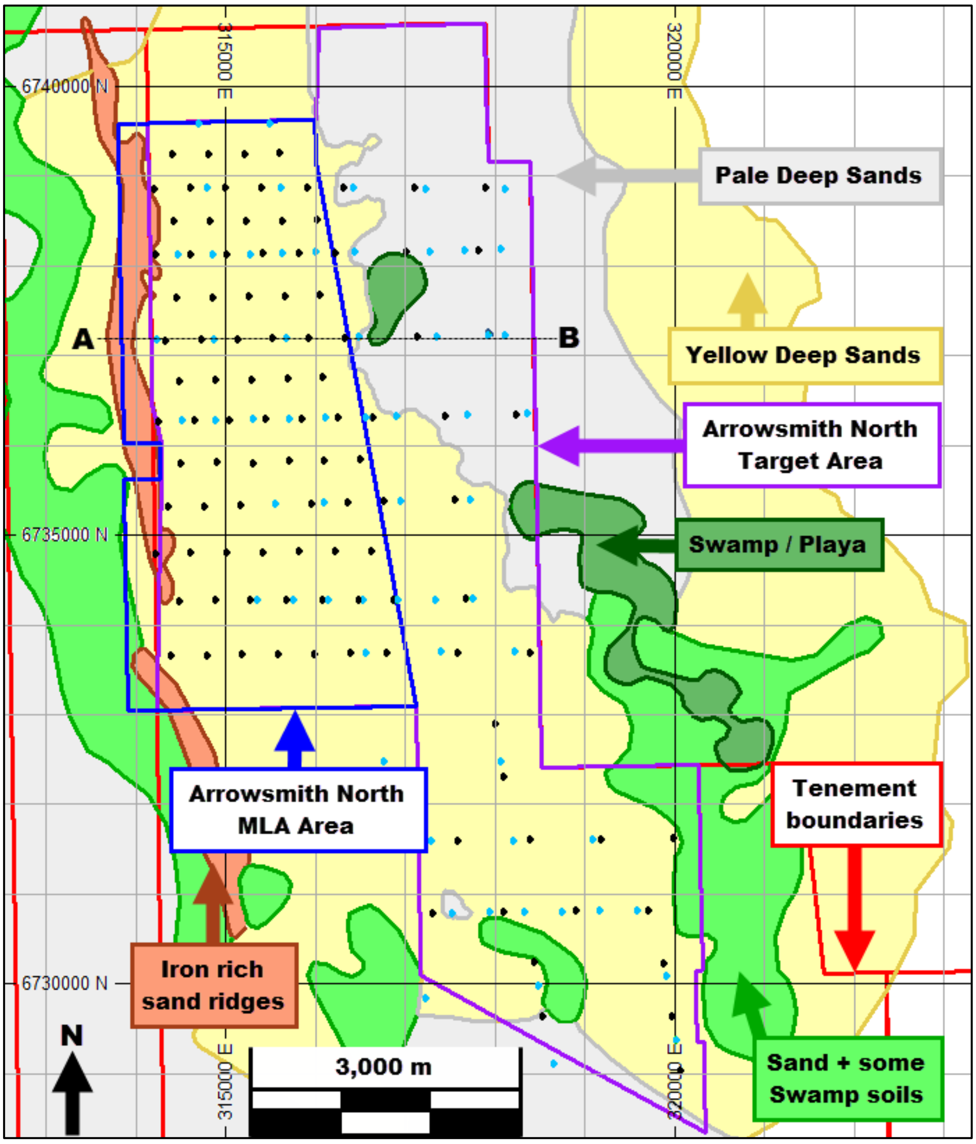


Figure 3: Simplified geology of the Arrowsmith North area. Section line A – B shown.

Black dots – Air Core collars, Blue Dots - Auger collars.

Source: Outlines based on DOAG soil mapping data, refined based on drill data.

3.2. Mineral Resources

Mineral Resource Estimate

In 2021 VRX completed 130 aircore holes for 1,459.1m of Grade control drilling. These holes were completed on a tight 50m x 100m spacing in an area planned to be the first 6 years of mining. The purpose of the drilling was as a pre-mining activity to gain additional geological information and metallurgical samples to reduce resource risk in the early years of mining. CSA Global was engadged to update the Mineral Resource estimate (**MRE**) for the Arrowsmith North deposit, this was completed in December 2021 reporting 768 Mt @ 98% SiO_2 in compliance with the JORC Code. This MRE is the third estimation for the Arrowsmith North deposit, prior estimates were made in July 2019 and September 2018.

The MRE is based on the results obtained from 62 hand auger drill holes for 234.6 m and 238 aircore (AC) drill holes for 2,631.1 m, including 130 AC holes (1,459.1 m) drilled in 2021. Drilling has defined two silica sand types, namely white and yellow sand, geologically logged and differentiated based on colour and through chemical analysis results.

Based on metallurgical testwork completed to date, both sand types are readily amenable to upgrading by conventional washing and screening methods to produce a high-purity silica sand product with high mass recoveries. The high-purity silica sand product specifications are expected to be suitable for the glassmaking industry, and as foundry sand, used for the manufacture of sand moulds for the casting of metals.

The MRE results are shown below.

Classification	Domain	Tonnage (Mt)	SiO_2%	Al_2O_3%	Fe_2O_3%	LOI%	TiO_2%
Measured	White Sand	-	-	-	-	-	-
	Yellow Sand	10	95.9	1.9	0.7	0.7	0.3
	All Sand	10	95.9	1.9	0.7	0.7	0.3
Indicated	White Sand	33	98.7	0.5	0.2	0.2	0.2
	Yellow Sand	204	97.6	1.1	0.4	0.5	0.2
	All Sand	237	97.7	1.0	0.4	0.5	0.2
Inferred	White Sand	280	98.7	0.5	0.1	0.2	0.2
	Yellow Sand	241	97.7	1	0.4	0.5	0.2
	All Sand	521	98.2	0.8	0.3	0.4	0.2
Total	**All Sand**	768	98.0	0.9	0.3	0.4	0.2

Table 2: Arrowsmith North Mineral Resource

*Note: Interpreted silica sand mineralisation is domained above a basal surface wireframe defined based on drill logging data. The upper (Topsoil) layer within 0.5 m of surface is depleted from the modelled silica sand unit, being reserved for rehabilitation purposes. All classified silica sand blocks in the model are reported. Differences may occur due to rounding.

ASX Listing Rules 5.8.1 Summary

The following summary covers the requirements of the ASX Listing rules for the public reporting of the Mineral Resource estimate.

Geology and Geological Interpretation

Silica sand mineralisation at Arrowsmith North occurs within the coastal regions of the Perth Basin, and the targeted silica sand deposits are aeolian sand dunes that overlie limestones and paleo-coastline.

The geological modelling was completed based on government soil mapping data in conjunction with auger and AC drill logging data. The Mineral Resources were estimated above 3-D wireframe basal surfaces for the white and yellow sands, with the surfaces based on the geological boundaries defined by logged sand types and chemical analysis results from the drill data. The horizontal extents of the interpreted sand layers are limited to within the VRX nominated Arrowsmith North target area and with reference to the publicly available soil mapping data.

The silica sands are covered by a 300 m thick humus layer and are underlain by limestone.

Drilling Techniques

Drilling over the project area was completed by means of AC and hand auger methods. Auger drilling was completed in 2017 along existing tracks, with drill spacing of 400 m (east) by 1,000 m (north) along the section lines.

AC drilling was completed in two stages using a Landcruiser mounted drill rig. Stage 1 drilling was completed in 2019, with holes located on the auger drilling tracks as well as along new section lines, forming an overall nominal 400 m section line spacing with drill holes nominally spaced at 400 m (east) by 400 m (north) over the majority of the modelled area. Stage 2 drilling, also referred to as grade control drilling, was completed in March 2021, with 130 holes drilled for 1,459.1 m. Drilling was completed on a drillhole spacing of 50 m (east) by 100 m (north). AC drilling hole depths range between 3 m and 21 m with an average depth of 10.9 m. All holes were drilled vertically.

Drill hole collar locations are shown in image below.

Sampling and Sub-sampling Techniques

The 100 mm screw auger drilling samples were taken from 1 m down hole intervals. The sample was sufficiently moist to allow it to cling to the auger screw, with care taken during screw extraction to prevent sample disaggregating from the screw and falling back into the hole. At the end of each 1 m sample run, the screw was removed from the hole and the sand sample deposited into a plastic tub. The samples typically weighed 8 kg.

AC drilling samples are 1 m down hole intervals with sand collected from a cyclone mounted rotary cone splitter, and approximately 2-3kg (representing 50% of the drilled sand) was collected. Two sub-samples, A and B, of approximately 200 g were taken from the drill samples. Samples were bagged and ticketed with sample numbers prior to transport to the analytical laboratory.

Sample Analysis Method

The "A" samples from all drilling were submitted to Intertek Laboratory, located in Maddington, W.A. The samples were dried and then pulverised in a zircon bowl to reduce the particle size to -75 µm. Multi-element analysis from the pulverised samples was completed by an initial four-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon tubes. The digest was then analysed by means of Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry (ICP-OES) analysis. Loss on Ignition at 1000°C (LOI) was analysed by Thermal Gravimetric Analyser (TGA). Silica is then reported by difference (SiO_2 % = 100% - (LOI % + Major oxides)).

The assay results have also undergone internal laboratory quality assurance (QA), which includes the analysis of standards, blanks, and repeat quality control (QC) samples. Standards were included in the drill sample submissions at a ratio of 1:20. Field duplicate samples were submitted in a ratio of 1:20, and the laboratory routinely duplicated analyses from the pulverised samples at a ratio of 1:25.

An analysis of all the QC data was undertaken and validates the drill assay dataset for use in the Mineral Resource estimate.

Estimation Methodology

A single block model with two parent cell sizes was constructed and used for grade interpolation. The first block dimensions of 200 m (E) x 200 m (Y) x 4 m (Z) are considered appropriate for the areas covered by wide spaced drilling. The second block sizes of 25 m (E) x 50 m (Y) x 2 m (Z) cover the area with the grade control drilling.

Grade interpolated into the block model included SiO_2, Al_2O_3, CaO, Fe_2O_3, K_2O, LOI (1000°C), MgO and TiO_2. Particle size distribution data (PSD) for -150 µm, >500 µm and > 600 µm were also interpolated. Grades from top cut and composited data were interpolated into the parent cells by ordinary kriging. Blocks were estimated using a search ellipse of 150 m (major) x 100 m (semi-major) x 4 m (minor) dimensions, with a minimum of 6 and a maximum of 16 samples from a maximum of 4 samples per drillholes. Cell discretisation of 3 x 3 x 2 (X, Y, Z) was employed.

Hard boundary estimation was used when estimating within the mineralisation domains, such that samples from one sand domain could not be used to interpolate blocks in an adjacent domain.

PSD sample analyses for -150, +500 and +600 fractions were interpolated using ordinary kriging. Blocks were estimated using a search ellipse of 1000 m (major) x 600 m (semi-major) x 2 m (minor) dimensions for the -150 PSD fraction, and 1500 m (major) x 400 m (semi-major) x 2 m (minor) dimensions for the +500 and +600 PSD fractions. A minimum of 2 and a maximum of 6 samples were used for all PSD grade interpolations, from a maximum of 4 samples per drillhole.

A dry bulk density value of 1.66 t/m^3 was applied to all blocks in the white and yellow sand domains.

Mineral Resource Classification

The Mineral Resource has been classified based on the guidelines specified in The JORC Code. The classification level is based upon an assessment of geological understanding of the deposit, geological and mineralisation continuity, drillhole spacing, QC results, search and interpolation parameters and an analysis of available density information. JORC Code Clause 49 was also considered when classifying the Mineral Resource.

The Mineral Resource is classified as a combination of Measured, Indicated and Inferred. Image below shows the distribution of the classification across the deposit.

Material that has been classified as Measured was considered by the Competent Person to be sufficiently informed by geological and sampling data to confirm geological and grade continuity between data points. The volumes of silica sand classified as Measured are constrained within the area drilled in 2021 (aircore “grade control” programme).

Silica sand Mineral Resources must be reported at least in terms of purity and size distribution, in addition to SiO_2 and tonnes, and should also take account of logistics and proximity to markets. Likely product specifications for the Arrowsmith North deposit are supported by the results of the composite sample process test work program undertaken between 2018 and 2021.

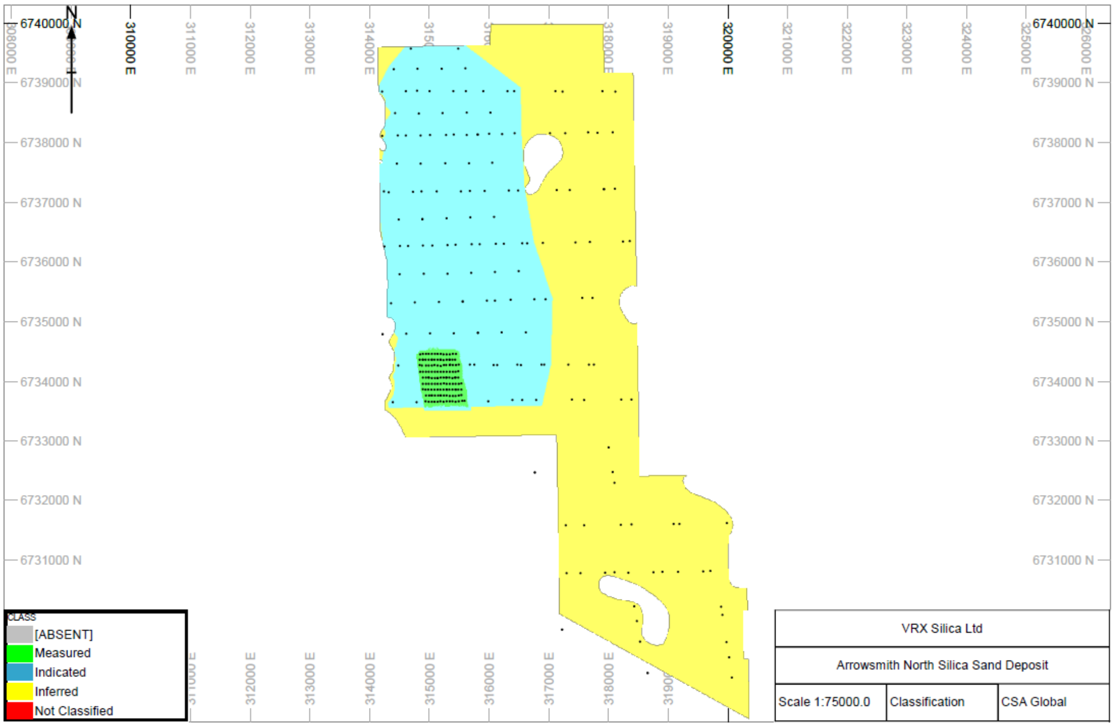


Figure 4: Mineral Resource classification with drill hole collars (black)

Cut-Off Grades

No cut-off grades were used for reporting the Mineral Resource. The Mineral Resource is reported from all classified blocks with interpolated SiO2 grades.

Modifying Factors

VRX have completed metallurgical test work on composites of selected drill hole samples during 2018, 2019 and 2021, to gain knowledge of attributes including final product size distribution, purity and particle shape, to allow consideration of potential product specifications and general product marketability. Discussion of results is presented in JORC Table 1 (Section 3), in Appendix A.

CSA Global is of the opinion that process test work on the composite drill samples indicates that the Arrowsmith North deposit should be suitable for the eventual production of silica sand for glass, ceramic and foundry markets. In addition, project location and logistics support the classification of the Arrowsmith North deposit as an industrial Mineral Resource in terms of Clause 49 of the JORC Code.

Reasonable Prospects Hurdle

The Competent Person deems that there are reasonable prospects for eventual economic extraction on the following basis:

Available process testwork indicates that likely product qualities for glass, ceramics and foundry sand are considered appropriate for eventual economic extraction from Arrowsmith North.

Potentially favourable logistics and project location support the classification of the Arrowsmith North deposit as an industrial Mineral Resource in terms of JORC Clause 49.

The deposit is located adjacent to major road and rail infrastructure, and is 270 km north of Perth, which offers a large and suitably qualified workforce to develop the Project.

The Mineral Resource has no overburden (excluding a shallow zone of sand to be retained for rehabilitation purposes) and is of shallow depth.

Brand Mineral Resource Estimate – Effect on Arrowsmith North

In May 2023 VRX announced an MRE for a new silica sand Project, Arrowsmith Brand. The Projects locations is shown below.

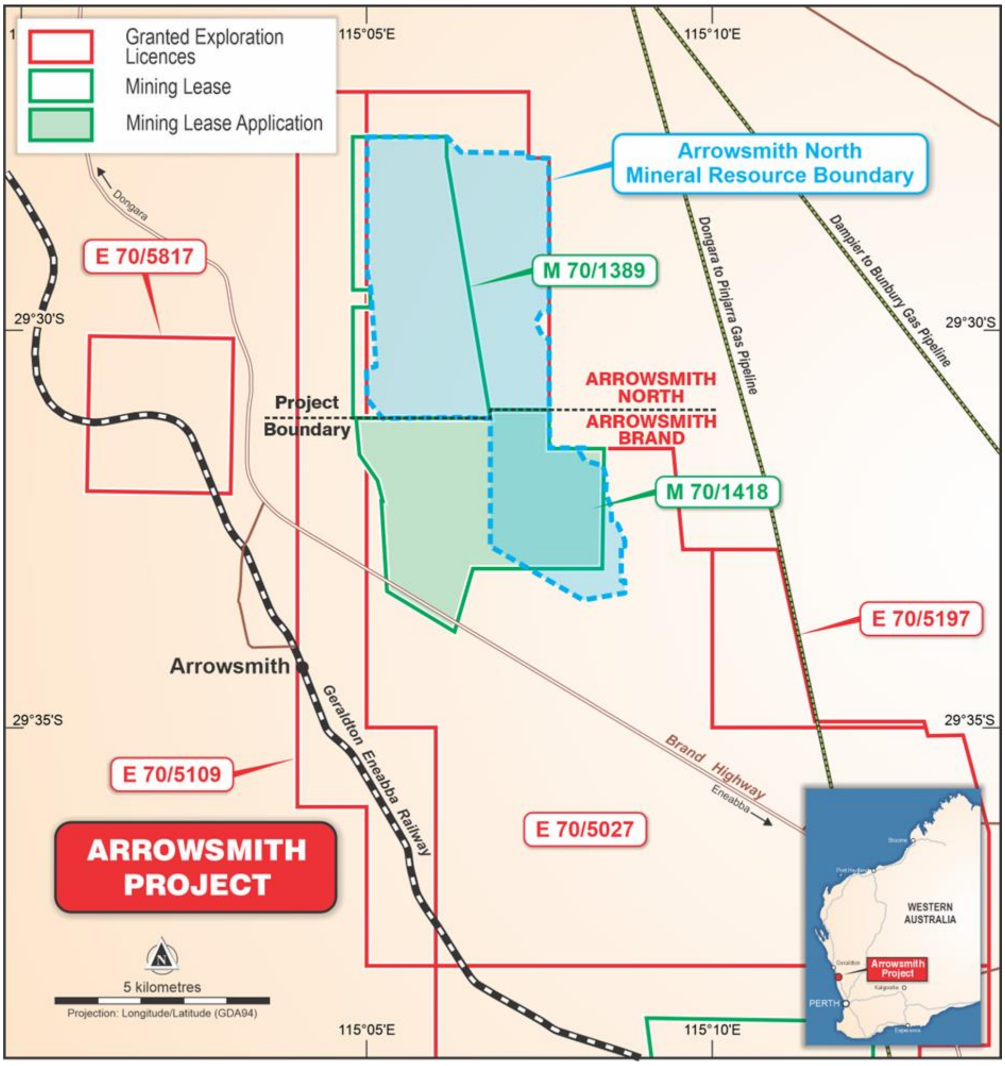


Figure 5: Arrowsmith North and Brand Project locations.

The Project boundary shown in the image above resulted in 255Mt of the previously reported Arrowsmith North MRE being reallocated to the Brand Project. The Table below shows the current MRE reoprted within the Arrowsmith North Project.

Classification	Mt	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	LOI
Measured	10	95.9	1.9	0.7	0.3	0.7
Indicated	237	97.7	1.0	0.4	0.2	0.5
Inferred	266	98.4	0.7	0.3	0.2	0.4
Total	**513**	**98.0**	**0.9**	**0.3**	**0.2**	**0.4**

Table 3: Current Arrowsmith North MRE

4. Ore Reserves and Life of Mine Schedule

VRX engaged Cube Consulting (**Cube**) to estimate the Ore Reserves and has completed the necessary work to to complete mining engineering work towards a life of mine production schedule which would then result in an updated Ore Reserve estimate for their Arrowsmith North Project in Western Australia.

The scope of work included: Importing and reconciling the supplied mineral resource block model, defining mining boundaries for successive schedule timing, preparing the mining area into appropriate blocks which would form the basis of the mining schedule, preparing a mining schedule for the total mine life, reporting of the mining schedule physicals including material mined and the associated products, for inclusion in the financial model, culminating in the reporting of an updated Ore Reserves estimate for the Project.

The production schedule was completed in quarterly increments for the first 7 years, followed by annual increments for the following 38 years after which the schedule was aggregated and reported in 5 year increments to the end of the mine's 111 year life.

Total material movements planned are shown for the first seven years in quarterly increments in the image belowand annually for years eight to forty five in Figure 7.

The work completed supports the reporting of an updated Ore Reserve estimate for this project in accordance with the guidelines in the JORC Code (2012 Edition). Proved and Probable Ore Reserves and have been derived from the Measured and Indicated Mineral Resources respectively contained within the current mining lease area M70/1389. The Arrowsmith North updated Ore Reserve estimate is shown in the Table below.

	Product				
Ore Reserve Classification	**Total Mt**	**AFS20 Mt**	**AFS35 Mt**	**AFS55 Mt**	**Local Mt**
Proved	9.2	0.8	3.9	2.7	1.8
Probable	211.8	24.2	102.5	51.1	34.1
Total	**221.0**	**25.0**	**106.4**	**53.8**	**35.9**

Table 4: Arrowsmith North Open Pit Ore Reserve Estimate – October 2022

The rounding in the above table is an attempt to represent levels of precision implied in the estimation process which may result in apparent errors of summation in totals shown in rows or columns.

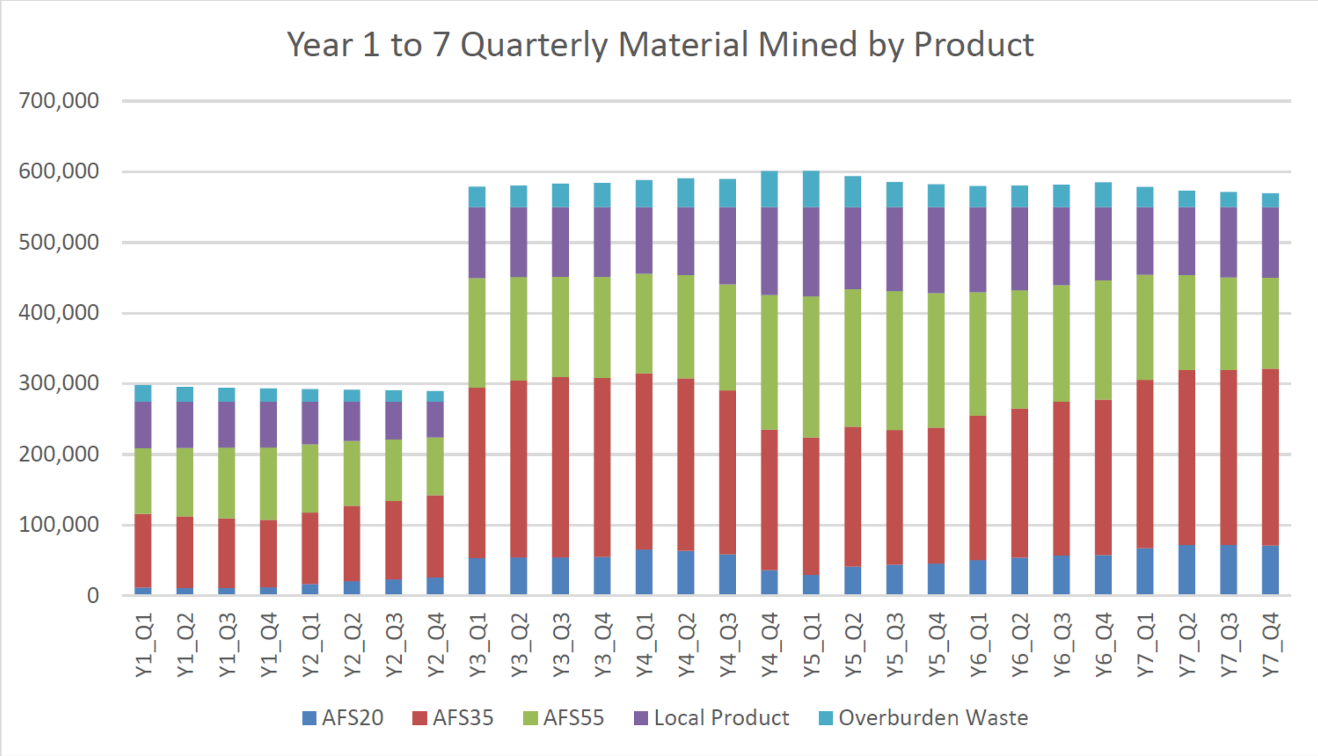


Figure 6: First 7 Years Production Profile

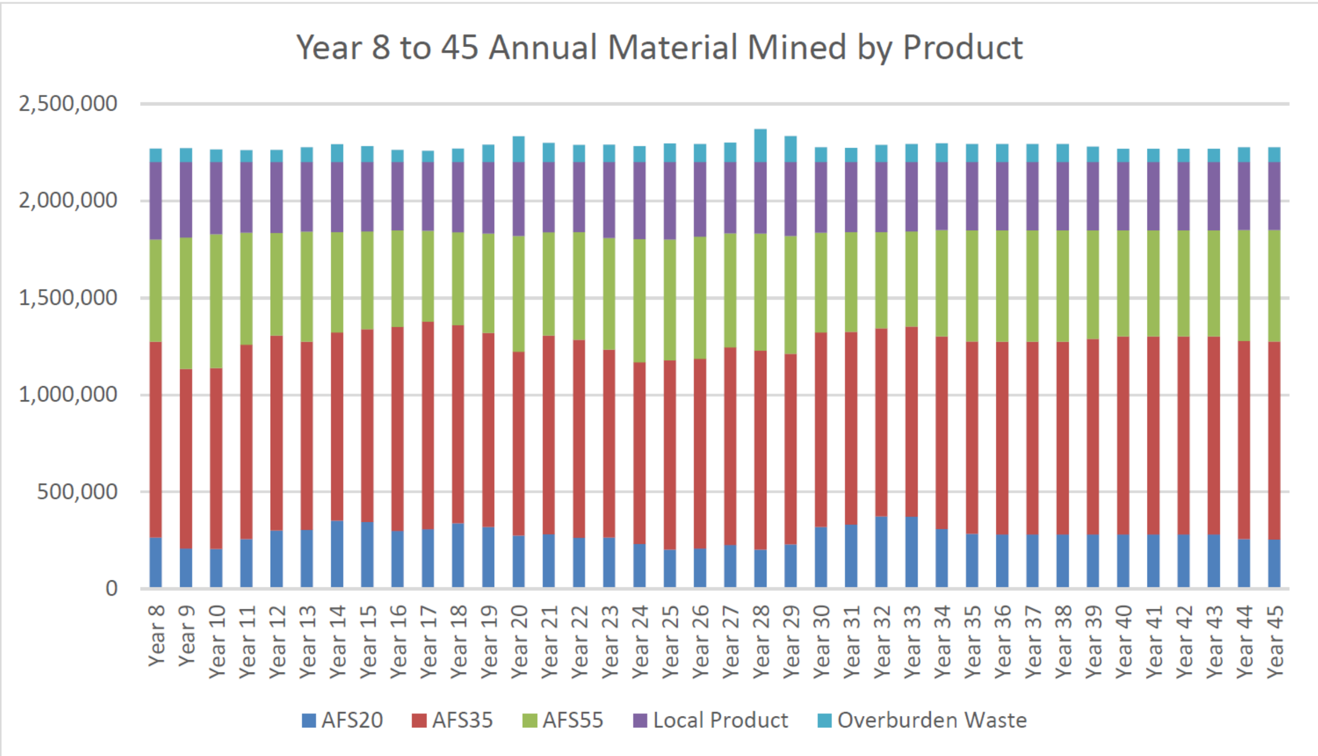


Figure 7: Years 8 to 45 Production Profile

4.1. Resource Model

The resource model was supplied by VRX from CSA. It was a DATAMINE sub-celled model the prototype of which is described in Table 5.

BLOCK MODEL SUMMARY						
Name	An0621md		File format	Datamine		
File size (Mb)	205.5		Date	20 Aug 2021		
Number of records	924930					
Model Source	X Block	X Block	Y Block	Y Block	Z Block	Z Block
Datamine	XC	XINC	YC	YINC	ZC	ZINC
BLOCK MODEL TONNAGE AND GRADE						
Cut-off grade	Tonnage	SiO2	Al2O3	Fe2O3	LOI	TiO2
	767,616,973	98.0	0.86	0.30	0.41	0.17
BLOCK MODEL PROTOTYPE						
Co-Ordinate	X		Y		Z	
Origin (Min Extent)	314000		6728100		16	
Maximum Extent	320400		740900		72	
Range (m)	6400		12800		56	
Parent cell	200		200		4	
Smallest sub cell	25		25		0.5	
No. of Parent Cells	32		64		14	

Table 5: Resource Block Model Extents and Description

This original resource block model was then regularised by Cube to be used for mine engineering and Ore Reserve reporting. The dimensions of the regularised bock model are shown in Table 6below.

Description	X	Y	Z
Minimum Coordinates	314,000	6,728,100	16
Maximum Coordinates	320,400	6,740,900	72
User Block Size	6.25	12.50	0.25
Min. Block Size	6.25	12.50	0.25
Rotation	0	0	0

Table 6: Regularised Reserves Block Model Extents

4.2. Mining Parameters and Scheduling

The development of the life of mine schedule and ore reserves for the project does not follow a conventional open pit approach which would normally consist of open pit optimisations, detailed pit designs prior to the scheduling. This is due to the fact that the entire resource is planned to be mined and processed into four distinct product categories.

The mined product material is fed onto a conveyor which delivers it to the processing facility where it is to be sorted into four product categories as shown in the image below.

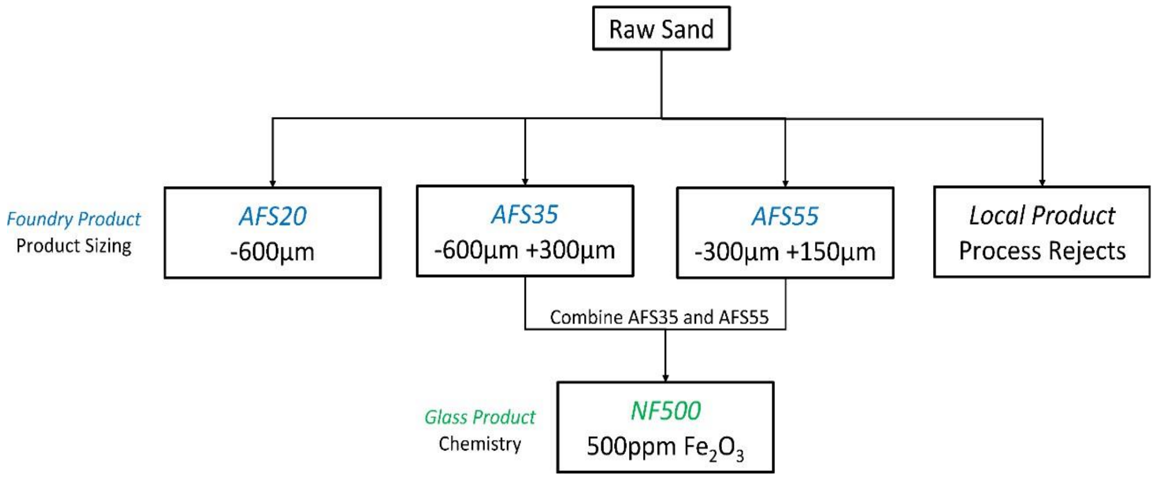


Figure 8: Product Summary

The Tails, Local Product, shown in Table 77 result from sizing processes for the -150µm size and from the hydrofloat for the coarser sizings. This mass deportment can therefore be used to estimate the yield of each of the 4 products from the information contained within the Mineral Resource Estimate (MRE) blockmodel.

	Mass Deportment (%)				
Stream	Total	+600um	-600um, +300	-300um, +150	- 150um
Feed		***12.3%***	***47.0%***	***34.4%***	***6.4%***
Fines Product stockpile	29.0%	0.00%	2.13%	81.0%	2.33%
Coarse Product stockpile	10.5%	82.9%	0.84%	0.00%	0.00%
Intermediate Product stockpile	42.5%	0.00%	83.2%	9.71%	0.00%
Tails	18.0%	17.1%	13.8%	9.28%	97.7%

Table 7: Nominal Feed Sizing

The MRE block model has estimated within each block attributes representing the following;

- % of sand -150µm
- % of sand +300µm
- % of sand +600µm

New attributes were generated in the Ore Reserve block model to represent 4 sizing groups, the formula refers to above;

- % of sand +600 µm
- % of sand -600µm +300µm = 2 – 3
- % of sand -300µm +150µm = (100- 1) – 2
- % of sand -150µm = 1

There should be a check attribute created adding A, B, C, D which should = 100%

The yield of each final product was then generated by using the mass deportment from Table 7, rounded as follows;

- +600µm = 17%
- -600µm +300µm = 14%
- -300µm +150µm = 9%
- -150µm = 97.5%

New attributes were then generated in the Ore Reserve block model to reflect the products shown in Figure 8, and the % calculation of each final product is therefore;

- **AFS20** = A x (100% - 17%)
- **AFS35** = B x (100% - 14%) + (C x 10%)
- **AFS55** = C x (100% - (9% + 10%)

Local Product = D + (A x 17%) + (B x 14%) + (C x 9%)

The next step in the process was to divide the resource into schedule 'blocks' to enable the schedule to achieve mining in a specified sequence to satisfy practical and strategic objectives. The primary guide for the schedule was to commence mining in the southwest corner of the project, where the initial processing facility is planned to be set up. The next target for the schedule is the Development Envelope which is an area specifically delineated in support of the primary EPA approvals. This area is to be the source of production for approximately the first 25 years of the operations. Following the depletion of the Development Envelope area, the remainder of the deposit is to be mined out in a northerly direction.

The schedule mines out the total resource which includes approximately 10Mt outside of the mining lease area, however the Ore Reserves estimated and reported here were limited to inside the mining lease area M70/1389. The total blocks scheduled together with the target Development Area and the Mining Lease are shown in the image below together with the sequencing of the schedule shown in various progressive increments of Years 1-7; Years 8 to 25 and Years 25 to 45.

The schedule targets total product tonnes of 2.2 Mt per annum over the full mine life with the exception of the first 2 years which are scheduled at half of the full production target as part of a conservative ramp up plan. The total material mined averages just over the target of product tonnes, which is due to the very low volumes of overburden waste to be moved to expose the target product material. Total material movements planned are shown for the first seven years, in quarters in the and annually for years eight to forty five in Figures 6 and 7.

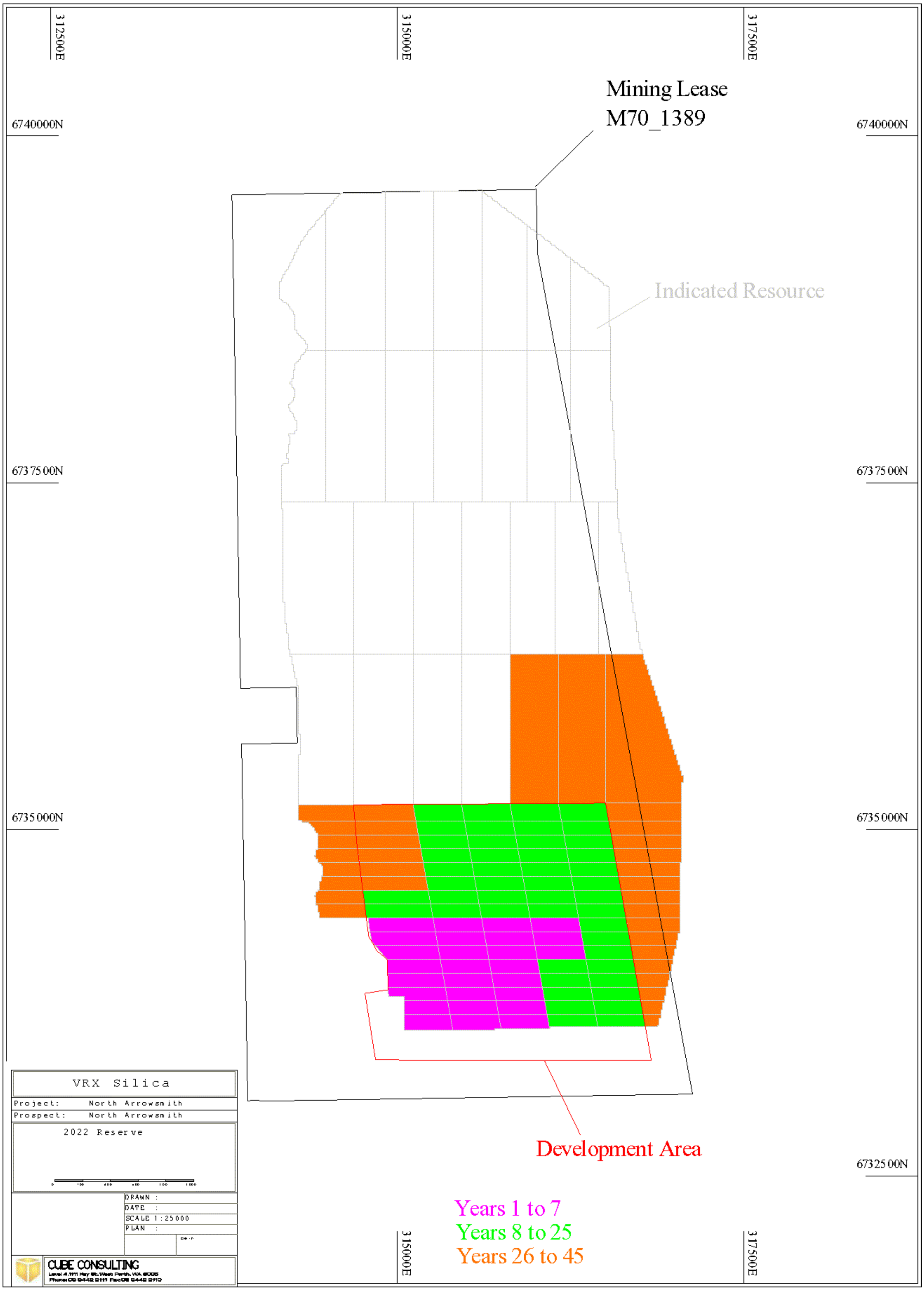


Figure 9: Mine Schedule Blocks, Development area and Mining Lease Area

4.3. Ore Reserve Estimate

At the conclusion of this study, it was demonstrated that the project is economically viable considering all relevant factors, test work and design criteria, culminating in a financial analysis with favourable economic metrics.

The work completed supports the reporting of an updated Ore Reserve estimate for this project in accordance with the guidelines in the JORC Code (2012 Edition). Proved and Probable Ore Reserves have been derived from the Measured and Indicated Mineral Resources respectively, contained within the current mining lease area M70/1389. The Arrowsmith North updated Ore Reserve estimate is shown in Table below.

	Product				
Ore Reserve Classification	**Total**	**AFS20**	**AFS35**	**AFS55**	**Local**
	Mt	**Mt**	**Mt**	**Mt**	**Mt**
Proved	9.2	0.8	3.9	2.7	1.8
Probable	211.8	24.2	102.5	51.1	34.1
Total	**221.0**	**25.0**	**106.4**	**53.8**	**35.9**

Table 8: Arrowsmith North Open Pit Ore Reserve Estimate – October 2022

The rounding in the above table is an attempt to represent levels of precision implied in the estimation process which can result in apparent errors of summation in some columns.

5. Material Modifying Factors

5.1. Environmental Studies

Development location:

- South of the Yardongo Nature Reserve
- Approximately 10 km inland from the coast
- North of the Arrowsmith River (Registered Aboriginal Heritage Site)
- Outside of World Heritage Areas, National Heritage Places, Ramsar Wetlands, Conservation Reserves or Commonwealth Marine Reserves

The Probable Ore Reserve is located within an area of deep loose, pale yellow sands, leached of nutrients. The vegetation is coastal low scrub heath (known as Kwongan Heath). There are relict dune structures which are represented as low rolling hills.

5.2. Assessment Process

Referral submission to the Federal Department of the Environment and Energy (DotEE) since renamed Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW);

- Submission of Section 38 referral to State Environmental Protection Authority (**EPA**);
- Have received an Accredited *Environment Protection and Biodiversity Conservation* Act 1999 (Cth) Assessment under the State *Environmental Protection Act* 1986 (WA) via an Environmental Review Document with public comment;
- ERD lodged in April 2022 with updates submitted in June 2022 and February 2023;
- PER period ended July 2023 and Summary of Submissions from PER provided by EPA to VRX in September 2023;
- VRX lodged its 'Response to Submissions' (RtS) October 2023 for further assessment by EPA and other authorities.
- The EPA has collated comments from all relevant State Government departments and has provided preliminary comments.
- The Company has lodged a response to address these comments
- VRX is awaiting formal notice of comments on the RtS from State Government Departments and DCCEEW, being collated by EPA.
- Following formal notice and acceptance of the updated 'Response to Submissions' document by the EPA, the EPA will prepare an assessment report recommending whether the Proposal should be approved by the Western Australian Environment Minister and provide recommended conditions.

5.3. Mitigation Strategies

Proposed action lies within a large Mine MDE, allowing for the flexibility to target areas of lower significance to matters of national environmental significance (**MNES**)

- Disturbance will be kept to a minimum, up to 25 ha per year and 14 ha cleared for the duration of the project
- Progressive rehabilitation using topsoil re-location via the VDT mining method to ensure topsoil and plants are translocated intact to previously mined areas
- Conduct further surveys required under approval commitments
- Use findings to steer the project and avoid MNES where possible
- There are no mine tailings storage requirements.
- There are no waste dumps.
- Processing requires no toxic chemicals.

5.4. Infrastructure

The project is located on Unallocated Crown Land which is east of freehold land and bounded to the north by a Nature Reserve and by the 100% held VRX Mining Lease M70/1418. The east boundary of the project area is the limit of tenure of Mining Lease M70/1389. The Brand Highway is proximal to the area and access is via either the Mount Adams Road from the north or a proposed southern access road to Brand Highway to the south. The Eneabba/Geraldton railway line lies to the south west of the project and will be considered for future use to transport the processed silica sand to Geraldton Port for bulk export.

The Project will require its own installed power and water infrastructure.

Labour will be sourced from the nearest towns, Dongara and Eneabba (approximately 30 km from the mine site) and there will be no accommodation installed at the mine site.

5.5. Costs

Operating costs

Operating costs have been determined from first principles and are estimated to include all costs to mine, process, transport and load product on to ships. They are estimated on 1 million tonnes per year throughput, with expected unit cost savings if throughput is increased as anticipated to potentially 2 million tonnes per year.

Royalties

The prevailing rate of royalty due to the State is used in VRX's economic assessments. The State Royalty rate is A$1.17 per dry metric tonne and reviewed every 5 years with the next review due in 2025.

There are no other royalties payable (including private).

5.6. Revenue

Product Quality

Multiple products will be differentiated during processing subject to required particle size distribution by screening. Recovery of products has been independently assessed by BHM Process Consultants (**BHM**).

Commodity Prices

Maintaining its conservative approach to pricing for silica sand products, the Company has based pricing at the same level as in the 2019 BFS.

The industry standard is that sales contracts are in US dollars. The exchange rate to convert to Australian dollars will be the prevailing rate at the time of payment.

Subject to final quality produced, the prices for the commodity will range from US$38 to US$43 per dry metric tonne Incoterms Free on Board (FOB) international contracts of sale. There are no shipping cost estimates with all contracts to be based on FOB rates.

Revenue will be based on a negotiated per shipment basis per dry metric tonne FOB with payment by demand on an accredited bank letter of credit. There will be no other treatment, smelting or refining charges.

Revenue will be based on a negotiated per shipment basis per dry metric tonne FOB with payment by demand on an accredited bank letter of credit.

Market Assessment

The global value and volume of the silica sand market indicated growing demand for supply of silica sand as shown below. The future tightening of supply of suitable quality silica sand, particularly for glassmaking, is commensurate with future increases in price.

Figure 10: Global Washed Silica Sand Market by Value and Volume (2018 to 2031 by Report Ocean Pvt Ltd, 2023.

5.7. Economic Factors

The Company's economic analysis has calculated a 10% discounted ungeared post tax net present value (**NPV**).

The assessment has not considered any escalated future product prices nor any inflation to operating costs. The analysis has used a US$/A$ exchange rate of US$0.66/A$1.00.

The analysis is based on a 25-year production profile despite the Probable Ore Reserve far exceeding that project life.

Capital requirements are based on independent estimates following detailed engineering and re-tendered prices late 2023 and early 2024.

The analysis is most sensitive to the exchange rate and sales prices. The analysis indicates the financials of the project are very robust and there is a high confidence that a viable long-term mining operation can be justified.

5.8. Social Factors

The Company was granted a mining lease (M70/1389) in November 2020.

The Mining Lease area lies within the Yamatji Nation Native Title Determination (WCD2020/001)(Yamatji Nation). The formation of the Yamatji Nation consolidated the existing four native title determinations, being, Mullewa Wadjari, Southern Yamitji, Hutt River and Widi Mob. The WA State Government then entered into an Indigenous Land Use Agreement (ILUA) with the Yamitji Nation thereby resolving the State Government's native title compensation liability in relation to the area covered by the ILUA. The Yamatji Southern Regional Corporation Ltd (YSRC) was established to act as the Regional Entity to manage the benefits of the ILUA.

The Company enjoys a strong relationship with, and continues to engage with, Traditional Owners and their representatives.

The project is wholly on Unallocated Crown Land. There is little negative impact on local communities.

5.9. Project Funding

The financial model summarised in the BFS sets out the project metrics and provides a basis for the development of the project. Total capital expenditure at Arrowsmith North (for a 2 million tonnes per annum processing plant) is estimated at approximately A$66 million (the Updated BFS details capital cost estimates).

The Company anticipates that the source of funding the capital investment at Arrowsmith North will be any one, or a combination of, equity, debt and pre-paid offtake from the project. Whilst no final decision has been made in that regard, the financial model assumes a maximum A$55 million in debt.

The Company has received a number of enquiries and expressions of interest from debt financiers for the project. As noted above, the financial model provides for debt capacity and is designed to meet the expectations of any providers of potential debt funding for their due diligence and other internal requirements.

In addition, VRX has also received enquiries and expressions of interest from organisations across Asia for silica sand products from the project and holds signed letters of intent for substantial tonnages. A number of these organisations have expressed interest in becoming a funding partner of the Company for development of a mine by way of pre-paid offtake arrangements. The Company has executed non-binding term sheets with two South Korean companies setting out terms and conditions for aggregate offtake of 200,000 tonnes of foundry sand.

Given the number of inbound inquiries and test work on products capable of production from Arrowsmith North, the Company has a reasonable basis to believe binding offtake agreements will be entered into in the future. However there can be no certainty that one or more binding agreements will be reached or that any conditions precedent to any such binding agreements will be satisfied.

The balance of the Company's capital requirements will be funded from equity capital.

Whilst the envisaged project development requires a low capital intensity relative to a greenfields hard rock mining project, and any one of, or a combination of equity, debt and pre-paid offtake is planned, VRX has not as yet secured the required capital. The positive financial metrics of the Updated BFS and feedback from potential funding partners provides encouragement as to the likelihood of meeting optimum project and corporate capital requirements.

6. Mining

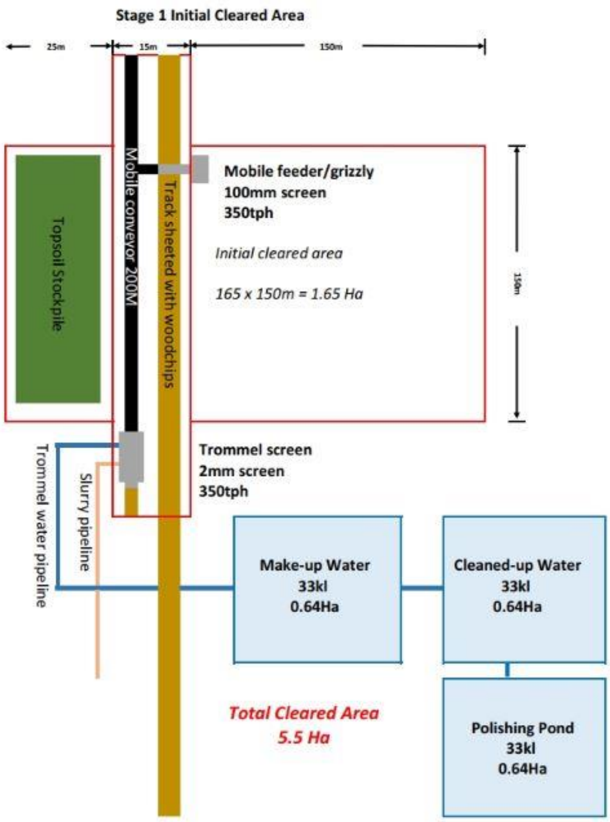
The Project will utilise a unique and flexible mining and rehabilitation method to maximise production and the recovery of rehabilitated mined areas.

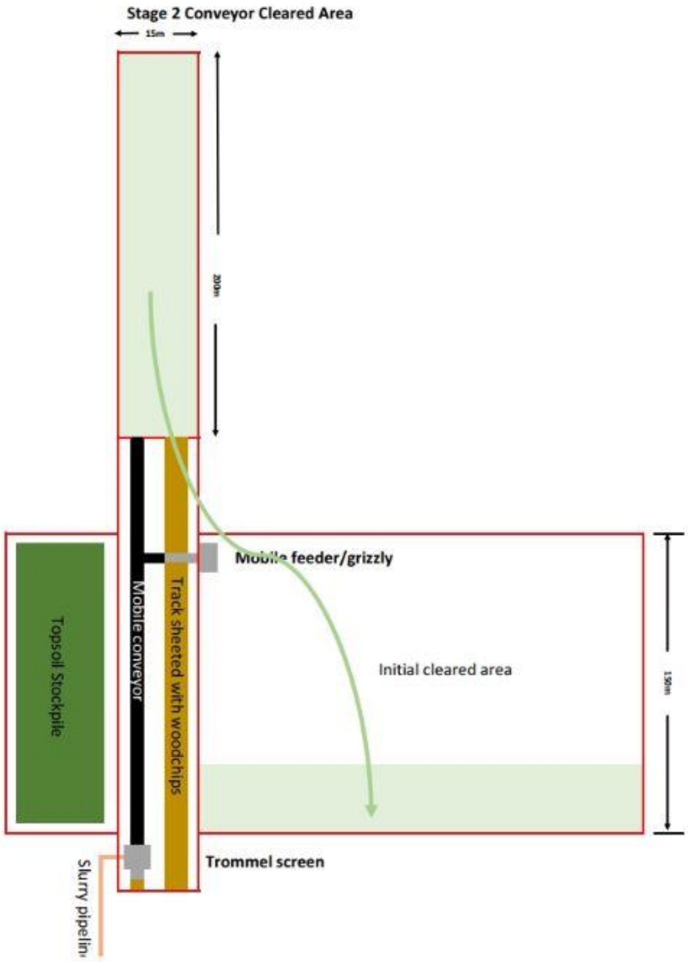
The proposed mining process is to sequentially mine 8-15 m of sand from below the base of the soil profile in 2.25 ha blocks (150 m x 150 m), with up to 8 blocks mined per year (18 ha).

High grade silica sand will be produced in line with the following sequential process:

An initial area of 150metres x 150metres will be cleared conventionally by dozing the topsoil to 400mm into a topsoil stockpile to one side of the proposed mining area.

This windrow will be undisturbed for a significant time (up to 10 years). The windrow will be utilised as a seed bank and will be later reused as topsoil on the last area mined.





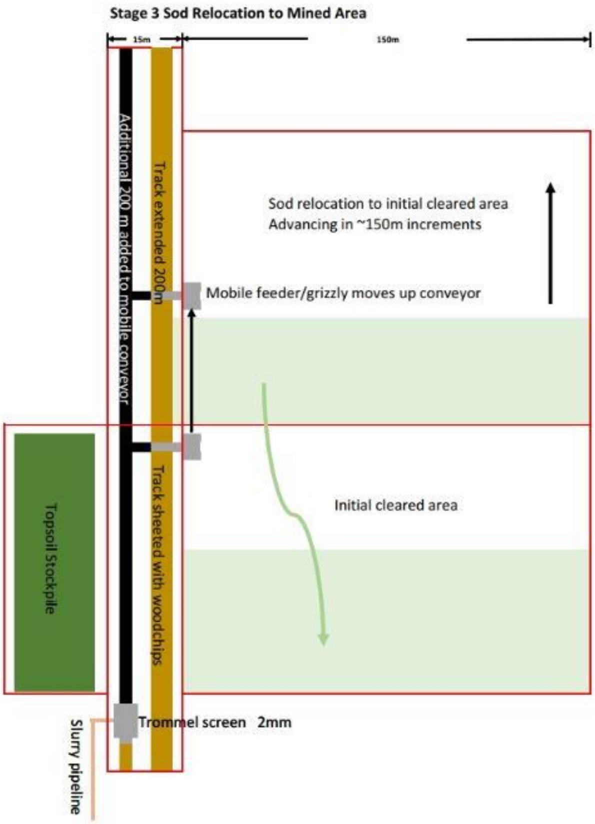
Vegetation is trimmed in preparation for translocation.

This will utilise a front mounted mulcher which will trim the vegetation to approximately 300 – 800 mm above ground. This will create vegetation material which will later breakdown as a humus but most important will reduce the foliage and aspiration rates to increase the survival rates after the Vegetation Direct Transfer (VDT) in a low rainfall area.

A modified FEL will be used to excavate a 3metre x 3metre x 400mm sod of topsoil which will include the relatively undisturbed microbial and invertebrate content. The sod including the topsoil and vegetation will be translocated to the previously mined area.

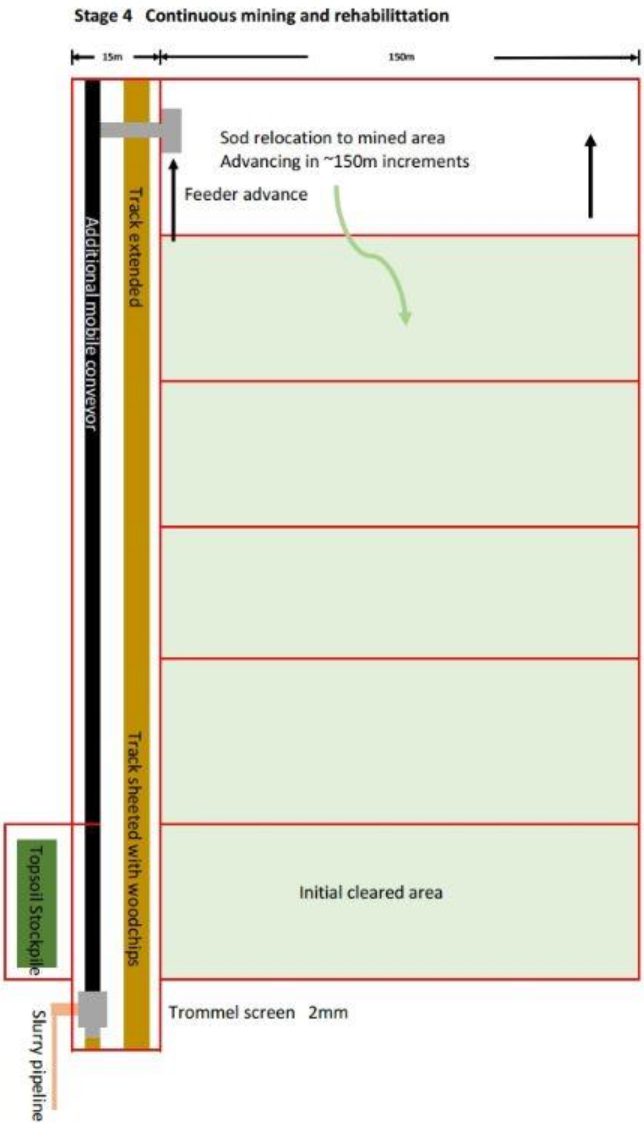
Figure 11: Modified FEL Bucket

Silica sand is mined in 2.25 ha panels to allow continuous rehabilitation of the site.



Silica sand is mined and screened in a mobile feeder site located at the mine face. A conventional FEL will load sand on to a feeder bin which will transfer on to a conveyer.

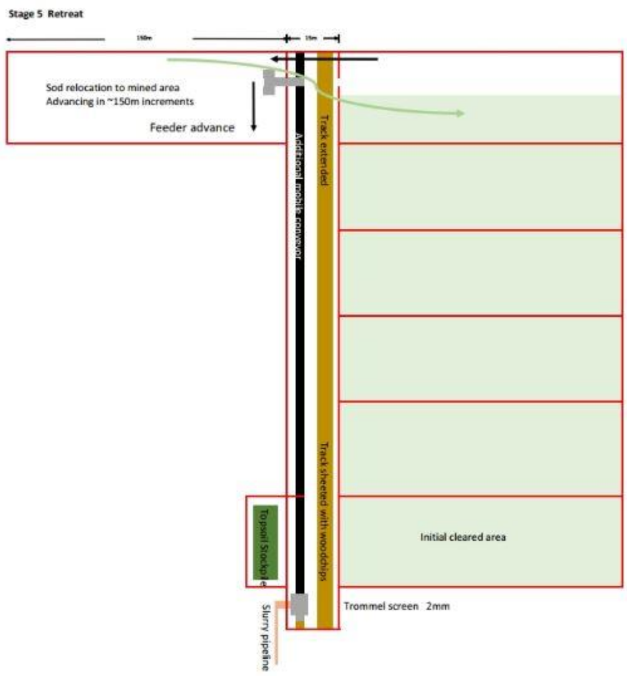
Figure 12: Mobile Feeder



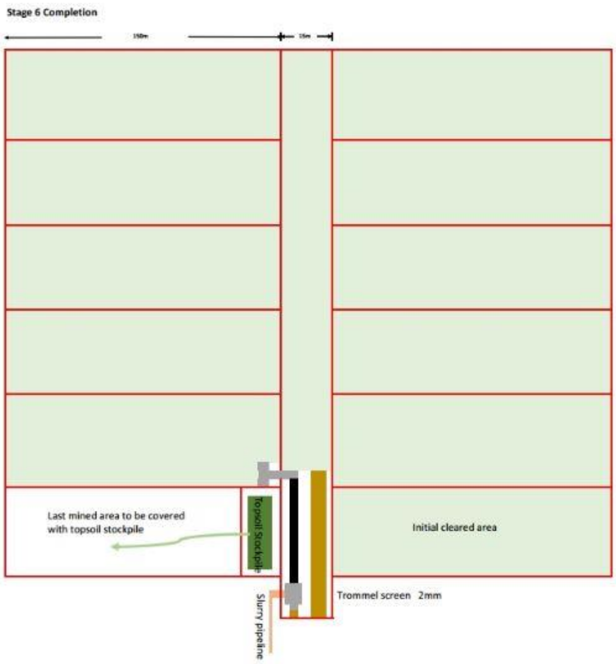
Sand is conveyed to a rotating trommel.

This trommel will have a water washed 2mm screen which will remove any oversize and organic material. The sand will then be slurried (water sand mixture) and pumped to an off-site processing plant. There the sand will be beneficiated into the final saleable products.

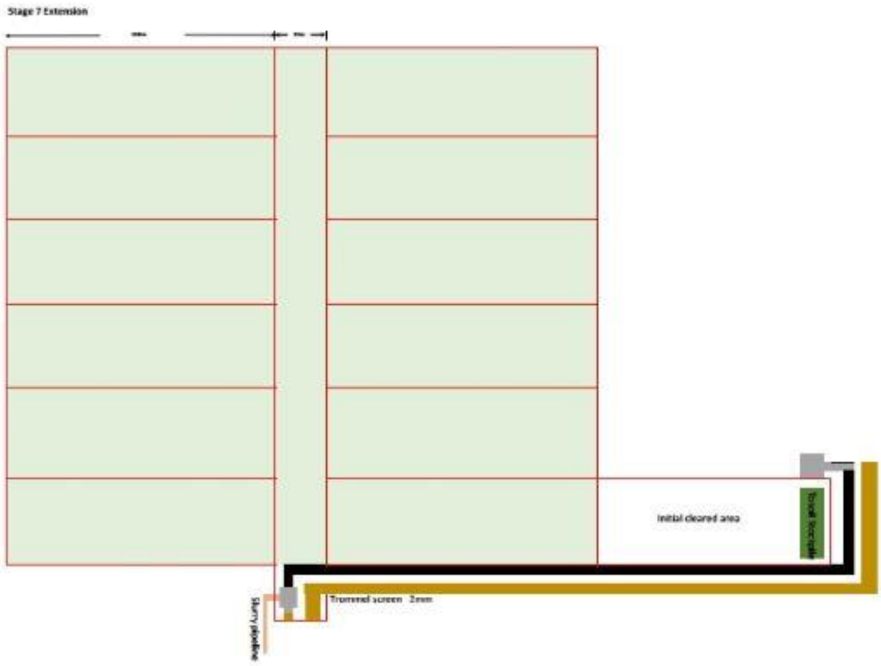
The mining and conveyor will advance in 150metre x 150metre panels with continuous VDT rehabilitation to the extent of the conveyor system at which point it will change to the other side of the conveyor and retreat back to the initial mined area.



Mining will continue in panels to the initial cleared area where the previously stockpiled topsoil will be spread across the final mined panel.



The conveyor will then have a transverse added component and move the mining to a new area where the process will be repeated.


Stage 7 Extension
Initial cleared area
Topsoil Stockpile
Trommel screen 2mm
Slurry pipeline

7. Metallurgy

7.1. Sampling

A composite drill sample of sand from Arrowsmith North was sent to Nagrom Laboratories in Perth (**Nagrom**) for testing. The sample was screened at 1 mm to remove oversize particles. The remaining material was then subjected to a metallurgical testwork program at Nagrom and supervised by BHM. The summary below was extracted from BHM report “Process Development Metallurgical Test Work Report”, March 2023.

Figure 13: Pilot silica sand test plant at Nagrom Laboratories

7.2. Testwork Program

The Arrowsmith North silica project has reported an ore reserve of 223 Mt contained at an SiO_2 grade of 99.7 %. VRX undertook a flowsheet development study with CDE Engineering in 2019 that returned a capital cost estimation and flowsheet based on the supplied samples at the time. Subsequent investigation of the supplied samples versus the in-situ resource determined that the material tested in 2019 represented the lower 10th percentile when it came to the deleterious elements of iron and titanium and VRX engaged BHM to develop a more robust metallurgical flowsheet with respect to iron and titanium bearing mineral removal. BHM embarked on an investigative metallurgical testwork program in 2020 and is covered in the previous report Process Development Metallurgical Testwork Report (1075-VRX-PDR-001) dated Nov 2021. This report covers the scale-up and piloting of more representative Arrowsmith North bulk samples and the investigative work assessing the applicability of Hydrofloat technology.

ID	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
	%	ppm	ppm	ppm	ppm	%
2019 CDE Eng Sample	98.230	11,600	3,880	N/A	1,100	N/A
Arrowsmith North Composite	95.955	18,860	6,520	3,130	3,100	0.66

Table 9: Arrowsmith North Pilot Master Composite Head Grade

The intention of this body of work was not to compare the historical works, the data above is provided to give context to the levels of contaminants contained within the two studies feed material. The purpose of the testwork program was to replace the developmental conventional flotation used previously, and investigate the applicability of the Hydrofloat technology to address the issue surrounding coarse particle size in flotation. It was also designed to investigate the scale-up of attritioning units to industrial standards over the small scale test unit utilised in the previous program whilst locking down the metallurgical flowsheet.

Ultimately, the best performance in respect to combination of unit operations is described by:

- Fine particle removal (-106 µm) via the use of a Constant Density Tank, or LFCU elutriator.
- Attritioning to remove particle surface coatings.
- Cycloning prior to the Hydrofloat conditioning tank to remove attrition generated fines as best as practicable.
- Hydrofloat utilising the Hexion C3025T reagent for removing iron bearing minerals from the quartz product grains.

The above combination of unit operations ultimately achieved in the generation of the following silica product size fraction chemical analysis and approximate mass yields.

ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
	% of Feed	%	ppm	ppm	ppm	ppm	%
Head	100	95.955	18,860	6,520	3,130	3,100	0.66
+1.18mm	0.06	67.335	10,640	4,000	2,810	910	16.4
RC O/F	6.78	78.104	111,784	34,945	17,738	6,704	4.14
Hydrofloat Feed	93.16	97.738	9,489	3,387	2,002	2,576	0.35
O/F	14.6	90.124	39,793	16,867	8,572	14,600	1.39
Underflow	78.5	99.293	3,354	791	764	359	0.14
+0.6mm	10.4	99.495	2,290	650	180	270	0.11
-0.6mm, +0.3mm	43.2	99.402	2,850	710	390	360	0.13
-0.3mm, +0.106	24.9	99.031	4,640	970	1,640	380	0.17

Table 10: Summary of Testwork

The above table is a summarisation of all the testwork undertaken as represented within this report, it is not a perfect mass balance of the testwork, however represents the expected outcomes from the combination of unit operations as applied and represented in the Process Flow Diagrams that underpin the project plant design. A mass yield to product of 80 % of the incoming feed is expected to report to the three (3) silica product size fractions with the above chemical signatures.

The Hydrofloat process (and the optimal reagent regime) has proven to be integral in producing the products as described in the above table, however must be supported by the correct series of preceding unit operations in order to obtain maximum efficiency and the best possible product grade in respect to the deleterious elements of iron, aluminium and titanium.

It is expected that with further development and continual optimisation of the Hydrofloat during operation the iron grades contained within the final products will only improve and decrease further over that achieved in this phase of testswork.

7.3. Introduction

This report continues the testwork development from the previous diagnostic and investigative metallurgical testwork program as reported in the Process Development Metallurgical Testwork Report (1075-VRX-PDR-001) dated Nov 2021.

After further metallurgical and engineering development of the project, several changes to the flowsheet had been formed resulting from discussions with vendors. The most significant of these were the concerns around conventional flotation considering the relative coarseness of the material. Eriez's Hydrofloat technology was deemed suitable for the application as a mix between column flotation and elutriation.

Additionally, the implementation of elutriation upfront on the plant to mimic a constant density tank was deemed the most suitable unit operation to remove fines (-106um) material from the feed and increase the density of the slurry for attritioning.

The overview of this phase of testwork to support the Process Design can be summarised as follows:

- Sighter testwork around the implementation of a Hydrofloat unit to replace conventional flotation.
- A 2 tonne pilot testwork program focusing on up-scaling attritioning and the implementation of the Hydrofloat.
- The pilot testwork would also enable the generation of sufficient quantities of material formarketing purposes.

7.4. Sighter Testwork Program

The sighter testwork required processing sufficient material to enable feeding into a laboratory scale Hydrofloat unit. This required a minimum of 20kg. A 1 tonne parcel of material was selected by VRX for use in this testwork.

The test plan for the sighter program can be seen below.

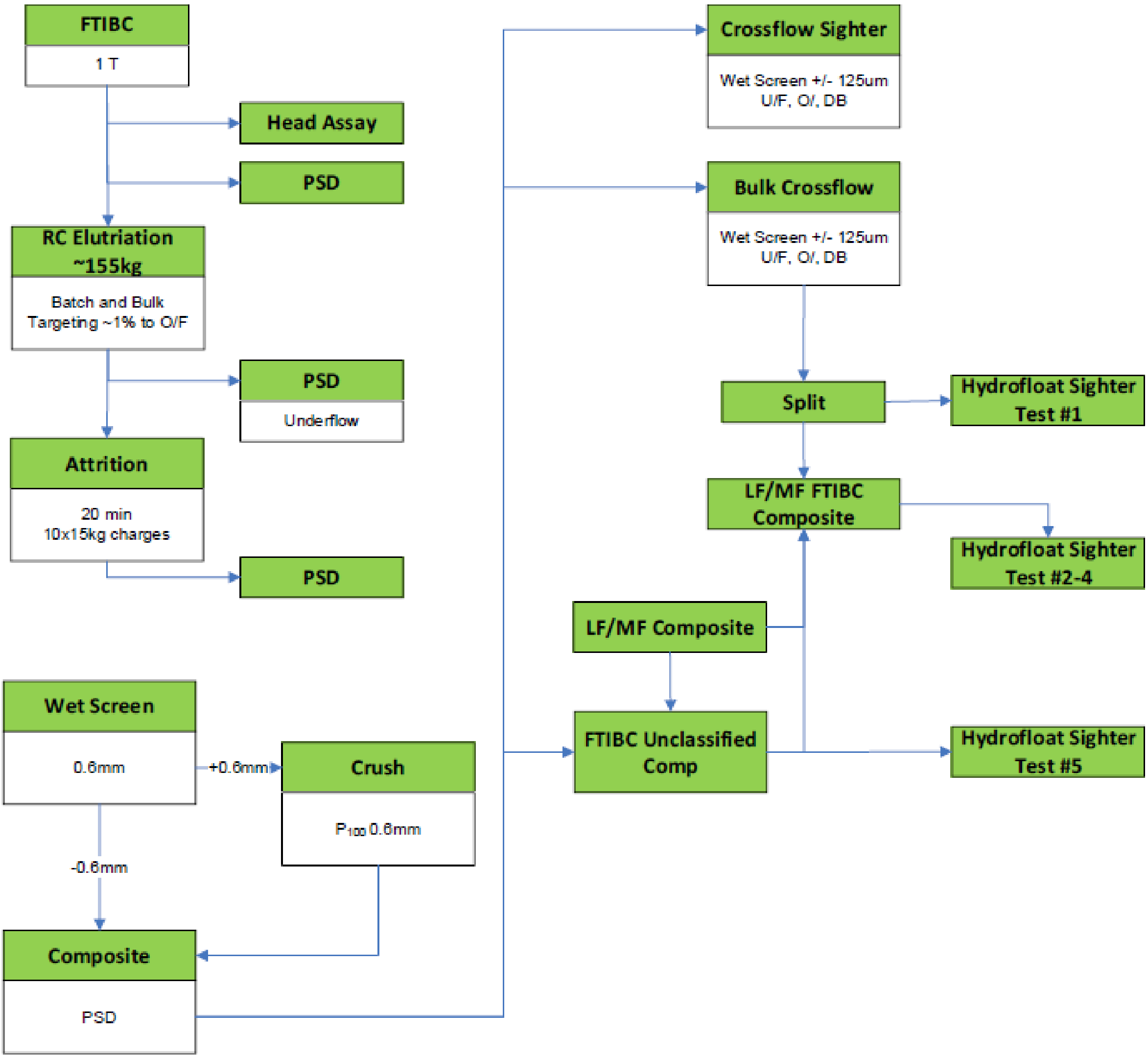


Figure 14: Hydrofloat Scoping Testwork

7.5. Head assay

The head assay for the parcel of material can be seen below.

Sample	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
	%	ppm	ppm	ppm	ppm	%
Head	99.815	770	260	70	680	0.12

Table 11: FTIBC Head

7.6. RC, Elutriation

Based on the previous testwork programs, the batch reflux classifier (RC unit) was conducted to remove a large portion of the -106um material in the feed. A mass yield of ~1% to the overflow was targeted in the batch run (5kg) to establish conditions before the remainder of the material (~150kg) was processed. A summary of the test conditions and results can be found in the tables below.

Parameter	Unit	Value
Vessel Dimensions	mm	60x100
Channel Length	m	1
Inclined angle	°	70
Channels	#	7
Plate Thickness	mm	0.55
Channel spacing	mm	6x7.55mm, 1 x11.7mm
Charge Size	kg	~5
Overflow Flowrate	l/hr	954
Collection Time	Min	35

Table 12: Bulk RC testwork Conditions

Sample	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
	%	%	ppm	ppm	ppm	ppm	%
Overflow	1.26	94.003	17,440	5,570	1,840	5,510	2.70
Underflow	98.7	99.720	490	140	60	560	0.07
Back-Calc Head		99.648	704	209	82	623	0.10

Table 13: Bulk RC results, Grade

Sample	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
	%	%	ppm	ppm	ppm	ppm	%
Overflow	1.26	1.19	31.3	33.7	28.2	11.2	33.1
Underflow	98.7	98.8	68.7	66.3	71.8	88.8	66.9

Table 14: Bulk RC results, Deportment

To summarise the data presented, there is a substantial rejection of the impurities into ~1% of the feed mass.

7.7. Attritioning, Screening and Crushing

Attritioning was conducted on the RC underflow material under conditions like the previous testwork programs. These conditions are summarised below.

Parameter	Unit	Value
Density	%w/w	75
Residence Time	min	20
Impellor tip speed	m/s	4.57
Charge size	kg	~15

Table 15: Attritioning conditions

Additionally, one charge was conducted at 70% solids and one at 80% solids to provide some preliminary power draw data for engineering purposes. This data is largely superseded later during the pilot run where more detailed information on a scaled-up attritioner unit was obtained. Please see section 3.3 for more details.

Parameter	70%	75%	80%
Hz	22.238	22.397	22.500
Amps	2.025	2.017	1.936
kW	0.384	0.385	0.364

Table 16: Average Power Draw data from Sighter Attritioning

The attrition charges were combined post attritioning and screened at 0.6mm, with the +0.6mm reporting to a rolls crusher with a Closed Side Setting (CSS) of 0.6mm.

Sample	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
mm	%	%	ppm	ppm	ppm	ppm	%
+0.6	19.4	99.874	130	100	0	220	0.06
-0.6	80.6	99.702	290	210	40	530	0.06
Back-Calc Head		99.735	259	189	32	470	0.06

Table 17: Attritioned material screened, assays

Figure below shows the comparative sizing of streams from feed to post attritioning.

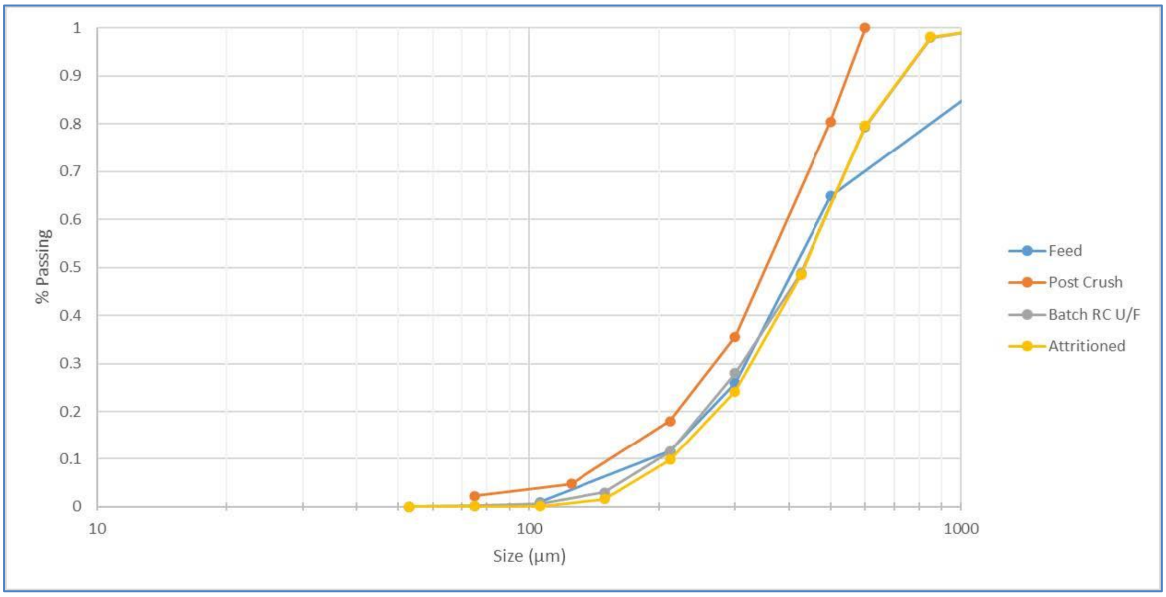


Figure 15: Sizing (Cumulative Passing) of subsequent streams

When comparing between the attritioned material and the crushing of the +0.6mm fraction there can be determined an increase in the fines generation from the crushing operation. Specifically, there is an increase in the -150µm of roughly 3% mass which ultimately becomes a loss stream.

mm	Attritioned	Post Crush
+0.85	1.81%	-
+0.6	18.6%	-
+0.3	55.4%	64.4%
+0.150	22.5%	13.2%
-0.150	1.66%	4.79%

Table 18: Relative sizing between Attritioned material and post crush composite

7.8. Crossflow

The supplier recommended the use of a classifier prior to the Hydrofloat to remove excess fines. The recommended unit was the Crossflow (50mm x 205mm). A separation of -125 µm was targeted inline with previous knowledge. While the fines generated from the attritioner is more likely to be - 53µm, the -150µm was known to be low quality and to be a waste stream. The upstream elutriation (section 2.2) removes the bulk of this material but was not expected to remove all of it.

As the unit is a continuous throughput, with several instreams, samples were taken upon reaching steady state at various up-current flowrates to establish the cut achieved alongside a screen of +/-125um on the overflow samples. Once this was received, the setpoint was selected and the remainder of the material processed. A summary of the various tests can be seen in the table below.

Parameter	Unit	IS#1	IS#2	IS#3	Bulk
Dry Feed Rate	kg/min	1.0	1.0	1.0	1.0
Feed Water	l/min	0.9	0.9	0.9	0.9
Upflow water	l/min	2.5	3.0	3.5	3.5

Table 19: Crossflow Test Conditions

A summary of the results can be seen in the tables below.

Sample	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	-125µm	+125µm
	%	%	ppm	ppm	ppm	ppm	%	%	%
Underflow	97.9%	99.808	280	100	30	490	0.06	1.51	98.5
Overflow	2.07%	99.301	1,470	1,120	360	770	0.18	98.8	1.17
Back-Calc Head		99.798	305	121	37	496	0.06		

Table 20: Crossflow test, IS#1

Sample	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	-125µm	+125µm
	%	%	ppm	ppm	ppm	ppm	%	%	%
Underflow	97.5%	99.673	280	100	30	500	0.10	1.09	98.9
Overflow	2.51%	99.267	1,900	1,110	400	910	0.23	95.7	4.28
Back-Calc Head		99.663	321	125	39	510	0.10		

Table 21: Crossflow test, IS#2

Sample	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	-125µm	+125µm
	%	%	ppm	ppm	ppm	ppm	%	%	%
Underflow	96.6%	99.901	220	100	20	510	0.04	0.70	99.3
Overflow	3.43%	99.191	2,070	1,290	410	1,010	0.23	96.8	3.17
Back-Calc Head		99.877	284	141	33	527	0.05		

Table 22: Crossflow test, IS#3

Due to the favourable balance between mass loss and -106µm rejected, an up-current flow of 3.5 l/min was selected for processing the bulk of the material.

Sample	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	-125µm	+125µm
	%	%	ppm	ppm	ppm	ppm	%	%	%
Underflow	92.4%	99.768	230	150	0	510	0.01	1.00	99.0
Deadbed	3.71%	99.937	220	180	40	490	-0.01	3.55	96.4
Overflow	3.90%	99.407	1,330	1,140	350	800	0.12	97.7	2.29
Back-Calc Head		99.760	273	190	15	521	0.01		

Table 23: Bulk Crossflow, Assays

7.9. Hydrofloat testwork

During feed preparation of the FT IBC material, it was uncovered that an error had been made and the material did not accurately reflect the Arrowsmith north resource average as was believed. As a result, the feed grade post elutriation (Crossflow post +0.6m Crush) was significantly lower than anticipated as per feed grades reporting into flotation during previous testwork programs utilising conventional flotation (~130ppm vs ~700ppm). Given the testwork focus was proof of concept, and the sample preparation had already been completed, the test plan continued to generate a generic comparison against conventional flotation.

With the discovery of the sample genesis discrepancy, the previously rejected material from the LF/MF bulk flotation testwork (more detail can be found within the testwork report 1075-VRX-PDR- 001) was composited with the classifier product to ensure there was enough material for 4 charges at ~700ppm Fe_2O_3. For ease of reference the material that is composited will be referred to as spiked.

A summary of the test regime that was utilised for the Hydrofloat was:

- Test#1, Unspiked, 680g/t Collector under standard The supplier feed density conditions

- Standard feed conditions are 65% w/w solids with dilution while feeding with a vibrating feeder
- Test#2, Spiked, 680g/t Collector, 50g/t Depressant, pH modification to 7.5 in conditioning, under standard The supplier feed density conditions
- Test#3, As per test #2 with feed density adjusted to 45% w/w
- A discussion around the need to thicken the feed (65%) when feeding the Hydrofloat was occurring at the time from a flowsheet/capital perspective. The necessity of the having an elutriator (Crossflow) before Hydrofloat was being questioned due to capital concerns around its inclusion.
- Test#4, Spiked, 350g/t Collector, 150 g/t depressant and pH modified. Density was to be determined based on results of test #2 and #3. It was decided to utilise standard feed conditions (as Per test #2)
- Test#5, Spiked, (Unclassified) 350g/t Collector, 300g/t Depressant and standard feed conditions.

Due to the volume of frother required for the Hydrofloat testwork and the subsequent availability of this frother previously used at the laboratory, the decision made was to switch to MIBC. This does not appear to have had a negative impact on the process. Compared to the previous frother in use (Polyfroth W22) MIBC would be a cheaper frother and easier to supply.

Test#1, Unspiked

The initial Hydrofloat was conducted with parameters as set in consultation with the supplier based off of the previous elutriation steps conducted. The results can be seen in the table below.

								Distribution
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	68.02%	99.835	170	100	30	300	0.10	41.2%
Bed	20.57%	99.757	160	100	30	300	0.08	12.5%
Overflow	11.42%	99.295	930	670	150	1,770	0.21	46.3%
Back Calc Head		99.757	255	165	44	468	0.11	
Head Assay		99.768	230	150	10	510	0.01	

Table 24: Test #1, Hydrofloat of FTIBC

As can be observed, ~46% of the Fe_2O_3 in the feed was rejected. The bed in the unit and the underflow generated during the test were kept separate as there is the potential for some difference between these samples. However as can be seen they are effectively identical.

The sample in the test above (Table 14) can be seen in comparison to the prior test run of Muchea White from an earlier program (1075-VRX-PDR-001) using conventional cell flotation.

								Distribution
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Rougher Tail	97.16%	99.835	940	290	180	300	0.03	60.2%
Back Calc Head		99.666	1,144	468	197	628	0.06	
Head Assay		99.519	1,450	270	220	650	0.07	

Table 25: Muchea White, Conventional Flotation

While the head grade is substantially higher in the conventional flotation, the Fe_2O_3 rejection difference of 40% vs 46.3% highlights that the Hydrofloat is showing a comparable performance in terms of rejection of gangue.

Test#2 and #3, Spiked Feed

Following on from Test #1, the next two tests were conducted with the spiked feed and utilising the standard flotation regime as previously conducted in terms of collector, depressant and pH adjustment. The major difference between test #2 and #3 being the feed density. This comparison was deemed necessary to assess the requirement, from a flowsheet perspective, of feed density into the Hydrofloat.

								Distribution
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	63.57%	99.808	410	220	100	300	0.07	24.1%
Bed	23.70%	99.898	330	90	80	280	0.06	3.7%
Overflow	12.73%	99.295	3,880	3,290	680	5,760	0.22	72.2%
Back Calc Head		99.637	833	580	169	990	0.09	
Head Assay		99.598	880	590	180	1,130		

Table 26: Test#2, Spiked Feed @ standard feed density conditions

								Distribution
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	52.04%	99.918	270	40	70	280	0.05	4.3%
Bed	24.34%	99.869	230	60	40	260	0.08	3.0%
Overflow	23.62%	99.295	2,390	1,900	430	3,330	0.23	92.7%
Back Calc Head		99.670	761	484	148	996	0.10	
Head Assay		99.598	880	590	180	1,130	<0.01	

Table 27: Test#3, Spiked Feed @ 45% w/w feed

It can be seen there is a substantial increase in Fe_2O_3 rejection in the above tests compared to test #1 (Table 14) suggesting a degree of efficacy removing the material that has been spiked into the feed samples. There are also anomalies in respect to Fe_2O_3 grades. Test#3 has poor head grade reconciliation in respect to Fe_2O_3 and abnormally low Fe_2O_3 grade in the underflow and dead bed. While test #2 has an unusual discrepancy observed between the underflow and the bed.

It would be expected that the underflow/bed would reach close to the feed of the classified Muchea white material (~130ppm Fe_2O_3) if all the spiked material was removed. Both test #2 and #3 appear to have reached ~100ppm being comparable to the test #1. This suggests that the Hydrofloat will remove all the material that has previously been removed via conventional flotation.

The Fe_2O_3 rejection observed is impressive, however test #3 appears overstated due the large variance in respect to the back-calculated head and assay head. Additionally test #3, while seeing a greater Fe_2O_3 rejection, has also seen roughly double the mass rejected. This potentially indicated some short circuiting with a lower feed density highlighting that feed density into the Hydrofloat is a critical parameter.

Test #4

The primary focus of Test#4 was to see the impact of reducing the collector from 650g/t down to 350 g/t. Subsequently, the depressant was also increased from 50g/t to 150g/t as it was previously identified that the collector has some degree of depressant added to it. The previous conventional flotation saw a substantial increase in mass pull with decreased collector dosage due to this lack of depressant, from either the individual depressant, or within the collector chemical concoction.

ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	60.48%	99.960	400	140	40	250	<0.01	13.7%
Bed	24.10%	99.850	290	130	30	270	<0.01	5.1%
Overflow	15.42%	99.295	3,910	3,250	710	5,740	0.13	81.2%
Back Calc Head		99.700	915	617	141	1,101	0.01	
Head Assay		99.598	880	590	180	1,130	<0.01	

Table 28: Test#4, Spiked Feed @65% w/w with reduced collector

No negative impact was observed with the shift between collector and depressant as a comparable mass pull and similar rejection of Fe_2O_3 was achieved.

Test #5

While tests 1-4 were undertaken to prove the efficacy of the Hydrofloat versus conventional flotation under the established conditions utilising an un-elutriated sample that was conducted to observe the impact of not removing -125µm material. The sample also shows a higher grade of Fe_2O_3 that more accurately represents the expected feed. This was done under the same conditions (reagent and up-current flow) as per test #4, except for increased depressant (300g/t versus 150g/t).

ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	60.48%	99.960	400	140	40	250	0.08	13.7%
Bed	24.10%	99.850	290	130	30	270	0.09	5.1%
Overflow	15.42%	99.295	3,910	3,250	710	5,740	0.22	81.2%
Back Calc Head		99.700	915	617	141	1,101	0.10	
Head Assay		99.598	880	590	180	1,130	0.05	

Table 29: Test#5, Spiked Feed @65% w/w, 350g/t Collector and 300g/t Depressant

The Fe_2O_3 rejection and mass rejection is consistent with the previous tests. With a higher feed grade the final product grade is higher, however with the bulk of the spiked material being removed.

In relative terms tests 1-4 had a -125µm component of 1.1% while test #5 had 4.87% -125µm material highlighting that the increase in -125µm does have a minor negative impact on the Hydrofloat performance.

Sighter Testwork Program outcomes

The Hydrofloat testwork has shown a number of key outcomes that impact on the process design:

- Hydrofloat is as effective as conventional flotation in reducing the Fe2O3 and ensuring on-specification material
- The feed density has a significant impact on mass yield with an increase of overflow waste from 12-14% (65% w/w feed) to 24% (45% w/w). On this basis, the process design is recommended to have the conditioning conducted between 55-65% solids w/w prior to feeding the Hydrofloat unit.
- Due to the nature of the Hydrofloat, the collector addition has currently been reduced by
- ~45% with minimal impact on Fe_2O_3 grade. This has been counteracted with an increase in depressant. It is believed that the depressant addition may also be able to be reduced which will be confirmed in upcoming testwork
- An inefficiency in separation is observed when the proportion of -125µm material present in the flotation feed is elevated. Within the flowsheet this could easily be accommodated with cycloning

before the conditioning tank, which will be needed regardless to increase the Hydrofloat feed density prior to feeding the Hydrofloat unit/s.

7.10. Pilot Scale Testwork

Following on from the sighter testwork program, a representative bulk sample of the resource average of Arrowsmith north was sourced for pilot scale testwork with three main focus points:

- Putting material through an up scaled attritioner to see the impact on power draw and resulting metallurgical impact (~1.6T solids capacity)
- To assess the upscale of the Hydrofloat unit on a larger unit (~1-2 t/h feed)
- The generation of sufficient quantities of product for marketing purposes

In addition to this, samples were generated and sent off for :

- Constant Density testwork-This enables the design and supply of the Constant Density Tank (CD Tank)
- Dynamic Thickening Testwork under conditions closer to the current process flowsheet
- Centrifuge testwork at Alfa Laval and G-tech

An overview of the test plan as conducted can be seen below.

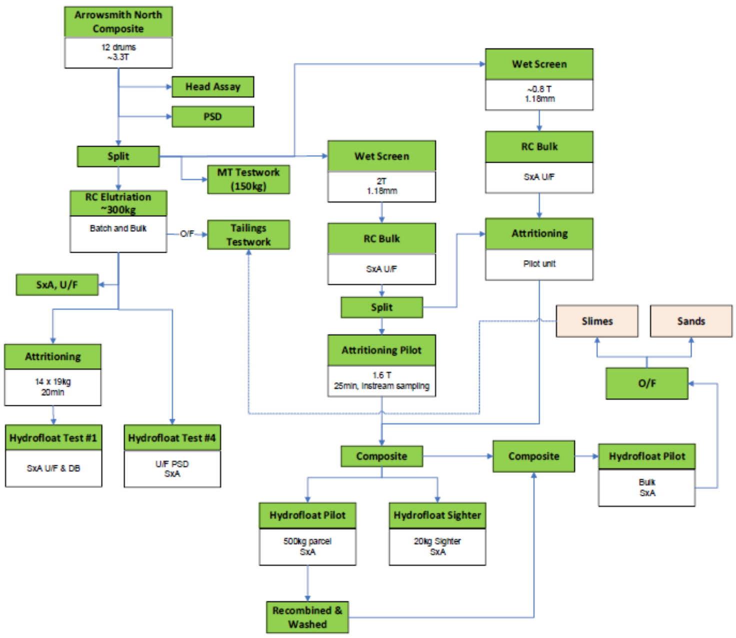


Figure 16: Pilot Scale Test plan

Head Assay

ID	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
	%	ppm	ppm	ppm	ppm	%
Arrowsmith North	95.955	18,860	6,520	3,130	3,100	0.66

Batch RC

A 3-4% mass pull to the overflow was targeted for the 106µm rejection based on the Particle Size Distribution (PSD) as shown in Table below.

Size	Mass
mm	%
+0.85	1.25%
+0.6	10.6%
+0.425	17.4%
+0.3	32.9%
+0.212	19.3%
+0.15	9.20%
+0.106	3.49%
+0.075	1.35%
+0.053	0.67%
-0.053	3.75%

Table 30: Arrowsmith North Pilot PSD

As per the previous program, as outlined in section 2.2, the same unit was utilised and a 5kg subsample was tested first to establish the required cut-point based on the estimated mass split as per above.

The following flow set points were tested with the subsequent mass to overflow (cumulative) displayed below.

ID	Collection	Flowrate	Mass of
	min	l/hr	%
Flow 1	15	274	1.03
Flow 2	15	388	1.12
Flow 3	15	547	2.39
Flow 4	15	756	2.57
Flow 5	20	945	3.50
Flow 6	15	1,071	5.96
Flow 7	15	1,260	13.3
Flow 8	15	1,512	23.8

Table 31: Flow Set Points

Thus, an up-current flowrate of 942 l/hr was selected for the processing of the bulk of the material. A summary of the results can be seen in the table below.

ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
	%	%	ppm	ppm	ppm	ppm	%
Overflow	3.65%	62.629	193,360	64,240	21,690	11,600	7.57
Underflow	96.35%	97.868	9,990	3,450	1,860	1,770	0.35
Back Calc Head		96.583	16,679	5,667	2,583	2,129	0.61
Assay Head		95.955	18,860	6,520	3,130	3,100	0.66

Table 32: Batch RC of 300 kg Parcel

The size by assay of the elutriated material (underflow) can be seen in Table below.

Size Fraction	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
(µm)	%	%	ppm	ppm	ppm	ppm	%
+850	1.15	98.609	4,210	2,100	350	1,240	0.31
+600	10.2	99.168	4,300	1,480	210	410	0.20
+425	19.1	98.866	4,870	1,590	280	450	0.23
+300	25.9	98.924	5,630	1,920	520	580	0.22
+212	24.1	98.403	7,710	2,570	1,650	880	0.27
+150	14.3	97.154	13,130	3,760	4,580	2,730	0.37
+106	4.07	92.408	26,320	10,630	11,620	16,930	0.52
+75	0.97	83.613	36,100	31,820	17,270	53,480	0.67
-75	0.19	70.521	92,720	61,980	22,260	50,340	-
Back-Calc Head		98.088	8,208	2,992	1,949	2,199	0.27

Table 33: Size by Assay of Elutriated Product

The elutriated product was attritioned in 15kg batches for 20min as per previously tested conditions. The size by assay post attritioning can be seen below:

Size Fraction	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
(µm)	%	%	ppm	ppm	ppm	ppm	%
+850	1.15	99.161	2,130	800	150	360	0.19
+600	10.3	99.502	2,430	820	190	530	0.13
+425	19.5	99.447	2,700	800	250	340	0.12
+300	26.4	99.447	3,080	780	430	440	0.13
+212	23.9	98.896	4,720	1,150	1,530	690	0.15
+150	13.1	97.823	9,170	2,090	4,390	2,590	0.17
+106	3.91	93.352	20,590	8,460	11,720	17,500	0.29
+75	1.27	85.728	35,140	23,270	22,690	42,480	0.37
-75	0.50	83.538	55,350	23,450	28,900	27,870	-
Back-Calc Head		98.613	5,471	1,747	2,015	2,108	0.15

Table 34: Size by Assay post Attritioning (Hydrofloat Feed)

Hydrofloat Test #1, Attritioned

A Hydrofloat test was conducted under the same conditions as had been established with the FTIBC material (Section 2.5) with the only variable changed being the up-current flowrate increased due to the coarser particle size (19.5 $m^3/m^2/hr$ vs the previous 17.5 $m^3/m^2/hr$). The reagent dosage was maintained at 350g/t Collector with 200 g/t sodium silicate.

The results from the Hydrofloat can be seen in the table below. These results are consistent with those achieved in previous Hydrofloat testwork with 80% rejection of Fe_2O_3. The mass to tails is marginally higher than previously observed with the Sighter Testwork Hydrofloat (17% vs 14-15%).

								Distribution
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	57.7%	99.236	3,520	740	850	410	0.13	13.0%
Bed	25.2%	99.187	3,880	890	930	390	0.16	6.9%
Overflow	17.1%	99.295	38,400	15,370	8,920	11,910	1.31	80.1%
Back Calc Head		97.768	9,573	3,278	2,250	2,371	0.34	
Head Assay		97.729	9,860	3,490	2,170	2,310	0.35	

Table 35: Hydrofloat Test #1, Arrowsmith North

The size by assays of the combined products (Bed and Underflow) can be seen below.

Size Fraction	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
(µm)	%	%	ppm	ppm	ppm	ppm	%
+850	1.49	99.191	2,419	762	381	257	0.20
+600	12.6	99.444	2,243	631	204	243	0.13
+425	22.7	99.378	2,632	646	271	320	0.14
+300	30.5	99.367	2,999	695	464	330	0.14
+212	23.6	99.054	4,309	793	1,436	354	0.15
+150	8.59	98.560	6,940	929	3,186	329	0.17
+106	0.48	97.075	11,260	3,944	5,416	1,018	0.41
+75	0.02	97.021	11,369	4,004	5,448	1,030	0.42
-75	0.03	96.961	11,489	4,069	5,483	1,043	0.44
Back-Calc Head		99.221	3,503	737	876	325	0.15

Table 36: Size by assay, Combined Bed and Underflow

As can be seen, the Fe_2O_3 grades are in the expected ranges and comparable to previous testwork, with the typically higher Fe assays that are consistently observed at the laboratory.

A breakdown of the products streams from test 1 underflow can be seen below.

Size Fraction	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
(µm)	kg	%	ppm	ppm	ppm	ppm	%
+600	1.77	99.417	2,261	645	223	244	0.14
-600, +300	6.68	99.372	2,842	674	382	326	0.14
-300, +150	4.04	98.922	5,011	829	1,903	347	0.16
-150	0.07	97.066	11,277	3,954	5,421	1,020	0.41

Table 37: Estimate of products, Size by assay of Underflow Test#1

Hydrofloat Test #4, Un-Attritioned

A flotation test was conducted on the un-attritioned parcel under the same conditions as above. In respect to the test labelling, there has not been a Hydrofloat test #2 and #3 conducted in this program. These were reserved for potential parametric work but was not deemed necessary at the time. The results for test#4 can be seen below.

								Distribution
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	39.8%	98.921	4,670	1,320	990	420	0.18	15.4%
Bed	26.1%	98.965	4,440	1,090	940	420	0.20	8.3%
Overflow	34.1%	99.295	20,600	7,610	3,930	4,490	0.75	76.2%
Back Calc Head		97.718	10,042	3,405	1,979	1,808	0.38	
Head Assay		97.868	9,990	3,450	1,860	1,770	0.35	

Table 38: Un-attritioned Hydrofloat, Test#4

As can be seen the grades are substantially higher without attritioning, though there is still a substantial reduction of Fe_2O_3 at 76%.

The mass rejection to overflow is substantially greater at 34% instead of 15% which represents unpolished and stained surfaces of quartz particles activating and responding to the collector.

7.11. Attritioning Pilot

From the master composite, two tonnes of material was split out to process through the flowsheet route to the attritioning stage.

An overview of the results can be seen in the tables and figures below.

ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI1000
	%	%	ppm	ppm	ppm	ppm	%
+1.18	0.06%	72.459	14,560	5,050	3,530	1,250	14.5
-1.18	99.9%	95.783	19,120	6,550	3,230	3,010	0.69
Back-Calc head		95.769	19,117	6,549	3,230	3,009	0.70
Head Assay		95.955	18,860	6,520	3,130	3,100	0.66

Table 39: Wet Screening of Head material (2T), Arrowsmith North

Parcels of the undersize material (~5-6kg) were first tested to establish cut-points for running the full 2 tonnes of -106µm material through the elutriation unit. A summary of the outcome of these sighters can be seen below. It was decided that the test conditions #1 were the most suitable in respect to a balance of minimising mass rejection with high -106µm removal.

			Underflow Grade	
ID	Mass to	-106µm	Fe_2O_3	LOI1000
	%	%	ppm	%
Test #1	4.44%	73.4%	4,080	0.37
Test #2	13.3%	82.7%	3,850	0.33
Test #3	3.35%	65.5%	4,260	0.40

Table 40: Elutriation Cut-Point Establishment

The outcome of the full two tonne parcel can be seen below.

ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
	%	%	ppm	ppm	ppm	ppm	%
Underflow	95.88%	97.098	12,850	4,610	2,580	3,170	0.42
Overflow	4.12%	67.472	168,820	53,730	23,720	10,270	6.09
Back-Calc Head		95.877	19,280	6,635	3,451	3,463	0.66

Table 41: Elutriation of 2T parcel of -1.18mm Arrowsmith North Material

From the collected underflow material, 1.6 tonnes was split out and added to the pilot attritioner unit and made up to a density of 75% w/w. Samples were drawn from the dump valve of the vessel every 5 min. Originally it was intended to be taken from a line recirculating from the dump valve back to the top of the vessel via a Bredel pump, however this line bogged shortly after start-up and became impossible to sample from.

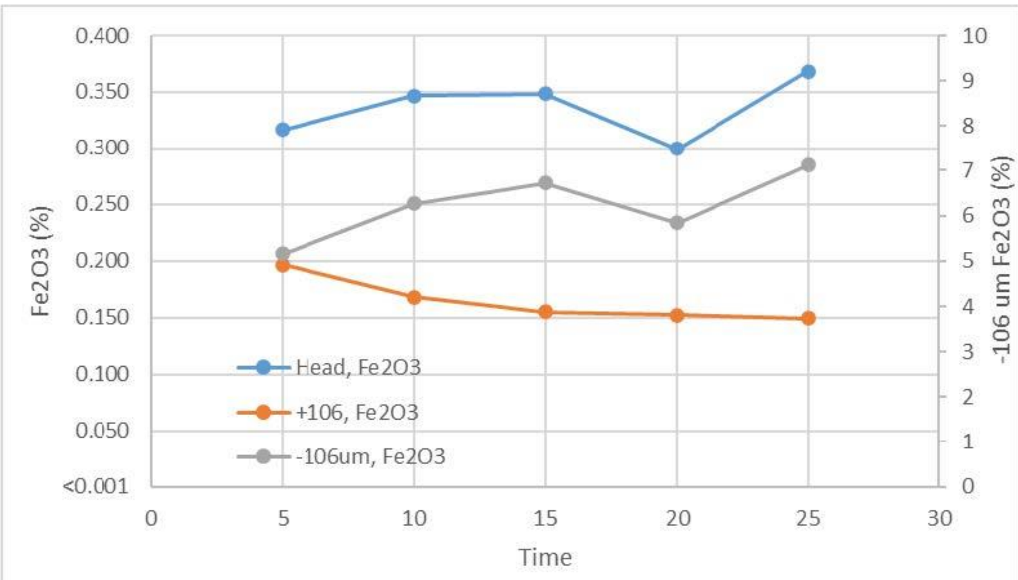


Figure 17: Fe2O3 Grades across the attritioning pilot run

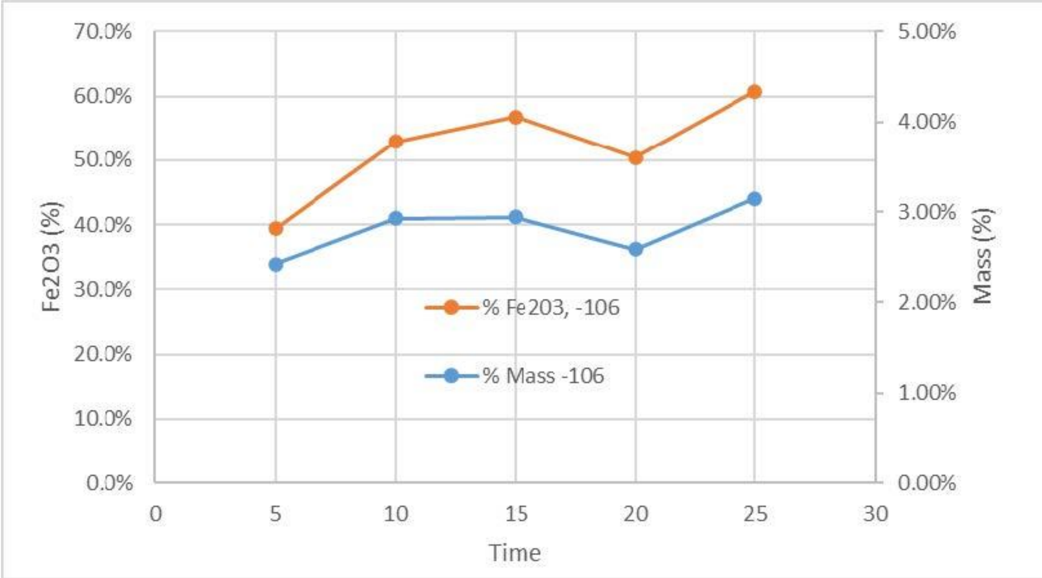


Figure 18: Mass and Fe2O3 rejection into the -106µm fraction

With the exception of the 20min mark, the Fe_2O_3 grade and deportment is following the expected trend. While Fe_2O_3 rejection appears to be continuing past the 25min mark, it begins reaching diminishing returns post 15min.

The back-calculated head Fe_2O_3 grade also appears to be increasing. The difference between 5-15 minute may potentially just be assay variance. The 20 minute sample as stated before appears to be an outlier. With the unit rubber lined, along with the shaft and impeller, it can only be assumed that the variance observed is due to non-homogenous nature of Fe-staining across a relatively wide size distribution.

Little is visible from the change in the particle size distribution (PSD) across the 5 samples. The mass in the -106µm presented in below highlights the change is PSD with increasing fines generated.

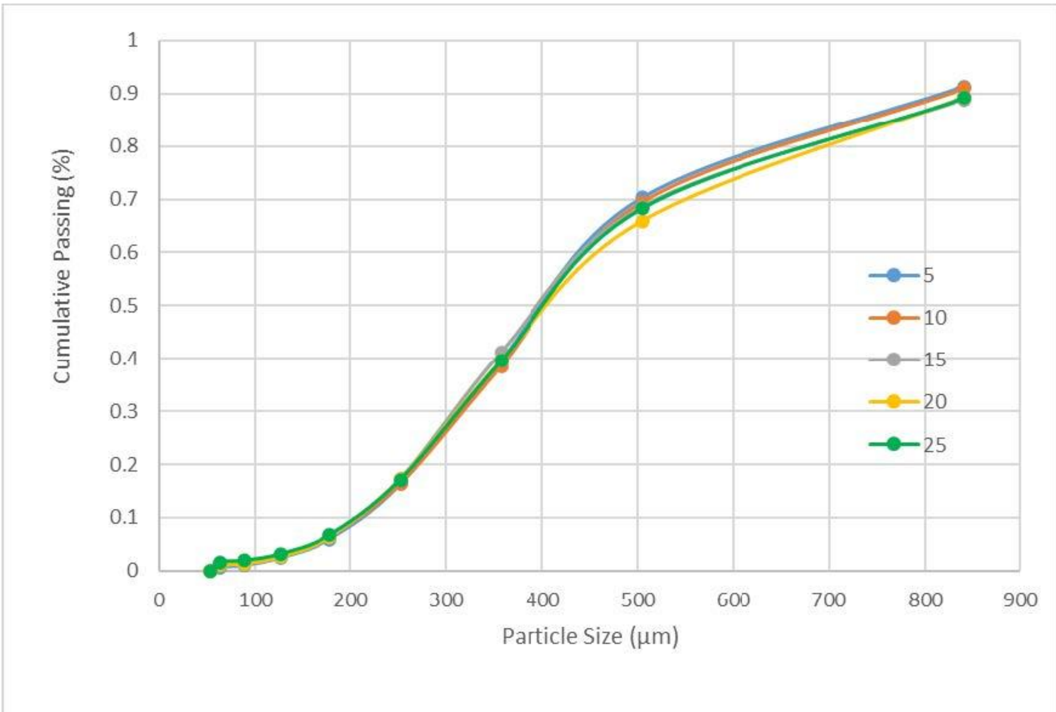


Figure 19: PSD vs Time

The logged power draw is relatively consistent running at ~17kW with an overshoot to ~19kW upon start-up. The start-up was from fully loaded conditions, whilst not exactly bogged, it bodes well that the power draw and project risk to loaded starts from short stops or outages causing overload trips is not as big a concern as originally thought.

7.12. Additional Sample Preparation

With the attritioner pilot test run complete, additional material was processed through the flowsheet to maximise the amount of marketing sample generated. An additional ~770kg of the Arrowsmith North composite was wet screened and elutriated via RC. This was then composited with the unattritioned material from the previous charge. Only 1.6T from the ~2 tonne parcel was utilised for the attritioning pilot and then attritioned. This was then composited up for the Hydrofloat piloting. Summary tables of this can be seen below:

ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI1000
	%	%	ppm	ppm	ppm	ppm	%
+1.18	0.06%	67.335	10,640	4,000	2,810	910	16.4
-1.18	99.9%	95.927	19,090	6,550	3,280	3,110	0.71
Back-Calc Head		95.909	19,085	6,548	3,280	3,109	0.72
Head Assay		95.955	18,860	6,520	3,130	3,100	0.66

Table 42: Wet Screen, Additional Arrowsmith North Pilot material

ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI1000
	%	%	ppm	ppm	ppm	ppm	%
Underflow	93.2%	97.425	11,483	4,133	2,078	2,596	0.4
Overflow	6.79%	78.104	111,784	34,945	17,738	6,704	4.1
Back-Calc Head		96.113	18,290	6,224	3,141	2,875	0.7
Head Assay		95.927	19,090	6,550	3,280	3,110	0.7

Table 43: RC, Additional Arrowsmith North Pilot material

ID	Mass	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI1000
	kg	%	%	ppm	ppm	ppm	ppm	%
Underflow	713	78.2%	97.424	11,485	4,133	2,079	2,596	0.41
Reserve	199	21.8%	97.214	12,210	4,530	2,270	3,210	0.41
Back-Calc Head	912		97.378	11,643	4,220	2,121	2,730	0.41

Table 44: Compositing Attritioner Feed, Additional Arrowsmith North Pilot Material

ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI1000
	kg	%	ppm	ppm	ppm	ppm	%
Hydrofloat Feed	2,486	97.539	11,340	4,010	1,820	2,040	0.43

Table 45: Attritioner Discharge Composite, Hydrofloat Pilot Feed

7.13. Hydrofloat Bulk Run

The attritioned material was composited and a 500kg parcel of was passed through to confirm if the previously established conditions were suitable for the larger scale unit. During this run a representative from The supplier was present to confirm and establish the testwork conditions for the larger scale unit. The results from instream samples taken during the run (preliminary results) and the overall samples from the run can be seen below in Tables below:

		Grade						Deportment
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	98.6%	99.315	3,130	820	500	320	0.13	43.1%
Overflow^	1.45%	61.026	185,650	73,660	15,880	21,460	8.20	56.9%
Calc head		98.761	5,770	1,874	722	626	0.25	

Table 46: 500kg Hydrofloat Pilot Instreams

^Instream #1 Overflow mass and grade show a significant bias as a result of material hold up in the pipework during sampling

		Grade						Deportment
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	61.5%	99.330	3,230	840	550	340	0.11	17.2%
Deadbed	23.0%	99.029	4,680	1,000	1,410	390	0.16	7.69%
Overflow	15.5%	91.352	33,840	14,540	8,290	14,390	1.09	75.1%
Calc head		98.026	8,300	2,996	1,945	2,525	0.27	

Table 47: 500kg Hydrofloat Pilot Results

As can be seen from the above results roughly a ~80% rejection of Fe_2O_3 was achieved with a final grade in the range of ~820-860 ppm Fe_2O_3 with a ~15.5% mass loss. Which is within expectation from previous testwork. A further breakdown of the key streams by size fractions can be seen in the tables below. The -0.6, +0.3mm stream is targeted to achieve a final Fe2O3 grade of <500ppm and this was clearly not achieved.

		Grade						Deportment
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
mm	%	%	ppm	ppm	ppm	ppm	%	%
+0.6	16.1%	99.411	2,570	690	160	290	0.14	3.71%
-0.6, +0.3	53.1%	99.287	2,980	720	340	380	0.14	12.8%
-0.3	30.8%	99.046	4,220	920	1,140	370	0.16	9.45%
Calc head		99.233	3,295	777	557	362	0.15	

Table 48: 500kg Hydrofloat Pilot Size by assay, Underflow

		Grade						Deportment
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
mm	%	%	ppm	ppm	ppm	ppm	%	%
+0.6	0.09%	97.795	9,250	3,570	650	2,730	0.25	0.11%
+0.3	4.84%	97.795	9,250	3,570	650	2,730	0.25	1.48%
-0.3	95.1%	92.480	27,960	12,100	8,790	14,280	0.78	98.5%
Calc head		92.742	27,037	11,679	8,388	13,710	0.75	

Table 49: 500kg Hydrofloat Pilot Size by assay, Overflow

Confirmatory assays of the underflow and dead bed, size by assay pulps were sent out for high purity analysis.

	Grade				
ID	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2
mm	est*%	ppm	ppm	ppm	ppm
UF- +0.6	99.588	2,419	872	211	274
UF- -0.6, +0.3	99.532	2,796	904	308	341
UF- -0.3	99.303	4,043	1,124	1,055	359
DB- +0.6	99.573	2,570	868	247	279
DB- -0.6, +0.3	99.475	3,174	939	472	359
DB- -0.3	98.924	6,122	1,413	2,385	415

Table 50: Source Certain Assays, Sighter Hydrofloat

**SiO2 is calculated based off of the subtraction of 60 elemental assays converted to oxides*

7.14. Lab Scale Check

There were a number of variables that were considered in order to improve performance. These came under two broad groupings. Either modification of reagent dosages or physical characteristics (bed height, upcurrent flow or airflow rate)

While modification of the bed depth in the pilot unit was considered, one of the main parameters that would yield a positive effect, it was decided to first check reagent dosage via a 20kg sighter.

A 20kg split of the Hydrofloat feed was tested using the small scale test unit under a collector dosage of 420g/t and 200 g/t depressant (in comparison to 350g/t collector and 200 g/t depressant in the Hydrofloat pilot sighter and the Hydrofloat Test#1 referenced in section 3.2.1).

		Grade						Deportment
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	33.6%	99.355	3,150	740	620	300	0.12	8.05%
Deadbed	22.6%	99.139	3,550	860	780	340	0.16	6.30%
Overflow	43.7%	96.193	15,470	6,050	3,580	5,060	0.55	85.7%
Calc head		97.923	8,630	3,090	1,951	2,391	0.32	

Table 51: Small Scale Hydrofloat Pilot Check

In comparison to the previous testwork on this material (see Table 24) a 740 ppm Fe_2O_3 in the underflow was achieved in both tests with the major difference observed being a larger Fe_2O_3 rejection observed (85.7% vs 80.1%) but at a higher mass loss to the overflow (43.7% mass to overflow vs 17.1%). This is suggesting that an increased collector dosage would simply increase mass rejection but would not have a significant impact on selectivity and the subsequent Fe_2O_3 grade observed in the underflow. It was derived that the major difference was physical in nature due to the upscaling of the unit.

The size by assay on the small scale shows a similar breakdown of grades in respect to the underflow as the pilot 500kg run, with more of the -0.6, +0.3mm material reporting to the overflow.

		Grade						Deportment
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
mm	%	%	ppm	ppm	ppm	ppm	%	%
+0.6	20.8%	99.431	2,240	690	200	300	0.14	19.3%
-0.6, +0.3	64.6%	99.395	2,820	720	370	340	0.14	62.6%
-0.3	14.6%	98.772	5,710	920	2,400	350	0.17	18.1%
Calc head		99.311	3,121	743	631	333	0.14	

Table 52: Small Scale Hydrofloat Pilot Check Size by assay, Underflow

		Grade						Deportment
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
mm	%	%	ppm	ppm	ppm	ppm	%	%
+0.6	0.10%	99.166	3,370	1,070	330	570	0.17	0.03%
-0.6, +0.3	20.8%	99.166	3,370	1,070	330	570	0.17	5.8%
-0.3	79.1%	96.860	12,260	4,540	4,260	5,290	0.34	94.1%
Calc head		97.342	10,401	3,815	3,438	4,303	0.30	

Table 53: Small Scale Hydrofloat Pilot Check Size by assay, Overflow

7.15. Bulk Hydrofloat and Re-run

The 500kg parcel of material that was previously processed was rewashed in Perth tap water at 60% solids, dropped to a pH of 2.5 using sulphuric acid to eliminate surface coatings and residual reagent, and then washed with Perth Tap water and re-run along with the remaining feed material. With higher reagents dosages showing little benefit, a marginal increase from 350g/t to 370g/t of collector was increased to promote more mass pull. The major operational change in respect to the Hydrofloat runs was the bed depth which was decreased in height in order to increase mobility within the bed.

The summary of the Hydrofloat® results can be seen in the table below.

ID	Mass	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI1000
	kg	%	%	ppm	ppm	ppm	ppm	%
Underflow	1896.2	80.6%	99.170	3,760	860	740	330	0.16
Deadbed	86.5	3.68%	98.932	5,410	1,100	1,550	370	0.18
Overflow	370.2	15.7%	90.124	39,793	16,867	8,572	14,600	1.39
Back-Calc head	2352.9		97.738	9,489	3,387	2,002	2,576	0.35
Head Assay			97.720	10,298	3,606	1,845	2,097	0.37

Table 54: Summary of Hydrofloat® Results

Size	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI1000
mm	%	%	ppm	ppm	ppm	ppm	%
+1.18	0.03%	98.967	3,330	1,080	290	320	0.27
+0.85	1.44%	98.967	3,330	1,080	290	320	0.27
+0.6	11.8%	99.315	2,490	660	200	280	0.15
+0.425	28.9%	99.372	2,880	700	280	330	0.13
+0.3	27.3%	99.308	3,190	780	500	350	0.09
+0.212	22.5%	99.086	4,480	890	1,420	330	0.10
+0.15	7.58%	98.812	5,950	1,070	2,250	350	0.15
+0.106	0.29%	97.447	8,060	6,980	3,000	1,490	0.31
+0.075	0.14%	97.447	8,060	6,980	3,000	1,490	0.31
+0.053	0.00%	97.447	8,060	6,980	3,000	1,490	0.31
-0.053	0.01%	97.447	8,060	6,980	3,000	1,490	0.31
Back-Calc head		99.227	3,540	821	748	336	0.12
Head Assay		99.17	3,760	860	740	330	0.16

Table 55: Size by assay of HydrofloatU/F material

Size	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI1000
mm	%	%	ppm	ppm	ppm	ppm	%
+0.6	13.3%	99.276	2,583	707	210	284	0.16
-0.6, +0.3	56.2%	99.341	3,031	739	387	340	0.11
-0.3, +0.106	30.3%	99.002	4,881	993	1,642	346	0.11

Table 56: Summary of Underflow Products

The -0.6mm, +0.3mm fraction achieved a relatively high Fe_2O_3 grade at 740ppm Fe_2O_3. Previously with this material, where a smaller parcel was processed (see section 3.2.1), a grade of 674 ppm Fe_2O_3 in this size fraction was achieved, which at the time was considered acceptable.

Pulps from the size by assay seen in Table 45 were sent out for confirmatory assays.

	Grade				
ID	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2
mm	est*%	ppm	ppm	ppm	ppm
UF- +0.6	99.534	2,570	769	172	282
UF- -0.6, +0.3	99.466	3,325	826	519	362
UF- -0.3	99.181	4,837	972	1,494	350
DB- +0.6	99.476	3,146	944	248	317
DB- -0.6, +0.3	99.445	3,458	848	575	374
DB- -0.3	98.914	6,330	1,177	2,385	399
OF, Sands	94.603	20,595	10,208	7,878	12,948
OF, Slimes	60.548	260,746	96,079	12,889	14,633

Table 57: Bulk Hydrofloat Source Certain Assays

**SiO2 is calculated based off of the subtraction of 60 elemental assays converted to oxides*

Note that the Hydrofloat overflow was split out into a sands and slimes component via decanting.

With the Fe_2O_3 grade higher than would be expected, remediation works were planned to see if there were any potential improvements that could be made to bring the Fe_2O_3 grade down specifically in respect to the -0.6mm, +0.3mm fraction.

7.16. Pilot Hydrofloat Product Screening and Remediation Works

With the completion of the bulk processing of the Arrowsmith North material, as outlined in section 3.5.2, the separation of the underflow products into their respective streams for dispatch to VRX for their marketing and testwork requirements outside of this scope of work. The flow of material can be seen below. Additional testwork on a split of the -0.6mm, +0.3mm fraction was conducted to assess if there was further amenability to improve the Fe_2O_3 rejection of the material

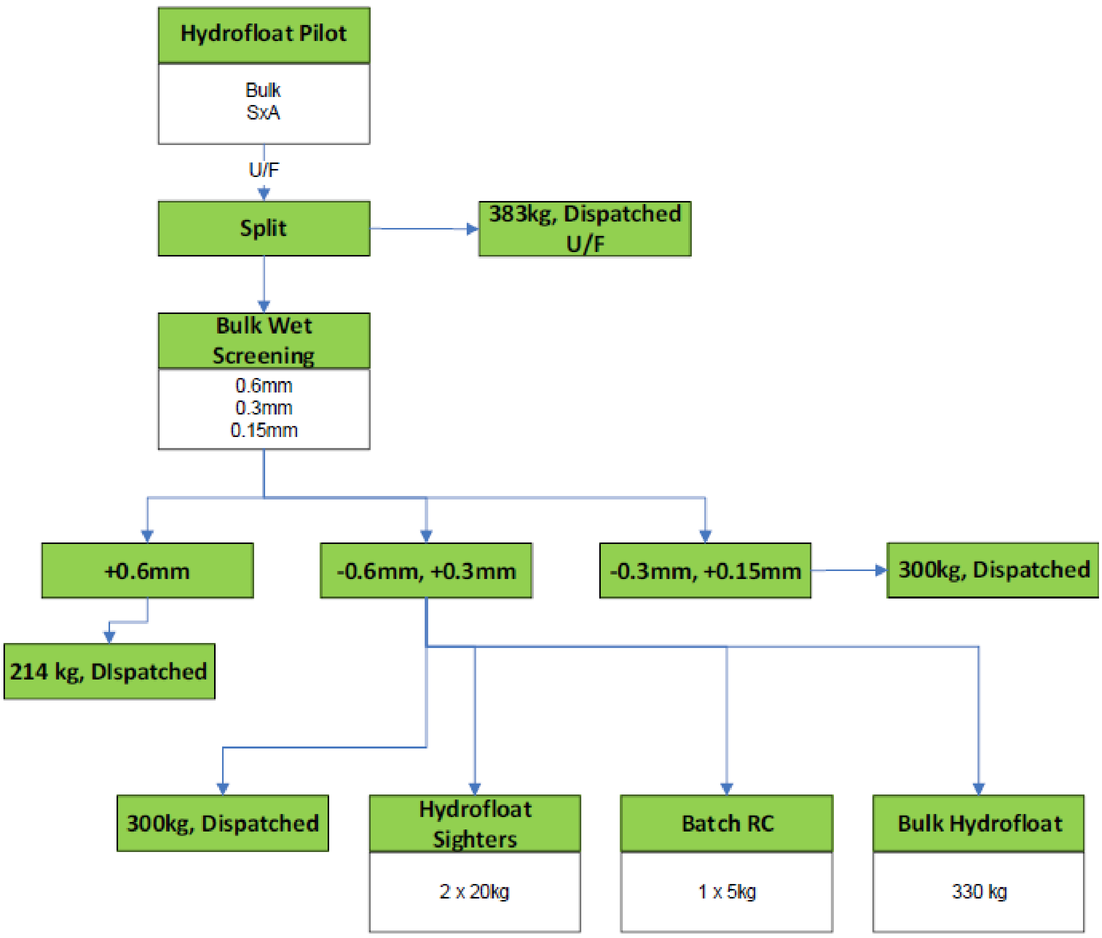


Figure 20: Material flow of Bulk Hydrofloat Pilot Products

7.17. Screening checks

With the relatively coarse particle size of the Hydrofloat, a triplicate of the size by assay was conducted on splits of the underflow before screening out the products at the designated sizes as verification. There is some variability, however within expected limits.

Size	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI1000
mm	%	%	ppm	ppm	ppm	ppm	%
Split #1							
+0.6	13.3%	99.495	2,290	650	180	270	0.11
-0.6, +0.3	55.0%	99.402	2,850	710	390	360	0.13
-0.3, +0.106	31.7%	99.031	4,640	970	1,640	380	0.17
-0.106	0.07%	94.536	18,570	9,440	9,220	7,270	0.00
Back-calc head		99.293	3,354	791	764	359	0.14
Split #2							
+0.6	13.6%	99.484	2,330	640	230	270	0.11
-0.6, +0.3	55.5%	99.375	2,900	690	400	350	0.15
-0.3, +0.106	30.8%	99.074	4,720	900	1,630	350	0.16
-0.106	0.07%	93.843	20,650	13,030	10,120	7,670	0.00
Back-calc head		99.293	3,395	756	763	344	0.15
Split #3							
+0.6	13.8%	99.413	2,300	630	190	270	0.13
-0.6, +0.3	55.3%	99.358	2,890	730	390	330	0.14
-0.3, +0.106	30.8%	99.023	4,750	890	1,630	360	0.15
-0.106	0.06%	93.870	20,920	10,890	10,650	8,090	0.00
Back-calc head		99.259	3,393	772	751	336	0.14

Table 58: Triplicate Size by Assay of Bulk Hydrofloat U/F

Pulps of the screened material were sent for confirmatory assays.

	Grade				
ID	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2
mm	est*%	ppm	ppm	ppm	ppm
U/F	99.432	3,571	752	710	320
U/F +0.6mm	99.641	2,305	556	212	240
U/F -0.6mm,	99.545	2,957	629	370	315
U/F, -0.3mm,	99.258	4,516	748	1,446	302

Table 59: Screened Product Source Certain Assays

*SiO2 is calculated based off of the subtraction of 60 elemental assays converted to oxides

Sizing

After each size fraction was generated, a split was taken for sizing of each of the individual streams.

The PSD's of the streams can be seen in the tables below;

Size	Mass
mm	%
+1.7	0.00%
+1.18	0.08%
+0.85	9.06%
+0.6	83.8%
-0.6	7.05%

Table 60: Bulk Hydrofloat U/F PSD, +0.6mm

Size	Mass
mm	%
+0.6	0.91%
+0.425	46.9%
+0.3	49.0%
-0.3	3.24%

Table 61: Bulk Hydrofloat U/F PSD, -0.6mm +0.3mm

Size	Mass
mm	%
+0.3	1.70%
+0.212	77.0%
+0.15	21.2%
+0.106	0.15%
-0.106	0.02%

Table 62: Bulk Hydrofloat U/F PSD, -0.3mm +0.15mm

Size	Mass
mm	%
+1.7	0.00%
+1.18	0.01%
+0.85	1.35%
+0.6	12.9%
+0.425	25.5%
+0.3	26.1%
+0.212	27.1%
+0.15	6.99%
+0.106	0.05%
-0.106	0.01%

Table 63: Bulk Hydrofloat U/F PSD

7.18. Remediation works on -0.6mm, +0.3mm

With the relatively high Fe_2O_3 grade of the -0.6mm, -0.3mm fraction from the Hydrofloat underflow sighters were conducted to assess if an improvement in quality was possible. The underlying theory was the poor Hydrofloat performance could be attributed to the excessive fines (specifically -53µm material generated during attritioning). Two potential routes were investigated:

- A repeat of the Hydrofloat on the size fraction targeted or
- Up-current classification to see if any further upgrade via gravity is possible.

Hydrofloat Sighters

Two tests were conducted on re-processing the -0.6mm,+0.3mm fraction. With the ultrafines no longer in the feed, it was expected that a more selective response would occur. The broad difference between the two tests were the following flotation regimes:

- Test #2, 200g/t Na_2SiO_3 and 350 g/t Collector
- Test #3, 50 g/t Na_2SiO_3 and 200 g/t Collector

A summary of the results can be seen in the tables below.

		Grade						Deportment
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	72.2%	99.309	2,810	680	370	310	0.17	68.3%
Deadbed	23.6%	99.295	2,890	680	400	360	0.18	22.3%
Overflow	4.2%	98.848	3,520	1,590	650	1,320	0.31	9.35%
Calc head		99.286	2,859	718	389	364	0.18	

Table 64: Test #2 Hydrofloat Results Summary

ID		Grade						Deportment
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Underflow	63.1%	99.382	2,860	650	390	370	0.16	59.9%
Deadbed	23.3%	99.284	2,950	660	430	340	0.16	22.5%
Overflow	13.6%	99.358	2,610	890	310	350	0.19	17.6%
Calc head		99.356	2,847	685	388	360	0.16	

Table 65: Test #3 Hydrofloat Results Summary

As can be seen, a modest improvement in grade was achieved with the Fe_2O_3 grade dropped down to 680ppm and 650ppm respectively in test #2 and test #3. However, test #2 shows a greater deal of selectivity with a higher Fe_2O_3 grade in the overflow and ratio of Fe_2O_3 rejection to mass of overflow of 2.2 vs 1.3.

Elutriation

Another sub split of the -0.6mm+0.3mm fraction was put through the batch elutriator to see if there was any potential for upgrade. This, in addition, would also clarify if there was any value in adjusting the up-current flow in the Hydrofloat™ unit if re-processed. The overflow was collected with increasing up-current flow. A summary can be seen below.

		Grade						Deportment
ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI	Fe_2O_3
	%	%	ppm	ppm	ppm	ppm	%	%
Flow 1 (678 l/hr)	2.08%	99.130	3,790	820	660	430	0.17	2.03%
Flow 2 (720 l/hr)	1.54%	99.106	4,170	860	740	440	0.17	1.57%
Flow 3 (738 l/hr)	1.21%	98.823	4,680	900	1,070	470	0.32	1.29%
Flow 4 (756 l/hr)	2.92%	99.151	3,880	850	650	450	0.17	2.95%
Flow 5 (762 l/hr)	4.95%	99.232	3,950	850	660	450	0.14	5.00%
Flow 6 (768 l/hr)	2.64%	99.106	4,420	850	920	430	0.16	2.67%
Underflow	84.7%	99.425	2,940	840	300	380	0.10	84.5%
Calc head		99.381	3,114	842	368	390	0.11	

Table 66: Elutriation of -0.6mm, +0.3mm fraction

Given the Fe_2O_3 deportment is identical to the mass pull (%), there is no further selectivity and no potential upgrade available. This removes elutriation as a variable under both the conditions of use as a single unit operation (classifier) or of modification of the up-current flow within a Hydrofloat™.

Bulk Hydrofloat Re-run of -0.6mm, +0.3mm

Following on from the sighter tests, it was decided to utilise the Hydrofloat pilot unit to re-run the remainder of the target size fractions (~336kg). The conditions under test #3 were chosen, for processing of the remaining material to minimise the Fe_2O_3 grade. This was at the expense of product mass to provide a contrast of the quality of the originally processed material versus the 300kg sub-split as per below.

ID	Mass	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI1000
	kg	%	%	ppm	ppm	ppm	ppm	%
Underflow	223.7	66.5%	99.372	2,850	740	370	320	0.12
Deadbed	97.7	29.0%	99.383	2,930	720	420	340	0.09
Overflow	15.3	4.54%	99.229	2,650	1,090	430	680	0.16
Back-Calc head	336.6		99.369	2,864	750	387	342	0.11
Head Assay			99.353	3,130	710	400	330	0.15

Table 67: Summary of Re-run -0.6mm, +0.3mm Hydrofloat® Results

Size	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI1000
mm	%	%	ppm	ppm	ppm	ppm	%
+0.6	0.85%	98.241	3,050	700	250	330	0.31
+0.5	23.2%	99.413	2,720	660	210	350	0.13
+0.425	27.3%	99.348	3,040	680	280	360	0.13
+0.355	26.3%	99.362	3,150	720	360	390	0.14
+0.3	19.3%	99.233	3,440	760	620	390	0.16
-0.3	3.04%	98.993	4,550	930	1,370	400	0.17
Back-Calc head		99.324	3,118	709	384	372	0.14

Table 68: Summary of Underflow Products, -0.6mm+0.3mm Re-run Hydrofloat

While there was some rejection of material to the overflow (~4% mass and ~6% Fe_2O_3) this had minimal impact and did not replicate the results as observed in the sighter works (see Table 54).

Pulps from the Size by assay were sent for confirmation assays.

	Grade				
ID	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2
mm	est*%	ppm	ppm	ppm	ppm
U/F	99.540	2,910	599	336	325
DB	99.526	3,042	619	404	335
O/F	99.496	276	85	39	51

Table 69: -0.6mm,+0.3mm Hydrofloat Re-run Source Certain Assays

*SiO2 is calculated based off of the subtraction of 60 elemental assays converted to oxides

7.19. External Vendor Testwork

Throughout the testwork program there have been several samples that have been sent out for external vendor testing and this section is to provide some context of the genesis of specified samples in respect to their respective origins.

The samples consist of:

- A 150kg feed sample sent to a vendor for the sizing of the CD tank
- This was organised by ProjX for engineering design
- Report BS0028 dated 08/03/22
- ~5kg of RC O/F solids along with 1kg of Hydrofloat overflow slimes sent to
- A vendor for Thickening and Rheology testing, Centrifuge testing

7.20. Sample Preparation - Tailings

The tailings sample utilised was composited from the RC Bulk overflows (Section 3.2 and section 3.4) and from the Bulk Hydrofloat overflow sample slimes component (section 3.5.2).

The slimes component of the overflow was generated by separating out the coarse and slimes via decanting with the coarse (for this exercise called sands) component being filtered. The slimes component showed extremely poor filtration rates and was kept as a slurry at ~20% w/w.

7.21. Thickening and Rheology Testing

Three SNF products were used for flocculant screening tests. In order of increasing anionic charge, the products were the AN934SH, AN956SH and AN977SH. Each of these were tested to determine the best performing flocculant in terms of underflow solids density, settling rates and suspended solids in the overflow. AN977SH was chosen to explore further as it performed best compared to the other two flocculants.

AN934SH			AN956SH			AN 977SH		
Dose	SR	Clarity	Dose	SR	Clarity	Dose	SR	Clarity
121	12.41	3	152	17.02	8	152	21.69	16
167	90.87	24	182	87.89	40	182	80	27
212	139.7	26	212	93.60	40	212	92.22	40
258	132.77	26	242	101.74	40	242	171.74	46

Table 70: Flocculant Screening

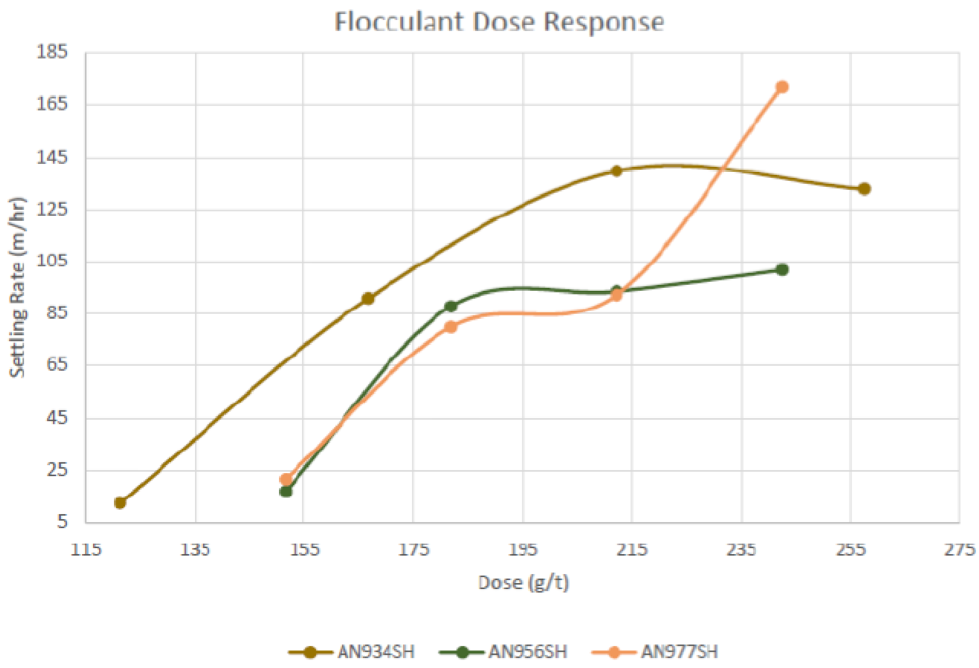


Figure 21: Flocculant Dose Response Curve

Dynamic Thickening Testing was conducted with the use of AN9777SH with the feed diluted down to 3.3% solids w/w and passing through a dynamic thickener rig.

Test	Flux Rate (t/m²h)	Rise Rate (m/h)	Feed % Solids	Flocculant		Underflow % Solids	Overflow (mg/L)
				type	g/t		
1	0.20	5.93	3.30	AN97	245	42.65	310
2	0.10	2.96	3.30	AN97	245	44.27	160

Table 71: Dynamic Thickening Test Results

Rheology of the material was studied using the Haake ViscoTester iQ equipped with a vane spindle. Underflow samples generated by the thickening tests were centrifuged and varying amounts of water were decanted to generate samples at different solids densities. Each sample was agitated prior to measurement for homogenisation.

A yield stress measurement was then taken at each density at a constant shear rate of 0.30 s^{-1}. The yield stress curve can be seen below.

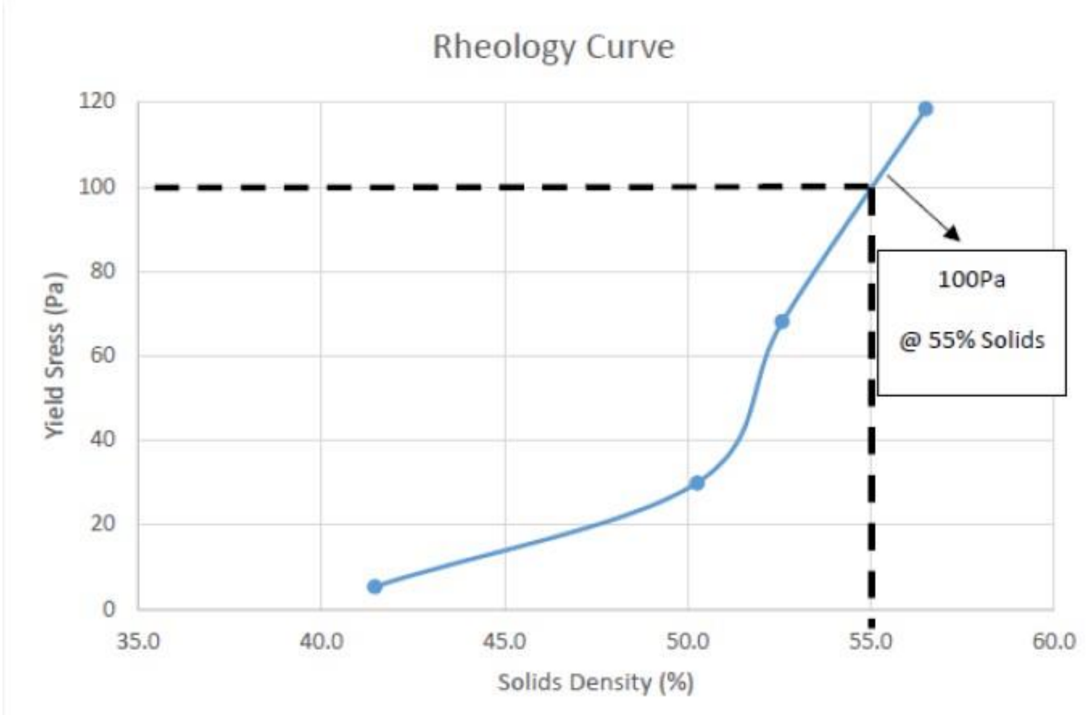


Figure 22: Yield Stress Curve

7.22. Discussion and Optimisation

The testwork programs discussed in this document have provided several key learnings in respect to the development of the Arrowsmith North project. These have mostly been around the applicability of unit operations in their current location, their efficacy and potential nuances in terms of operation and process control. From a high-level perspective key outcomes have been:

- A high degree of confidence has been obtained in respect to the power requirements around upscaling of the attritioners from the initial bench scale.
- Relatively little difference in performance from the bench scale and an indication that the current residence times do not need to be extended.
- The Hydrofloat will perform on par with conventional flotation in respect to metallurgical performance.
- The practical application / limitation of conventional flotation at the required particle sizes and the desired design tonnage dictated that the Hydrofloat would be required.
- There are keys aspects in respect to the Hydrofloat that need to be incorporated into the design in order for it to function adequately:
- Feed density need to be~65% solids to limit short-circuiting
- Ultrafines need to be removed, within practical limits, before feeding the Hydrofloat.

There are still areas where optimisation that can occur, however these appear limited from a testwork sense. The nature of the impurities in being removed are predominately Fe staining on Silica particles.

This, as has been observed in the testwork, as defined by the poor reconciliation of Fe_2O_3 and provides a form of randomness that makes the measurement of Fe_2O_3 as a marker of impurity somewhat erratic.

7.23. Attritioning Performance

In establishing a direct comparison of the effectiveness of the pilot attritioner to the testwork conducted to date (the smaller batch unit of 16kg) some of the same Arrowsmith North material was processed in parallel on a smaller test scale (in specific reference to section 2.3).

The size by assay data comparison is difficult to interpret due to it does not mass balance. The two columns in question are labelled Batch. Before and after the attrition step there is a significant difference in respect to the head grade. In terms of a rejection % of Fe_2O_3 into the -106µm this is significantly understated. Potentially, there may have been some ultra-fines loss distorting the back calculated Fe head grade. If the +106 assays are correct, then an estimated rejection to the -106um fraction would be around ~61%, which is comparable to the results obtained in the pilot.

Additionally, the grade of the +106µm fraction was comparable, though lower than that observed in the pilot run (0.136 % Fe_2O_3 vs 0.150% Fe_2O_3).

ID	Batch, Post	Batch, Pre	LF/MF	Est, Post
Head, Fe_2O_3 (Grade)	0.175	0.345	0.445	0.345
+106um, Fe_2O_3 (Grade)	0.136	0.26	0.130	0.136
-106um, Fe_2O_3 (Grade)	2.33	3.67	6.55	
% Mass, -106um	1.77%	1.16%	4.36%	1.77%
% Fe_2O_3 Deportment, -106um	23.6%	14.3%	69.6%	61.3%

Table 72: Comparison to Test Scale

Looking at previous testwork conducted, during the Bulk LF/MF testwork program (1075-VRX-PR-001), this can be seen in the table above labelled as LF/MF. This material did not have the -106um fraction removed before attritioning as per the current flowsheet.

Taking into account, the smaller unit operated at a tip speed of 4.57m/s while the pilot was operated at a tip speed of 5.57m/s. While the results are not definitive, it appears that the scale up in the pilot unit has been comparable, though potentially slightly less efficient but any variance can be accounted for within feed sample, sampling and assaying errors.

BHM deem the result as a success by which the scale up attritioning performance is very similar to that envisaged in the plant design and the installation of these units should achieve the project goals of scrubbing quartz particle surfaces so long as the feed material presented to the Hydrofloat is adequate.

7.24. Hydrofloat Flotation Variance

One of the noticeable variances observed in the testwork program is the discrepancy in performance between the small scale tests of the Hydrofloat unit and the bulk test runs that were conducted. As has been discussed above, the difference in the grade observed in the -0.6mm, +0.3mm fraction between small scale and pilot runs were ~670ppm Fe_2O_3 vs ~760ppm Fe_2O_3. However, while the material in both tests was from the same feed stock and processed in the same manner there is a difference in the Hydrofloat feed size distribution which can be seen in the PSD displayed below. While there is good agreement across most of the size ranges, within the ultrafine size fraction (- 53µm) there is substantially more mass. This is an outcome of the feed elutriation and the attritioners. The attritioners will generate more ultrafines and there is no downstream removal of the fines. This had been implemented in the original program as outlined previously, but not in this program due to changing flowsheet evaluations.

	Bulk	Small Scale
Size	Mass	Mass
mm	%	%
0.85	1.00%	1.15%
0.6	10.2%	10.3%
0.425	18.4%	19.5%
0.3	26.9%	26.4%
0.212	22.7%	23.9%
0.15	13.8%	13.1%
0.106	3.91%	3.91%
0.075	1.21%	1.27%
0.053	0.29%	0.33%
-0.053	1.52%	0.17%

Table 73: PSD variance between small scale and bulk Hydrofloat Feed

In respect the elutriation upstream from the attritioners, while the small scale rejected ~3% mass and the bulk ~7% to the overflow, there was ~3% -106um remaining in the bulk in comparison to ~1% in the small scale.

The impact of ultrafines in flotation operations is well documented and understood in all forms of flotation (for example sulphide/oxide/carbonate). A high proportion, or higher in this case, results in more reagent absorption due to the exponentially increase in surface area.

From a reagent point of view, the tests were conducted at the same dosages there will always be some degree of variance. As highlighted in the difference between the initial sighter pilot run (Table 36) and the re-run with similar reagents dosages but modified bed depth (Table 43).

7.25. Hydrofloat Operation

In consultation with the supplier in respect to an operating Hydrofloat, from an operational perspective there are four main variables that could be manipulated to adjust the performance of the separation during operation

- Chemical Regime
- Up-current water flow
- Bed Depth
- Air-flow/proportion

From the perspective of chemical regime this would be adjusted to, in flotation terminology, to increase the mass pull rate across the unit to maximise mass pull (pull harder). It is known from previous attempts that there comes a point where increasing collector has a depressing effect where the selectivity is reduced completely. The testwork above highlights that under the current conditions 650-680ppm indicates a best case scenario.

Up-current water flow - This typically is not adjusted during operation unless there is a substantial change in the sizing of the material entering the Hydrofloat. Fines, specifically ultrafines, are a problem in the conditioning stage and this isn’t a suitable control for fines and needs to be dealt with before entering the Hydrofloat. The testwork observed in section 4.2.2 highlights how insensitive this is.

Bed depth is a common control factor, however is difficult to test outside of optimisation during full-scale optimisation. Benefits have been observed during this testwork when operating a smaller bed depth.

Airflow optimisation has not been adjusted in great detail and has been run at what the supplier believes is optimal air flow. However, this is based on the supplier's experience with various hard rock applications and there is potential room for optimisation here. Potentially targeting a maximum air-flow rate could increase Fe_2O_3 rejection while maintaining the selectivity.

7.26. Conclusion

Ideally, the project goal was to produce a glass sand product in the individual size fraction of 300-600µm as dictated by the market at an Fe_2O_3 grade of <500 ppm. The other materials / size fractions were intended for foundry sand markets at <1000 ppm Fe_2O_3.

The process has proven to be robust and reproducible with respect to final product Fe_2O_3 grade. It is suspected that the Arrowsmith North deposit has iron staining within the quartz grains that cannot be extracted via physical means to improve the product grade beyond a certain point.

The Hydrofloat process has proven to be integral in producing the products as described in this report however, must be supported by the correct series of preceding unit operations in order to obtain maximum efficiency and the best possible product grade with respect to the deleterious elements of iron, aluminium and titanium.

The overall process flow that has yielded the best results can be summarised by the following combination of unit operations and is reflected within the final process flow diagrams and design for implementation:

- Fine particle removal (-106 µm) via the use of a Constant Density Tank elutriator.
- Attritioning to remove particle surface coatings.
- Cycloning prior to the Hydrofloat conditioning tank to remove attritioned fines as best as
- practicable.
- Hydrofloat utilising the Hexion C3025T reagent for removing iron bearing minerals from the quartz product grains.

The outcome of the testwork can be summarised in the following table describing the key out streams, product streams, mass yields and chemical signatures derived from the body of works.

ID	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LOI
	% of Feed	%	ppm	ppm	ppm	ppm	%
Head	100	95.955	18,860	6,520	3,130	3,100	0.66
+1.18mm	0.06	67.335	10,640	4,000	2,810	910	16.4
RC O/F	6.78	78.104	111,784	34,945	17,738	6,704	4.14
Hydrofloat Feed	93.16	97.738	9,489	3,387	2,002	2,576	0.35
O/F	14.6	90.124	39,793	16,867	8,572	14,600	1.39
Underflow	78.5	99.293	3,354	791	764	359	0.14
+0.6mm	10.4	99.495	2,290	650	180	270	0.11
-0.6mm, +0.3mm	43.2	99.402	2,850	710	390	360	0.13
-0.3mm, +0.106	24.9	99.031	4,640	970	1,640	380	0.17

Table 74: Testwork Summary

8. Engineering

8.1. Detailed Engineering

The Company has completed all material engineering work for construction of a 2 million tonne per year silica sand processing plant at the Arrowsmith North Silica Sand Project.

The detailed design phase of the project is largely complete. Remaining minor areas/items will be easily and efficiently detail designed during the execution phase of the project, without affecting the execution schedule.

This phase of engineering has been based on a comprehensive metallurgical testwork program and peer reviewed process circuit design and testing.

The design incorporates some innovative processing techniques which allows flexibility for the Company to produce multiple products subject to market requirements for foundry and glassmaking silica sand.

The design is significantly different to the design used in the 2019 BFS study which used a conventional spiral design and significant of readily available second hand components. The updated design allows for a process plant which can produce a consistent product but with flexibility to produce multiple specialised sand products for the glassmaking and foundry industries.

8.2. Design

The following areas/items are detail designed, peer reviewed and ready to progress to execution:

- Site and plant layout drawings.
- The attritioning/flotation building (structural, mechanical, and concrete packages).
- The product area (structural, mechanical, and concrete packages).
- Rejects cyclone stacker.
- Civil works for the plant & product area.
- Civil works for the southern access road.
- Civil works for the Brand Highway interface. (Note that this has been fully approved by Main Roads WA).
- Concrete has been detail designed.
- Electrical reticulation design and single line diagrams.
- Process Flow Diagrams (PFDs).
- Piping & Instrumentation Diagrams (PIDs).
- Circuit mass balance.
- Water management
- Mechanical Equipment List (MEL).
- Fabrication drawings verified.
- 3D design model.

The functional control philosophy document is currently being developed.

The following areas/items are concept designed only and will be detail designed or completed during the execution phase of the project:

- The mine plant area, including the feed hopper, transfer conveyors, trommel and other associated equipment such as water tank & pump skids, pipe systems etc. This area is all concept designed but is essentially comprised of vendor equipment linked together. The trommel is sourced and refurbished, and the other vendor equipment has been tendered and the preferred vendor selected. Finalisation of this area and design of ancillary items will be completed during the execution phase.

- Non-Process Infrastructure (NPI) will be designed/selected during the execution phase but have been included in site layout drawings. This includes items such as the following:
    - Admin, crib, toilet buildings etc and associated water and wastewater system.
    - Fire and raw water services.
    - Workshop, stores, laydown, etc.
    - Vehicle wash bays.

8.3. Equipment

The following major equipment has been tendered, selected as preferred and therefore used in the detailed design:

- Cyclone cluster
- Attritioners
- Hydrofloat separators
- Classifiers
- Conditioning tank
- Thickener
- Transformers
- Ring main unit
- MCC/switchrooms
- Product dewatering screens
- Feed hopper and conveyors (preferred vendor yet to be selected)
- Slurry pumps (preferred vendor yet to be selected)
- Water pumps
- Air compressors

The following minor equipment is yet to be officially tendered:

- Bore pumpset.
- Transportable buildings.
- Samplers.
- Pipe supply.
- Fabricated steelwork, chutes, etc.

Several items of second hand process equipment have been purchased and refurbished:

- A second hand feed trommel was purchased, refurbished, and is now in storage in a Bunbury fabrication contractor's premises. This machine is the primary screening machine at the mine plant.
- A vibrating screen (Schenck vibrating banana screen) was purchased, refurbished, and is now in storage at a Bunbury workshop. This machine is the final product sizing screen.

8.4. Project Execution Schedule

The most recent execution schedule uses the following key milestones prior to the decision to commence construction:

- Finalise finance and establish commencement date.
- Site access date to construct the northern access road.

- Approval to place orders for major long lead equipment.
- Site access date for plant construction.

8.5. Processing Plant Cost Estimate

The baseline project cost estimate, determined at a preliminary level in 2019 with a simple processing circuit, was $28.3M (including ~$6M contingency).

Following the comprehensive testwork program incorporating the attritioning and Hydrofloat components the Company has completed the processing plant detailed engineering to the level of completion of fabrication drawings.

The financial model has been updated with an updated capital estimate with recent tenders for budget estimates for major equipment.

PHASE	DELIVERABLE DESCRIPTION	Estimated Cost	Contingency	TOTAL $ incl Contingency
1	Project Management, Design, QC, etc	$ 1,646,180	$ 164,618	$ 1,810,798
2.1	Supply - Equipment	$ 13,835,970	$ 2,452,011	$ 16,287,981
2.2	Supply - Piping & Valves	$ 658,000	$ 162,000	$ 820,000
2.3	Supply - Steel Fabrication	$ 3,413,600	$ 682,720	$ 4,096,320
2.4	Supply - NPI Infrastructure	$ 1,708,300	$ 341,660	$ 2,049,960
2.5	Supply - Electrical & Instrumentation	$ 7,390,318	$ 1,415,471	$ 8,805,789
2.6	Supply - Signage, Safety, Other Minor Items	$ 100,812	$ 20,162	$ 120,974
2.7	Supply - Freight (road transport to site)	$ 399,500	$ 79,900	$ 479,400
2.8	Supply - Capital Spares	$ 620,831	$ 124,166	$ 744,997
3.1	Site Works - Construction Management	$ 2,122,540	$ 212,254	$ 2,334,794
3.2	Site Works - Civil Works (Roads, Bulk Earthworks, Dams & Drainage)	$ 5,256,966	$ 691,233	$ 5,948,199
3.3	Site Works - Concrete Works (Slabs, Footings, Plinths, etc)	$ 1,538,000	$ 153,800	$ 1,691,800
3.4	Site Works - Electrical & Instrumentation Works (HV, LV & PC)	$ 2,211,150	$ 442,230	$ 2,653,380
3.5	Site Works - SMP Works (inc. NPI)	$ 8,832,600	$ 1,763,020	$ 10,595,620
4	Commissioning	$ 540,200	$ 108,040	$ 648,240
5	Other Project Costs	$ 1,880,950	$ 193,095	$ 2,074,045
	TOTALS	$ 52,155,917	$ 9,006,380	**$ 61,162,297**

Additional costs for first fill, pre-production and purchase of offset land costs have been included in the financial model.

Figure 23: Render of process plant design

8.6. Major Equipment Procurement

VRX has prepared a summary of the major long lead time equipment that will be procured and has recently refreshed the quotations for most of these items. Some equipment has not been retendered for some time and will require retendering closer to the execution phase. Timing for procurement is subject to the EPA approvals process.

When evaluating tenders VRX uses a Tender Evaluation (TEV) process to summarise the tender submissions and to essentially land on the preferred tender.

8.7. Infrastructure

Roads

The project will be accessed by a 6 km dedicated road from a junction with the adjacent Brand Highway. The access road has had all required heritage, vegetation, flora and fauna surveys to be included in the Project referral area..

Brand Hwy Intersection

The Company has lodged and had approved a design proposal for the intersection of the Project southern access road where it joins Brand Hwy to the south.

Mine Services Area

The mine services area of 1 Ha will include demountable offices, workshop and ablutions.

Accommodation

No accommodation will be constructed or is required on the site

Fuel Storage

Fuel storage will require 1 x 55,000 litre bunded fuel storage facility for mining operations.

Water Supply and Distribution

Raw Water

Processing will recycle 95% of water and require 0.9 Gigalitres per year as top up process water. Water will be stored in a 80 m x 80 m lined storage dam constructed in the vicinity of the process plant.

Water supply will be from a bore sunk to the Yarragadee North deep acquifer and piped to the storage dam at the processing plant site.

The bore has been drilled, cased and tested and is capable of producing adequate water supplies. A 5C application for abstraction has been lodged with the DAWE for assessment and granting subject to EPA project approval.

Potable Water

Potable water requirements will be from off site and trucked to a day storage tank.

Waste Disposal

The site will generate very little waste products which will be disposed of offsite. Waste hydrocarbon products will be disposed of offsite at licensed disposal sites.

Power Supply

The Project will have a dedicated gas fired power supply adjacent to the processing plant facility. Power requirements for the feeder and mining area will be reticulated by aerial power lines.

Total power requirements will be 4 Megawatts with 5 Megawatts installed with redundant capacity.

The Company is assessing a power supply station to be installed at an adjacent gas wellhead and reticulating power to site by an aerial power line.

Communications

The site has mobile phone coverage and will utilise VHF channels for site communications.

Mill Residue Dry Stacking

Figure 24: Product and clay stacking

Water Management

The processing plant will utilise a thickener and polishing ponds to recycle 95% of the processing water.

Residue Management

The processing plant will produce a tailings clay residue of up to 40,000 tonnes per year of fine-grained clay. The clay will be predominately fine feldspar containing aluminium and titanium with some iron. The clay contains no heavy metals or significant deleterious elements. A series of high-pressure cyclones will be utilised to produce a near dry (3-5% moisture) tail as clay and recover the water for re-use. There is a local market for clay residue as a soil conditioner in the local sandy agricultural areas.

8.8. Product Logistics

Road Haulage

The project will initially use road haulage from site to the port until a rail unloader at the port becomes available.

A number of contractors have tendered rates for haulage and storage and the Company will examine all options for an extended term and lock down terms following EPA approval.

Haulage rates will be initially at a rate of one million tonnes per year.

Rail

There is a rail connection from the project area to the Geraldton Port via Narngulu, which is the route previously used by the Eneabba mineral sands operations. The rail is rated at 19 tonnes per axle and is a Tier 1 railway line. The mineral sands operations have depleted reserves and are no longer operating. The rail turnaround is at Eneabba and there is also a passing bay near Dongara. Rail operations for Arrowsmith North would most likely use the Dongara passing bay to avoid the Brand Highway crossing at Eneabba. There is very little rail traffic on the route.

The owner of the line is Arc Resources Pty Ltd, a subsidiary of Brookfield Limited.

While Arc Resources owns and maintains the railway line, it does not operate rolling stock.

The main operators in Western Australia are Watco Group, Pacific National and Aurizon. Carriages will be the same as for grain cartage; namely, covered wagons and bottom dumping. All operators have available carriages but locomotives are in short supply. Each operator will require six months' notice to begin haulage operations. All operators have submitted haulage proposals.

The rail capacity can haul up to 2 million tonnes per year with one train set. The rail operators have estimated that up to 4 million tonnes per year and two train sets is the maximum capacity without significant upgrades to the rail operations.

There is limited access to the rail unloader at the port and the Company has been in discussions with current operators to access the unloader and also with the Mid West Port Authority to establish a dedicated unloader for silica sand.

Port

Geraldton port operations are operated by Mid West Port Authority, which owns the rail unloading and ship loading equipment and leases storage areas.

The Company has engaged with the Mid West Ports Authority for unloading, storage and shiploading and has received indicative operating costs, barrier limits and capacity.

8.9. Environment, Water and Social Factors

The Company has undertaken detailed surveys and investigations regarding flora and vegetation, fauna, inland waters and social surroundings for the Project area.

Table below sets out a summary of the surveys undertaken, potential impacts and impact management plans.

EPA Factor*	Surveys and investigations undertaken	Potential impact(s) – based on the surveys	Management of impacts
Flora and Vegetation	Desktop and Field study of Flora and Vegetation, Spring 2018 (Mattiske). Key notes: Survey covers part of the DE No Threatened Flora found in DE to date No Threatened Flora with high likelihood of occurrence Priority Flora recorded in DE No TECs or PECs Over the period 2018 to 2023, a total of ten separate surveys have been conducted. These surveys have amounted to a total of 146 field person days. A total of 157 vegetation quadrats were established to sample all the apparent vegetation community types which were located within the Arrowsmith North survey area. These vegetation quadrats were established and monitored over multiple seasons. A total of 113 vegetation quadrats	Vegetation Clearing: Mining will occur in 2.25 ha blocks (150 m x 150 m), up to 16 blocks will be mined each year (35 ha) 12 ha of vegetation will be cleared for long term infrastructure, this will last the life of the mine A total of 15 ha will be 'open' at any one time (inclusive of long term clearing) This strategy will result in 353 ha of vegetation being cleared and rehabilitated over the life of the Proposal. No clearing of Threatened Flora (will be avoided if new specimens found during surveys) Clearing of Priority Flora could occur and their survival after VDT cannot be guaranteed at this stage. The health of 353 ha of vegetation will be affected by the VDT method.	Detailed flora and vegetation survey over DE to identify areas of significance (i.e. significant flora and vegetation) Any Threatened Flora records will be avoided Long-term clearing restricted to 12 ha for mining and processing infrastructure. Mining will be carried out in panels, with only 2.25 ha of active mining area at any one time. Direct rehabilitation will happen in parallel with mining, using VDT Vegetation will be removed in situ and transferred directly to already mined and landformed areas to retain vegetation and rootstock Flexibility is provided by a 1,572 ha Mine MDE, with the Proposal encompassing 365 ha of this area By utilising a larger Mine MDE it is possible to select areas to mine which will not have an impact on significant flora and vegetation Implementing VDT results in a greater likelihood of retaining the complete vegetation assemblage. This method retains hard to rehab flora such as recalcitrant species

EPA Factor*	Surveys and investigations undertaken	Potential impact(s) – based on the surveys	Management of impacts
	were established to sample all the apparent vegetation community types which were located within the Arrowsmith North mine area in 2018 and 2019. An additional 44 vegetation quadrats were established in 2020 within the Arrowsmith North transport corridor alignment options. In 2021, a total of 44 vegetation quadrats were remonitored, 33 from the original 133 in the Arrowsmith North mine area and 11 in the Arrowsmith North transport corridor to provide supplementary survey data.		
Terrestrial Fauna	Level 1 Fauna Survey, Summer 2019 (Bamford Consulting Ecologists) Key notes: Survey covers part of the DE No Threatened Fauna found in DE to date Vegetation represents Carnaby's Black Cockatoo foraging habitat No roosting trees recorded or expected No Malleefowl mounds recorded	Habitat clearing (refer above for size and method). All habitat predicted to be potential Carnaby's Black Cockatoo foraging habitat No impacts to active Malleefowl mounds (will be avoided if found) Direct impacts (mortality, injury) to conservation significant fauna from clearing and mining operations could occur Impacts to fauna habitat health are	Detailed fauna survey over DE to identify areas of significant habitat Refer above for clearing method If roosting trees are recorded they will be avoided If active Malleefowl mounds are recorded they will be avoided

EPA Factor*	Surveys and investigations undertaken	Potential impact(s) – based on the surveys	Management of impacts
	High pest numbers (wild cats, foxes and dogs)	expected to e minimal due to VDT method	
Inland Waters	H3 Hydrogeological Report lodged for assessment. Key notes: All mining to occur above water table Water supply to target deeper Yarragadee North Aquifer No defined surface drainage due to sandy soils No contamination risk – process plant simply washes clays (2%) out of sand	Potential impact on other groundwater users of the Yarragadee Aquifer Changes to surface water infiltration and flows due to removal of 3 – 8 m of silica sand and deposition of clays	Abstraction will be from the Yaragadee aquifer which will minimise the impact on groundwater dependent ecosystems (if present) or users of the surficial aquifer. Abstraction managed under RIWI Act No other groundwater users were identified in close proximity to the Proposal. Landforming of the mined areas to maintain a natural water regime.
Social Surroundings	None to date. No registered Aboriginal or European heritage sites in DE	Noise and dust impacts unlikely given small scale of operations and distance to residents (buffer distance can be maintained) Impacts to Aboriginal heritage sites expected to be able to be avoided if recorded	Buffer distance between operations and residential properties Use of existing rail – no transport on public roads Aboriginal heritage surveys to be completed Heritage sites to be avoided if recorded, or S18 approval if it cannot be avoided (unlikely)

Table 75: Summary of flora and vegetation, fauna, inland waters and social surroundings

9. Environment

The Project site falls into the Lesueur Sandplain subregion – (Thackway & Cresswell 1995).

The climate is warm Mediterranean with a hot, dry summer and a cool, wet winter.

Median and mean annual rainfall in this region are 481 mm and 489 mm respectively. The Lesueur Sandplain is dominated by proteaceous heath on sandy over lateritic soil; the dominant land uses are dryland agriculture, conservation and crown reserves.

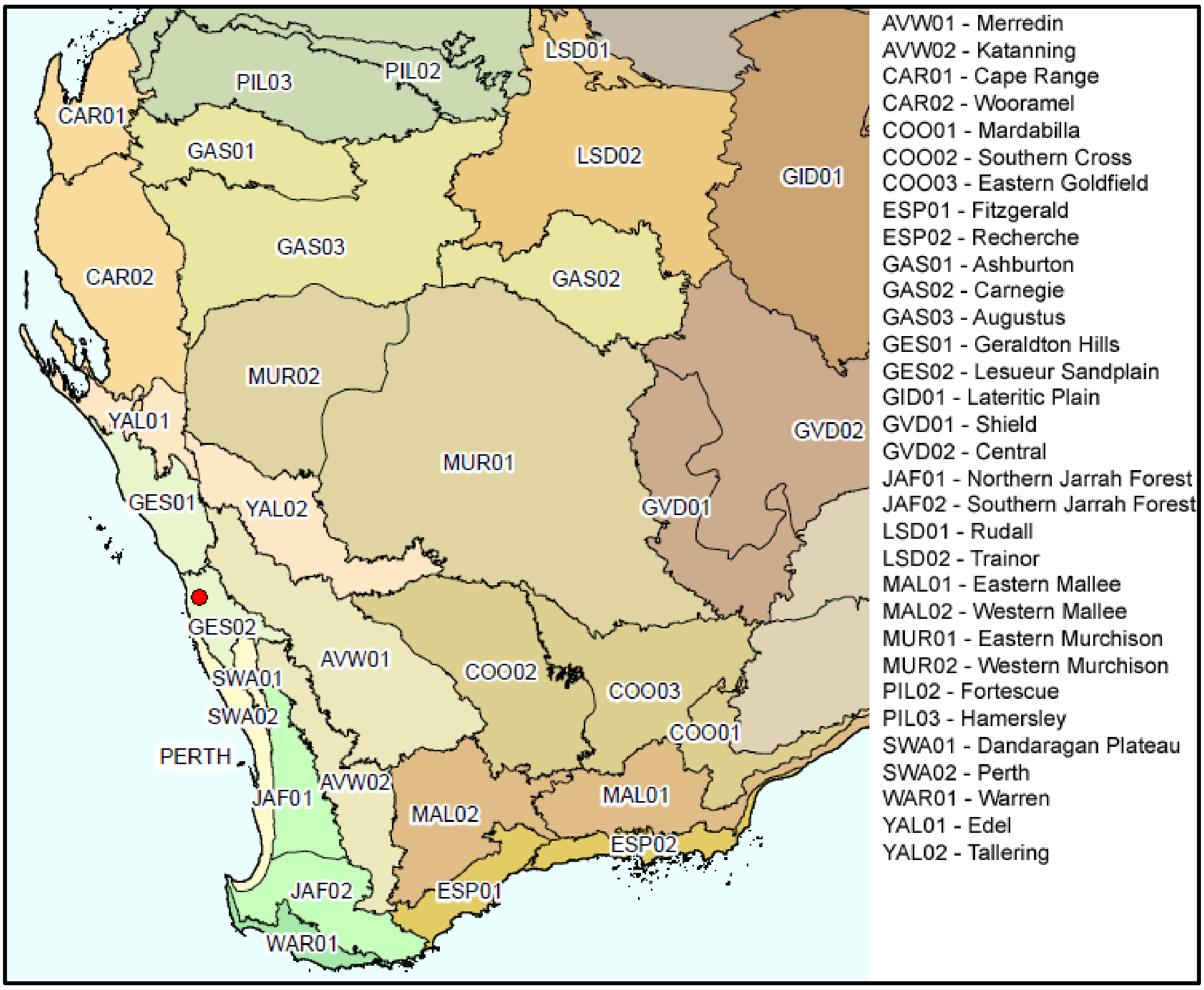


Figure 25: Bioregions across Western Australia, location of the project area in the Lesueur Sandplain subregion.

Vegetation of the project area primarily consists of scattered eucalypts over mixed *Kwongan* shrubland on sand. There is seasonal drainage line running through the northern part of the Project area.

9.1. Vegetation and Flora

Summary

Mattiske Consulting was commissioned by VRX Silica Ltd to undertake detailed flora and vegetation surveys of the Arrowsmith North survey area. Over the period 2018 to 2023, a total of ten separate surveys have been conducted. These surveys have amounted to a total of 146 field person days. The Arrowsmith North survey area occupies an area of approximately 2900 ha of mostly native vegetation, and is located between the towns of Eneabba and Dongara, Western Australia.

A total of 157 vegetation quadrats were established to sample all the apparent vegetation community types which were located within the Arrowsmith North survey area. These vegetation quadrats were established and monitored over multiple seasons. A total of 113 vegetation quadrats were established to sample all the apparent vegetation community types which were located within the Arrowsmith North mine area in 2018 and 2019. An additional 44 vegetation quadrats were established in 2020 within the Arrowsmith North transport corridor alignment options. In 2021, a total of 44 vegetation quadrats were remonitored, 33 from the original 133 in the Arrowsmith North mine area and 11 in the Arrowsmith North transport corridor to provide supplementary survey data.

Conservation significant flora have been extensively sampled in the Arrowsmith North survey. Targeted threatened and priority flora surveys were carried out in 2020, 2021 and 2023, in addition to opportunistic records obtained in 2018 and 2019. The targeted threatened and priority surveys consisted of extensive (467 km), systematic foot traverses over a 20 m grid covering an area of 458 ha.

A summary of the ten field surveys found the following:

- 305 vascular plant taxa, representative of 137 genera and 52 families were recorded within the Arrowsmith North survey area. The most common families overall, were Myrtaceae, Proteaceae, and Fabaceae.
- 40 annual plant taxa were recorded within the Arrowsmith North survey area, representing 13.1 % of all taxa recorded.
- Species accumulation analysis shows that approximately 83 % of taxa potentially present in the Arrowsmith North survey area were recorded during the field surveys.
- No threatened flora species were recorded within the Arrowsmith North survey area.Paracaleana dixonii (T) has not been recorded despite extensive surveys. The closest records are approximately 5 km to the east of the Arrowsmith North survey area near the Dampier to Pinjarra Natural Gas Pipeline. The preferred soil type of Paracaleana dixonii (T), grey sand over granite, is also not found in the Arrowsmith North survey area (mostly comprised of deep white to pale yellow sand).
- Eleven priority flora species were recorded in the Arrowsmith North survey area (Table 1). These are: Schoenus sp. Eneabba (F. Obbens & C. Godden I154) (P2), Beyeria gardneri (P3), Comesperma rhadinocarpum (P3), Hemiandra sp. Eneabba (H. Demarz 3687) (P3), Hopkinsia anoectocolea (P3), Hypocalymma gardneri (P3), Leschenaultia juncea (P3), Persoonia rudis (P3), Banksia elegans (P4), Schoenus griffinianus (P4) and Stawellia dimorphantha (P4).
- Of the priority flora species, Comesperma rhadinocarpum (P3) and Leschenaultia juncea (P3) are locally and regionally more restricted. The latter may relate to the difficulty in locating these two priority flora as they are small and inconspicuous. In view of their small size, it is expected that both species may be dependent on seed and also be shallow rooted.
- No taxa recorded within the Arrowsmith North survey area represent extensions to current known distributions.
- Eleven introduced (weed) species, *Aira caryophyllea (Silvery Hairgrass), *Brassicaceae sp., *Briza maxima (Blowfly Grass), *Eragrostis curvula (African Lovegrass), *Hypochaeris glabra (Smooth Cats-ear), *Lysimachia arvensis (Pimpernel), *Sonchus oleraceus (Common Sowthistle), *Trifolium arvense var. arvense (Haresfoot Clover), *Ursinia anthemoides (Ursinia), *Wahlenbergia capensis (Cape Bluebell) and*Vulpia myuros forma myuros (Annual Fescue) were recorded within the Arrowsmith North survey area. None of these are listed as declared pest organisms or weeds of national significance.

Flora & Vegetation – Arrowsmith North Survey Area 2.

- A total of 17 vegetation communities were mapped across the Arrowsmith North survey area. Eight from the Arrowsmith mine area and 10 from the Arrowsmith North transport corridors; one of these is recorded in both areas.
- The eight vegetation communities mapped across the Arrowsmith North mine area: consisted of five Heathland communities, one Scrub community, one Thicket to Scrub community and one Low Open Woodland community. Two Heathland communities, H2 and H4, made up most of the vegetation of the Arrowsmith North mine survey area (47.7 %).
- The ten vegetation communities mapped across the Arrowsmith North transport corridors: consisted of two Heathland communities, one Scrub community, four Thicket communities and three Woodland communities. One of these communities (T1) mapped is shared across both areas. Two communities, a Woodland (W4) and a Thicket (T6), were the dominant vegetation communities in the Arrowsmith North transport corridor (34.3 %).
- No Threatened or Priority ecological communities were inferred as occurring in the Arrowsmith North survey area.
- The majority of the vegetation was assessed as being in Pristine or Excellent condition. In the Arrowsmith North survey area 96.5 % of the vegetation was in Pristine condition. In the Arrowsmith North transport corridor 35.6 % of vegetation was in Pristine condition. A large portion (22.9 %) of the Arrowsmith North transport corridor was located in agricultural land and considered in Completely Degraded condition.
- No Malleefowl or Malleefowl mounds were opportunistically recorded during field surveys at Arrowsmith North.

SPECIES	CONSERVATION	TOTAL LOCATIONS	TOTAL PLANTS
Schoenus sp. Eneabba (F.	P2	30	467
Beyeria gardneri	P3	8	33
Comesperma	P3	47	59
Hemiandra sp. Eneabba	P3	242	323
Hopkinsia anoectocolea	P3	85	657
Hypocalymma gardneri	P3	322	517
Lechenaultia juncea	P3	1	1
Persoonia rudis	P3	1	1
Banksia elegans	P4	1046	4400
Schoenus griffinianus	P4	137	343
Stawellia dimorphantha	P4	258	430

Table 76: Summary of Priority Flora species recorded 2018 to 2023

Overall, the vegetation communities mapped and species recorded in the Arrowsmith North survey area were consistent with the historical mapping of Beard (1976, 1990). The majority of the Arrowsmith North survey area is situated on sand plains supporting mixed open to closed heath communities consisting of *Banksia attenuata, Banksia hookeriana,Melaleuca leuropoma* and *Conospermum triplinervium*, over mixed *Myrtaceae, Restionaceae* and *Haemodoraceae species*. The vegetation communities recorded within the Arrowsmith North survey area are not locally or regionally unique and are well represented in the wider area. However, the presence of conservation significant flora species within the Arrowsmith North survey area corridor is of local importance with regard to clearing of vegetation.

9.2. Environmental Legislation and Guidelines

The following key Commonwealth (federal) legislation relevant to this survey is the:

- Environment Protection and Biodiversity Conservation Act 1999.
- The following key Western Australian (state) legislation relevant to this survey include the:
- Biodiversity Conservation Act 2016 (BC Act);
- Biosecurity and Agriculture Management Act 2007 (BAM Act);
- Environmental Protection Act 1986 (EP Act); and Wildlife Conservation Act 19 50 (WC Act).

Furthermore, key Western Australian guidelines relevant to this survey are the:

- Environmental Factor Guideline: Flora and Vegetation (Environmental Protection Authority [EPA] 2016a); and
- Technical Guidance – Flora and vegetation surveys for environmental impact assessment (EPA 2016b).

9.3. Desktop Assessment

A desktop assessment was conducted using FloraBase (WAH 1998-), NatureMap (DPaW 2007-) and Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Protected Matters Search Tool (DoTEE 2013) databases, to identify the possible occurrence of threatened and priority flora and threatened and priority ecological communities within the Arrowsmith Project survey area.

The NatureMap search was conducted separately for the three Arrowsmith Project Tenements; North (E70/5027), Central (E70/4987) and South (E70/4986). Search parameters were 'by rectangle' and encompassed each Arrowsmith Project Tenement

9.4. Field Survey

The Arrowsmith North survey area lies approximately 35km North of Eneabba and approximately 20 km southeast of Dongara, Western Australia. The survey areas are within the Irwin Botanical District of the South-West Botanical Province (Beard 1990) and the Lesueur Sandplain subregion of the Geraldton Sandplains Region of the Interim Biogeographic Regionalisation for Australia (IBRA) (Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2021).

Mattiske Consulting has undertaken vegetation surveys in the Arrowsmith North survey area since 2018. Over this time there have been several areas surveyed. The figure shows a map of the different areas surveyed over the past four years. In summary, the 2018 survey (Mattiske 2019) included the majority of the Arrowsmith North mine survey area. The 2019 survey expanded on this Arrowsmith North mine survey area (Mattiske 2020a). The autumn 2020 transport corridor survey included two potential transport corridors, Western Alignment and Southern Alignment (Mattiske 2021a). A targeted threatened and priority flora survey was completed in Spring 2020 covering 119 ha (Mattiske 2021b). In 2021, the targeted threatened and priority flora survey area was expanded covering 420 ha and flora and vegetation surveys were undertaken in the Arrowsmith North mine area and transport corridor area. In Spring 2023, a targeted threatened and priority flora survey was completed on an infrastructure corridor between the Arrowsmith North survey area and Beharra Springs gas plant (38 ha). For ease of use, naming terminology in this report refers to the Arrowsmith North survey area collectively, which includes the Arrowsmith North mine survey area, Arrowsmith North transport corridors (including Western and Southern alignments) and infrastructure corridor.

A detailed field assessment of the flora and vegetation of the Arrowsmith North survey area within tenements and L70/199, M701389 and E70/5109 was conducted by experienced botanists from Mattiske Consulting between 2018 and 2023. Ten separate surveys were completed (Table 3). Of these, nine were conducted in Spring and one conducted in Autumn. Four of the surveys were targeted flora surveys for threatened and priority species and were completed in 2020, 2021 and 2023 (Table 3). All surveys totalled 138 field person days.

Survey	Year	Dates	Personnel	Area / Survey Type
1	2018	29th October to 2nd November	4 botanists (20 days)	L70/199, M70/1389 and E70/5109 Flora & Vegetation
1	2018	5th November to 9th November	2 botanists (10 days)	L70/199, M70/1389 and E70/5109 Flora & Vegetation
2	2019	21st October to 25th October	4 botanists (20 days)	L70/199, M70/1389 and E70/5109 Flora & Vegetation
2	2019	11th November to 14th November	3 botanists (12 days)	L70/199, M70/1389 and E70/5109 Flora & Vegetation
3	2020	19th May to 22nd May	2 botanists (8 days)	L70/208 Transport Corridor Flora & Vegetation
4	2020	27th October to 30th October	3 botanists (12 days)	M70/1389 Targeted Threatened & Priority
5	2021	13th September to 17th September	4 botanists (20 days)	M70/1389 Targeted Threatened & Priority
5	2021	20th September to 24th September	4 botanists (20 days)	M70/1389 Targeted Threatened & Priority
6	2021	4th October to 7th October	4 botanists (16 days)	L70/199, L70/208 and M70/1389 Flora & Vegetation
7	2023	23rd October to 26th October	2 botanists (8 days)	L70199, M70/1389 and E70/5027 Infrastructure Corridor Targeted Threatened & Priority

Table 77: Summary of field surveys of Arrowsmith North survey area, 2018 to 2023

All surveys were conducted in accordance with methods outlined in Technical Guidance – Flora and vegetation surveys for environmental impact assessment (EPA 2016b). All botanists held valid collection licences to collect flora for scientific purposes, issued under the Wildlife Conservation Act 1950 (WA).

A total of 98 quadrats were established in the Arrowsmith North survey area in 2018, and a further 15 quadrats were established in 2019. These 113 quadrats were selected to sample all vegetation types, with replication, within the survey area. A total of 33 quadrats of these 113 were re-monitored in October 2021, this supplementary survey was undertaken to provide additional survey data on the range of flora that is likely to occur in the Arrowsmith North survey area.

In addition, a total of 44 quadrats were established in 2020 within the Arrowsmith North transport corridor survey area, these quadrats were selected to sample all vegetation types, with replication, within the survey area. Eleven of these 44 quadrats were re-monitored in October 2021, this supplementary survey was undertaken to provide additional survey data on the range of flora that is likely to occur in the Arrowsmith North transport corridor survey area.

Vegetation quadrats consisted of marked (fence dropper, NW corner) 10 x 10 metre quadrats. Flora and vegetation were described and sampled systematically at each survey site, and additional opportunistic collections were undertaken wherever previously unrecorded plants were observed. At each quadrat the following floristic and environmental parameters were recorded:

- GPS location (GDA94 datum, zone 50J);
- Local site topography;
- Soil type and colour;
- Outcropping rocks and their type;
- Percentage litter cover and percentage bare ground;
- Approximate time since fire;
- Vegetation condition (based on [Keighery 1994); and
- For each vascular plant species, the average height and the percentage cover (of both alive and dead material) over the survey site.

A targeted threatened and priority flora survey of the was also undertaken in the Arrowsmith North survey area. The methodology consisted of extensive foot traverses within the Arrowsmith North mine survey area and Arrowsmith North transport corridor. In the 2020 targeted survey work, botanists used handheld Garmin GPS units loaded with the survey polygon and a 20m wide grid overlayed. The 20 m wide grid was searched in a systematic meandering manner which is 50 % more intensive than walking in a straight line.

During the 2021 and 2023 targeted survey, botanists had access to all relevant data in the Esri iOS application, Collector for ArcGIS on Apple iPads. Data layers accessible in the field included the Arrowsmith North mine survey area and the Arrowsmith North transport corridor plan boundary, locations of all known conservation significant flora from both historical and contemporary surveys and aerial imagery supplied by CAD Resources. The 2021 and 2023 targeted survey area was also populated with a grid 20 m in a north-south and east-west orientation. The grid was used as a guide for foot traverses and was also surveyed in a systematic meandering manner.

The locations of any conservation significant flora were recorded with the Esri iOS application, Collector for ArcGIS. If there was more than one plant of the same species in the same location (within 10 m) the area of the population was recorded. During field surveys botanists also had access to detailed taxonomic and ecological data on all potential conservation significant species which may potentially be encountered during the field survey. If suspected or known conservation significant flora species were encountered, a specimen was collected for subsequent identification, and plant numbers were recorded for the population.

All plant specimens collected during the field surveys were dried and processed in accordance with the requirements of the Western Australian Herbarium (WAH). The plant species were identified based on taxonomic literature and through comparison with pressed specimens housed at the WAH. Where appropriate, plant taxonomists with specialist skills were consulted. All priority plant species have been re-confirmed by WAH identification botanist Mike Hislop. Nomenclature of species recorded is in accordance with the WAH (1998-). Unless otherwise stated, all photographs used in this report were taken by S. Ruoss of Mattiske Consulting.

9.5. Survey Timing

According to Table 3 in the Technical guidance – Flora and vegetation surveys for environmental impact assessment (EPA 2016b), the primary survey timing for the Irwin Botanical Province is spring (September/November). As the current survey was conducted in October and November, it falls within this period. The survey was timed, where possible, to align with peak flowering periods of conservation significant flora with the potential to occur in the Arrowsmith Project survey area. Rainfall in the three months preceding the survey (July to September 2018) was slightly above average.

9.6. Analysis of Site Data

A species accumulation curve, based on accumulated species versus sites surveyed was prepared to provide an indication of the level of adequacy of the survey effort (EstimateS – Colwell 2006). As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. The asymptotic value was determined using Michaelis-Menten modelling and provided an incidence based coverage estimator of species richness (Chao 2004). When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered to be adequate.

Plymouth Routines in Multivariate Ecological Research v7 (PRIMER) statistical analysis software was used to analyse species-by-site data and discriminate survey sites on the basis of their species composition (Clarke and Gorley 2006). To down-weight the relative contributions of quantitatively dominant species, a fourth root transformation was applied to the data set. Introduced species, annual species, specimens not identified to species level and singletons (species recorded at a single quadrat and not forming a dominant structural component) were excluded from the data set prior to analysis. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Data were analysed using a series of multivariate analysis routines including Similarity Profile (SIMPROF), Hierarchical Clustering (CLUSTER), Analysis of Similarity (ANOSIM) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography and delineation of individual plant communities.

9.7. Vegetation Descriptions

Vegetation descriptions were based on Alpin's (1979) modification of the vegetation classification system of Specht (1970), to align with the National Vegetation Information System (NVIS). Vegetation communities were described at the association level of the NVIS classification framework, as defined by the Executive Steering Committee for Australian Vegetation Information (2003). Vegetation condition of each of the mapping sites was assessed as per the criteria developed by Keighery (1994)

9.8. Survey Limitations

A general assessment was made of the current survey against a range of factors that may have limited the outcomes and conclusions of this report (Table 3). Based on this assessment, the present survey has not been subject to constraints which would affect the thoroughness of the survey, and the conclusions which have been formed.

POTENTIAL SURVEY LIMITATION	IMPACT ON CURRENT SURVEY
Availability of contextual information at a regional and local scale	**Not a limitation:** Reference resources such as Beard's mapping, together with online flora and vegetation information, has provided an appropriate level of information for the current survey.
Competency/experience of team carrying out survey; experience in the bioregion surveyed	**Not a limitation:** All botanists had extensive experience working in a range of botanical districts across the state. Majority of the plants observed in the field were collected for formal identification and were compared

	with specimens at the Western Australian State Herbarium where required.
Proportion of flora collected and identification issues	**Potential limitation:** While many plants were in flower during the survey, a proportion of plants encountered during the survey were sterile and may impact the chance of identification of some specimens to species level. Orchid species may not emerge each year if conditions are not favourable. Although this may affect the completeness of the species list, it is not expected to have a significant effect on mapping reliability, nor on the identification of threatened and priority species in the area as the majority were perennial species.
Effort and extent of survey (Was the appropriate are surveyed for the type of survey (reconnaissance/targeted/detailed)?	**Potential limitation:** The survey area was thoroughly covered. Survey quadrats were initially selected from high resolution aerial maps, with additional quadrats selected in situ based on in field observations. Low replication of some vegetation communities was unavoidable given their low occurrences within the survey area. It is acknowledged the MDE had been altered between completing fieldwork and reporting, however top up field surveys will be completed in spring 2019 to infill remaining unsurveyed areas.
Access restrictions within survey area	**Not a limitation:** Vehicle access to the Arrowsmith Project survey area and foot traverses were sufficient to allow access to the entirety of the survey area.
Survey timing, rainfall, season of survey	**Not a limitation:** The EPA (2016a) recommends that flora and vegetation surveys in the South – West Botanical Province be conducted in Spring (September-November). The current survey was conducted in October and November which falls within this period. Rainfall in the three months preceding the survey (July to September 2018) was slightly above average.
Disturbances (fire/flood/clearing)	**Not a limitation:** The Arrowsmith Project survey area exhibits minimal levels of disturbance, mainly from past fire events.
Data and statistical analysis	**Not a limitation:** Introduced species, annual species and singletons were excluded from the data set prior to analysis. Data collected was sufficient for delineation of vegetation communities based on statistical analysis.

Table 78: Potential limitations affecting the conclusions

9.9. Field Survey Results

A total of 139 survey quadrats were used to assess the flora and vegetation of the Arrowsmith Project survey area. A total of 16 quadrats were surveyed within the current MDE. A list of plant taxa recorded at each survey quadrat within the Arrowsmith Project survey area

9.10. Flora

A total of 263 vascular plant taxa, representative of 126 genera and 48 families, were recorded within survey quadrats within the Arrowsmith Project survey area. The majority of taxa recorded were representative of the *Proteaceae* (36 taxa), *Myrtaceae* (33 taxa) and *Fabaceae* (22 taxa) families. From within the current MDE, total of 154 vascular plant taxa, representative of 88 genera and 38 families were recorded. Thirty-three annual plant species were recorded during the survey of the Arrowsmith Project survey area, representing 14.35 % of all taxa recorded, five of these represent introduced annual species. A number of plant species collected could not be identified accurately to species level due to the absence of sufficient taxonomic characters to enable accurate identification. The principle reasons for not being able to fully identify some of the collected specimens to species level were:

Plant material was sterile or lacked sufficient taxonomic feature to permit accurate identification to species level. In these cases the species is identified as, for example, *Thysanotus* sp. or *Drosera* sp. and,

The plant material collected could not be determined to a known taxon. For example, *Lepidosperma* species are currently undergoing taxonomic revision.

A species accumulation curve was used to evaluate the sampling adequacy and is presented below. The incidence based coverage estimator (ICE) of species richness was 309.41. Based on this value and the total of 263 species recorded (in vegetation mapping sites only), approximately 85% of the flora species potentially present within the Arrowsmith Project survey area were recorded.

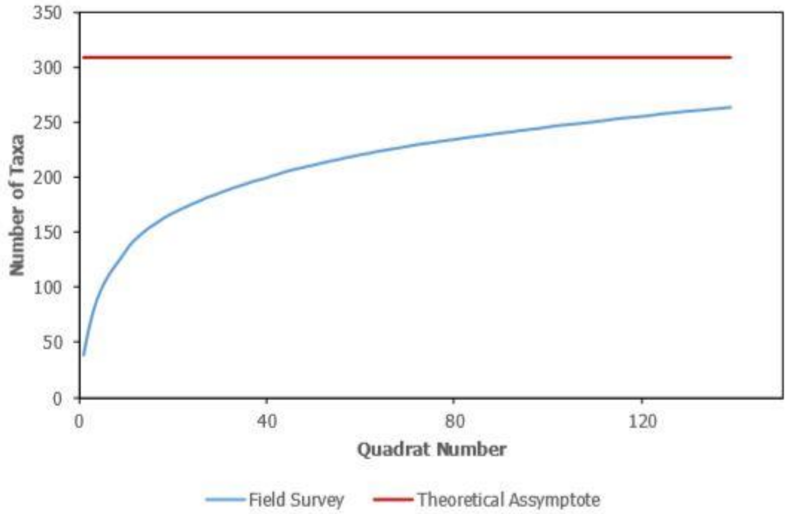


Figure 26: Average randomised species accumulation graph

9.11. Threatened and Priority Flora

No threatened flora species pursuant to subsection (2) of section 23F of the WC Act and as listed by the DBCA (2018a), or pursuant to section 179 of the EPBC Act or listed by the DotEE (2019b), were recorded within the Arrowsmith Project survey area.

Ten priority flora species, Comesperma rhadinocarpum (P3), Hemiandra sp. Eneabba (H. Demarz 3687) (P3), Hopkinsia anoectocolea (P3), Hypocalymma gardneri (P3), Leschenaultia juncea (P3), Persoonia rudis (P3), Banksia elegans (P4), Calytrixchrysantha (P4), Schoenus griffinianus (P4) and Stawellia dimorphantha (P4), as listed by the WAH (1998-), was recorded within the Arrowsmith Project survey area (Table 6). Two of these species are present in the current MDE, Hemiandra sp. Eneabba (H. Demarz 3687) (P3) and Persoonia rudis (P3). Hemiandra sp. Eneabba (H. Demarz 3687) (P3) was recorded from 23 locations totalling 26 plants and Persoonia rudis (P3) was recorded from 6 locations totalling 8 plants.

9.12. Flora Range Extensions

Two species recorded at the Arrowsmith Project survey area represented extensions to their current known distributions, these species being *Tricoryne* sp. *Mullewa* (G.J. Keighery 12080) and *Synaphea spinulosa* subsp. *borealis*. *Tricoryn* e sp. *Mullewa* (G.J. Keighery 12080) represents a range extension of approximately 110 km to the south of its current known distribution (WAH 1998-). While, *Synaphea spinulosa* subsp. *borealis* represents a range extension of approximately 130 km to the south of its current known distribution (WAH 1998-). In this report, 100 km has been used as a basis to determine an extension to the currently known range for a species.

9.13. Introduced (Weed) Species

A total of five introduced (weed) species were recorded within the Arrowsmith Project survey area (Table 7). None of these species, **Aira caryophyllea* , **Hypochaeris glabra* , **Lysimachia arvensis*, **Ursinia anthemoides* and **Wahlenbergia capensis* are declared pest organisms pursuant to section 22 of the BAM Act. None are listed as Weeds of National Significance (DotEE 2019c). All species recorded are listed in the Midwest region impact and invasiveness ratings (DPaW 2013). Two were listed as having high ecological impact and two was listed as being of low ecological impact, the remaining species **Wahlenbergia capensis* is listed as having unknown ecological impacts (DPaW 2013). All weed species recorded were described as having rapid invasiveness (DPaW 2013).

9.14. Statistical Analysis

SIMPROF analysis identified four significantly associated groups of quadrats. Four significantly dissimilar vegetation communities were delineated within the Arrowsmith Project survey area. A dendrogram representing the results of the cluster analysis, and the corresponding four vegetation communities was produced.

9.15. Vegetation Communities

Based on statistical analysis (Section 5.2.1.), four vegetation communities were defined and mapped across the Arrowsmith Project survey area. In addition to the statistical analysis, survey quadrat physical data and aerial photographic maps were used to delineate the boundaries of the vegetation communities in the Arrowsmith Project survey area. A summary of the vegetation communities is presented below.

S1: Isolated trees of *Eucalyptus todtiana*, over shrubland of *Banksia leptophylla* var. *melletica, Acacia blakelyi* over mixed understorey of *Proteaceae* and *Myrtaceae* species on grey/white sand plains.

S2: Isolated trees of Eucalyptus todtiana, over shrubland of Melaleuca leuropoma, Calothamnus quadrifidus subsp. quadrifidus and Xanthorrhoea drummondii, over isolated Ecdeiocolea monostachya and Mesomelaena pseudostygia on cream/grey sand plains

W1: Woodland of Xylomelum angustifolium and Eucalyptus todtiana, over open shrubland of Melaleuca leuropoma and Hakea polyanthema over isolated Mesomelaena pseudostygia on cream sand plains.

H1: Heathland of Banksia attenuata, Hakea polyanthema and Melaleuca leuropoma over isolated Verticordia grandis and Banksia nivea on white sand plains.

9.16. Threatened and priority Ecological Communities

No TECs, pursuant to Schedule 1 of the WC Act and as listed by the DBCA (2018b) or DoTEE (2019d) were recorded within the Arrowsmith Project survey area. No PECs as listed by the DBCA (2019b) were recorded within the Arrowsmith Project survey area

9.17. Vegetation Condition

The condition of the vegetation within the Arrowsmith Project survey area ranged from Pristine to Completely Degraded, with majority of the area was considered Pristine according to the Keighery (1994; Appendix A5) scale.

Within the Arrowsmith Project survey area these areas can be delineated as follows:

- **Pristine**: Majority of the current MDE, away from edge effects on western side and recently burnt area in south. No tracks or disturbances present.
- **Excellen**t: Areas in the southern section of the MDE, very little disturbance from fire and associated fire breaks.
- **Completely Degraded**: Road, dam next to railway line on western side.

9.18. Conclusion

Overall, the vegetation communities mapped and species recorded in the Arrowsmith Project survey area were consistent with the historical mapping of Beard (1976, 1990). The majority of the survey area is situated on sand plains supporting *Eucalyptus todtiana* over mixed heath. The vegetation communities they hosted were not locally or regionally unique as they are well represented in the wider area. It is recommended to infill areas in the current MDE that were not assessed in the current survey - spring is the optimal time.

Given two priority flora species were recorded in the current MDE,

Hemiandra sp. Eneabba (H. Demarz 3687) (P3) and *Persoonia rudis* (P3), it is recommended that the MDE be further refined so a more detailed and targeted search can be carried out to obtain an accurate idea of population numbers to be impacted.

10. Fauna

The objectives of investigations to date are to: identify fauna values; review impacting processes with respect to these values and the proposed activity; and provide recommendations to mitigate these impacts.

The methods used for this assessment are based upon the general approach to fauna investigations for impact assessment. The impact assessment process involves the identification of fauna values, review of impacting processes and, where possible, preparation of mitigation recommendations.

This approach to fauna impact assessment has been developed with reference to guidelines and recommendations set out by the Western Australian Environmental Protection Authority (**EPA**) on fauna surveys and environmental protection, and Commonwealth biodiversity legislation (EPA 2002; EPA 2004). The EPA proposes two levels of investigation that differ in the approach to field investigations, Level 1 being a review of data and a site reconnaissance to place data into the perspective of the site, and Level 2 being a literature review and intensive field investigations (e.g. trapping and other intensive sampling). The level of assessment recommended by the EPA is determined by the size and location of the proposed disturbance, the sensitivity of the surrounding environment in which the disturbance is planned, and the availability of pre-existing data.

The following approach and methods are divided into three groupings that relate to the stages and the objectives of impact assessment:

- **Desktop assessment.** The purpose of the desktop review is to produce a species list that can be considered to represent the vertebrate fauna assemblage of the project area based on unpublished and published data using a precautionary approach.
- **Field investigations.** The purpose of the field investigations is to gather information on this assemblage: confirm the presence of as many species as possible (with an emphasis on species of conservation significance), place the list generated by the desktop review into the context of the environment of the project area, collect information on the distribution and abundance of this assemblage, and develop an understanding of the project area's ecological processes that maintain the fauna. Note that field investigations cannot confirm the presence of an entire assemblage, or confirm the absence of a species. This requires far more work than is possible in the EIA process. For example, in an intensive trapping survey, How and Dell (1990) recorded in any one year only about 70% of the vertebrate species found over three years. In a study spanning over two decades, Bamford et al. (2010) has found that the vertebrate assemblage varies over time and space, meaning that even complete sampling at a set of sites only defines the assemblage of those sites at the time of sampling.
- **Impact assessment.** Determine how the fauna assemblage may be affected by the proposed development based on the interaction of the project with a suite of ecological and threatening processes.

10.1. Desktop Assessment

Information on the fauna assemblage of the survey area was drawn from a wide range of sources. These included state and federal government databases and results of regional studies. Databases accessed were the Atlas of Living Australia (ALA), the WA Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap (incorporating the Western Australian Museum's FaunaBase and the DBCA Threatened and Priority Fauna Database), BirdLife Australia's Birdata (Atlas) Database (BA), the EPBC Protected Matters Search Tool and the Bamford Consulting Ecologists (BCE) Database

(Table 1). Information from the above sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns were:

- Frogs: Tyler et al. (2000) and Anstis (2013);
- Reptiles: Storr et al. (1983, 1990, 1999 and 2002) and Wilson and Swan (2013);
- Birds: Blakers et al. (1984); Johnstone and Storr (1998, 2004), Barrett et al. (2003) and Menkhorst et al. (2017);
- Mammals: Menkhorst & Knight (2004); Churchill (2008); and Van Dyck and Strahan (2008).

Sources of information used for the desktop assessment.

- Atlas of Living Australia (ALA 2019) Records provided by collecting institutions, individual collectors and community groups 29° 40' 10''S, 115° 10' 41''E – plus 20 km buffer.
- NatureMap (DBCA 2019) Records in the WAM and DPaW databases. Includes historical data and records on Threatened and Priority species in WA. 29° 40' 10''S, 115° 10' 41''E – plus 20 km buffer.
- BirdLife Australia Birdata (Atlas Database) Records of bird observations in Australia, 1998-2018. 29° 40' 10''S, 115° 10' 41''E – plus 20 km buffer.
- EPBC Protected Matters Records on matters of national environmental significance protected under the EPBC Act. 29° 40' 10''S, 115° 10' 41''E – plus 20 km buffer.

10.2. Previous fauna surveys

BCE has conducted multiple fauna surveys at Arrowsmith and nearby areas. These surveys have included monitoring, targeted fauna assessments and a level 2 fauna assessment. Other surveys conducted by BCE further afield will be used as background information only to inform potential species lists compiled during desktop studies. There have also been studies by other consultants in the region, particularly for the Eneabba mineral sands mine. Species records from these studies are contained in the Naturemap database which was consulted as part of the desktop study. In addition, BCE maintains a detailed database and annotated species lists that were available for reference as part of the desktop study. Some of the BCE records pre-date Naturemap. Previous reports consulted for background information include Harris et al. (2008), Metcalf and Bamford (2008), Bamford (2009), Bamford (2012), Everard and Bamford (2014), Bamford et al. (2015) and Bamford and Chuk (2015-17). Some of these studies were undertaken within 1km of the project area; others within about 10km.

10.3. Nomenclature and taxonomy

As per the recommendations of EPA (2004), the nomenclature and taxonomic order presented in this report are based on the Western Australian Museum's (WAM) Checklist of the Fauna of Western Australia 2016. The authorities used for each vertebrate group were: amphibians (Doughty et al. 2016a), reptiles (Doughty et al. 2016b), birds (Johnstone and Darnell 2016), and mammals (Travouillon 2016). In some cases, more widely-recognised names and naming conventions will be followed, particularly for birds where there are national and international naming conventions in place (e.g. the BirdLife Australia working list of names for Australian Birds). English names of species where available are used throughout the text; Latin species names are presented with corresponding English names in tables in the appendices.

10.4. Interpretation of species lists

Species lists generated from the review of sources of information are generous as they include records drawn from a large region and possibly from environments not represented in the survey area. Therefore, some species that were returned by one or more of the data searches will be excluded because their ecology, or the environment within the survey area, meant that it is highly unlikely that these species will be present. Such species can include, for example, seabirds that might occur as extremely rare vagrants at a terrestrial, inland site, but for which the site is of no importance.

Species returned from the databases and not excluded on the basis of ecology or environment are therefore considered potentially present or expected to be present in the survey area at least occasionally, whether or not they were recorded during field surveys, and whether or not the survey area is likely to be important for them. This list of expected species is therefore subject to interpretation by assigning each a predicted status in the survey area.

The status categories used are:

- **Resident:** species with a population permanently present in the survey area;
- **Migrant or regular visitor:** species that occur within the survey area regularly in at least moderate numbers, such as part of annual cycle;
- **Irregular Visitor:** species that occur within the survey area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the survey area in at least moderate numbers and for some time;
- **Vagrant:** species that occur within the survey area unpredictably, in small numbers and/or for very brief periods. Therefore, the survey area is unlikely to be of importance for the species; and
- **Locally extinct:** species that would will be present but has not been recently recorded in the local area and therefore is almost certainly no longer present in the survey area.

These status categories make it possible to distinguish between vagrant species, which may be recorded at any time but for which the site is not important in a conservation sense, and species which use the site in other ways but for which the site is important at least occasionally. This is particularly useful for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive, and further recognises that even the most detailed field survey can fail to record species which will be present at times, or may will be previously confirmed as present. The status categories are assigned conservatively. For example, a lizard known from the general area is assumed to be a resident unless there is very good evidence that the site will not support it, and even then it may be classed as a vagrant rather than assumed to be absent if the site might support dispersing individuals.

10.5. Field Investigation Methodology and Personnel

The survey area was visited on 18 November 2018 by Dr Mike Bamford (BSc Hons. Ph.D. (Biol.)), Dr Wes Bancroft (BSc Hons. Ph.D. (Zool.), Sarah Smith (Bsc. (Biol.) and Peter Smith (Dip. Ag. Sc.). Mike Bamford and Katherine Chuk - B. Sc. (Zool.) Hons. prepared a report.

During the site inspection as much as possible of the site was visited, habitat observations were made in order to develop descriptions of Vegetation and Substrate Associations (VSAs), and opportunistic fauna observations were recorded when relevant to the survey. Access to the site was good due to the rail alignment from Eneabba to Geraldton passing along the western side.

10.6. Survey Limitations

The EPA Guidance Statement 56 (EPA 2004, now EPA 2016) outlines a number of limitations that may arise during surveying. These survey limitations are discussed in the context of the BCE investigation of the survey area in Table below.

EPA Limitation	BCE Comment
Level of survey.	Level 1 (desktop study and site inspection). Survey intensity was deemed adequate due to the scale of the project and the amount of data available in the region.
Competency/experience of the consultant(s) carrying out the survey.	The ecologists have had extensive experience in conducting fauna surveys and have conducted several fauna studies within the immediate region.
Scope. (What faunal groups were sampled and were some sampling methods not able to be employed because of constraints?)	The survey focussed on vertebrate fauna and fauna values.
Proportion of fauna identified, recorded and/or collected.	All vertebrate fauna observed were identified. Extensive desktop information allowed for a robust predicted species list to be developed.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	Abundant information from databases and previous studies.
The proportion of the task achieved and further work which might be needed.	The survey was completed and the report provides fauna values for the project area.
Timing/weather/season/cycle.	Timing is not of great importance for level 1 investigations.
Disturbances (e.g. fire, flood, accidental human intervention etc.) that affected results of survey.	None
Intensity. (In retrospect, was the intensity adequate?)	All major VSAs were visited and significant species habitat and traces were identified.
Completeness (e.g. was relevant area fully surveyed).	Site was fully surveyed to the level appropriate for a level 1 assessment and for the proposed impact. Fauna database searches covered a 20 km radius beyond the survey area boundary. Detailed field investigations covered the VSAs present.
Resources (e.g. degree of expertise available in animal identification to taxon level).	Field personnel have extensive experience with fauna and habitat in the region.
Remoteness and/or access problems.	There were no remoteness/access problems encountered.
Availability of contextual (e.g. biogeographic) information on the region.	Regional information was available and was consulted.

Table 79: Survey Limitations

Fauna values within the survey area can be summarised as follows:

- **Fauna assemblage.** Moderately rich but incomplete with some species locally extinct. Assemblage is typical of the Lesueur Sandplains subregion. Notable for a rich reptile assemblage and high proportion of non-resident birds, many of which are nectarivorous and exploit seasonal abundance of nectar and pollen from the species-rich flora.
- **Species of conservation significance.** Few species of high conservation significance are present or expected, but the Carnaby's Black-Cockatoo is important, with known roost sites nearby and the species very likely to be a regular foraging visitor to the project area. The locally significant Rufous Fieldwren and Rainbow Bee-eater are almost certainly present, with the bee-eater a breeding visitor. The Western Ground Parrot may be locally extinct but because of its very high conservation significance (with the only known wild population estimated as <150 birds; A. Burbidge pers. comm.), the slight possibility of the species being extant in the general rea is important.
- **Vegetation and Substrate Associations (VSAs).** The survey area supports few but distinct VSAs, all of which are mostly intact. All are very extensive regionally.
- **Patterns of biodiversity.** Within the survey area all VSAs, aside from a small disturbed area in the north-west, are intact and likely to support a high level of species richness. VSA3 may support some aquatic and wetland-associated species not found in VSAs 1 and 2 due to the seasonal presence of water. VSAs 1 and 2 are likely to support a high diversity of terrestrial species, with VSA1 notably important for conservation significant species such as Carnaby's Black-Cockatoo.
- **Key ecological processes.** The main processes which may affect the fauna assemblage are likely to be local hydrology, the fire regime and the presence of feral predators.

10.7. Recommendations

Because of the fairly continuous and undisturbed habitat surrounding the survey area, potential impacts are mostly considered to be minor or negligible. Potential impacts of greatest concern to fauna include:

- loss of habitat
- mortality during clearing
- habitat fragmentation (drainage line)
- roadkill due to increased traffic
- impacts of feral species
- hydrological change
- altered fire regimes
- light

Recommendations to manage potential impacts include:

- Referral to the Department of Energy and the Environment under the EPBC Act for impact on >1ha of moderate to high forging value vegetation for Carnaby's Black-Cockatoo.
- Undertake baseline surveys (bird censusing and systematic sampling of small, terrestrial vertebrates) to provide data for the assessment of the effectiveness of post-mining rehabilitation. Rehabilitation is assumed as a standard part of the mining process.
- Conduct aural surveys for the Western Ground Parrot to see if the species persists in the broader area. In the unlikely event that it is confirmed to be present, even within 5-10km, discussions will need to be held with DBCA regarding management actions for this species.
- Conduct survey for Mallee fowl mounds before clearing.
- During clearing operations, investigate options for fauna rescue to reduce direct mortality.

- Clearing is likely to increase feral species activity (particularly Fox, Cat and Goat). Waste management to reduce increase in feral species and control of pre-existing feral species (particularly Fox and Cat) would provide further benefit. Survey lines and access tracks should be rehabilitated as soon as they are no longer needed as these re utilised by feral fauna.
- Minimising clearing where possible and progressively rehabilitate where practical after mining.
- Minimise impact on the drainage line, and manage ground water if the project may impact groundwater levels.
- Minimise disturbance. Night time operations and lighting are of particular concern and lighting should be directed away from bushland areas.
- Fire management measures should be implemented to prevent extensive fires affecting the project area or surrounding landscapes. Ideally this would protect infrastructure and contribute to a regional approach to fire management.

11. Groundwater

Water is required for processing with groundwater resources considered the most reliable source. The water demand is approximately 0.9 Gl/yr at the Arrowsmith North project. In order to meet these water requirements, there is a need for a groundwater licence from the Department of Water and Environmental Regulation (DWER).

The following report is extracted from a H3 Level Hydrogeological assessment which has been submitted to DWER for assessment. The report includes a computer model of the groundwater system following the construction of a production bore into the Yarragadee formation to meet the Arrowsmith North Silica Sand project requirements.

11.1. Development of groundwater

The most viable option for developing a groundwater supply is the construction of bores into the Yarragadee aquifer. The production bore has been constructed to a depth of ~350 m; with screens in the lower 60 m. Following pump testing it has been determined that a single bore is adequate for the operation and capable of providing 50 l/s. Pump testing has demonstrated that there is minimal decline in the watertable and minimal impact on any groundwater dependent ecosystems.

11.2. Hydrogeology

The Project is situated upon the Swan Coastal Plain, which is up to about 30 km wide comprising several geomorphic units parallel to the coast. Specifically, the Project is located upon the Eneabba Plain, which is made up of shoreline, lagoonal and dune deposits possibly reworked from late Tertiary alluvial fans.

The area lies within the northern end of the Perth Basin, containing a succession of Quaternary to Permian age deposits up to a total of 12,000 m thick, but thinning to around 1,000 m over the Beagle Ridge southwest of the tenements. A detailed description of the geology and hydrogeology in the northern Perth Basin is given by 'Northern Perth Basin: Geology, hydrogeology and groundwater resources' (Department of Water, 2017).

Two aquifers are present beneath the tenements, one within the relatively thin Superficial Formations, which is underlain by a major regional aquifer within the Yarragadee Formation.

11.3. Climate/Rainfall

The Arrowsmith area experiences a Mediterranean climate, characterised by mild, wet winters and hot, dry summers. The nearest Bureau of Meteorology meteorological station is at Eneabba, for which a rainfall record since 1964 to 1969 and 1972 to March 2017 is available. The station was closed in 2017.

The long-term average annual rainfall at Eneabba is approximately 489.6 mm with most rainfall being recorded during the months of May through to August. Rainfall exceeds potential evaporation only during May to September.

11.4. Geomorphology

The Arrowsmith North project area is located on the Swan Coastal Plain at elevations varying between 24 and 50m AHD in an area which is very gently undulating. The Swan Coastal Plain is bounded to the east by the Gingin Scarp which is approximately 8 kilometres from the eastern tenement boundary of the project area.

The Swan Coastal Plain is divided into two physiographic units; the Eneabba Plain and the Coastal Belt (Nidigal, 1995) with the project area on the Eneabba Plain.

The Arrowsmith River is the only significant drainage in the area, an intermittent drainage that passes east to west to the south of the project area. The northern part of the river system terminates in Arrowsmith Lake and a southern part terminates on the Eneabba Plain. When the Arrowsmith Lake is full water overflows into the superficial formations.

Much of the Arrowsmith area is covered with native vegetation with only small areas cleared along the Brand Highway and some farms cleared for grazing.

11.5. Regional Hydrology

The Project is located in the northern portion of the onshore Perth Basin some 28 km to 50km southeast of Dongara. The Perth Basin is a deep linear trough of sedimentary rocks covered by a thin veneer of coastal plain sediments. It extends north-south for some 1,000 km in the southwest of Western Australia onshore beneath the coastal areas and offshore beneath the continental shelf and continental slope. The basin covers an area of 45,000 km2 onshore and 55,000 km2 offshore. The Perth Basin is essentially a half-graben (down faulted block) bounded on the east by the north trending Darling Fault, some 1,000 km long, which separates the Basin from Archaean crystalline rocks of the Yilgarn Block.

In the Arrowsmith area, the total thickness of sediments in the Perth Basin exceeds 4,000 m with exploration oil wells at the Beharra Springs wellfield exceeding 3,700m. Exposure of rock outcrop is poor throughout the Perth Basin with much of the geological information based on interpretation of exploratory drilling, boreholes and geophysical data. There is extensive Quaternary sand cover (sand, laterite and alluvium) over the Basin, which masks much of the underlying geology. For a detailed description of the geology of the Perth Basin the reader is directed to Playford, et al (1976).

11.6. Structure

The project area straddles the Dongara, Beharra Springs and Donkey Creek Terraces which are located to the west of the Dandaragan Trough and to the east of the Beagle Ridge. The Dongara Terrace is located to the west of the Mountain Bridge Fault. The Beharra Terrace lies between the Beharra Springs Fault and the Mountain Bridge Fault. The Donkey Creek Terrace lies to the east of the Beharra Springs Fault to the Eneabba Fault.

The North project area is located mainly between the Beharra Springs Fault to the east and the Mountain Bridge Fault which passes through the western tenement boundary. Both faults are east side down with the oldest lithologies to the west.

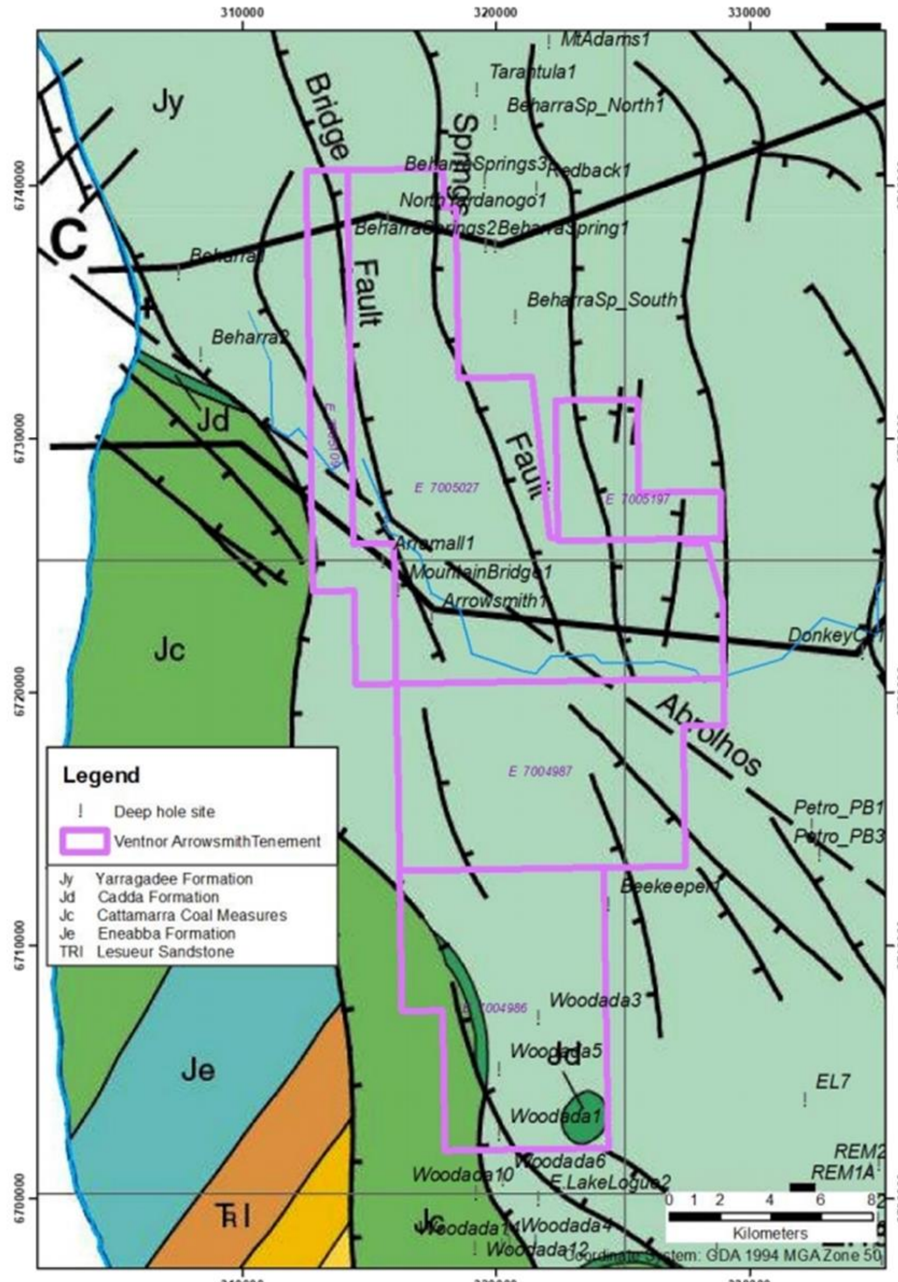


Figure 27: Regional Structure

11.7. Geology

The project area straddles the Dongara, Beharra Springs and Donkey Creek Terraces which are located to the west of the Dandaragan Trough and to the east of the Beagle Ridge (Figure 3). The Dongara Terrace is located to the west of the Mountain Bridge Fault. The Beharra Terrace lies between the Beharra Springs Fault and the Mountain Bridge Fault. The Donkey Creek Terrace lies to the east of the Beharra Springs Fault to the Eneabba Fault.

The project area is located mainly between the Beharra Springs Fault to the east and the Mountain Bridge Fault which passes through the western tenement boundary. Both faults are east side down with the oldest lithologies to the west.

In the Project area a veneer of Quaternary aged superficial formations aquifer sediments mainly consisting of Tamala Limestone, Bassendean Sands and Guildford Formation unconformably overlie the Jurassic aged Yarragadee Formation. The superficial formations can be up to 60m thick.

The Yarragadee Formation is generally flat lying and is fault bounded.

The Yarragadee Formation is spilt into four units of which the uppermost and youngest unit, Unit D, is predominantly fine-grained sediments with minor sand. The next unit is Unit C which is predominantly sands, followed by Unit B which contains about 50% siltstone and shale and underlain by Unit A which is predominantly sands. Units B and D can act as confining layers with Units C and A being the better aquifers.

Unit ID	Lithology	Max. Onshore Thickness (m)
D	Shale, siltstone and clayey sandstone	1,741
C	Sandstone and clayey sandstone	719
B	Siltstone, shale and sandstone	967
A	Sandstone, siltstone and shale	1,095

Table 80: Yarragadee Units

In the project area to the east of the Mountain Bridge Fault, on the Beharra Springs Terrace, the Yarragadee consists of Unit D to about 200m and underlain by Unit C to a depth of in excess of 1,000m below ground level. To the north of the mineral tenement in the Leeman Shallow LS31 drill hole, the lithology of Unit D was described as interbedded grey-back siltstone, black clay and shale with coarse-grained sand.

To the west of the Mountain Bridge Fault, on the Dongara Terrace, the superficial sediments are underlain by Unit B to a depth of approximately 300m and then the sands of Unit A. The depth of the Yarragadee Formation in the Dongara Terrace is considered to be in the order of 600 – 800m. Geophysical interpretation of seismic work has indicated that the throw of the Mountain Bridge Fault could be in the order of 500m with the east side down.

The Yarragadee is underlain by the Cadda Formation.

11.8. Recharge

Recharge to the Yarragadee Formation aquifer in the Arrowsmith region is mainly via direct infiltration of rainfall to the overlying superficial aquifer where present. Rainfall that reaches the ground is mainly used by native vegetation with only that water passing the root zone deemed as recharge. The Water and Rivers Commission in their report Managing the Water Resources of the Arrowsmith Groundwater Area, WA, 2002 have determined the rainfall recharge rate to the superficial aquifer at 6 to 8% of rainfall and to the Yarragadee aquifer as 5% of rainfall.

Areas directly underlain by Yarragadee Units A and C are considered to have the greater recharge due to their sandy native whereas Yarragadee Units B and D are considered to have lower recharge due to their shaley and silty nature.

Occasionally when winter rainfall is significant, recharge can also be obtained from the Arrowsmith River. In 2021, the river flowed for the first time in many years overfilling the Arrowsmith Lake and discharging into the Central project area.

11.9. Groundwater Levels, Flow Directions and Discharge

The groundwater levels in the Arrowsmith Region of the superficial aquifers and the underlying Yarragadee aquifers are similar, indicating hydraulic connection of the aquifers near the surface. Available regional water levels are limited to those monitored by the Leeman Shallow bores and two Dongara Line bores. The Leeman Shallow bores were drilled to a maximum depth of 100m with a shallow bore, designated the B bore, generally screened in the superficial aquifer and a deeper bore designated the A bore, screened near the base of the 100m hole mainly in the Yarragadee aquifer.

In the Arrowsmith area the superficial aquifer groundwater movement is westwards to the Indian Ocean. The Yarragadee aquifer flow is constrained by the older lithologies to the west of the Beagle Fault System although there is a lack of information as to the extent of the flow. The older units are the Triassic aged Lesueur Sandstone and the Jurassic aged Cadda Formation, Cattamarra Coal Measures and the Eneabba Formation.

Groundwater discharge from the Yarragadee aquifer is either upwards into overlying aquifers or offshore into the Indian Ocean. Nidigal, (1995) noted that “The groundwater salinity and upward hydraulic heads in the Leeman Shallow bores to the west of the Beagle Fault indicate that there is also groundwater discharge across the fault into the “Cattamarra Coal Measures”.

11.10. Groundwater Quality

Groundwater quality in the superficial aquifer varies from fresh (460mg/L total dissolved salts (TDS)) to marginal (4,560mg/L TDS). The fresher groundwater is in the east and the more saline nearer the coast. There is a saline water interface beneath and to the east of the coastline.

Groundwater quality in the Yarragadee aquifer varies from fresh (520mg/L TDS) to saline (27,600mg/L TDS). Water bore drilling has identified an increase in salinity with depth in some areas. The high salinity recorded in Leeman Shallow 30A is due to proximity to the ocean and a saline interface that is located to the east of the coastline. The two highest salinity bores are located to the west of the Mountain Bridge Fault.

11.11. Site Hydrogeology

The location for the proposed groundwater abstraction is mainly on the Beharra Springs Terrace and partially on the Dongara Terrace. The Mountain Bridge Fault is the boundary between these two terraces and crosses the western boundary of the mining tenement (M70/1389). The majority of the mining tenement is also covered by the Eneabba Plains Sub-area. A thin, <20m width of the Dongara Sub-area occurs in the southwestern portion of the tenement. At the time of application for 900,000kL/annum from the Yarragadee Formation the Department of Water and Environmental Regulation informed Ventnor Mining Pty Ltd of a lack of allocation in the Eneabba Plains Sub-area but pointed out the sliver of Dongara Sub-area and the abundant allocation in this sub-area. The southwestern portion of the mining tenement was therefore targeted as the site for an exploratory water bore into the Yarragadee Formation targeting Unit A below Unit B.

The lithologies identified during exploratory drilling at the tenement are shown below. The interpreted geology is mainly taken from the geophysical log. Chip samples of the drill cuttings were logged by the drilling contractor.

From (m bgl)	To (m bgl)	Formation	Unit	Description
0	30	Superficial – Bassendean Sands, Tamala Sands	-	Fine to very coarse-grained quartz sands
30	303	Yarragadee	B	Fine to coarse grained clayey sands over interbedded sands and swelling grey shales
303	404	Yarragadee	A	Medium to coarse grained sands with minor grey shale

Table 81 Summary of Lithologies Encountered

The target aquifer was the Unit A of the Yarragdee Formation which extensively underlies the area to the west of the Mountain Bridge Fault. Unit A was intersected in drilling from 303m to 404m and was interpreted from seismic and petroleum exploration drill holes (Beharra No1 - 726m and Beharra No2 - 636m) to extend to a depth in the order 600m to 800m.

The north-south trending Mountain Bridge Fault cuts through the western edge of the tenement. The hydraulic connectivity between the eastern side and western side of the fault are unknown. The Unit A sands to the west of the Mountain Bridge Fault should coincide with the Unit C sands but information on the connectivity is currently limited to the test production bore. The elevated salinity of the test production bore Unit A groundwater from the western side of the fault is higher than would be expected from the Unit C groundwater from the eastern side of the fault. This may indicate a low level of connectivity.

11.12. Groundwater Dependent Ecosystems

There are no groundwater dependent ecosystems (GDE) on M70/1389. The depth to water of any vegetation on these tenements is generally in excess of 15m.

There are some possible GDE's to the west and north west of M70/1389, associated with Arramall Lake and the superficial aquifer. These are in excess of 4km from the Yarragadee production bore YPB1 and therefore unlikely to be affected by abstraction.

Ngunkakara Well has been identified as a GDE and is located on the western boundary of M70/1389 about 2.2km north of the Yarragadee production bore YPB1. The superficial aquifer water level at this site would be in the order of 6m RL AHD with the surface level being in the order of 25m AHD resulting in a depth to water in the order of 19m.

South of the project area the Department of Water and Environmental Regulation has identified the Arrowsmith River and Arrowsmith Lake areas as requiring consideration. These areas also have depths to water exceeding 15m indicating and therefore do not contain GDE's. Any vegetation in these areas would be reliant on perched water coming from surface flow events for the Arrowsmith River.

The Superficial Formations form an unconfined aquifer referred to as the Superficial aquifer. The project area is underlain by a relatively thin cover of sand belonging to the Bassendean Sand upon a thicker section of predominantly clayey sand forming the Guildford Clay, which are approximately coincident with the Eneabba Plain. Calcarenite limestone of the Tamala Limestone is located west of the project areas beneath the Spearwood Dunes, and frequently contain karstic cavities.

11.13. Drilling

The aim of the exploratory drilling was to identify Unit A of the Yarragadee Formation to the west of the Mountain Bridge Fault.

Test production bore, YPB1, and monitoring bore YMB1 were drilled and constructed during this investigation by Western Drilling and the Table below summarises the construction details.

Bore ID	YPB1	YMB1
Date Completed	10 January 2022	31 January 2022
GPS Location	313924E 6733521N - GDA94	313923E 6733518N - GDA94
Drilled By	Western Drilling	Western Drilling
Method	Mud Rotary	Mud Rotary
Aquifer	Yarragadee Formation Unit A	Yarragadee Formation Unit A
Surface Casing		
Hole Diameter	533mm	317mm
Hole Depth	30m	30m
Casing Diameter	406mm	250mm
Casing Depth	30m	30m
Casing Type	ERW Steel	ERW Steel
Centralised	Yes	Yes
Cemented	Yes	Yes
Pump Chamber		
Hole Diameter	381mm	218mm
Hole Depth	300m	320m
Casing Depth	300m	320m
Casing Diameter & Type	250mm ID Fibreglass Reinforced Plastic	125mm ID Fibreglass Reinforced Plastic
Centralised	Yes	Yes
Cemented	Yes	Yes
Screens		
Hole Diameter	212mm	100mm
Top Screen	320m	326m, 362m
Base Screen	392m	332m, 374m
Diameter	168mm OD	80mm OD
Type	304 Stainless Steel	304 Stainless Steel
Aperture	0.5mm	0.5mm
Placed	Telescopic	Telescopic
Development	Airlift/jetting/surging – 72 hours	Airlifting/jetting/surging - 24 hours
Water Level	7.63m below top of casing (10-Mar-22)	8.34m below top of casing (10-Mar-22)
Electrical Conductivity	11,400uS/cm at 25 degrees C (12-Mar-22)	NA

Table 82: Summary of Bore Details – North Yarragadee

A pilot hole was drilled by Western Drilling to 404m below ground level to obtain samples of the lithologies and to enable geophysical logging. The drilling indicated that the surficial formations extended from the surface to approximately 30m below ground level. The pilot hole below 30m intersected the Unit B of the Yarragadee Formation to approximately 303m below ground level and then Unit A of the Yarragadee Formation to 404m below ground level.

At the completion of the pilot hole it was geophysically logged by Westlog Wireline Services for natural gamma and long and short normal resistivity (Appendix B). The natural gamma logging was undertaken to determine the position of the Unit A sands so they could be accurately screened. The long and short normal log confirmed that the target section with a geophysically estimated salinity of 4,000mg/L was located from 320 to 392m.

The pilot hole was then re-entered and reamed to a depth of 30m at a diameter of 550mm. Steel casing (406mm OD) was installed to a depth of 30m and then cement grouted in place.

The next phase of drilling involved reaming the pilot hole from 30 to 300m at a diameter of 406mm. Centralised 250mm NB fibreglass reinforced plastic (FRP) was then installed to a depth of 300m. The base of the casing string was equipped with a cement/casing shoe assembly and a landing ring. Cement was then pressure installed in the annulus, via the cementing shoe at 300m, between the hole and the outside of the casing to seal the upper part of the hole above 300m. The pilot hole was then cleaned from 300 to 392m and 72m of 168mm stainless steel wire wound screens with 20m of stainless steel casing on the top containing an M Packer with anti-rotation devices were installed and hung on the landing ring incorporated in the cement/casing shoe. The bore screens were then developed using jetting, surging and airlift methods for approximately 72 hours. The final airlift yield was estimated at 20L/s.

A Yarragadee aquifer monitoring bore (YMB1) was drilled 15.1m south of the test production bore and screened over a similar interval. A second monitoring bore (SMB1) was drilled into the superficial aquifer to initially supply drilling water and to act as a superficial monitoring bore. It was located 27m east of the test production bore.

The water levels in the Yarragadee bores were in the order of 7.7m below the top of the casing and the superficial water level was 17.5m below the top of the casing indicating 10m of confining effect by the Unit B layer acting as an aquitard.

11.14. Test Pumping

Test pumping was undertaken on the test production bore YPB1 by Western Irrigation Pty Ltd from 9 to 12 March 2022. Water level measurements were logged and recorded manually and via water level loggers in the pumping bore YPB1, the Yarragadee aquifer monitoring bore YMB1 and the superficial aquifer monitoring bore SMB1. The test pumping consisted of a step test of four 100-minute steps followed by a 33 hour constant rate test and 6 hours of recovery.

Date	Static Water Level (m btoc)	Maximum Available Drawdown (m)	Test Type	Test Duration (minutes)	Pumping Rate (L/s)	Maximum Drawdown (m)
9-Mar-22	7.68	60	Multi-Rate	100	22	3.40
				100	26	4.67
				100	29	5.45
				100	32	6.12
10-Mar-22	7.68	60	Constant	1990	30	6.12
11-Mar-22	-	-	Recovery	320	-	-

Table 83: Summary of Test Pumping

11.15. Test Pumping Analysis

The general shape of the curve suggests a confined aquifer. Correspondingly, Cooper and Jacob straight line analysis was conducted on the section of the curve from 100 minutes to the end resulting in an aquifer transmissivity of 1,140m2/d. for the test production bore. Theis straight line analysis was also conducted on the section of the curve after 100 minutes resulting in an aquifer transmissivity of

1,070m2/d. for the test production bore. Therefore, the average hydraulic conductivity over the 55m sand section of the aquifer is 19.4 to 20.7m/d.

The aquifer storage coefficient ranged from 1.05 x 10-4 (Cooper & Jacob) to 2.74 x 10-4 (Theis).

Analysis of the recovery data using the Theis recovery method for the straight-line portion of the recovery curve indicates an aquifer transmissivity of approximately 750m2/d and therefore hydraulic conductivity of the 55m screened interval is about 13.6m/d.

The transmissivity figures derived from the recovery test data differ from than those determined from the pumping part of the constant rate test. The difference is due to well or bore effects induced by the electric submersible pump reducing the transmissivity in the pumping bore. The use of the recovery data removes most of the well effects, especially after the first 10 minutes of the recovery test when some leakage of water from the pump column back into the bore can affect results.

11.16. Groundwater Chemistry

A water sample was taken from the production bore during the constant rate test pumping 1 hour after the test commenced and 24 hours after the test commenced and submitted to Agrifood Technology for major component analysis. The laboratory report detailing the analysis is presented in Appendix E. A summary of the assay data is presented in Table 84.

The analytical data indicates that the groundwater is a sodium-chloride water with a slightly acidic pH that would be fit for purpose. The data in Table 84 below indicates that the water is not potable with salinity, sodium, calcium, magnesium, manganese, chloride and sulphate exceeding the ANZEEC potability guidelines. The water quality is otherwise fit for purpose.

Bore No	1 hours	24 hours	Potability Standard
Colour	Iron	Iron	
Odour	Odourless	Odourless	
pH	6.8	6.8	6.5 – 8.5 (2)
Electrical Conductivity @ 25^0C (uS/cm)	11,900	11,400	<850 (2)
Total Dissolved Salts	6,610	6,670	500 (2)
Sodium	1,900	1,900	<180 (2)
Potassium	110	110	
Calcium	240	240	<200 (1)
Magnesium	290	280	<150 (1)
Bicarbonate	120	120	
Chloride	3,700	3,800	<250 (2)
Sulphate	290	280	<250 (2)
Nitrate	19	7.7	<50 (1,2)
Phosphate-P	<0.01	<0.01	<5 (3)
Ammonia	1.4	1.3	
Iron	5.8	5.5	<0.3 (2)
Manganese	0.79	0.83	<0.1 (2)
Silica	17	16	
Hardness (as $CaCO_3$)	1,770	1,755	
Alkalinity (as $CaCO_3$)	100	100	
Dissolved Carbon Dioxide	30	30	

Table 84: Groundwater Chemistry

Concentrations reported as ppm (mg/L) unless otherwise stated. (1) = World Health Authority (2) = NHMRC/NRMMC Aust Drinking Water Guidelines 2004.

12. Social factors

12.1. Population Centres

The nearest population centres and equidistant from the Project via Brand Highway at 30 km. The nearest farmhouse is more than 5 km from the Project.

The Company will source labour requirements from these two population centres.

12.2. Land Ownership and Use

The entire project is located on vacant, Unallocated Crown Land.

The Company has a Mining Lease (M70/1389) which is predominately within granted Exploration License E70/5027 and encroaching on E70/5109 to the west. The Mining Lease and Exploration Licenses are held by Ventnor Mining Pty Ltd a 100% owned subsidiary of VRX.

The Project area is predominately native vegetation but is criss-crossed with mulched/cleared tracks previously used over the last 40 years for oil and gas exploration. The Company has been able to use these tracks to access areas for exploration and sampling.

12.3. Socio-economic Context

The project can provide significant benefits to the State through very long-term employment and Royalties and locally provide employment and contract opportunities.

The Project will initially be using road haulage but in future use the under-utilised rail system and potentially significantly increase exports through the Geraldton Port.

12.4. Potential Development

Once the Project has reached an expected production rate and quality of final product the Company can consider further downstream processing of silica sand in to glass products.

Any further processing will have to consider the logistics of transporting both raw material and final products and the economic imperative of supplying a potential domestic and international market.

13. Project Implementation

13.1. Construction

Initially the Project will require the construction of the processing facility and the remote feeder station. Mining will initially include front end loader excavation to a feeder station to a run rate of up to two million tonnes of sand.

It is estimated that the project will ramp up to two million tonnes over two years. This will enable the introduction of the commodity to the Asian markets. This approach will support the planned ramp up of production which allows for silica sand products to be introduced to the glass making and foundry industries in Asia before maximising production at 2 million tonnes per year.

13.2. Implementation Plan

The Company has completed detailed mine scheduling and processing and engineering for the construction of the processing plant and infrastructure. Fortunately, the scheduling detail is made significantly simpler due to the consistency of the ore source which will also reflect in the consistent quality of the final products.

The Implementation plan for the Project will depend on:

- Final approvals for mining
- Finalise offtake contracts for a significant portion of projected production
- Definitive Feasibility Study
- Financing of construction and working capital
- Construction
- Commencement of mining and commissioning of the processing plant

13.3. Contracting Strategy

The Company will own, operate and maintain the feeder station, processing operations and manage the project operations.

The Company will contract the supply of mining and haulage equipment and the power supply.

13.4. Operational Readiness

VRX will develop a comprehensive risk-based program to ensure VRX has the requisite capability and systems to operate the Arrowsmith North Silica Sand Project successfully from day one.

This approach will commence with a thorough enterprise-wide risk assessment and identification of the standards, controls and systems which will be required to mitigate these risks through the life of the operation. The outcome is an intellectual architecture comprising of well thought, thorough and effective operating systems, which will be designed to ensure operational readiness and logical prioritisation of the project's many moving parts.

The process will be detailed and involve a higher level of operational systems design than is typically undertaken by single asset sponsors for new projects of this scale. This is done primarily due to the high bar of performance that VRX has set for the project and the strong business imperative to have the asset predominantly run and operated by persons living locally. In addition, VRX recognizes that the bulk silica sand mining industry is an emerging industry in WA and thus has fewer established practices and less depth of expertise than is typical in other sectors of the mining industry.

The key aims of this approach are:

- To rigorously and effectively manage the project execution and the project start up and ramp-up to full capacity, thereby avoiding operational start-up dip.
- To align the Company with ISO 9000 quality compliance through effective controls and management of those controls governing product quality.
- To control the scope of roles within the Company and to manage the amount of discretion that people have in their roles so that they are positioned to focus on the project outcomes.
- To facilitate role clarity and enabling effective decision making, successful team work, and accountability.
- To the achieve the Company's vision of being "a globally significant silica sand producer, who is recognised for our great quality of products produced safely and ethically".
- To achieve the Company's planned localisation targets and strategy, which will provide sustainable business opportunities and jobs for locals, and a sense of ownership of the asset within the district.
- To minimise the dependence on expensive contracting resources.
- To drive safety, productivity and product quality through an in-built and inherent business improvement mindset.
- To enable the most efficient management of the asset in a global market, with all the inherent challenges involved in managing markets and cultures.

13.5. Company Values

A simple but set of company values, has been firmly established within VRX and will underpin the operational strategy of the company.

- **Safety:** All of us have an equal right to go home safely.
- **Team Work:** We achieve superior results by working together.
- **Accountability:** We are accountable to our family, our community and our colleagues – do them proud, give it your best.
- **Respect:** We are a diverse organisation who respect each other.
- **Stakeholders:** Our stakeholders measure our success – our customers, our investors and our community all have expectations of us.

13.6. Operational Strategy

VRX is staffed by experienced mining and mineral industry veterans. Our experienced team has a clear opportunity to provide a fresh approach to operations of a Western Australian Silica Sand mining and processing facility, and a global marketing function, with best operating and management practice supported by an Australian (Perth) head office governance team.

The Arrowsmith North mine and processing facility will be operated by a predominantly local workforce and an experienced leadership team. This strategy will create a high level of government and local community support.

To ensure the project is run safely and will reliably produce an on-specification product at nameplate capacity and cost from day one, a robust suite of management systems and operating standards will be developed jointly by an early recruited leadership team and the Perth head office and will be implemented during commissioning.

Capable local operational staff will be recruited with sufficient lead time to be fully trained in the operation of mine and plant with emphasis on the key controls and expectations by which their performance will be measured.

There will be early recruitment of key management and technical roles for the express purpose of developing and implementing the management systems, and then training the operating staff in the lead up to operations.

The design of the organisation structure and operational systems will be fit for purpose striking the right balance between the required level of governance and operating efficiency which will ensure sustained performance of safe, efficient, on specification operational delivery through the life of the project.

Risk Based Approach

An operational readiness will be developed using a strong risk-based approach. The lesson from other projects is that where there is a failure to fully understand and prepare for operational risks early, projects are exposed to significant value loss arising from production shortfall, out of specification product, and cost increases, collectively referred to as “start-up dip”. In addition, there is often a high level of safety and environment incidents.

Project risk workshops identify the following key project risks:

- failure to achieve project financing
- failure to achieve project permitting and land compensation arrangements
- project cost overrun or delay resulting in significant dilution of value for existing shareholders
- excessive working capital requirements for the project and possible loss of market niche for VRX’s high value silica sand products, due to:
- inadequate orebody knowledge or unexpected complexity
- inadequate operational preparedness and capability resulting in out of specification product
- product logistics delays
- sales and marketing issues - production issues
- loss of government or community support for the project
- health, safety and environmental (HSE) risks.

These risks will be captured in a detailed risk register. The approach will be to prepare mitigation strategies accordingly.

Risk controls will be identified for all risks, comprising:

- Mitigation actions to be completed prior to commencement of operations
- Operational standards and management systems which will govern operations and mitigate risks through the life of the project.
- Risk mitigation actions include:
- Specific studies to ensure full anticipation of technical, quality, reliability and environmental issues.
- Engagement of specialist consultants to advise on critical technical, marketing and government and community aspects of the project.
- Design reviews to ensure engineering controls are included in plant design.
- Specific obligations to include in third-party contracts that will be critical to safety, environment, production and product quality.
- Definition of infrastructure upgrades and government co-commitments.
- Establishment of project control for construction management.
- Planned and targeted early recruitment and training.

On-going control of risk through the life of the operation will be through effective implementation of standards and management systems.

In particular, the controls for HSE risks will be documented in a set of HSE standards and systems which collectively define the Health, Safety and Environment Management System (HSEMS) for the project. The HSEMS, consists of a set of Health and Safety standards, Environment standards, and systems which are critical to effective HSE management. This will provide a comprehensive risk management framework for the project.

Development of Operational Readiness Plan

Risk mitigation actions will be prioritised and sequenced into a comprehensive work plan for operational readiness. The work plan will also include completion of the design of standards and systems in a prioritised way and implementing these as required for the project construction phase and for the operations phase of the project.

The operational readiness project plan will have clear links to the financing, permitting, and construction project plans.

Implementation of Operational Readiness Plan

The operational readiness plan will be implemented by an early recruited operations team, supported by expert consultants where required, and with a Project Management Office (PMO) function to track and report on status throughout. The recruitment schedule is aligned with the operational readiness plan to ensure timely implementation of key roles to complete the work plan tasks. The clear remit of early recruited roles will be to build the organisational systems and to have their teams fully operationally-ready at start of operation.

A readiness methodology will be used to support key aspects of the implementation including coaching and training on standards and systems design, access to a comprehensive library of checklists and requirements from equivalent operations design, and executive leadership advice where required.

There is a close relationship between the operational readiness plan and the human resources strategy for the project. In particular, the design of the standards and systems will provide clear role clarity for all operations positions. The training and development of personnel recruited into leadership roles will include training in standards and systems design methodology and in the style of leadership required of VRX managers at all levels to ensure that the management systems are effectively utilised.

Human Resources

Where possible the Company will source employees from the local communities of Eneabba and Dongara.

The skills required to operate this type of mining equipment and processing are well represented within the Western Australian mining industry personnel.

The Company will operate and maintain the feeder and processing equipment but contract the power generating equipment and mining operations equipment and relevant personnel.

Where possible the Company will preferentially offer opportunities to local Indigenous operators.

VRX will work with the Yamatji Southern Regional Corporation to investigate opportunities for local contracts and assist in the establishment of a Ranger program.

14. Operating Cost Estimate

Operating costs have been determined from either first principles or contract budget submissions and estimates.

The operating costs have been estimated on a one million tonnes per year runrate for two years and thereafter a ramp up two million tonnes per year. There are marginal unit cost savings as throughput is increased.

15. Capital Cost Estimate

ProjX Engineering is a Bunbury based engineering and design consultancy with experience in construction of sand plants and construction in WA. ProjX has provided VRX with a cost estimate for a 2 million tonne per annum (Mtpa) processing plant which is a detailed proposal with updated budget and tender pricing and accurate to ±15% in estimation.

PHASE	DELIVERABLE DESCRIPTION	Estimated Cost	Contingency	TOTAL $ incl Contingency
1	Project Management, Design, QC, etc	$ 1,646,180	$ 164,618	$ 1,810,798
2.1	Supply - Equipment	$ 13,835,970	$ 2,452,011	$ 16,287,981
2.2	Supply - Piping & Valves	$ 658,000	$ 162,000	$ 820,000
2.3	Supply - Steel Fabrication	$ 3,413,600	$ 682,720	$ 4,096,320
2.4	Supply - NPI Infrastructure	$ 1,708,300	$ 341,660	$ 2,049,960
2.5	Supply - Electrical & Instrumentation	$ 7,390,318	$ 1,415,471	$ 8,805,789
2.6	Supply - Signage, Safety, Other Minor Items	$ 100,812	$ 20,162	$ 120,974
2.7	Supply - Freight (road transport to site)	$ 399,500	$ 79,900	$ 479,400
2.8	Supply - Capital Spares	$ 620,831	$ 124,166	$ 744,997
3.1	Site Works - Construction Management	$ 2,122,540	$ 212,254	$ 2,334,794
3.2	Site Works - Civil Works (Roads, Bulk Earthworks, Dams & Drainage)	$ 5,256,966	$ 691,233	$ 5,948,199
3.3	Site Works - Concrete Works (Slabs, Footings, Plinths, etc)	$ 1,538,000	$ 153,800	$ 1,691,800
3.4	Site Works - Electrical & Instrumentation Works (HV, LV & PC)	$ 2,211,150	$ 442,230	$ 2,653,380
3.5	Site Works - SMP Works (inc. NPI)	$ 8,832,600	$ 1,763,020	$ 10,595,620
4	Commissioning	$ 540,200	$ 108,040	$ 648,240
5	Other Project Costs	$ 1,880,950	$ 193,095	$ 2,074,045
	TOTALS	$ 52,155,917	$ 9,006,380	**$ 61,162,297**

Table 85: Summary of quote details for processing plant

Capital expenditure has increased materially since the 2019 BFS, however this still remains modest with an approx. 4.4 year payback. The increase is largely driven by:

- a significant rise in steel, concrete and construction labour costs for the processing plant, with prices for fabricated steel having doubled since 2019
- a change to the process circuit from gravity spirals to hydrofloat that will produce superior products but has a higher initial capital cost component
- additional costs associated with power reticulation, flotation reagent storage and additional supporting infrastructure for administration and laboratory services
- additional costs for the construction of the road and designed and approved Brand Highway intersection, and
- purchase of Offset land to conform with State Offsets Policy guidelines.

Figures below show renders of the proposed operating plant and surrounding area.

Capex also includes a 20% contingency, notwithstanding the recent re-tendering of supplied capital components. This reflects the Company's conservative approach to pricing when modelling the financial metrics for the project. In efforts to reduce the capex, the Company continues to seek out second-hand equipment for refurbishment and to-date has sourced a feed trommel and final screen, with significant cost-savings as compared to new equipment.

Operating expenditure has increased marginally from the 2019 BFS.

Sale prices for silica sand products have been left unchanged towards the lower end of the range of estimates provided for in the 2019 BFS, notwithstanding the growing market for silica sand products in Asia and upward pricing pressures. Again, this reflects the Company's conservative approach to pricing when modelling the financial metrics for the project as well as providing an additional contingency.

Figure 28: An aerial view render of the proposed Arrowsmith North processing plant and facilities

Figure 29: Close up render of proposed processing plant at Arrowsmith North

The Project metrics have depreciated all of the capital cost at 15% per year.

16. Marketing

Sale prices for silica sand products have been left unchanged towards the lower end of the range of estimates provided for in the 2019 BFS, notwithstanding the growing market for silica sand products in Asia and upward pricing pressures. Again, this reflects the Company's conservative approach to pricing when modelling the financial metrics for the project as well as providing an additional contingency.

Globally, silica sand is in a growth phase due to increasing demand from the construction sector, with both volume and value having increased worldwide. This was due to its applications across a range of industries, including glass making as well as foundry casting, water filtration, chemicals and metals, along with the hydraulic fracturing process.

Accelerations in construction spending and manufacturing output worldwide are expected to drive growth in important silica sand-consuming industries, including the glass, foundry and building products sectors. Particularly rapid gains are projected for the hydraulic fracturing market as horizontal drilling for shale oil and gas resources expands, largely in North America. Nevertheless, faster gains in the overall market will be constrained by ongoing efforts to incorporate higher volumes of recycled glass cullet in the manufacture of glass containers.

The Asia-Pacific region is expected to remain the largest regional consumer of industrial sand through future years, supported by the dominant Chinese market.

16.1. Silica Sand Markets

High-grade silica sand is a key raw material in the industrial development of the world, especially in the glass, metal casting, and ceramics industries. High-grade silica sand contains a high portion of silica (normally more than 99% SiO_2) and is used for applications other than construction aggregates. 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.

Glassmaking

Silica sand is the primary component of all types of standard and specialty glass. It provides the essential SiO2 component of glass formulation; its chemical purity is the primary determinant of colour, clarity and strength in glass. Industrial sand is used to produce flat glass for building and automotive use, container glass for foods and beverages, and tableware. In its pulverised form, ground silica is required in the production of fibreglass insulation and for reinforcing glass fibres. Specialty glass applications include test tubes and other scientific tools, incandescent and fluorescent lamps.

Foundry Sand

Silica sand is an essential part of both the ferrous and non-ferrous foundry industries. Metal parts ranging from engine blocks, heads and manifolds to sink faucets are cast in a sand-and-clay mould to produce their external shape, often using a resin coat to create the desired internal shape. Silica's high fusion point (1,760°C) and low rate of thermal expansion produce stable cores and moulds compatible with all pouring temperatures. Its chemical purity also helps prevent interaction with catalysts or affecting the curing rate of chemical binders, for that reason, customers are looking for high quality silica sand that meets their specifications for size and shape. Silica sand is an essential part of both the ferrous and non-ferrous foundry industries. Metal parts ranging from engine blocks to sink faucets are cast in a sand-and-clay mould to produce their external shape, often using a resin coat to create the desired internal shape. Silica's high fusion point (1,760°C) and low rate of thermal expansion produce stable cores and moulds compatible with all pouring temperatures. Its chemical purity also helps prevent interaction with catalysts or affecting the curing rate of chemical binders, for that reason, customers are looking for high quality silica sand that meets their specifications for size and shape.

Paint Fillers

Paint formulators select micron-sized silica sand to improve the appearance and durability of architectural and silica paint and coatings. High purity silica produces critical performance properties such as brightness and reflectance and colour consistency. In architectural or exposed paints (Ship and Container especially), silica fillers improve tint retention, durability, and resistance to dirt, mildew, cracking and weathering. Low oil absorption allows increased pigment loading for improved finish colour. In marine and maintenance coatings, the durability of silica imparts excellent abrasion and corrosion resistance.

Filtration and Water Production

Silica sand is used to filter water to become drinkable. It is also necessary in the processing of wastewater and the production of clean water from wells. Uniform grain shapes and grain size distributions produce efficient filtration bed operations for the removal of contaminants from wastewater to provide potable water. As silica is chemically inert, it will not degrade or react when it encounters acids, contaminants, volatile organics or solvents. Silica is used as packing material in deep-water wells to increase yield from the aquifer by expanding the permeable zone around the well screen and by preventing the infiltration of fine particles from the formation.

16.2. Glass Manufacturing Basics

Manufactured glass is the single largest use of silica sand after construction/concrete sands. The key to well manufactured glass is to have the correct particle size (below 600µm).

Size segregation of silica sand represents a major processing function. Each glass maker may have slightly different requirements for their gradation, but generally they want raw materials to range from 0.106 to 0.60mm. After processing to remove impurities, and classifying the product into its proper size range, the next step is drying the product. Glass producers generally prefer the raw materials to contain less than 5% moisture.

The physical specifications deal exclusively with particle size. The grain size of batch materials strongly affects the amount of energy required for melting. Glass makers prefer a near uniform size within the batch ingredients to ensure efficient melting. However, in reinforcing fiberglass, more than 99.5% of the raw material grains are smaller than 0.045 mm (45µm). There is consideration to tighten these limits from 0.5% larger than 45µm, especially for coarse particles that are the most difficult component to melt. Grain shape of the sand also affects melting. If the majority of the batch is coarser than the specified range, incomplete melting often occurs, which results in a poor-quality product.

Glassmaking is a major sector which needs consistent quality, correctly sized, and low iron content silica sand. Silica sand is the major raw material used in glassmaking, comprising some 65 to 75% by volume of raw material, but far less percentage than that by value. Glass manufacturers usually classify silica sand into separate groups on the basis of chemical and physical properties.

Metallurgical Uses

In metal production, silica sand operates as a flux to lower the melting point and viscosity of slag to make them more reactive and efficient. Lump silica is used either alone or in conjunction with lime to achieve the desired base/acid ratio required for purification of final metals. These base metals can be further refined and modified with other ingredients to achieve specific properties such as greater strength, corrosion resistance or electrical conductivity. Ferroalloys are essential in specialty steel production. Industrial sand is used by the steel and foundry industries for de-oxidation and grain refinement.

Chemical Production

Silicon-based chemicals are found in thousands of everyday applications ranging from food processing to soap and dye production. In this case, SiO_2 is reduced to silicon metal by coke in an arc furnace, to produce the Si precursor of other chemical processes. Industrial sand is the main component in chemicals such as sodium silicate, precipitated silica, silicon tetrachloride and silicon gels. These chemicals are used in products such as household and industrial cleaners, in the manufacture of fibre optics and to remove impurities from cooking oil and brewed beverages.

Paint and Coatings

Paint formulators select micron-sized industrial sands to improve the appearance and durability of architectural and industrial paint and coatings. High purity silica produces critical performance properties such as brightness and reflectance and colour consistency. In architectural paints, silica fillers improve tint retention, durability, and resistance to dirt, mildew, cracking and weathering. Low oil absorption allows increased pigment loading for improved finish colour. In marine and maintenance coatings, the durability of silica imparts excellent abrasion and corrosion resistance.

Ceramics

Ground silica is an essential component of the glaze and body formulations of all types of ceramic products, including tableware, sanitary ware and floor and wall tile. In the ceramic body, silica is the skeletal structure onto which clays and flux components attach. The SiO_2 contribution is used to modify thermal expansion, regulate drying, contain shrinkage and improve structural integrity and appearance. Silica products are also used as the primary aggregate to provide high temperature resistance to acidic attack in industrial furnaces.

Filtration and Water Production

Industrial sand is used to filter water to become drinkable. It is also necessary in the processing of wastewater and the production of clean water from wells. Uniform grain shapes and grain size distributions produce efficient filtration bed operations (including multimedia) for the removal of contaminants from wastewater to provide potable water. As silica is chemically inert, it will not degrade or react when it comes in contact with acids, contaminants, volatile organics or solvents. Silica is used as packing material in deep-water wells to increase yield from the aquifer by expanding the permeable zone around the well screen and by preventing the infiltration of fine particles from the formation.

Fibre glass including optical fibres

Washed, correctly sized and dry sorted, the silica sand from the Projects can potentially be targeted for high-grade applications in the glass industry. The main export destinations countries for these types of products are China, Japan, Taiwan and Korea.

Suppliers need to work with the customers and or distributors in each key market to provide the required tonnages of suitably specified high grade sand delivered in container loads, or bulker bags and that the sand would be delivered from the site to a port facility. Final delivery is often in pneumatic tanker or bulker bags. Some large producers have on-site grinding facilities using flint pebbles as media.

Container Glass

The introduction and use of lightweight containers is critically dependent upon the glass forming technologies available for their manufacture. For many years, 'blow-blow' technology was the dominant glass bottle forming process. However, more recently 'narrow neck press and blow' (NNPB) has become the dominant technology for the production of lightweight bottles. Superior dimensional control and consistency available from NNPB allows lighter bottles to be produced without compromising fitness for purpose or market appeal. The current NNPB process inevitably has limitations on the minimum bottle weight which can be achieved, this also being critically dependent on bottle design and volume.

Market Risk

A key risk for industrial minerals projects is not meeting market specifications. For example, the silica sand market has demanding major element specifications for parameters such as purity (e.g. SiO2 content) in addition to tight specifications for trace elements such as Fe and Ti and Cr in the glass industry.

Failure to meet specifications may result in selling the products at discounted rates, or indeed not finding markets at all.

Other risks for silica sand may include particle size distribution and physical strength (crush resistance) as in the case of proppants for the oil industry.

Industrial minerals are generally considered to be bulk commodities and are therefore susceptible to distance to market and transport costs; therefore, logistics may pose a risk to supplying markets.

16.3. Glassmaking Silica Sand Pricing

Chemical Composition (%)

Product	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	K_2O	May 2019 Price FOB
F80	99.95	0.02	0.008	0.030	0.005	0.001	0.004	US$38-43 per dmt (subject to quality, contract terms and quantity)
F80C	99.95	0.02	0.005	0.030	0.005	0.001	0.004	
F150	99.8	0.07	0.015	0.035	0.020	0.001	0.004	
F200	99.9	0.06	0.02	0.030	0.010	0.001	0.020	
F350	99.5	0.30	0.050	0.030	0.010	0.002	0.050	
F400	99.6	0.25	0.040	0.030	0.005	0.001	0.050	
F500	99.7	0.20	0.050	0.035	0.010	0.002	0.030	

Table 86: Glassmaking Silica Sand Pricing

Particle Size **Sieve Opening / µm retained**

Product	850	600	425	300	212	150	106	75	53
F80		0.5%	49%	50%	0.5%				
F80C	9.0%	90.0%	1.0%						
F150				0.5%	88%	11%	0.5%		
F200		0.5%	30%	40%	21%	8%	0.5%		
F350		0.5%	40%	39%	16%	1%			
F400		0.5%	44%	39%	16%	0.5%			
F500		0.5%	40%	42%	17%	0.5%			

Table 87: Glassmaking Silica Sand Particle Sizes

16.4. Market Assessment

The global value and volume of the silica sand market indicated growing demand for supply of silica sand as shown in Figure below. The future tightening of supply of suitable quality silica sand, particularly for glassmaking, is commensurate with future increases in price.

Figure 30: Global Washed Silica Sand Market by Value and Volume (2018 to 2031). Report by Report Ocean Pvt Ltd, 2023.

Product requirements will be based on SiO_2 content, other impurities and particle size distribution. There are many and varied requirements generally dependent on the final product.

16.5. Foundry Silica Sand Pricing

Chemical Composition (%)

Product	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	K_2O	May 2018
F20	99.7	0.20	0.05	0.035	0.010	0.002	0.03	US$38-43 per dmt (subject to quality, contract terms and
F20 - B	99.9	0.02	0.008	0.03	0.005	0.001	0.004	
F40	99.7	0.20	0.05	0.035	0.010	0.002	0.03	
F20 - B	99.6	0.25	0.04	0.030	0.005	0.001	0.05	
F50	99.6	0.25	0.04	0.030	0.005	0.001	0.05	

Table 88: Foundry Silica Sand Pricing

Particle Size **Sieve Opening / Mesh retained**

Product	10	20	30	40	50	70	100	140	200	AFS
F20	0.1%	3%	87%	8%	1%	0.1%				21
F20 - B		9.0%	90.0	1.0%						20
F40		0%	21%	36%	24%	13%	5%	1%	0%	36
F20 - B	6%	22%	30%	38%	3%	0.3%	0.1%	0%		22
F50		0%	0.3%	32%	28%	17%	14%	8%	1%	49

Table 89: Foundry Sand Particle Sizes

16.6. Foundry Silica Sand Demand

Metal Casting / Foundry: Industrial sand is an essential part of the ferrous and non-ferrous foundry industry. Metal parts ranging from engine blocks to sink faucets are cast in a sand and clay mould to produce the external shape, and a resin bonded core that creates the desired internal shape. Silica's high fusion point (1,760°C) and low rate of thermal expansion produce stable cores and moulds compatible with all pouring temperatures and alloy systems. Its chemical purity also helps prevent interaction with catalysts or curing rate of chemical binders. Following the casting process, core sand can be thermally or mechanically recycled to produce new cores or moulds. Chromite, zircon and olivine sand all compete with silica but usually in small quantities and mainly as a thin covering on top of the silica for actual molten metal contact.

It is becoming increasingly difficult to source appropriate sand in Asia suitable for the foundry industry and VRX Silica is ideally placed to supply this market from it Arrowsmith North Silica Sand Project.

17. Financial

17.1. Key Financial Assumptions

A financial analysis for the project has been undertaken based on the following assumptions:

- only 25 years of the Resource tonnage has been taken into account
- revenue is based on prices used in the 2019 BFS study with no future projections
- operating costs are based on first principles and current rates for equipment
- sales contracts in Asia for silica sand are invariably based on US dollars, and the exchange rate applied is A$1.00 to US$0.66

17.2. Project Metrics

Post Tax, ungeared NPV_{10}	$166,700,000
Post Tax, ungeared IRR	35%
Payback period (yrs) (post tax) (ramp up rate)	4.4
Exchange Rate US$/A$	$0.66
Life of Mine (yrs) (BFS Study)	25
EBIT	$965,000,000
Total Sales (25 years) no escalation	$2,691,000,000
Life of Mine C1 costs, FOB Geraldton (inc Royalties)	$31.43
Cashflow after finance and tax	$650,000,000
Capex (2 mtpa)	$66,787,100
Capex contingency (inc)	20%
Life of Mine C1 costs, FOB Geraldton (inc Royalties)	$31.43
Tonnes Processed (million tonnes) (BFS Study)	52
Probable Reserves (million tonnes) @ 99.7% SiO_2	221
Reserve life (yrs)	111
JORC Resources (million tonnes)	512

Table 90: Project Metrics

17.3. Production Profile

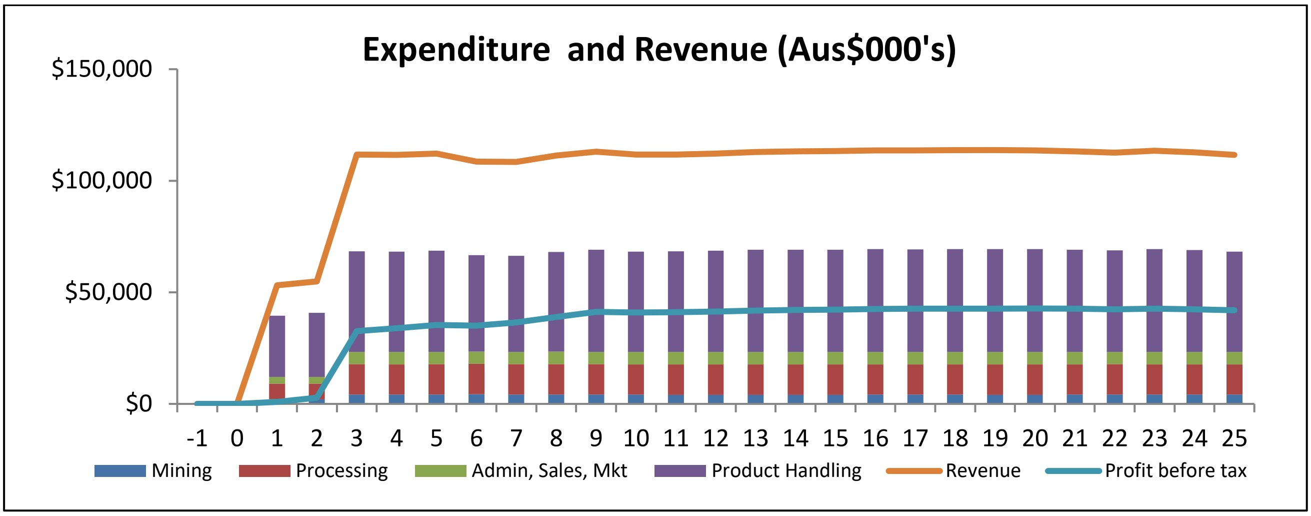


Figure 31: Production Expenditure and Revenue

17.4. Sensitivity Analysis

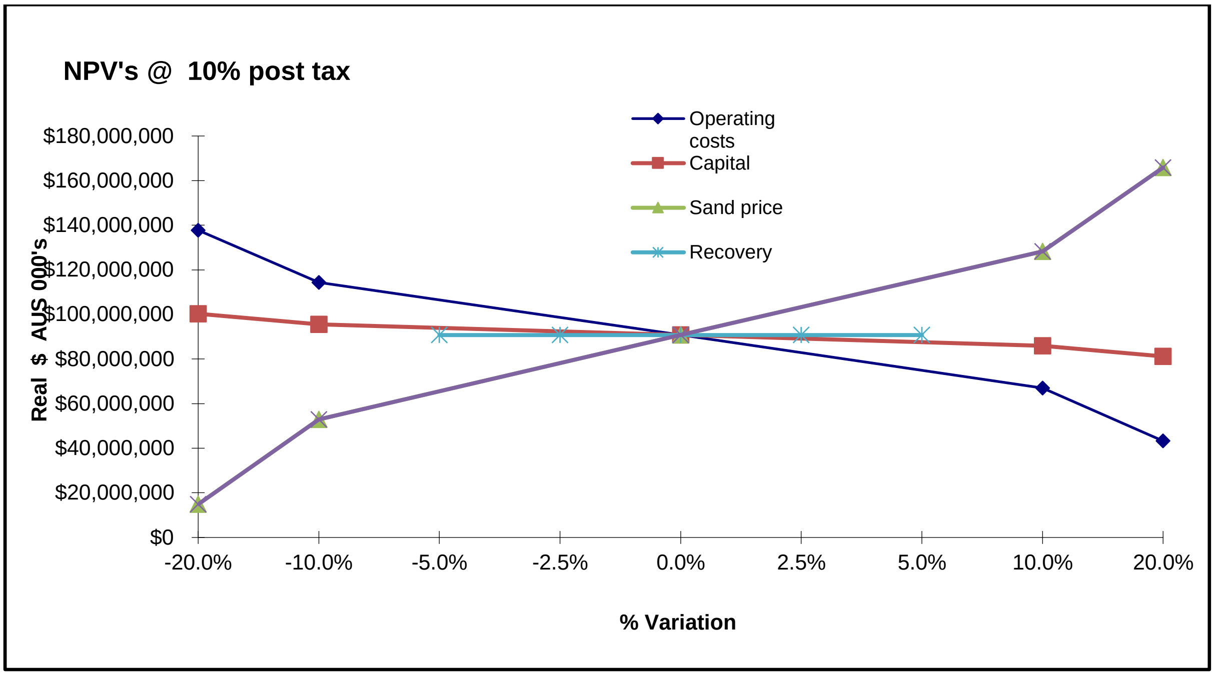


Figure 32: Sensitivity Analysis

18. Resources and Reserves JORC Tables

18.1. JORC Code 2012 Edition Table 1

Sampling Techniques and Data

Section 1: Sampling Techniques and Data

Criteria	Commentary
Sampling techniques	Aircore drilling samples are 1 m down hole intervals with sand collected from a cyclone mounted rotary cone splitter, ~2-3kg (representing 50% of the drilled sand) was collected. Two sub-samples, A and B, of ~200g were taken from the drill samples. The remainder was retained for metallurgical testwork. Auger drilling samples are 1m down hole intervals with sand collected from a plastic tub which received the full sample, ~8kg, from the hole. The sand was homogenised prior to sub sampling, two sub-samples, A and B, of ~200g were taken from the drill samples. A bulk sample of ~5kg was retained for each 1m interval for metallurgical testwork. The "A" sample was submitted to the Intertek Laboratory in Maddington, Perth for drying, splitting (if required), pulverisation in a zircon bowl and a specialised silica sand 4 acid digest and Inductively Coupled Plasma Mass Spectrometry analysis. All auger samples were weighed to determine if down hole collapse was occurring, if the samples weights increased significantly the hole was terminated to avoid up hole contamination. The targeted mineralisation is unconsolidated silica sand dunes, the sampling techniques are "industry standard". Due to the visual nature of the material, geological logging of the drill material is the primary method of identifying mineralisation. The Competent Person is satisfied that the sampling techniques are appropriate for this style of deposit, and for use in Mineral Resource estimation.
Drilling techniques	Vertical NQ sized aircore drilling was completed by a Contract Drilling Company using a Landcruiser mounted Mantis 82 drill rig. A 100mm diameter hand screw auger was used to drill until hole collapse. The Competent Person is satisfied that the drilling techniques are appropriate for this style of deposit, and for use in Mineral Resource estimation.
Drill sample recovery	Aircore: • Visual assessment and logging of sample recovery and sample quality. • Reaming of hole and clearance of drill string after every 3m drill rod. • Sample splitter and cyclone cleaned regularly to prevent sample contamination. • No relationship is evident between sample recovery and grade. Auger: • All material recovered from the hole is collected in a plastic drum and weighed, the weights are used to determine when the hole is collapsing, and drilling is terminated. • No relationship is evident between sample recovery and grade. The Competent Person is satisfied that the sample recoveries are appropriate for this style of deposit, and for use in Mineral Resource estimation.

Criteria	Commentary
Logging	Geological logging of drill samples is done by the field geologist with samples retained in chip trays for later interpretation. Logging is captured in an Excel spreadsheet, validated and uploaded into an Access database. This information is of a sufficient level of detail to support the Mineral Resource estimate. The Competent Person is satisfied that the geological logging techniques are appropriate for this style of deposit, and for use in Mineral Resource estimation.
Subsampling techniques and sample preparation	Aircore drill samples are rotary split 50:50 into a calico bag resulting in 2-3kg of dry sample, 2 x 200g sub-samples, A and B, are taken from the drill sample. The A sample is submitted to the laboratory and the B sample is retained for repeat analysis and QA/QC purposes. The bulk sample is retained for later metallurgical testwork. Auger drill material, ~8kg, is collected in a plastic tub and homogenised, 2 x 200g sub-samples, A and B, are taken from the drill material. The A sample is submitted to the laboratory and the B sample is retained for repeat analysis and QAQC purposes. A 5kg bulk sample is retained for later metallurgical testwork. The sample size is considered appropriate for the material sampled. The 200g samples are submitted to the Intertek Laboratory in Maddington. Intertek use a zircon bowl pulveriser to reduce the particle size to -75µm. The Competent Person is satisfied that the sub-sampling techniques and sample preparation are appropriate for this style of deposit, and for use in Mineral Resource estimation.
Quality of analytical data and laboratory tests	Samples were submitted for analysis to the Intertek Laboratory in Maddington in Perth WA. The assay methods used by Intertek are as follows: multi-elements are determined by a specialised four-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry, silica is reported by difference. The assay results have also undergone internal laboratory quality assurance (QA), which includes the analysis of standards, blanks, and repeat quality control (QC) samples. The Company has been validating a high-purity silica standard that was created for the Company by OREAS Pty Ltd. This was required as there is no commercial standard available for high purity silica sand. The standard was “round robin” assayed at several laboratories in Perth prior to the commencement of drilling. The standard was then included in the drill sample submissions to Intertek, in sequence, on a ratio of 1:20. Field duplicate samples were submitted in a ratio of 1:20 and in addition to this Intertek routinely duplicated analysis from the pulverised samples in a ratio of 1:25. The number of QC samples therefore represents ~14% of the total assays. A full analysis of all the QC data has been undertaken. This analysis validates the drill assay dataset and conforms with the guidelines for reporting under the JORC Code. The Competent Person is satisfied that the QA procedures put in place are appropriate for this style of deposit, and for use in Mineral Resource estimation.
Verification of sampling and analyses	Significant intersections were validated against geological logging. Three aircore twinned holes have been completed which shows strong correlation between the paired assays.

Criteria	Commentary
Location of data points	Auger drill hole locations were measured by hand-held GPS with the expected relative accuracy; GDA94 MGA Zone 50 grid coordinate system is used. Aircore drill holes were surveyed by RM Surveys using base stations on GOLA SSM DON53 and a Project Control point established as GFM001, situated within the Arrowsmith North prospect and coordinated by RTK from DON53, with the expected relative accuracy of 0.05m E, N and RL. The drill collar RL's were transformed to the topographic DTM surface. The Competent Person is satisfied that the surveying techniques and accuracy of data are appropriate for this style of deposit, and for use in Mineral Resource estimation.
Data spacing and distribution	Auger holes were spaced 400-1,000m apart along existing tracks. The aircore drilling in the indicated resource was spaced 400m, along lines spaced 450m apart. In the Inferred area holes were spaces 800m apart, on line spaces 800m apart. Within the area containing the 2021 aircore drilling, drilling was completed on a drillhole spacing of 50 m (east) by 100 m (north). No sample compositing (down hole) has been completed.
Orientation of data in relation to geological structure	Sampling is being undertaken on aeolian sand dunes and all holes were drilled vertically. The drill orientation is therefore considered appropriate to the geological controls affecting mineralisation.
Sample security	All samples are selected onsite under the supervision of VRX Geological staff. Samples are delivered to the Intertek laboratory in Maddington. Intertek receipt received samples against the sample dispatch documents and issued a reconciliation report for every sample batch.
Audits or reviews	There has been no audit or review of sampling techniques and data.

Section 2: Reporting of Exploration Results

(Criteria listed in the preceding section also apply to this section.)

Criteria	Commentary
Mineral tenement and land tenure status	VRX has six granted exploration licenses covering 342.9 km2 and has two granted mining leases, covering 36.3km2 of that area, which are excised from the exploration licences. The granted exploration licences E70/5027, E70/5109, E70/5197 and E70/5817 at Arrowsmith North; E70/4987 at Arrowsmith Central and E70/4986 at Arrowsmith South. The granted mining leases are M70/1389 at Arrowsmith North and M70/1392 at Arrowsmith Central. All drilling supporting the Arrowsmith North Mineral Resource has been within tenement E70/5027, which is owned by Ventnor Mining Pty Ltd, a 100% owned subsidiary of VRX Silica Limited. The tenement was granted 14 June 2018 and all drilling was conducted on vacant crown land.
Exploration done by other parties	Minor exploration for oil and gas, and for mineral sands was completed by various companies. Other than work completed by VRX, no exploration for silica sand has been completed.
Geology	Most economically significant silica sand deposits in Western Australia are found in the coastal regions of the Perth Basin, and the targeted silica sand deposits are the aeolian sand dunes that overlie Pleistocene limestones and paleo-coastline, which also host the

Criteria	Commentary
	regional heavy mineral deposits. Within the project area, data obtained from the Department of Agriculture soil mapping shows there are pale and yellow deep sands predominating with lesser swampy areas and occasional iron rich sand ridges. Locally the silica sand deposit is understood to be layered where yellow sand is deposited it is underlain by white sand. The silica sand deposit is bounded at depth by a basal limestone which is closer to the surface in the south and deeper in the north.
Drillhole information	Not relevant. Exploration results are not being reported. Mineral Resources are being disclosed (see Section 3). Sample and drillhole coordinates are provided in previous market announcements.
Data aggregation methods	Not relevant. Exploration results are not being reported. Mineral Resources are being disclosed (see Section 3).
Relationship between mineralisation widths and intercept lengths	Not relevant. Exploration results are not being reported. Mineral Resources are being disclosed (see Section 3).
Diagrams	Refer to figures within the main body of this report.
Balanced reporting	Not relevant. Exploration results are not being reported. Mineral Resources are being disclosed (see Section 3).
Other substantive exploration data	Geological observations are consistent with aeolian dune mineralisation. Seven, certified, dry *in situ* bulk density measurements were completed by Construction Sciences Pty Ltd using a nuclear densometer. Groundwater was intersected in only a few holes that were drilled deeper deliberately to ascertain the position of the water table. The water table is typically below 15m depth. The mineralisation is unconsolidated sand. There are no known deleterious substances.
Further work	The Company is progressing the Project into a Development phase having formally referred the project to the Department of Agriculture, Water, and the Environment for assessment under the Environment Protection and Biodiversity Conservation Act 1999 (Cth) and to the Environmental Protection Authority for assessment under Part IV of the Environmental Protection Act 1986 (WA). In parallel Approvals under the Mining Act are being prepared with a view to lodgment in the near future. Approval under Part V of the EP Act will also be required (Works Approval and Licence) to allow construction and operation of a mine and processing facility to produce a bulk product for transport to the Geraldton Port for bulk shipment to customers in Asia. VRX plans to commence preparation of a Works Approval application in the near future.

Section 3: Estimation and Reporting of Mineral Resources

(Criteria listed in the preceding section also apply to this section.)

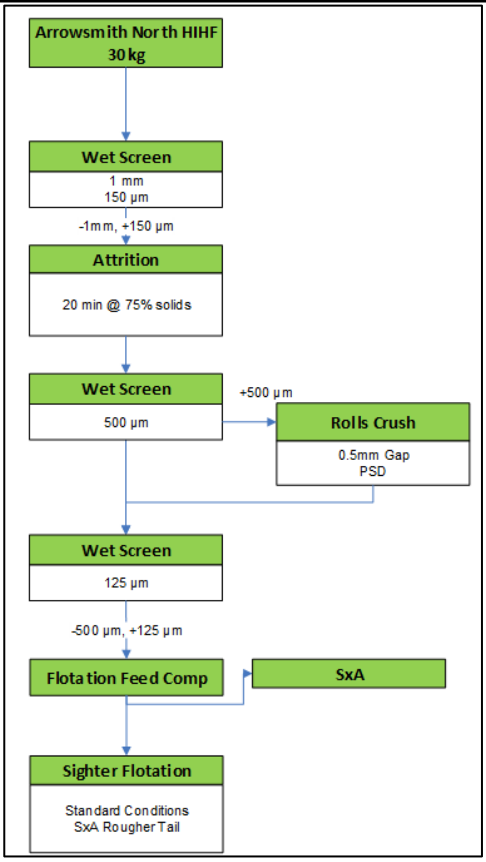
Criteria	Commentary
Database integrity	Data used in the Mineral Resource estimate is sourced from a Microsoft Access database. Relevant tables from the Microsoft Access database are exported to Microsoft Excel format and converted to csv format for import into Datamine Studio 3 software. Validation of the data imported comprises checks for overlapping intervals, missing survey data, missing analytical data, missing lithological data, and missing collars.
Site visits	A site visit by the previous Competent Person, Mr Grant Louw of CSA Global, took place on 3 July 2019. Geology – Mr Louw noted that the Arrowsmith tenements are primarily underlain by unconsolidated white / yellow silica sand, covered by low scrub and very few trees. Topographic relief is low. It was noted that the material recorded as ironstone ridges by the DOAG mapping is in fact a more iron rich sand unit, and not an ironstone. Drill collars – Mr Louw recorded and verified several marked drill sites using hand-held GPS. Project location – several points such as road intersections were located and plotted in Google Earth™ to verify the tenement location. Mr Louw visited the VRX sample storage on 17 October 2018 and noted the following: Sample storage – originals, field duplicates, pulps, standards and chip trays are housed appropriately. Some chip trays were photographed by the Competent Person as a check against company photographs and geology logs.
Geological interpretation	Silica sand mineralisation at Arrowsmith North occurs within the coastal regions of the Perth Basin, and the targeted silica sand deposits are the aeolian sand dunes that overlie the limestones and paleo-coastline. Within the project area, data obtained from the Department of Agriculture soil mapping shows there are pale (logged by VRX as white sands) and yellow deep sands predominating, with lesser swampy areas and occasional iron rich sand ridges. The geological modelling was completed based on this soil mapping data in conjunction with the auger and aircore drill logging data. The Mineral Resources were estimated above 3-D wireframe basal surfaces for the white and yellow sands, with the surfaces being based on the geological boundaries defined by logged sand types and chemical analysis results from the drill data. The aircore drilling demonstrated that the white sand layer extends to the west, past the interpreted contact, under the yellow sand in approximately the northern half of the modelled area. The basal surface of the yellow sand is defined by this lithological contact, or is limited by interpretation of nominal average thickness of the sand layer based on the data from surrounding deeper drill holes as required. The white sand layer basal surface is similarly defined by the drilling data and or is limited by interpretation of nominal average thickness of the sand layer based on data from surrounding deeper drill holes as required. The horizontal extents of the interpreted sand layers are limited to within the VRX nominated Arrowsmith North target area and with reference to the publicly available soil mapping data. The surface humus layer is typically about 300mm thick. In consultation with VRX, the upper 500 mm (overburden) is likely to be reserved for rehabilitation purposes. This overburden surface forms the upper boundary of the estimated Mineral Resource and is depleted from the reported Mineral Resources. Comparatively minor areas that are

Criteria	Commentary
	mapped as iron richer sand ridges, swamp or sandy swamp are also depleted from the Mineral Resources. A surficial zone of enriched CaO was modelled in the area drilled in 2021. This CaO zone is within the yellow sand domain and SiO2 population is reduced by negligible amounts compared to the non-calcareous domain. The purpose of the domain was to separate high and low grade CaO populations. The basal 2 m of the sands unit is not intended to be mined, and is therefore not reported as part of the Mineral Resource. Despite both white and yellow sands being readily amenable to beneficiation, they have been separately modelled, based on the drill logging data and mapped soil type boundaries, as they are separately estimated due to differences in grades of the various mineral components. Assumptions have been made on the horizontal extents of the mineralisation based on the soil mapping data and the spacing and extents of the drilling information. A nominal maximum horizontal extrapolation limit of 200m past known drill data points has been applied with the material types additionally constrained within the VRX nominated target area and by the mapped material type boundaries. The vertical extents of the sand layers have been limited by interpretation of the nominal average thickness of each layer based on data from the deeper drilled aircore holes. The nominal maximum interpreted combined layer sand vertical thickness is roughly 25 m and the nominal average interpreted thickness of sand is about 12 m. Approximately 15% of the modelled mineralisation zones can be considered to be extrapolated. Alternative interpretations based on the currently available data are considered unlikely to have a significant influence on the global Mineral Resource. Continuity of geology and grade can be identified and traced between drillholes by visual and geochemical characteristics. Confidence in the grade and geological continuity is reflected in the Mineral Resource classification.
Dimensions	The modelled and classified extents of the yellow sand material within the target area are roughly 10 km north to south, and on average roughly 2.5km west to east. The modelled and classified extents of the white sand material within the target area are roughly 4.6km north to south, and on average roughly 1.5km west to east. The modelled aeolian sand is roughly horizontal, with low relief. The currently modelled thickness of the sands is on average about 12m, ranging up to a nominal maximum thickness of 25m.
Estimation and modelling techniques	Ordinary Kriging (OK) was the selected interpolation method, with Inverse distance squared (IDS) used as a check estimate. Grade estimation was carried out at the parent cell scale, with sub-blocks assigned parent block grades. Grade estimation was carried out using hard boundaries between the two sand type zones. Statistical analysis on the 1m downhole composited drillhole data to check grade population distributions using histograms, probability plots and summary statistics and the co-efficient of variation, was completed on each sand type for the estimated grade variables. The checks showed there were some outlier grades in the interpreted sand types that required top-cutting. Top cuts for the white sand were applied to Fe_2O_3 (0.5%), and LOI (1%). Top cuts for the yellow sand domain in the Indicated volumes were applied to Al_2O_3 (2.8%), Fe_2O_3 (1.5%), and LOI (1.5%).

Criteria	Commentary
	In addition to SiO_2, the grade variables Al_2O_3, Fe_2O_3, LOI, K2O, MgO, CaO and TiO_2 are estimated into the model and reported. A volume block model was constructed in Datamine constrained by the topography, overburden layer, sand type zones, material depletion zones and target area limiting wireframes. Analysis of the drill spacing shows that the nominal average drill section spacing is 400m with drill holes nominally at 400m apart on each section over majority of the modelled area. The area drilled in 2021 has drill hole spacing of 50m (east) by 100m (north). Spatial (variogram) analysis was completed on SiO_2 from the 1m drill composite samples from the yellow sand zone, as this zone has the most samples. Two sets of variograms were modelled, one from the samples collected during the 2021 aircore programme, and the other from the 2019 drilling data. The resultant single spherical modelled variogram parameters were applied to an OK estimation as the primary grade estimation technique. For the variograms modelled from the 2021 aircore data: The modelled nugget was 13%, with 40% of the population variance constrained within a range of 130m. The primary orientation is 140°. For the variograms modelled from the samples from the 2017 and 2019 drilling programmes: The modelled nugget was a fairly low 15%. There was no preferred orientation for the horizontal variogram so the major axis is modelled towards 000° with the same 700 m range modelled for both major and semi-major axes. The minor vertical axis was modelled with a range of 8.5m. Based on the sample spacing of 50m(E) x 100m(N) within the 2021 drilling area, a block model covering the 2021 aircore grade control area was constructed, with block sizes and model limits designed to allow it to be stamped onto the 2019 block model. The block model used a parent cell size of 25m(E) x 50m(N) x 2m(RL) with sub-celling to 6.25m(E) x 12.5m(N) x 0.25 m(RL) to maintain appropriate resolution at the surface boundaries. The volume block model was validated on screen to ensure blocks were coded correctly according to the input wireframes. The block model was stamped onto the 2019 MRE block model, with the latter's block sizes of 200m(E) x 200m(N) x 4m(RL) retained in the output model. For the interpolated blocks within the 2021 aircore drilling area, the following grade interpolation parameters were applied: Blocks were estimated using a search ellipse of 150m (major) x 100m (semi-major) x 4m (minor) dimensions, with a minimum of 6 and maximum of 16 samples from a minimum of four drillholes per cell interpolation. Search radii were increased, and the minimum number of samples reduced in subsequent sample searches if cells were not interpolated in the first two passes. Cell discretization of 3 x 3 x 2 (X, Y, Z) was employed. For the interpolated blocks within the 2017/2019 drilling area, the following grade interpolation parameters were applied: Blocks were estimated using a search ellipse of 700m (major) x 700m (semi-major) x 10m (minor) dimensions, with a minimum of 16 and maximum of 24 samples from a minimum of four drillholes per cell interpolation. Search radii were increased, and the minimum number of samples reduced in subsequent sample searches if cells were not interpolated in the first two passes. Cell discretization of 3 x 3 x 4 (X, Y, Z) was employed. Model validation was carried out visually, graphically, and statistically to ensure that the block model grade reasonably represents the drillhole data. Cross sections, long sections and plan views were initially examined visually to ensure that the model grades honour

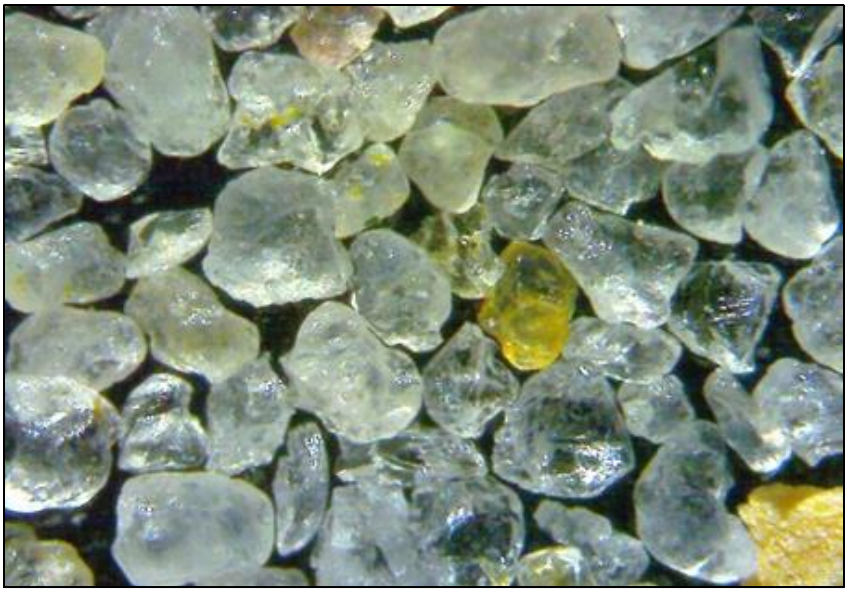
Criteria	Commentary
	the local composite drillhole grade trends. These visual checks confirm the model reflects the trends of grades in the drillholes. Statistical comparison of the mean drillhole grades with the block model grade shows reasonably similar mean grades. The IDS check estimate shows similar grades to the OK model, adding confidence that the grade estimate has performed well. The model grades and drill grades were then plotted on histograms and probability plots to compare the grade population distributions. This showed reasonably similar distributions with the expected smoothing effect from the estimation taken into account. Swath or trend plots were generated to compare drillhole and block model with SiO_2% grades. The trend plots generally demonstrate reasonable spatial correlation between the model estimate and drillhole grades after consideration of drill coverage, volume variance effects and expected smoothing. No reconciliation data is available as no mining has taken place.
Moisture	Tonnages have been estimated on a dry, *in situ,* basis. The sampled sand material was generally reasonably dry, with data collected from the density testing of seven intervals showing an average moisture content of 2.9%.
Cut-off parameters	No cut-off parameters have been applied, as both sand types appear to be readily amenable to beneficiation to a suitable product specification through relatively simple metallurgical processes as demonstrated by reported metallurgical testing results.
Mining factors or assumptions	The Project aims to mine high-grade silica sand via extraction and mechanical upgrading. Proposed activities include the sequential block mining of silica sand, development of a mine feed plant, moveable surface conveyor, pipeline, processing plant, freshwater supply bore, access corridor, laydown, administration, water storage and associated infrastructure including a gas fired power station, communications equipment, offices, workshop and laydown areas. The deposit is amenable to a shallow excavation where the upper surface is removed and continuously rehabilitated and are economic to exploit to the depths currently modelled. The deposit will be bulk mined and processed and therefore no requirement for minimum mining widths and dilution needs to be made. No mining has yet taken place.
Metallurgical factors or assumptions	2018 testing: A composite auger sand sample from Arrowsmith North was tested in Ireland. The sample was screened at 4mm to remove oversize particles. The remaining material was then subjected to an attrition process followed by spiral and magnetic separation methods. Attrition testing was carried out a retention period of 5 minutes, with the sample washed after attritioning to remove any liberated fine particles. Spiral testing was then carried out with approximately 80kg of attritioned material, after which the samples then underwent wet magnetic separation to explore the possibility of reducing the magnetic mineral content. Chemical analysis showed a general decrease in the Al_2O_3. Processing, attritioning and washing the material removed the largest fraction of Al_2O_3. The spiral separation process produced samples where the largest fraction of Al_2O_3 was found in the heavy mineral fraction. Magnetic separation resulted in the largest fraction of Al_2O_3 being in the magnetic fraction. The results for Fe_2O_3 follow the same general trend as for Al_2O_3. The percentage fraction of SiO_2 in the samples increased during the test process. Attritioning and washing the material removed fines and silt, which increased the SiO_2 content. The spirals test produced samples where the largest fraction of SiO_2 was found in

Criteria	Commentary
	the light fraction. Magnetic separation indicated that the largest fraction of SiO_2 was in the middling fraction. 2019 testing: raw material remaining from 2018 was removed from storage and was screened at 1mm to remove oversize material and organics. The sand was then wet screened through a 0.212mm sieve and PSD test run which showed that the +0.212 mm material contains some fines (3.25% passing the 0.212 mm sieve) and in contrast the -0.212mm sample contains a large amount of fines with 27.2% passing the 0.053mm sieve. Chemical analysis showed that the -0.212 mm fraction contains more Al_2O_3 and Fe2O3 than the +0.212 mm fraction, due to higher clay fraction in the finer sample. The 0.212-1 mm fraction was then attritioned for 5 minutes and washed over a 0.063 mm sieve, highlighting that the attrition and washing process removed fine particles, and reduced Al_2O_3, Fe_2O_3 and TiO_2 contents. The 0.212 mm material was then processed in a spirals test unit and three fractions were produced, namely heavy, middling and light. Particle size distribution analysis showed that the heavies contain the highest amount of fines and that the lights contain the lowest amount of fines, probably because fine-grained dense minerals containing Fe and Ti are concentrated with the heavy fraction. This observation was borne out by chemical analysis which showed that Al_2O_3, $Fe_2O_3$and TiO_2 are highest in the heavy fraction. Magnetic separation results in an increase in SiO_2 and a decrease in Al_2O_3, Fe_2O_3 and TiO_2 in the non-magnetic fraction compared with the feed material. The composite sample tested by CDE in 2018 and 2019 indicated that a product with AFS ~45 should be achievable and that some coarser AFS ~20 product may also be achievable. 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. Other foundry sand specifications include roundness and sphericity, clay content (generally <0.5%), moisture and SiO_2 content, which should be achievable with suitably processed Arrowsmith North silica sand. It was concluded that Process test work during 2018 and 2019 on composite drill samples indicated that the Arrowsmith North deposit is potentially suitable for producing silica sand for glass, ceramic and foundry markets. 2021 testing by BHM Perth indicated that some process steps could be eliminated from the previous flowsheet. The counter current classification (elutriation) and spiral stages were removed and replaced by flotation. High pressure grinding rolls (HPGR) were added to the flowsheet to crush all -1mm +500 µm sand to minus 500 µm which improved recoveries for glass sand products. The 2021 testing by BHM Perth was carried out on three sand types described by Ventnor as Low Feldspar (LF), Medium Feldspar (MF) and High Iron High Feldspar (HIHF) sands in the deposit. The LF and MF composites were from north of the March 2021 detailed QC drilling area. The HIHF composite was from the southern part of the 2021 drilling area. The HIHF product is higher in fines than LF and MF products. Bulk scale testwork on LF, MF and HIHF composites used a new flowsheet incorporating flotation and crushing as summarised below. Flowsheet incorporating crushing and flotation

Criteria	Commentary
	

Comparison of HIHF with LF and MF products (XRF analyses)

Stage	Mass	SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2
	%	%	ppm	ppm	ppm	ppm
-0.6, +0.425mm, NF500						
LF Bulk	24.10%	99.548	1,650	550	110	320
MF Bulk	34.50%	99.540	1,730	610	330	310
HIHF	16.85%	99.528	2,290	440	170	300
-0.425mm, +0.150mm,						
LF Bulk	74.20%	99.512	2,106	584	493	320
MF Bulk	64.90%	99.278	3,088	786	1,177	322
HIHF	82.56%	99.084	4,088	563	1,473	302

Criteria	Commentary
	Photomicrograph of rougher tail (product) from the HIHF composite  Photomicrograph of VRX 'AFS55' foundry sand product, showing sub-rounded quartz grains  BHM and VRX are of the opinion that the revised flowsheet, which includes flotation and high-pressure grinding rolls offers potential cost savings, may have lower environmental impact and should produce products suitable for glass, foundry and other industries. BHM are further of the opinion that the flotation process displays, to a high degree of confidence, that the material and mineralogical nature of the Arrowsmith North Silica Project can be processed to a consistent saleable glass sand product specification via the flotation process proposed. CSA Global considers that the sample preparation, sample testing and analytical techniques are appropriate for this type of deposit, at this stage of the exploration process.

Criteria	Commentary
	CSA Global notes that metallurgical (process) test methods can have a significant effect on the quality of concentrate produced at a laboratory scale, and that such tests should be tailored for specific geological and mineralogical conditions and desired product outcomes for specific markets. Therefore, it is cautioned that laboratory process test results used to estimate Mineral Resources for industrial minerals such as silica sand may not reflect either the process flowsheet adopted after completion of technical studies, or the layout of the final process plant. CSA Global is of the opinion that process test work on the composite drill samples indicates that the Arrowsmith North deposit should be suitable for the eventual production of silica sand for glass, ceramic and foundry markets. In addition, project location and logistics support the classification of the Arrowsmith North deposit as an industrial Mineral Resource in terms of Clause 49 of the JORC Code.
Environmental factors or assumptions	VRX is aiming to minimise impacts and speed up ecological recovery by employing modern and innovative mining and rehabilitation techniques. Mining will be progressively rehabilitated using Vegetation Direct Transfer (VDT). VDT is the practice of salvaging and replacing intact sods of vegetation with the underlying soil still intact (Ross et al. 2000). This results in faster regeneration of the ecosystem (Mattiske 2019) and increased survival rates of sensitive plant species that are often missing in other rehabilitation methods (Mattiske 2019, and references within). This form of mining and rehabilitation has the potential to minimise disturbance to fauna and their habitats. This includes minimising impacts to SRE species and allowing establishment and/or recolonisation of invertebrates much faster than traditional methods, as has been shown in trials by Rodgers et al. (2011).
Bulk density	Seven, certified, dry *in situ* bulk density measurements were completed by Construction Sciences Pty Ltd using a nuclear densometer. The results from the seven measurements are corrected based on the measured moisture factor. The mean dry *in situ* density result of 1.66 t/m^3 is used for all modelled material reported in the Mineral Resource estimate.
Classification	Classification of the Mineral Resource estimate was carried out accounting for the level of geological understanding of the deposit, quality of samples, density data and drillhole spacing. The Mineral Resource estimate has been classified in accordance with the JORC Code (2012 Edition) using a qualitative approach. All factors that have been considered have been adequately communicated in Section 1 and Section 3 of this Table. Material that has been classified as Measured was considered by the Competent Person to be sufficiently informed by geological and sampling data to confirm geological and grade continuity between data points. The volumes of silica sand classified as Measured are constrained within the area drilled in 2021 (aircore “grade control” programme). Material that has been classified as Indicated was considered by the Competent Person to be sufficiently informed by geological and sampling data to assume geological and grade continuity between data points. Material that has been classified as Inferred was considered by the Competent Person to be sufficiently informed by geological and sampling data to imply but not verify geological and grade continuity between data points. Overall, the mineralisation trends are reasonably consistent over the drill sections. The Mineral Resource estimate appropriately reflects the view of the Competent Person.

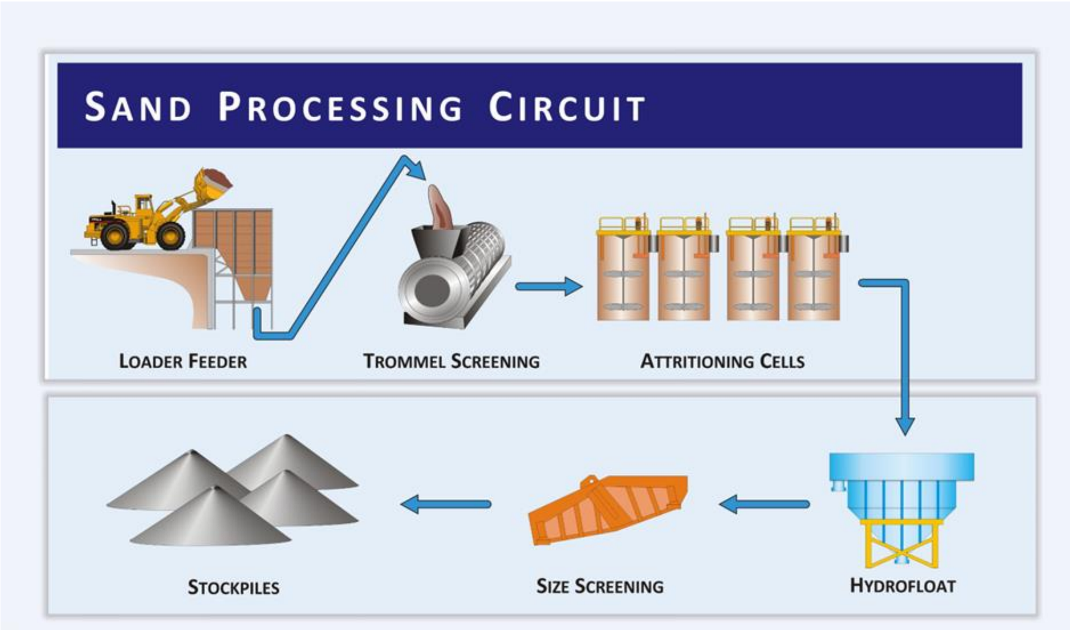
Criteria	Commentary
Audits or reviews	Internal audits were completed by CSA Global, which verified the technical inputs, methodology, parameters, and results of the estimate. No external audits have been undertaken.
Discussion of relative accuracy/ confidence	The relative accuracy of the MRE is reflected in the reporting of the Mineral Resource as per the guidelines of the JORC Code. The Mineral Resource statement relates to global estimates of *in situ* tonnes and grade.

Section 4: Estimation and Reporting of Ore Reserves

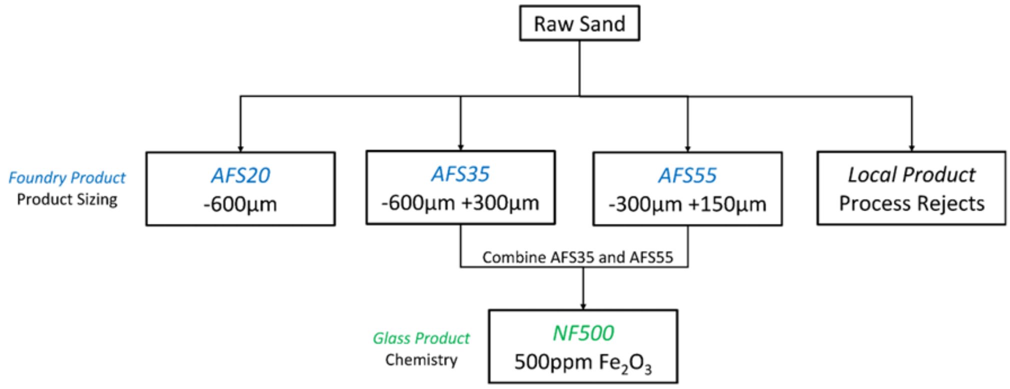
(Criteria listed in the preceding section also apply to this section.)

Criteria	Commentary
	The Mineral Resource Estimate (MRE) used as a basis for conversion to the Ore Reserve was provided by CSA Global Pty Ltd, with David Williams and Andrew Scogings as the Competent Persons on the Estimation and David Reid, a full time employee of VRX Silica as the Competent Person on the Exploration Results and data collection. The Arrowsmith North Mineral; Resource Estimate used in this conversion is dated 7 December 2021. The Mineral Resources as reported are inclusive of the Ore Reserves.
	The Competent Person, Quinton de Klerk, is a Principal Mining Consultant for Cube Consulting and has not attended a site visit due to the limitation of what such a visit would achieve based on his general knowledge of the area and has relied on discussions with VRX personnel to confirm the local conditions as outlined below. The competent person is satisfied that this does not limit the confidence in these estimated Ore Reserves. The following observations are applicable to this Conversion; The mining area is located between mid-west towns Eneabba and Dongara in Western Australia, ~270km north of Perth. The area is accessed via the Brand Highway, with the northern section of the area accessed via the Mount Adams gravel road. There are numerous existing tracks that also allow for alternative access. The regional population density is low, 147 persons in Eneabba, and 1,380 persons in Dongara. There are a small number of farming properties in the local area. The mining area is located on Unallocated Crown Land, VRX Silica has 100% ownership of the underlying mining tenure. The topographical relief is a series of low rolling sand dunes covered by low Kwongan Heath vegetation. The proposed mining operation will excavate the sand from the top of the sand dunes to a nominal undulating base as defined by the mineral resource. The eastern and southern sides of the mining area will be graded at 1:10 gradient. No ground water was intersected in the mining area drilling and rainfall is expected to drain into the surrounding sand with little or no runoff that could affect the mining operation. The sand to be mined is unconsolidated and will not require blasting. All mining can be carried out by a wheeled front-end loader. There are no power lines or water lines in the mining area. There are gas pipelines and gas production wells to the east of the mining area, however these will not be impacted during mining of these estimated Ore Reserves. There are Shire of Irwin road reserves within the mining area which VRX has permission from the Shire to mine over.
	VRX Silica announced a Feasibility Study on the ASX platform on 28 August 2019. All the inputs to the Feasibility Study are available to the Competent Person to be able to make this conversion of Mineral Resources to Ore Reserves. The Ore Reserves stated here are

Criteria	Commentary
	the result of an updated mine production schedule completed by Cube Consulting taking into account the physical, practical considerations for the project. This updated schedule has been evaluated within the financial model which was developed for the above mentioned Feasibility Study.
	Only Measured and Indicated Resources have been considered for conversion to Ore Reserves. The MRE defines two types of sand "yellow" and "white", both of which have been demonstrated are able to be beneficiated to a saleable product via non-chemical means in a custom sand processing plant. The MRE did not apply any cut-of grades during estimation as it simply modelled the two different types of sand, there is no waste in the MRE. The MRE differentiated the top 500mm as "topsoil" and excluded it from the estimation as it would be retained for rehabilitation purposes.
	The mining method chosen for Arrowsmith North is a rubber wheeled front-end loader, feeding into a 2mm trommel screen to remove organic material. The undersize sand is slurried and pumped to a sand processing plant which is located in the south west corner of the Mining Lease M70/1389. After processing the silica sand will be initially trucked to the Geraldton Port for bulk export. Ultimately transport to the Geraldton Port will utilise the Eneabba to Geraldton railway line once infrastructure works are completed. The front-end loader was chosen due to the flexible nature of the machine combined with a high load rate and low material handling cost. Mining of the dune sand will extract to the base of the mineral resource / ore reserve and will leave a slightly undulating surface. On the eastern side of the mining area the sand will slope upward at a 10% gradient to the top of the adjacent dunes. Mining will not create a void and there are no geotechnical requirements. Active mining faces exceeding 10m may be required, face stability issues will be determined during mining. Pre-production drilling is unlikely to be required due to the low in-situ variation of the bulk sand resource, the aircore drilling used in the MRE is considered to be sufficient. 100% of the material in the Mining Lease application area is considered to be sand that can be beneficiated to a saleable silica sand project. The top 500mm has been excluded from the MRE as it will be reserved for rehabilitation purposes. As there is no waste material, the recovery factor is considered to be 100% into the various products and ore loss therefore is considered to be 0%. The Ore Reserves reported here have been limited to within mining lease M70/1389. Depending on the thicknesses of white and yellow sand that are available at any one time, the decision may be taken to mine as separate units as they have different physical and chemical compositions. This may also depend on the customer's specification. The details of this separated mining have not been accounted for within the Life of Mine production schedule and are considered to be dealt with at an operational level.

Criteria	Commentary
	Inferred Resources are not used in the Ore Reserve output. There may be a small amount of Inferred material that falls into the Mining Area as the edges are mined, the relative amount of this material is insignificant and has been excluded. Infrastructure required will be a processing plant, administration office, mining contractor workshop and associated facilities.
	VRX Silica has completed a rigorous and extensive metallurgical testwork program. The original process flow has evolved from a predominantly physical separation process to the use of flotation to remove deleterious minerals from the in-situ mineral resource. The Process flowsheet, below, has been developed from the testwork program.  Metallurgical testwork has completed under the supervision of Mr Steven Hoban who is the Principal Metallurgist and a Director of BHM. Mr. Hoban is a Member of the Australasian Institute of Mining and Metallurgy. Mr Hoban has sufficient experience relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as Competent Person as defined in the 2012 Edition of the Australasian Code for the Reporting of Exploration Results, Mineral Resources, and Ore Reserves (JORC Code). Mr Hoban consents to the disclosure of information in this report in the form and context in which it appears. An independent Technical Summary Report by CSA Global on the Metallurgical Testwork to satisfy Clause 49 of the JORC 2012 code is included in the Minerals Resource Report. The BHM supervised testwork identified that the proposed process flowsheet could consistently and reliably produce products of acceptable chemical specification and sizing to supply the target supply markets. The bulk product is separated in the final stage of processing into saleable bulk products as shown below,

Criteria	Commentary



The yield of each product has been determined by the testwork and is shown in the table below:

Table 6 - Nominal Feed Sizing

	Mass Deportment (%)				
Stream	Total	+600um	-600um, +300	-300um, +150	-150um
Feed		***12.3%***	***47.0%***	***34.4%***	***6.4%***
Fines Product stockpile	29.0%	0.00%	2.13%	81.0%	2.33%
Coarse Product stockpile	10.5%	82.9%	0.84%	0.00%	0.00%
Intermediate Product stockpile	42.5%	0.00%	83.2%	9.71%	0.00%
Tails	18.0%	17.1%	13.8%	9.28%	97.7%

The Tails mass deportment represents the separating effect pf the process flowsheet on the 4 different size fractions, which represent classifier or screened final products. The mineral resource model has size fraction block attributes estimated,

1. % of sand -150µm
2. % of sand +300µm
3. % of sand +600µm

New Attributes can be generated in the Ore Reserve block model to represent 4 sizing groups, the formula refers to above;

A. % of sand +600µm = 3
B. % of sand -600µm +300µm = 2 – 3
C. % of sand -300µm +150µm = (100- 1) – 2
D. % of sand -150µm = 1
E. There should be a check attribute created adding A, B, C, D which should = 100%

The yield of each final product can then be generated by using the mass deportment from Table 6, rounded as follows;

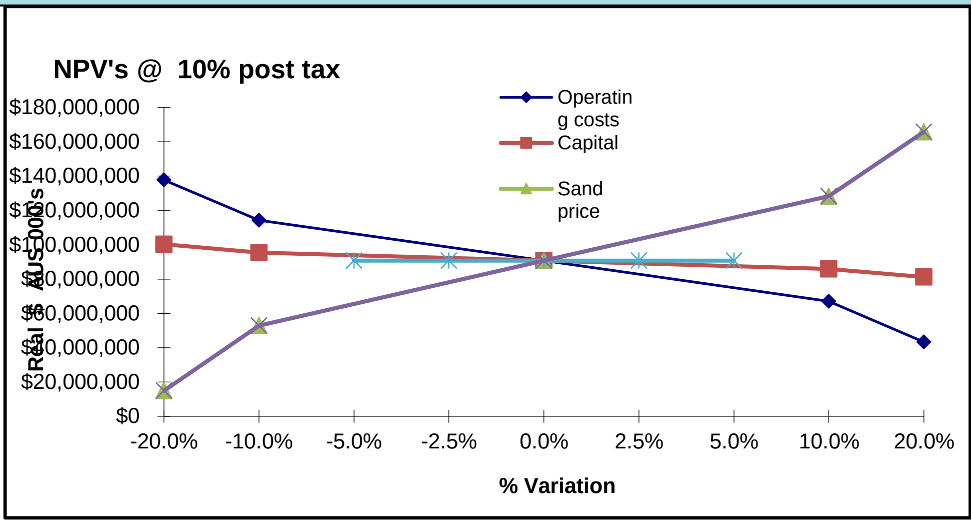
- +600µm = 17%
- -600µm +300µm = 14%
- -300µm +150µm = 9%
- -150µm = 97.5%

New Attributes are then generated in the Ore Reserve block model to reflect the products shown in Figure 4, and the % calculation of each final product is therefore;

Criteria	Commentary
	• **AFS20** = A x (100% - 17%) • **AFS35** = B x (100% - 14%) + (C x 10%*) • **AFS55** = C x (100% - (9% + 10%*) • **Local Product** = D + (A x 17%) + (B x 14%) + (C x 9%) *The 10% factor allows for the mass transfer from the finer AFS55 to the midsized AFS35 due to the use of up current classifiers in cutting the particle size at 300 µm in the Process Flow. The Mining Schedule produced by the Ore Reserve Model can now report the tonnage produced of each of the 4 final products above. The Financial Model then can reflect the sales of each product as determined from Marketing. The Ore Reserve conversion is declared as a plant recovered tonnage and is represented by the chemical and physical compositions of the final products that are produced for export, or for the local market.
	Environmental Characteristics of the Area The development is located: • South of the Yardanogo Nature Reserve; • Approximately 10 km inland of the coast; • North of the Arrowsmith River (Registered Aboriginal Heritage Site); and • Outside of World Heritage Areas, National Heritage Places, Ramsar Wetlands, Conservation Reserves or Commonwealth Marine Reserves. The Ore Reserve is located within an area of deep sands, leached of nutrients. The vegetation is coastal scrub heath (known as Kwongan heath). There are relict dune structures which are represented as low rolling hills. VRX are currently working through the Environmental Protection Authority of Western Australia (EPA) to gain approval to disturb native vegetation. On 15 March 2022 the EPA approved the Company's Environmental Scoping Document (ESD) for the proposed mining activities. On 14 April 2022 the Company submitted the Environmental Review Document (ERD), being a comprehensive summary of the project environmental setting, the physical elements of the mine and infrastructure, operational elements, the extent of effects on the environment and the proposed rehabilitation and closure plan. Currently the Company awaits the EPA to publish the ERD for public review. According to the EPA's indicative timeline the Company anticipates approval from the EPA towards the end of the 2022 calendar year. In parallel the Company is preparing the necessary approvals through DMIRS; • Mining Proposal and Closure Plan • Environmental Management Plan • Project Management Plan There is no reason to expect that the approval to mine will not be granted.

Criteria	Commentary
	The project is located east of the Brand highway and will construct a dedicated access road constructed for development and later haulage to the Geraldton Port. The project will require its own installed power and water infrastructure. The Company has completed a 400m deep water bore into the Yarragadee North Aquifer and is in the process of applying for a 5C water abstraction licence. Labour will be sourced from the nearest towns (35kms) Dongara and Eneabba There will be no accommodation installed at the mine site.
	Operating costs Costs were determined from first principles and are estimated to include all costs to mine, process, transport and load product on to ships, including; • Mulching • Topsoil cut • Topsoil re-location • Excavation • Plant Feed • Operating the trommel and pumping station • Processing • QA/QC • Power and Water • Administration • Product Handling • Road Transport • Port Storage • Ship Loading Product Quality • Multiple products will be differentiated during processing subject to required particle size distribution by screening • Recovery of products has been independently assessed by BHM, an independent expert in metallurgical testwork and process circuit design. Commodity Prices • Commodity prices for VRX silica sand products have been maintained at the 2019 rates • The industry standard is that sales contracts are in US dollars • The exchange rate to convert to Australian dollars will be the prevailing at the time of payment • Subject to final quality produced the current prices for the commodity will range from US$38 to US$43 per dry metric tonne Free on Board • There are no shipping cost estimates with all contracts to be based on FOB sales QA/QC

Criteria	Commentary
	• The company will undertake constant surveillance of product quality during production • An independent laboratory will be used to verify the product during loading on behalf of the buyer Royalties • The prevailing rate of Royalty due to the State is used in VRX economic assessments • The Royalty rate is per dry metric tonne ($1.17) and reviewed every 5 years with the next review due 2020 • There are no other private Royalties.
	Revenue will be based on a negotiated per shipment basis per dry metric tonne FOB with payment by demand on an accredited bank irrevocable Letter of Credit There are no other treatment, smelting or refining charges.
	The Company has maintained the same prices for products as the 2019 BFS. The company continues to assess projections for future demand and supply of Silica Sand The assessment concludes that there is a future tightening of supply suitable glassmaking and foundry silica sand with a commensurate increase in price Sales volumes have been estimated as a result of received Letters of Intent to purchase products
	The Company economic analysis has been calculated a 10% and 20% discounted ungeared post tax NPV The Company assessment has not escalated future product prices nor any inflation to operating costs The analysis has used a US$/A$ exchange rate of $0.66 Analysis is based on a conservative 25-year production profile despite the Reserves far exceeding that project life Tax rate used is 27% of profit Capital requirements are based on independent estimates Capital borrowings are based on a 12% borrowing rate Capital expenditure contingency is 20% of capital estimates Plant spares are estimated at 5% of capital value The economic analysis is most sensitive to the exchange rate

Criteria	Commentary
	
	The Arrowsmith North Project is on a granted mining lease M70/1389, expiry 15/11/2041. There is no reason to expect that future extensions of this mining lease will not be approved to cover the life span of this ore reserve. The mining area is within the Yamatji Nation State Agreement and the Company will operate under the Yamatji Nation Indigenous Land Use Agreement which was registered on 30 July 2020. The Company has executed a Standard Heritage agreement with the Yamatji Southern Regional Corporation which covers the area of operation. The Project is wholly on vacant, Unallocated Crown Land. The Company has completed an Air Emissions Assessment which concluded that, due to the sparsely populated area and the nature of the proposed operating mine, it is considered unlikely that the Operation will have a significant impact on air quality. The nature and scale of the Operation, and the separation distance to surrounding sensitive receptors (residences) is such that adverse impacts to human health and amenity are not expected to occur. Similarly, the Operation is not expected to adversely impact native vegetation as a result of dust deposition. Additionally, through the implementation of the proposed dust controls airborne dust generation can be maintained within acceptable levels.
	There are no known obvious or naturally occurring risks that have been identified which could affect the project and no reason why the Company cannot gain all approvals to mine the project from the relevant Regulatory Bodies, both State and Federal. The Company signed an offtake term sheet with two Korean based foundry sand suppliers in November 2021 for the supply of 200,000t per annum of AFS55 certified foundry sand. The Company has received expressions of interest from 20 manufacturers across the Asia Pacific Region for various silica sand products in its published catalogue, including specific requests for Arrowsmith North products. A number of Letters of Intent to purchase the Project's proposed products have been received from potential customers.

Criteria	Commentary
	Proved and Probable Reserves are converted from Measured and Indicated Resource materials respectively due to the nature of the deposit (consistency, homogeneity, low variability). This is considered reasonable.
	The Ore Reserve estimate has been reviewed internally by VRX. No external reviews or audits have been undertaken on the Ore Reserve estimate.
	The Mineral Resource, and hence the associated Ore Reserve, relate to global estimates. To date there has been no commercial production, therefore no reconciliation can be made. A feasibility study was completed in August 2019 and the results of that study are available to the Competent Person. The Feasibility Study and additional information available to the Competent Person has been completed to an appropriate level of detail that the Competent Person can be confident the project is robust and produce positive economic benefit to the Company once in production. Sensitivity analyses made during the Feasibility Study and this updated life of mine schedule have indicated that the economics are most sensitive to the USD/AUD exchange rate. It is believed that the revenue model is sufficiently conservative to ensure a positive economic return.

18.2. JORC Compliance Statement

The information in this document that relates to Exploration Targets, Exploration Results, Mineral Resources, Ore Reserves and Production Targets have been extracted from the report(s) and announcements listed below.

Mineral Resource estimate for Arrowsmith North Silica Sand Deposit Ref: R500.2020: David Williams, CSA Global Mining Industry Consultants (December 2021)

Life of Mine Scheduling and Updated Ore Reserves Estimate ARROWSMITH NORTH PROJECT: Quinton de Klerk, Cube Consulting (October 2022)

Desktop Assessment of Potential Flora, Vegetation and Fauna Values at the Arrowsmith Project Area: Mattiske Consulting (March 2017)

H3 Hydrogeological Assessment (Water Direct, December 2022)

18.3. Competent Person's Statement

The information in this report that relates to Arrowsmith Exploration Results are based on data collected and complied under the supervision of Mr David Reid, in his capacity as Exploration Manager. Mr Reid, BSc (Geology), is a registered member of the Australian Institute of Geoscientists and has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and the activity being undertaken to qualify as a Competent Person under the 2012 edition of the "Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves". Mr Reid consents to the inclusion of the data in the form and context in which it appears.

The information in this report that relates to Mineral Resources is based on, and fairly reflects, information compiled by Mr David Williams, a Competent Person, who is an employee of CSA Global and a Member of the Australian Institute of Geoscientists. Mr Williams has sufficient experience relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as Competent Person as defined in the 2012 Edition of the Australasian Code for the Reporting of Exploration Results, Mineral Resources, and Ore Reserves (JORC Code). Mr Williams consents to the disclosure of information in this report in the form and context in which it appears.

The information in this report that relates to Industrial Minerals considerations with respect to Clause 49 of the JORC Code is based on, and fairly reflects, information compiled by Dr Andrew Scogings, a Competent Person, who is an employee of CSA Global, a Member of the Australian Institute of Geoscientists and is a Registered Professional Geoscientist (RP Geo. Industrial Minerals). Dr Scogings has sufficient experience relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as Competent Person as defined in the 2012 Edition of the Australasian Code for the Reporting of Exploration Results, Mineral Resources, and Ore Reserves (JORC Code). Dr Scogings consents to the disclosure of information in this report in the form and context in which it appears.

The information in this report that relates to metallurgical test work is based on information compiled by Mr Steven Hoban who is the Principal Metallurgist and a Director of BHM. Mr Hoban is a Member of the Australasian Institute of Mining and Metallurgy. Mr Hoban has sufficient experience relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as Competent Person as defined in the 2012 Edition of the Australasian Code for the Reporting of Exploration Results, Mineral Resources, and Ore Reserves (JORC Code). Mr Hoban consents to the disclosure of information in this report in the form and context in which it appears.

The information in this report that relates to Ore Reserves is based on information compiled by Mr Quinton de Klerk, who is employed by Cube Consulting. Mr de Klerk is a fellow of the Australasian Institute of Mining and Metallurgy and has sufficient experience which is relevant to the activity he is undertaking to qualify as a Competent Person as defined in the 2012 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (the JORC Code). Mr de Klerk consents to the inclusion in the report of the matters based on his information in the form and context in which it appears.

19. Cautionary Statement Regarding Forward-Looking Information

Statements regarding plans with respect to the Company's mineral properties may contain forward looking statements. Statements in relation to future matters can only be made where the Company has a reasonable basis for making those statements. This announcement has been prepared in compliance with the current JORC Code 2012 Edition and the current ASX Listing Rules. The Company believes it has a reasonable basis for making the forward-looking statements, including any production targets, based on the information contained in the announcement and in particular the JORC 2012 - Bankable Feasibility Study.

All statements, trend analysis and other information contained in this document relative to markets for VRX, trends in resources, recoveries, production and anticipated expense levels, as well as other statements about anticipated future events or results constitute forward- looking statements. Forward-looking statements are often, but not always, identified by the use of words such as "seek", "anticipate", "believe", "plan", "estimate", "expect" and "intend" and statements that an event or result "may", "will", "should", "could" or "might" occur or be achieved and other similar expressions. Forward-looking statements are subject to business and economic risks and uncertainties and other factors that could cause actual results of operations to differ materially from those contained in the forward-looking statements. Forward-looking statements are based on estimates and opinions of management at the date the statements are made. VRX does not undertake any obligation to update forward- looking statements even if circumstances or management's estimates or opinions should change. Investors should not place undue reliance on forward-looking statements.

20. Glossary

- **Community Engagement**: Involving and communicating with local communities to address concerns, provide information, and gather feedback regarding the mining project.
- **Feasibility Study**: A comprehensive analysis and assessment of the practicality, viability, and potential success of a proposed project.
- **Financial Modeling**: The development of financial projections and analyses to assess the economic feasibility and profitability of the mining project.
- **Geological Exploration**: The process of studying the Earth's subsurface to understand the distribution of minerals and other geological resources.
- **Hydrogeology:** The study of the distribution and movement of groundwater in the soil and rocks.
- **Market Analysis**: An examination of the demand, supply, and potential market trends for silica sand, including pricing and market dynamics.
- **Mineralogy**: The study of minerals, including their composition, structure, and properties.
- **Mining**: The extraction of valuable minerals or other geological materials from the Earth.
- **NPV:** A financial metric used in feasibility studies and investment analysis to calculate the present value of all expected future cash
- **Permitting**: The process of obtaining legal authorisation, licenses, or permits required for mining activities from relevant regulatory authorities.
- **Rehabilitation**: The restoration of a mined area to a condition suitable for its intended future use, often involving landscaping and environmental rehabilitation.
- **Reserve Estimation**: The determination of the amount of extractable silica sand in a given deposit based on geological and engineering data.
- **ROI (Return on Investment):** A financial metric used to evaluate the profitability of an investment, calculated as the ratio of net profit to the initial investment cost.
- **Silica Sand**: Sand composed primarily of quartz, a common mineral found in the Earth's crust.
- **Stakeholder**: Any individual, group, or organisation that may be affected by or can affect the outcome of the mining project.
- **Tailings**: The waste material produced during the mining process, typically consisting of finely crushed rock and processing fluids.
- **Transportation Infrastructure**: The network of roads, railways, and other facilities needed to transport silica sand from the mining site to processing or distribution points.