Australian Strategic Materials Ltd

ASX Announcement

Release Date: 7 December 2021

Dubbo Project Optimisation Delivers Strong Financials

Key Points

- **Optimisation Work for Dubbo Project confirms a strong expected rate of return with pre-tax NPV of AUD 2,361 million, pre-tax IRR of 23.5%, and annual free cash flow (full ramp up) of AUD 425 million**
- **Capital cost estimate of AUD 1,678 million consisting of direct capital of AUD 1,307 million, indirect capital of AUD 208 million, and a contingency of AUD 163 million**
- **Forecast annual operating cost of AUD 287 million**
- **Forecast based on 20-year life of mine at 1Mtpa plant feed rate based on existing ore reserves. Measured and Inferred mineral resources, which have the potential to extend the mine life, have been excluded for this study**
- **Oxides of zirconium, hafnium, niobium, didymium (i.e.: neodymium and praseodymium), dysprosium and terbium to be produced**
- **Inclusion of major infrastructure to optimise environmental, social and governance (ESG) performance and deliver operating cost savings**

Australian Strategic Materials Ltd (**ASX: ASM** or the **Company**) is pleased to confirm strong financial results as an outcome of the Optimisation Study and Enhanced Project Addendum (**Optimisation Work**) for the Dubbo Project (**Dubbo Project**). The Optimisation Study was based on Alkane Resources Ltd's optimisation study released to the market in 2018 (*ALK: ASX Release 4 June 18 Dubbo Project Engineering and Financials Update*) (**2018 ASX Release**). A summary of the outcomes of the Optimisation Work is included at the end of this announcement entitled Dubbo Project: Project Summary (**Project Summary**).

The revised financials are based only on the initial ore reserve of 18.9 Mt. Substantial additional measured and inferred mineral resources beneath the ore reserve are excluded from this study.

The Optimisation Work simplifies the Dubbo Project process flow sheet and incorporates new operating strategies that will reduce operating costs and improve the ESG performance of the Dubbo Project. These strategies now include increasing the brine concentrator capacity (halving water consumption), refurbishment of the railway line (which simplifies project logistics and will provide new categories of local entry level jobs) and development of a chlor-alkali plant (which reduces the cost of reagents and their handling and transportation). These strategies facilitate ESG benefits by reducing water consumption, reducing the handling and quantum of process chemicals, and reducing the number of trucks on local roads, required for the Dubbo Project.

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The updated Dubbo Project base case for the 20-year life of mine is expected to achieve a pre-tax NPV of AUD 2,361 million and a pre-tax project internal rate of return of 23.5%. This is a pre-tax IRR improvement of 6.0% compared to the 2018 ASX Release.

The forecast financial outcomes from Optimisation Work are compared with those from the 2018 ASX Release in Table 1 (see Section 11 of the Project Summary for further details on financial information and key assumptions).

Table 1: Forecast Financial Outcomes (in Aud)

Key Outputs	2018 ASX Release (20 Years)	Optimisation Study Go Forward Case 2021 (20 Years)
Gross Revenue	12,768	15,802
Total undiscounted pre-tax Free Cash Flow	4,656	7,442
Annual Free Cash Flow (full ramp up)	323	425
Pre-tax Project IRR %	17.5%	23.5%
Post-tax Project IRR %	Not released	20.1%
Pre-Tax NPV	1,236	2,361
Post-tax NPV	Not released	1,581
	Assumptions unchanged: Exchange Rate (A$:US$) - 0.75; Discount Rate (real, post-tax %p.a.) 8.0%; Corporate Tax Rate (%) - 30%	

The capital cost estimate from the Optimisation Work is AUD 1,678 million compared to AUD 1,297 in the 2018 ASX release. Key drivers of the increased capital costs from the 2018 ASX Release include refinements in the design and updating of the pricing of the dehafniated zirconia solvent extraction plant (AUD 87 million), inclusion of a chlor-alkali plant (AUD 65 million), Brine Concentrator capacity upgrade (AUD 30 million), and owners contingency (AUD 163 million). These inclusions have the effect of reducing the forecast annual operating expenditure from AUD 317 million to AUD 287 million (an annual average saving of AUD 40 million) and have improved the ESG performance of the Dubbo Project.

The cost estimates from the Optimisation Work are compared with those from the 2018 ASX Release in Table 2 (see Section 11 of the Project Summary for further information on capital and operating cost estimates).

Table 2: Capital and Operating Cost Estimates

Description of Cost	2018 ASX Release (20 Years) AUD M	Optimisation Study Go Forward Case 2021 (20 Years) AUD M
Mining, Crushing and grinding	28	44
Roasting & Leaching	17	34
Solvent extraction, product refining and finishing	329	342
De-Hafniated Zirconia SX	30	117
Waste treatment (Incl. SRSF, Filtration, Brine Conc)	161	215
Reagents, Water, SAP, Chlor Alkali	197	250
Electricity	77	117
Site Wide Infrastructure	98	116
Offsite Infrastructure	72	72
EPCM	90	104
Temp Construction Facilities	24	27
Spares & First Fills	26	27
Owner's costs and provisions	45	50
Contingency	103	163
Total Capital Expenditure	1,297	1,678
Average annual operating expenditure Estimate	317	287

An independent review completed by consultants, Mining One Pty Ltd, has confirmed proven Ore Reserves estimate of 18.9 Mt. The Mineral Resource estimate for the Dubbo Project is 75.2 Mt of 42.8 Mt Measured and 32.4 Mt Inferred is unchanged.

The Dubbo Project has been optimised to produce neodymium, praseodymium, zirconium, hafnium, dysprosium, terbium and niobium oxides that can all be refined into high-purity alloys, metals and powders at ASM's metals plants.

ASM Managing Director, David Woodall, said:

"I am delighted with the outcomes of the Optimisation Work which demonstrates the financial strength of the Dubbo Project and ASM's focus on a sustainable future delivering improved performance and ESG outcomes.

The Optimisation Work supports a strong go forward case and is an exciting development for ASM, our partners and shareholders.

The Optimisation Work confirms we have a project that can integrate into our metals business to create an alternate, sustainable, secure and stable long-term supply of critical metals and oxides. This places ASM in an exceptional position in the critical metals value chain, as the vertically integrated owner of a globally significant polymetallic resource in Dubbo, and the capability to produce critical metals from this resource to the highest environmental standards.

These exciting outcomes allow the ASM team to focus on progressing the financing, engineering, and construction strategy, and to secure offtake agreements for the integrated metals business.

ASM is making good progress on these matters. In particular, with the financing of the Dubbo Project through the conditional Framework Agreement with the consortium of Korean private equity firms and the letter of support from Export Finance Australia."

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This document has been authorised for release to the market by David Woodall, Managing Director.

ABOUT AUSTRALIAN STRATEGIC MATERIALS – www.asm-au.com

Australian Strategic Materials Ltd (ASM) is an integrated materials business and emerging "mine to metal" producer of critical metals. The company's cornerstone Dubbo Project (100% owned) is a potential long-term resource of rare earths, zirconium, niobium, and hafnium located in central western NSW, Australia. It represents an alternative, sustainable and secure source of these metals, which are critical for a diverse range of advanced and clean technologies.
ASM's metals business is founded on an innovative metallisation process that converts oxides into high-purity metals, alloys, and powders using less energy than conventional methods. The pilot plant in South Korea has proven the commercial scalability of the process and successfully produced a range of high-purity metals and alloys, including titanium, neodymium, praseodymium, dysprosium, and zirconium. Following this success, ASM's first metallisation plant is being constructed in South Korea to initially supply a range of critical metals including rare earths, zirconium, and titanium.

IMPORTANT INFORMATION

Please refer to pages 6 – 8 of the Optimisation Study Report for important information in relation to this announcement.

Australian Strategic Materials Ltd

Dubbo Project:

Project Summary

Current as of 7 December 2021

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Table of contents

Listing of tables

Listing of figures

1 The Company

Australian Strategic Materials Ltd (**ASX: ASM** or the **Company**) is an emerging integrated producer of critical metals for advanced and clean technologies. The Company has a "mine to metal" strategy to extract, refine and manufacture high-purity metals and alloys supplying direct to global technology manufacturers. The strategy has two key components:

- the development of the large polymetallic Dubbo Project, which incorporates mining and processing operations that will produce key oxides of zirconium, rare earth elements, niobium and hafnium; and
- the development of a global critical metals business, with strategically located plants supplying directly to manufacturing sectors. The first metal plant is currently under construction in South Korea.

The Company was demerged from Alkane Resources Ltd (ALK) in July 2020.

1.1 Cautionary Statements and Risks

The report contains some statements regarding estimates or future events which constitute forward-looking statements. They include possible or assumed reserves and resources and production levels, as well as rates, costs, prices, future earnings, cash flow, financial performance (including references to, and statements about, net present values and expected cash flows) and future performance or potential growth of ASM, industry growth or other trend projections. Forward-looking statements include, but are not limited to, statements preceded by words such as "planned", "expected", "projected", "estimated", "may", "scheduled", "intends", "anticipates", "believes", "potential", "predict", "foresee", "proposed", "aim", "target", "opportunity", "could", "nominal", "conceptual" and similar expressions.

Forward-looking statements are provided as a general guide only and should not be relied on as a guarantee of future performance. Forward-looking statements involve unknown risks and uncertainties and may be affected by a range of variables beyond the control of ASM that could cause actual results to differ from estimated results and may cause the Company's actual performance and financial results in future periods to materially differ from any projections of future performance or results expressed or implied by such forward-looking statements. So, there can be no assurance that actual outcomes will not materially differ from these forward-looking statements.

These statements are subject to significant risks and uncertainties, which are summarised in Section 13 of this report. Investors should read, and consider, those risks and uncertainties carefully.

Forward-looking statements, opinions and estimates included in this report are based on assumptions and contingencies. Material assumptions are supporting the forward-looking statements contained within this document, including market growth rates, demand for products, the projected product pricing and resultant revenues, the projected production rates and quantities, the capital costs to develop and operate the Project, the ability to secure sufficient and binding offtake contracts with bankable counterparties, the availability, certainty and sources of funding, the marketing strategy, and financial performance (including the discounted cashflows analysis supporting the net present value and internal rate of return information included in this report).

Whilst the Company considers all of the material assumptions to be based on reasonable grounds at the time of writing, there is no certainty that they will prove to be correct or that the range of outcomes indicated will be achieved. These assumptions are subject to change without notice, as are statements about market and industry trends, which are based on interpretations of current market conditions. No representation or warranty, express or implied, is made by the Company that the matters stated in this report will be achieved or proven to be correct.

To develop the Dubbo Project to position the Company to achieve the outcomes indicated in this report, a significant amount of funding will be required, most likely from several sources (see Sections 13.8 - 13.12 of this report). Investors should note that as at the date of this report the Company has not yet secured any funding arrangements required in connection with the development of the project, and there is no certainty that the Company will be able to raise the required amount of funds when needed on reasonable terms or at all. However, having regard to the information available to it and the analysis undertaken (as explained in this report), the Company considers that it has a reasonable basis to expect it will be able to fund the development of the Project. The various assumptions underlying the Company's expectation that it will be able to fund the development of the Project, and the specific risks associated with those assumptions, are described throughout Section 13 of this report. A number of those assumptions relate to future events and conditions, which are difficult to predict. Should any of these assumptions prove to be incorrect, or where the Company is not ultimately able to secure the requisite amount of funding on acceptable terms, there is a risk that the Company will not be able to fund the development of the Project. In these circumstances, the financial metrics provided in this report will not eventuate.

Given the uncertainty involved, investors should not make any investment decisions based solely on the information included in this report.

1.2 Compliance Statement

The information relating to Mineral Resource estimates is extracted from the Company's Information Memorandum released to ASX on 29 July 2020 and is available to view on the Company's website and on the ASX website. The Company is not aware of any new information or data that materially affects the information included in the original market announcements[1] and that all material assumptions in the relevant market announcements continue to apply and have not materially changed. Information relating to a review of Ore Reserves is presented in Section 5 of this report. The Company confirms that the form and context in which the Competent Persons findings are presented here have not been materially modified from the original market announcements.

1.3 General Disclaimer

Except for statutory liability which cannot be excluded, the Company, its officers, employees and advisers expressly disclaim any responsibility for the accuracy or completeness of the material contained in this report and exclude all liability whatsoever (including in negligence) for any loss or damage which may be suffered by any person as a consequence of any information in this report or any error or omission there from.

This report does not take into account the individual investment objectives, financial or tax situation or particular needs of any person. It does not contain financial advice. Investors should consider seeking independent legal, financial and taxation advice concerning the contents of this report.

[1] ASM ASX and Media Release – "Information Memorandum & Demerger Booklet" dated 29 July 2020

Except as required by applicable law, the Company does not undertake any obligation to release publicly any revisions to any forward-looking statement to reflect events or circumstances after the date of this report or to reflect the occurrence of unanticipated events, except as may be required under applicable securities laws.

1.4 Competent Person

Unless otherwise stated, the information in this presentation that relates to mineral exploration, mineral resources and ore reserves is based on information compiled by Mr. D I Chalmers, FAusIMM, FAIG, (director of the Company) who has sufficient experience which is 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 Reporting of Exploration Results, Mineral Resources and Ore Reserves. Ian Chalmers consents to the inclusion in the presentation of the matters based on his information in the form and context in which it appears. Ian Chalmers is a shareholder in the Company.

2 Purpose of Report

This Project Summary Report updates the market on outcomes of the research, engineering, processing and other technical activities completed as part of the Optimisation Study and Enhanced Dubbo Project Addendum concerning the Dubbo Project.

3 Project Highlights

The Project highlights are summarised in this section 3.

3.1 Simplified Flowsheet & Improved ESG Performance

The Optimisation Work simplifies the Dubbo Project process flow sheet and incorporates new operating strategies that will reduce operating costs and improve the ESG performance of the Dubbo Project. These strategies include the increase in brine concentrator capacity (further reducing water consumption), refurbishment of the railway line (which simplifies project logistics and will provide new categories of local entry-level jobs) and development of a chlor-alkali plant (which reduces the cost of reagents and their handling and transportation). These strategies facilitate significant ESG benefits by reducing; water consumption; the handling and quantum of process reagents; and the number of trucks on local roads, required for the Dubbo Project.

3.2 Forecast Financial Outcomes

The updated Dubbo Project base case for the 20-year life of mine is predicted to achieve a pre-tax NPV of AUD 2,361 million and a pre-tax project internal rate of return of 23.5%. This is a pre-tax IRR improvement of 6.0% compared to the 2018 study. The forecast financial outcomes from Optimisation Study are compared with those from the 2018 ASX Release in Table 1.

Table 1: Forecast Financial Outcomes

Key Outputs	**2018 ASX Release Base Case (20 Years) AUD M**	**2021 Optimisation Study Go Forward Case (20 Years) AUD M**
Gross Revenue	12,768	15,802
Total undiscounted pre-tax Free Cash Flow	4,656	7,442
Annual Free Cash Flow (full ramp up)	323	425[2]
Pre-tax Project IRR %	17.5%	23.5%
Post-tax Project IRR %	Not released	20.1%
Pre-Tax NPV	1,236	2,361
Post-tax NPV	Not released	1,581
	Assumptions unchanged: Exchange Rate (A$:US$) - 0.75; Discount Rate (real, post-tax %p.a.) 8.0%; Corporate Tax Rate (%) - 30%	

3.3 Forecast Capital and Operating Costs

The capital cost estimate from the Optimisation Work is AUD 1,678 million compared to AUD 1,297 in the 2018 ASX Release. Key drivers of the increased capital costs from the 2018 ASX Release are further definition of technical aspects and pricing of the dehafniated zirconia solvent extraction plant (AUD 87 million), the inclusion of a chlor-alkali plant (AUD 65 million), Brine Concentrator capacity upgrade (AUD 30 million) and owners contingency (AUD 163 million). These inclusions have the effect of reducing the forecast annual operating expenditure from AUD 317 million to AUD 287 million (an annual average saving of AUD 40 million) and have improved the ESG performance of the Dubbo Project.

The cost estimates from Optimisation Work are compared with those from the 2018 ASX Release in Table 2.

[2] This amount is the average of years 7-10 pre-tax project cashflow in the Financial Model

Table 2 : Capital and Operating Cost Estimates

Description of Cost	2018 ASX Release Base Case (20 Years) AUD M	2021 Optimisation Study Go Forward Case (20 Years) AUD M
Mining, Crushing and grinding	28	44
Roasting & Leaching	17	34
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Temp Construction Facilities	24	27
Spares & First Fills	26	27
Owner's costs and provisions	45	50
Contingency	103	163
Total Capital Expenditure	1,297	1,678
Average annual operating expenditure Estimate	317	287

3.4 Mineral Resource and Ore Reserves

An independent review completed by Mining One Pty Ltd has confirmed Proven Ore Reserves estimate of 18.9 Mt. (See Annexure A for JORC Table 1).

The Mineral Resource estimate for the Dubbo Project of 75.2 Mt of 42.8 Mt Measured and 32.4 Mt Inferred is unchanged from that documented in the Information Memorandum and Demerger Booklet, ASX announcement of 29 July 2020.

The Project has been optimized to produce neodymium, praseodymium, zirconium, hafnium, dysprosium, terbium, and niobium oxides that can all be refined into high-purity alloys, metals and powders at ASM's metals plants.

4 Background

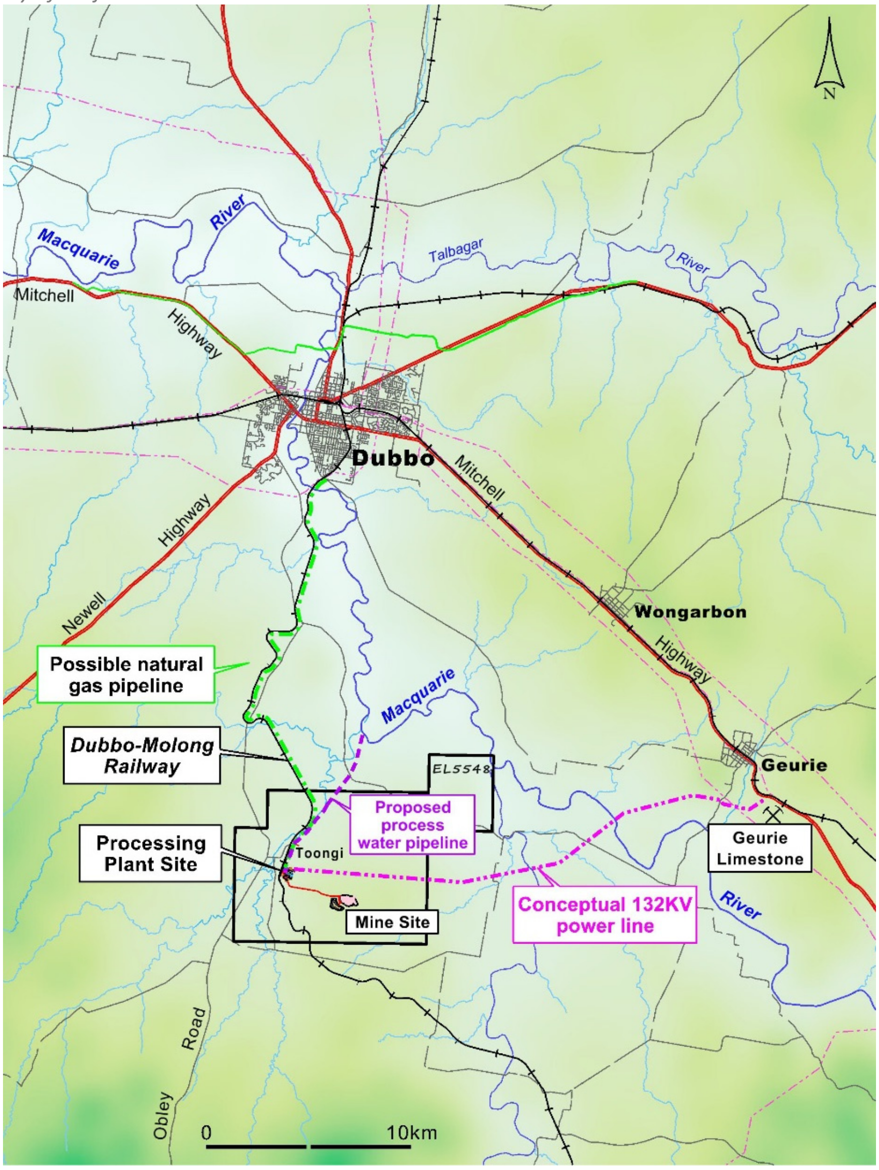
4.1 Dubbo Project Location

ASM's Dubbo Project is located near the village of Toongi, 25 km south of Dubbo, in central-western New South Wales (NSW), Australia, refer to Figure 1. The project site is approximately 400 km northwest of Sydney and Newcastle. Both major cities connect to Dubbo via road and rail.

Figure 1 – Dubbo Project Regional Location

Figure 2 shows that the project site is well situated with proximity to Dubbo with established utilities, road and rail networks.

Figure 2 – Proximity of Project to Dubbo Facilities

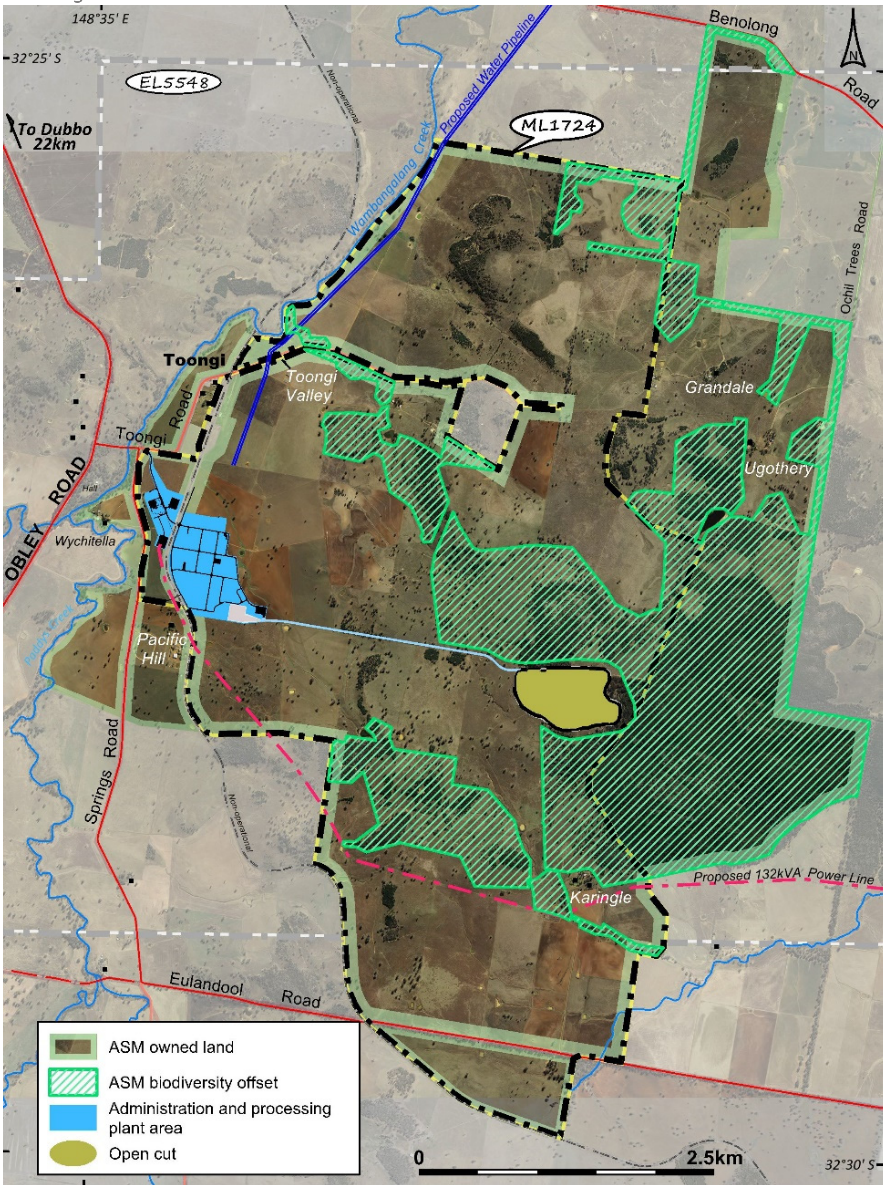


4.2 Dubbo Project Mining Lease and Landholding

The mining lease for the Dubbo Project is Mining Lease (ML) 1724, granted on 21 December 2015. The Company owns 3,456 hectares of land where ML 1724 is located. The mine and required processing facilities will all be located on this land.

Figure 3 includes the ore reserve as well as all the land required for processing facilities.

Figure 3 – Project Mining Lease



5 Mineral Resources & Ore Reserves

Independent consultants, Mining One Pty Ltd, were engaged to provide a review of the estimation of the Mineral Resources and Ore Reserves for the Toongi deposit which is the foundation of the Dubbo Project (see Annexure A). The revised estimation was based on the previous estimates summarised in the ASX Announcement of 19 September 2017 and a review of key aspects of metallurgical recoveries, updated product prices and revenue, and operating costs resulting from the current Optimisation Study.

Mining One concluded that the pit optimisation result indicates that the changes in the updated parameters, in particular processing parameters and mine schedule prepared for the 2017 Ore Reserve Estimate remain valid and have been used in the updated Ore Reserve Estimate.

The Resource and Reserve estimates follow the 2012 edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC 2012).

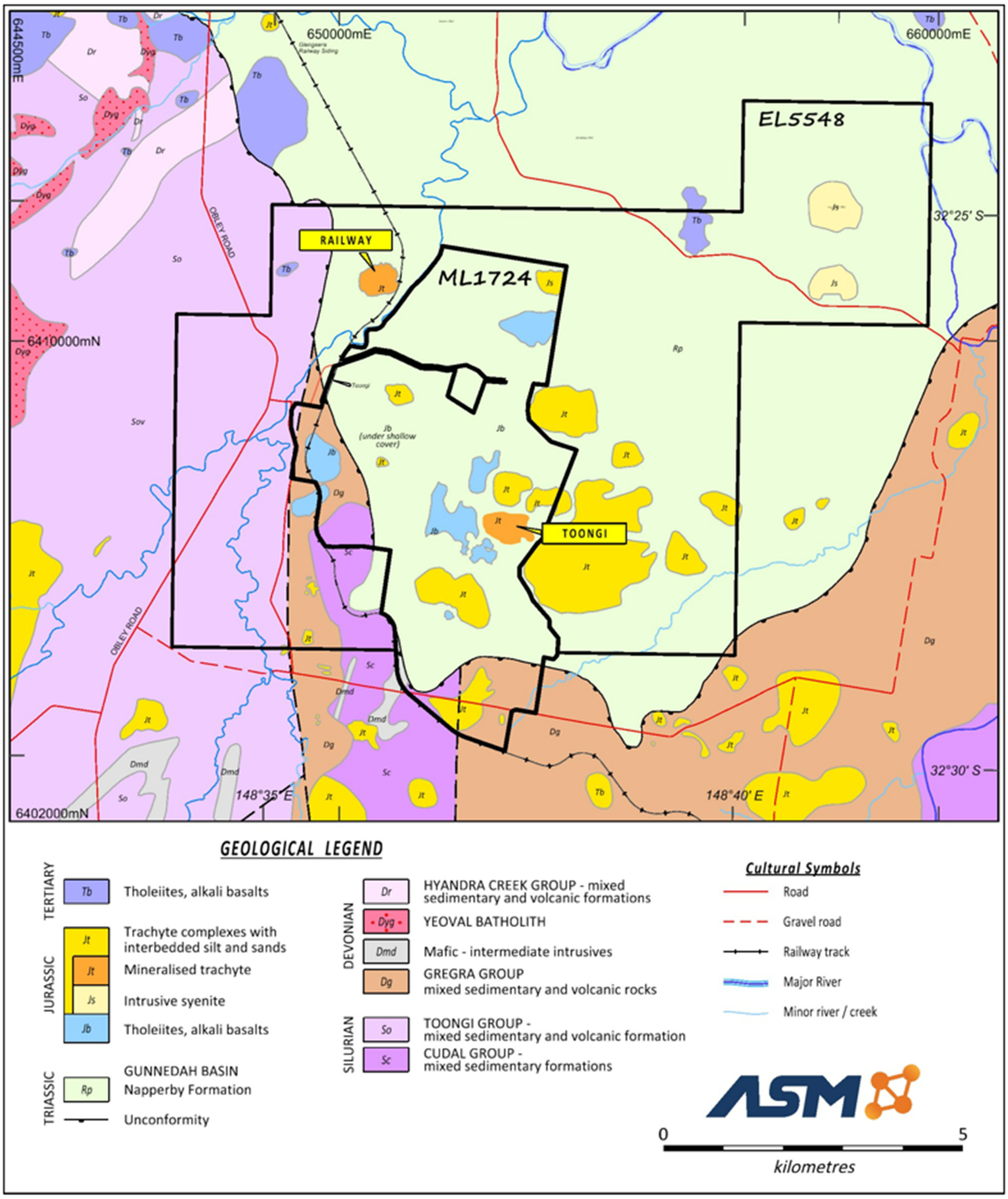
5.1 Geology

The Toongi deposit is centered on a trachyte outcrop that forms one of several alkaline volcanic and intrusive bodies of the Jurassic age in the region (formed 190 - 210 million years ago). The elliptical-shaped body has approximate dimensions of 850 m east-west by 550 m north-south. The deposit forms a low irregular topographic rise and has an average depth extent of 115 m below the surface.

The orebody is predominantly a massive, fine-grained microporphyritic trachyte with more than 80% of the orebody consisting of feldspar, albite and aegirine (in roughly equal amounts). The rest of the rock is made up of opaque minerals. Extensive mineralogical studies have indicated that the ore minerals contained in the deposit are extremely fine-grained, being less than 100 µm in size (and generally less than 10 µm), and uniformly distributed throughout the rock mass. The bulk of the ore metals are hosted in complex Na–Ca–Zr–Hf–HREE silicate phases (eudialyte like mineral). The dominant Nb (and Ta) mineral is close to $NaNbO_3$ (natroniobite) in composition. Separately bastnasite hosts the light rare earth metals.

The deposit contains elevated levels of the metals zirconium (Zr), hafnium (Hf), niobium (Nb), tantalum (Ta), yttrium (Y) and rare earth elements (REEs) – lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu). The orebody also holds some uranium and thorium and is classified as a weakly radioactive ore.

Figure 4 - Toongi Deposit Regional Geological Mapping



5.2 Drilling and Analysis

The Mineral Resource is based on 122 largely vertical reverse circulation (RC) holes drilled on a 50 m offset rectangular pattern to vertical depths varying from 50–100 m (Figure 6 and Figure 7). Five vertical diamond core holes were also drilled to confirm the geology and geochemistry of the deposit. Various analytical processes were used, and detailed statistical studies were completed to provide a comprehensive grade model within the deposit.

Figure 5 - Schematic of Toongi Deposit

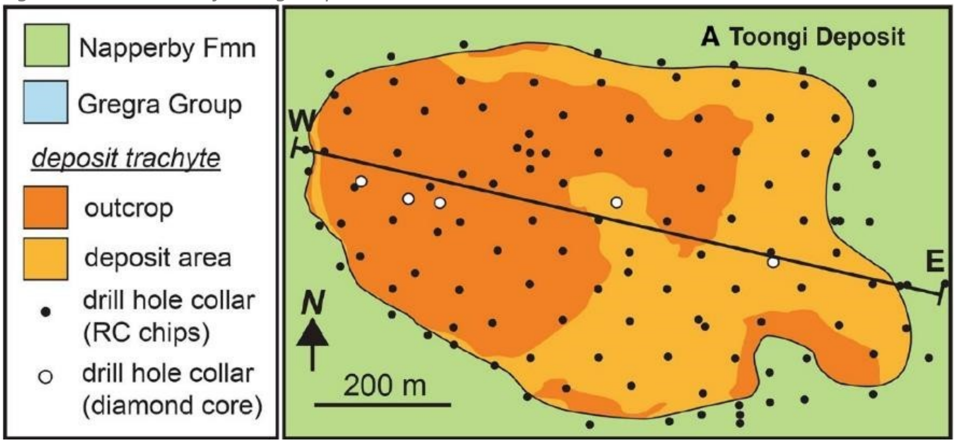
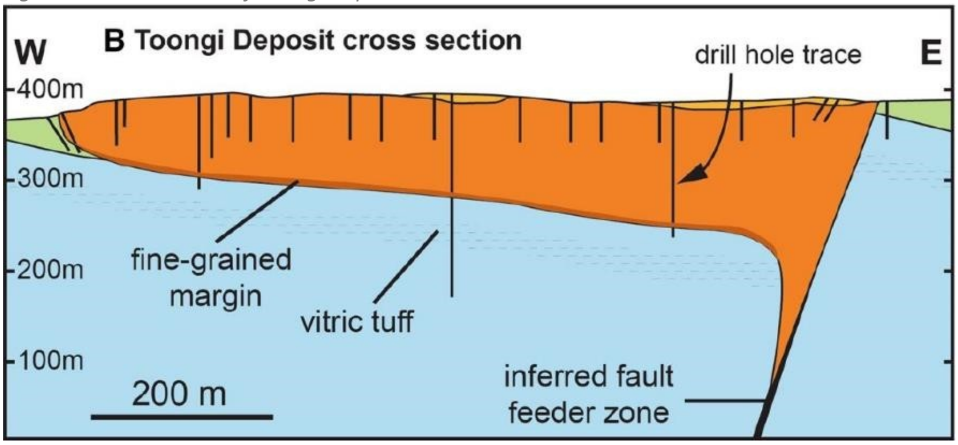


Figure 6 - Cross-section of Toongi Deposit



5.3 Mineral Resources – 2021

The 2016 Mineral Resources estimate has not been updated during the Optimisation Study and is summarised in Table 3.

Table 3 - Dubbo Project Mineral Resources

Resource Category	Tonnes (Mt)	ZrO_2 (%)	HfO_2 (%)	Nb_2O_5 (%)	Ta_2O_5 (%)	Y_2O_3 (%)	TREO* (%)	Resource Category
Measured	42.81	1.89	0.04	0.45	0.03	0.14	0.74	Measured
Inferred	32.37	1.90	0.04	0.44	0.03	0.14	0.74	Inferred
Total	**75.18**	**1.89**	**0.04**	**0.44**	**0.03**	**0.14**	**0.74**	**Total**

*TREO% is the sum of all rare earth oxides excluding ZrO_2, HfO_2, Nb_2O_3, Ta_2O_5, Y_2O_3,

5.4 Ore Reserves – 2021

Mining One has reconfirmed the estimated 2017 Ore Reserves[3] based on the Optimisation Study report, Enhanced Dubbo Project Addendum and improvements in operating costs.

[3] Alkane ASX and Media Release – "Dubbo Project Resource and Reserve Statements FY17" dated 19 September 2017

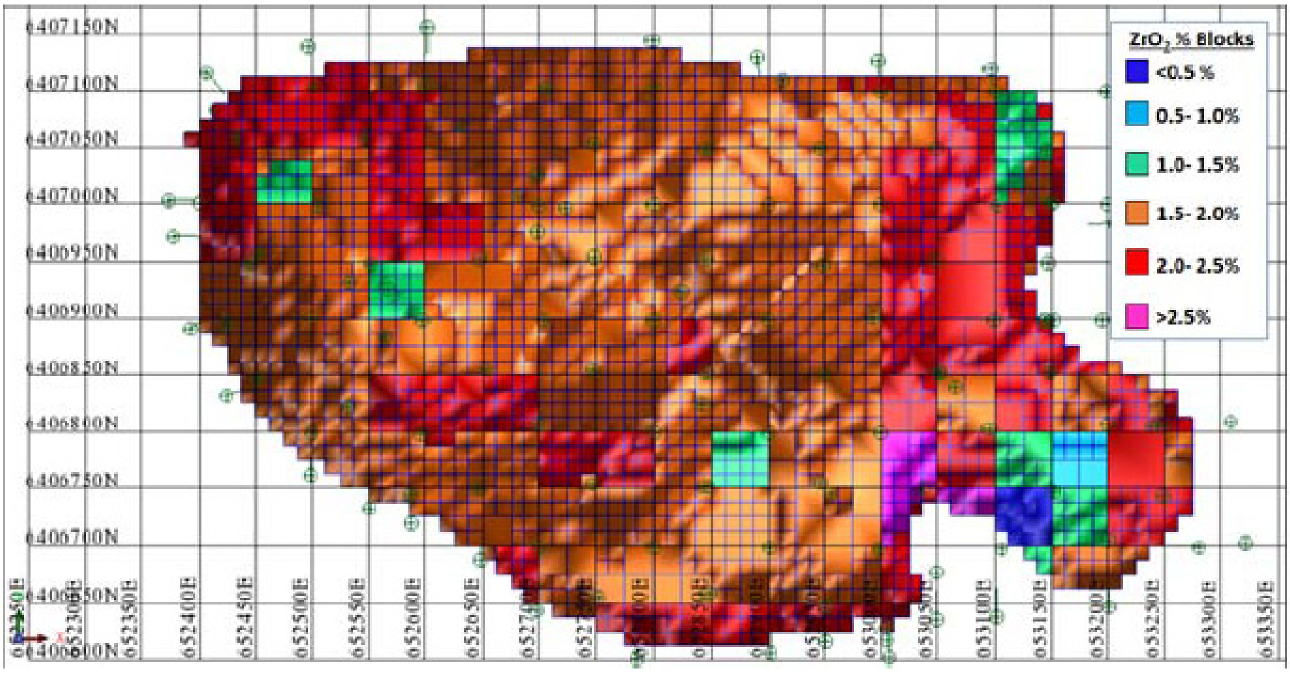
The Ore Reserve estimate is summarised in Table 4.

Table 4 - Dubbo Project Ore Reserves

Reserve Category	Tonnes (Mt)	ZrO2 (%)	HfO_2 (%)	Nb2O5 (%)	Ta2O5 (%)	Y2O3 (%)	TREO* (%)
Proved	18.90	1.85	0.04	0.44	0.03	0.14	0.74
Total	**18.90**	**1.85**	**0.04**	**0.44**	**0.03**	**0.14**	**0.74**

*TREO% is the sum of all rare earth oxides excluding ZrO_2, HfO_2, Nb_2O_3, Ta_2O_5, Y_2O_3,

Figure 7 - Toongi Block Model ZrO2 (%) Values



5.5 Resource -Reserve Upside and Exploration Potential

Current resource estimate of the Toongi deposit is limited due to the drilling coverage defining the lower boundary of the trachyte sill which remains open at depth. There is a similar but largely undrilled prospect at Railway located 4km to the northwest of Toongi (see figure 4 above). Details of the Railway deposit are given in ASX Announcement 27 January 2012.

The current Reserve estimate was limited by the initial 20 year mine life proposed for the Project, but the remainder of the Measured Resource could be reclassified as Probable Reserves if the development was extended to 40 years.

6 Environment, Social and Governance

ASM seeks to sustainably produce critical metals essential for advanced and clean technologies. Market forces require that the materials used in these clean technologies are responsibly sourced from manufacturers that adhere to the highest Environmental, Social and Governance (ESG) standards. The Company has a history of responsible ESG practices and nature conservation, and nurtures a culture of innovation, inclusion, integrity and safety. ASM understands the importance of managing environmental impacts, respecting human rights, minimising greenhouse gas emissions and supporting local communities. The Company recently appointed an executive team that has specific accountability for ESG. Over the next year, ASM will develop an ESG framework to manage key risks and opportunities.

6.1 Environment

ASM has completed studies to optimise key project environmental areas, including the disturbance footprint, utility requirements, water and waste management, materials handling and transportation activities. The outcome of these studies has identified and implemented improvements across some project areas including water consumption, logistics, processing and site disturbance. These improvements include increased process water recovery, the inclusion of a chlor-alkali plant to reduce the quantity of process reagent movement, the transport of the majority of reagents by rail and the elimination of some evaporation pond areas. ASM is also investigating the potential use of renewable energy as a part of the ongoing project development.

6.1.1 Dubbo Project Environmental Management Strategy

ASM prepares an annual review of environmental activities in accordance with the requirements of the Mining Lease (ML 1724) and Project Approval (SSD-5251), obtained in 2015. The annual environmental reports describe the environmental performance, baseline monitoring activities, rehabilitation activities and community engagement undertaken for the year. The annual environmental reports are available on ASM's website, along with a comprehensive Environmental Management Strategy (EMS) and associated management plans[4].

6.1.2 Biodiversity

Vegetation clearing and biodiversity offset obligations associated with the Project, including the clearing of up to 35.3 ha of *Aprasia parapulchella* (Pink-tailed Worm-lizard, also known as the Pink-tailed Legless Lizard) habitat, were approved under *Environmental Protection and Biodiversity Conservation* (EPBC) *Act 1999* approval EPBC 2012/6625. Fencing of the EPBC Offset Area in accordance with ASM's *Pink-tailed Worm-lizard Biodiversity Offset Management Plan* was completed by 30 June 2019. The biodiversity offset areas (1,021 ha) are designated for the restoration and maintenance of native habitats, especially for vulnerable species. They are managed by ASM's wholly owned subsidiary, Toongi Pastoral Company (TPC) and protected in perpetuity under a Conservation Property Vegetation Plan negotiated with Local Land Services.

6.1.3 Conservation and Land Management

Since 2016, TPC has managed the agricultural land, farm assets and offset areas associated with the Dubbo Project – a total of approximately 3,715 hectares. TPC applies the latest farming technologies and practices to ensure sustainable land management, increasing biodiversity, soil health and farm productivity.

6.1.4 Carbon Farming

In the 2021 financial year, ASM commenced registration of the property as a carbon farming project under the Australian Government's Emissions Reduction Fund (ERF). Under the ERF, measured increases of in-soil carbon content earn Australian carbon credit units (ACCU), with one ACCU earned for each tonne of carbon dioxide equivalent stored. Earned ACCUs have the potential to contribute to the carbon offsets for the Dubbo Project.

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[4] See https://asm-au.com/projects/dubbo-project/environmental-reports-management-plans/

6.1.5 Water Management

The Dubbo Project is within the Cockabroo Creek and Wambangalang Creek sub-catchments of the Macquarie River Catchment. Operational and construction water will be supplied from the Macquarie River and the Upper Macquarie River Alluvial Aquifer. The river water licences are in the Cudgegong-Macquarie Water Sharing Plan regulated by the NSW Department of Planning, Industry and Environment – Water. ASM holds sufficient river and groundwater licences (including some high-security licences) to develop the Dubbo Project as a 1 Mtpa operation at Toongi.

Extensive work since 2015 has significantly reduced the water required for the Dubbo Project from 4GL/annum to 1.5GL/annum. In an area where the climate is forecast to be drying, a reduction in water consumption is imperative for a climate-resilient operation. ASM engages with the Macquarie-Cudgegong Customer Advisory Group, which provides a forum for community consultation. A Stage 1 (construction phase) Water Management Plan, approved by the (then) NSW Department of Planning and Environment (DPE) on 12 October 2016, is available on the ASM website[5].

6.1.6 Energy and Emissions

Electricity will be supplied from the grid, and up to 1,878 TJ/year of natural gas will be required for the heating of reagents within various circuits of the processing plant. Discussions have continued with the owner and operator of the gas distribution network in NSW to supply the Dubbo Project site, as an alternative to ASM building and owning a connector gas pipeline approximately 35km long within the Dubbo-Molong rail line easement.

The Dubbo Project features a power cogeneration plant to utilise the heat and steam produced by the process. Discussions continue with several companies about the location of a renewable power plant at the project, it is anticipated that this will form part of the final project execution and development plan.

Improvements to the design of the Project have increased energy requirements since the initial approval in 2015. ASM is committed to achieving operational net zero emissions. There are several opportunities for emission reduction that are currently being investigated, including direct emissions reduction such as electric mining fleet, and indirect or purchased emission reductions. For purchased electricity, there will be an opportunity to source renewable energy due to the Dubbo Project being in the Central-West Renewable Energy Zone, as designated by the NSW Government.

6.1.7 Waste Management

Processing generates waste material that will be neutralized with limestone and stored on-site in an engineered solid residue storage facility (SRSF). The SRSF will comprise a series of cells, double-lined to prevent leakage, where each cell can be filled, closed, and rehabilitated independently of the other cells. At maximum production (1 Mtpa), approximately 2 Mtpa of wet solid residue will be produced, reducing to 1.3 Mtpa after drying.

The liquid residue from the processing plant will be chemically treated and neutralised, before being passed through a brine concentrator, involving forced evaporation of water to produce salts. The salts will be stacked and stored in covered salt encapsulation cells. The salt encapsulation cells will also incorporate a double-lining system with a leak-detection layer in-between.

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[5] See: https://asm-au.com/wp-content/uploads/2020/08/WaterManagementPlan-Stage1.pdf

The solid and liquid residue areas will consider international standards for tailings design, construction, operation, monitoring and closure.

6.2 Social

6.2.1 Culture

ASM lives its values by fostering a culture of innovation, equal opportunity, and integrity amongst its workforce, partners, and supply chain. The Company recognises that attracting, retaining, and developing the right people is critical to the achievement of its vision and strategic plan.

6.2.2 First Nations Engagement

ASM acknowledges the Traditional Custodians of Country throughout Australia and their connections to land, sea and community. We pay our respect to their Elders past, present and emerging, and extend that respect to all Aboriginal and Torres Strait Islander peoples today. Specifically, ASM acknowledges the Wilay Wiradjuri people – Dubbo and Toongi; Noongar Whadjuk people – Perth; and Turrbal and Jagera/Yuggera peoples – Brisbane.

ASM commenced engagement with the local Aboriginal community in 2001, when the initial heritage assessments were undertaken at Toongi. Over two decades, the Company has continued to consult with Elders and Aboriginal organisations, including Dubbo Aboriginal Community Working Party, Three Rivers Regional Assembly, Dubbo Local Aboriginal Land Council. Consultation and engagement were undertaken during the preparation of the Environmental Impact Statement (EIS) in 2013, when local Aboriginal people surveyed 2,864 ha of the project study area to identify heritage sites. Following project approval, measures to manage these heritage sites were included in the Heritage Management Plan approved by DPE on 8 February 2017. ASM reviews cultural heritage sites within the project footprint and ensures traditional owners are engaged and consulted on Heritage issues, as per the codes and guidelines established by Heritage NSW (which comply with the NSW National Parks and Wildlife Service Act 1974). ASM has identified heritage sites outside of the project footprint additional to those described in the EIS (2013); these sites have been protected from farming activities.

ASM continues to engage with representatives from Aboriginal organisations and Elders, listen to their priorities and grow relationships.

6.2.3 Responsible Supply Chain

Sustainable, responsible, and traceable supply chains will be an objective of ASM and an expectation of customers and consumers. Technology platforms and methods are currently being investigated to ensure supply chain management.

6.2.4 Health and Safety

ASM is committed to improving the health, safety and wellbeing of its team members and providing a safe workplace. The Project has included health and safety considerations in the design and will operate with leading controls and monitoring.

6.2.5 Dubbo Community and Social Benefits

ASM has been an active and engaged member of the Dubbo community for two decades, building strong relationships with government, commercial and community stakeholders. ASM supports Dubbo community development through the establishment of permanent infrastructure, sponsorship of local events and organisations, provision of training and career opportunities, and the creation of local economic opportunities for service providers.

Building upon this long-standing regional presence, ASM has consulted and communicated proactively with the community during the development of the Dubbo Project. All relevant impact studies conducted by ASM and adopted in the EIS, and project approval have forecast and accommodated likely community impacts, incorporating local stakeholder issues and concerns. ASM maintains and updates its community engagement strategies, including the establishment of the Dubbo Project Community Consultative Committee, and nurtures its community relationships through clear and regular communications about its activities.

The Dubbo Project will require a large processing plant, effectively establishing a new production business in regional NSW. It is expected Dubbo Project construction will attract a workforce that will peak at 1,000 people over the two-year construction schedule. Following construction, the facility will be operated by a team of approximately 270 people, comprising chemical engineers, metallurgists, mechanical and electrical engineers supervising tradespeople, logistics, trainees, apprentices and other operators. Numerous support businesses will evolve and grow to meet the operational and maintenance needs of the project. Throughout both construction and operations phases, local workers and contractors will be sourced as a preference. Furthermore, ASM anticipates both local and non-locally sourced personnel will live in Dubbo or the surrounding local communities. ASM will work with local training organisations to recruit and train locally based operators.

6.3 Governance

ASM is governed by an experienced Board committed to establishing and administering the Company's policies and procedures with openness and integrity. In establishing its corporate governance framework, the Company has referred to the recommendations set out in the ASX Corporate Governance Council's Corporate Governance Principles and Recommendations 4th edition (Principles & Recommendations). The Company's Corporate Governance Statement is available on the ASM website, along with the Board charter and details of Board sub-committees[6]. Also listed are key policies and procedures, including those pertaining to appointment and independence of directors, diversity, code of conduct, risk management, and anti-bribery and corruption.

ASM is committed to the implementation and maintenance of an integrated risk management program for all its activities in accordance with the Australian /New Zealand Standard on Risk Management AS/NZS ISO 31000:2018 Risk management – Principles and guidelines.

This policy promotes an understanding and creates an awareness and culture of Risk Management within ASM.

6.3.1 Approvals

ASM has obtained all major state and federal regulatory approvals necessary to commence detailed design and construction of the Dubbo Project.

[6] See: https://asm-au.com/company/governance/

- The Dubbo Project received development consent from the New South Wales Planning Assessment Commission on behalf of the Minister for Planning on 28 May 2015. This was followed by federal approval under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 on 24 August 2015.
- ML 1724 was granted by the NSW Department of Industry, Division of Resources and Energy (now known as NSW Department of Planning and Environment, Division of Resources and Geoscience) on 18 December 2015. It covers 2,390 hectares and includes the operating site, significant biodiversity offset areas and residual agricultural land.
- The Environment Protection Licence for construction activities was granted on 14 March 2016 by the NSW Environment Protection Authority under the NSW Protection of the Environment Operations Act 1997.
- A Conservation Property Vegetation Plan (PVP00199) has been negotiated with Central West Local Land Services to protect and conserve 1,021 ha of biodiversity offsets in perpetuity.

Following the granting of SSD-5251 on 28 May 2015, ASM has undertaken a range of studies and investigations targeting optimisation of the design and operation of the Project. As a result, several adjustments to the site layout and operations have been identified to maximise the efficiency of mining, processing, and transportation operations on site. These enhancements will require a modification to SSD-5251, under Section 4.55(2) of the Environmental Planning and Assessment Act 1979. In addition to the modification of SSD-5251, amendments or modifications to the following approvals will be required:

- Amendment to EPBC 2012/6625;
- Variation of EPL 20702; and
- Section 138 Permit(s) for road upgrade works on Toongi Road and Obley Road and construction of the Site Access Road/Toongi Road intersection.

The modifications will not increase the approved disturbance footprint area for the Project. No additional disturbance of Pink-tailed Worm-lizard habitat beyond the maximum area approved under SSD-6251 and EPBC 2012/6625 (i.e., 35.3 ha) is required. The Modification Report submission is scheduled for Q1 2022.

ASM has lodged a draft Mining Operations Plan with the Division of Resources and Geoscience for the construction activities. This will be finalised by the lodging of the Rehabilitation Bond at the time of financial approval for the Project.

Further permits and licences that will be required during detailed design, construction and operation phases include:

- Water Supply Works and Use Approvals under the NSW Water Management Act 2000.
- Approval from the NSW Dams Safety Committee for the design and construction of the solid and liquid residue storage facilities.
- A licence issued by the WorkCover Authority of NSW for the storage and use of explosives and other dangerous goods within the Dubbo Project Site.
- Occupation and Construction certificates from Dubbo Regional Council for site buildings.

As is always the case, modifications to project approval and the Environment Protection Licence may be sought once the detailed design is complete and final licensed discharge points are known.

7 Mining

7.1 Mining

Mining of the ore deposit will take place in a single open pit, using drill and blast methods to fragment material that will then be transported to the Run-of-Mine (ROM) Pad for crushing and grinding.

The scheduled 20-year mining quantities include 1.73 Mt waste and 18.9 Mt ore, indicating a waste: ore strip ratio of 9.1%. The pit is mined in stages with the initial 10 years of production sourced from the western half of the pit, Stage 1a (west) and Stage 1b (east) mined from year 10, resulting in increased waste movements from the commencement of Stage 1b.

Open-pit mining is envisaged to be based around a 5 to 5½ day week, 9 to 10 hour/day operation. This would attract local operators and promote flexibility of additional weekend operations if required to increase production.

Articulated dump trucks have been selected to allow flexibility while working in the rugged operating conditions when mining consists of benching out a hilly terrain and hauling downhill. Articulated haul trucks will also offer the flexibility to be utilised as a part of the pre-mining construction activities such as pond excavation, bund, run of mine stockpile are (ROM pad) and tailings storage facility construction.

The trucks will be loaded by a front-end loader (FEL). It is anticipated there will be five trucks hauling ore to the ROM pad (2,800 m from pit edge to ROM pad) and three trucks hauling waste material to the waste dump (950 m from pit edge to the waste dump). Given the low waste/ore ratio, there is minimal waste and minimal selective mining required. An FEL rather than an excavator will be the prime loading tool, providing a cheaper, more sustainable, and versatile solution. An FEL can also support the loader on the ROM pad feeding the crusher (or vice versa). An excavator will be mobilised to the site on a hire basis to trim final pit wall batters as required. Equipment selection has been made following the Mine Design Guideline MDG15 requirements for NSW.

The mining fleet will be supported by the establishment of a three-bay workshop facility with an additional light vehicle servicing bay.

ASM will provide the required mine management team including the statutory mine manager and supporting personnel.

7.2 Drilling & Blasting

Drilling and Blasting (D&B) will be contracted to a specialized D&B contractor on a campaign basis. Providers of D&B services in the region are well established and have been approached to assess availability and competency. The D&B services include a full explosives delivery, magazine compound, access roads and downhole service.

D&B activities will be conducted using a single drill on a day shift campaign basis up to five days/week and would be undertaken using 5 m benches and 89mm hole diameter. It is anticipated this strategy will be significantly cheaper and obtain optimum fragmentation rather than the alternative of primary and secondary crushing.

7.3 Haul Road Construction, Clearing & Topsoil Stripping

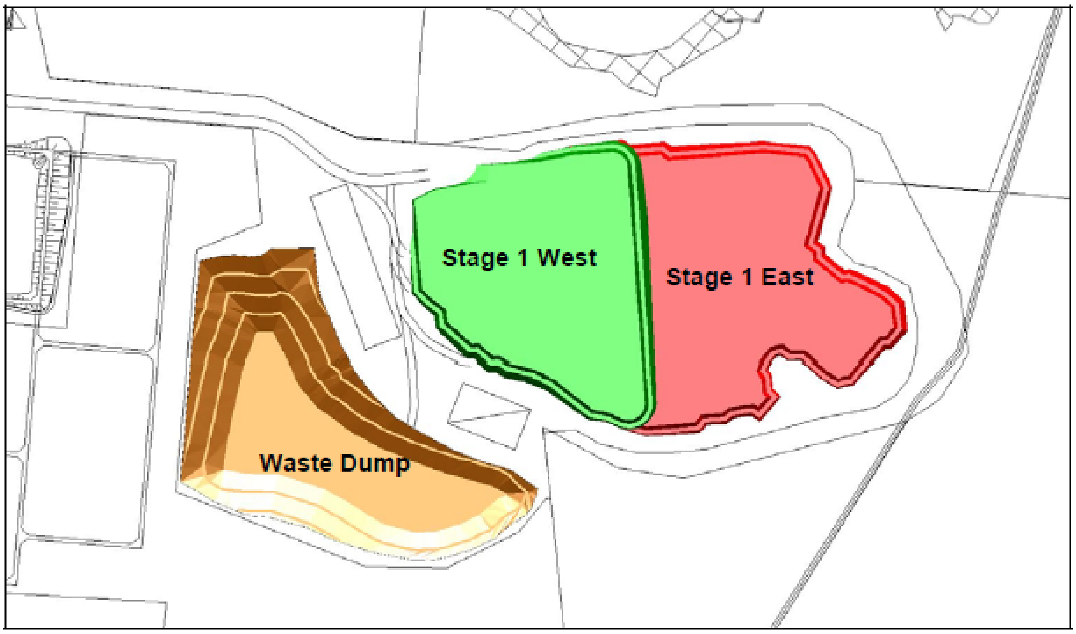
Construction of a proposed 2.8 km haul road from the edge of the open pit across to the processing plant and a further 400 m from the edge of this haul road to the waste dump is intended to be performed by a suitably experienced local civil or mining contractor.

Site clearing and topsoil stripping of the pit area will be conducted progressively. Other areas requiring clearing and topsoil stripping (estimated at 10 ha) include ROM Pad, Mining Yard, Laydown Area, Go Bay, access roads and magazine will be completed during the project construction phase. Topsoil cover is envisaged to be stripped, hauled, and placed in approved stockpiles by scrapers that will be used in the haul road construction phase.

7.4 Mining Schedule

The open cut will be developed in two stages, refer to Figure 8, each of approximately 10 years duration. Construction will commence in the western half of the orebody (in accordance with project approvals received to date). The initial open cut will cover an area of approximately 20ha, excavated to a maximum depth of 355 m Australian Height Datum. During the second 10-year period, the eastern half of the orebody will be mined to approximately 360 m Australian Height Datum. The depth below the natural land surface will vary from 15 m to 32 m. At the end of 20 years, the open-cut will cover approximately 40 ha, with a long axis (east-west) of approximately 925 m and a width (north-south) of approximately 550 m. All mining during the 20-year operation will remain above the groundwater table.

Figure 8 - Stage 1 Pit and Waste Dump Design



7.5 Waste Rock Management

Material that is excavated to enable access to the defined ore will be placed within a waste rock emplacement (WRE) located alongside the open cut to the southwest. The WRE has been designed with a capacity approximately 50% greater than the anticipated volume of waste rock to be generated from the open cut over 20 years. Waste rock will be used to back-fill a basalt quarry that will be commissioned to source construction materials.

8 Mineral Processing

8.1 Overview

The mined ore is delivered by road to the Run-of-Mine (ROM) pad, where it undergoes several stages of crushing in the comminution circuit. The crushed ore is then dry ground in a ball mill to the appropriate particle size for optimum extraction of valuable elements.

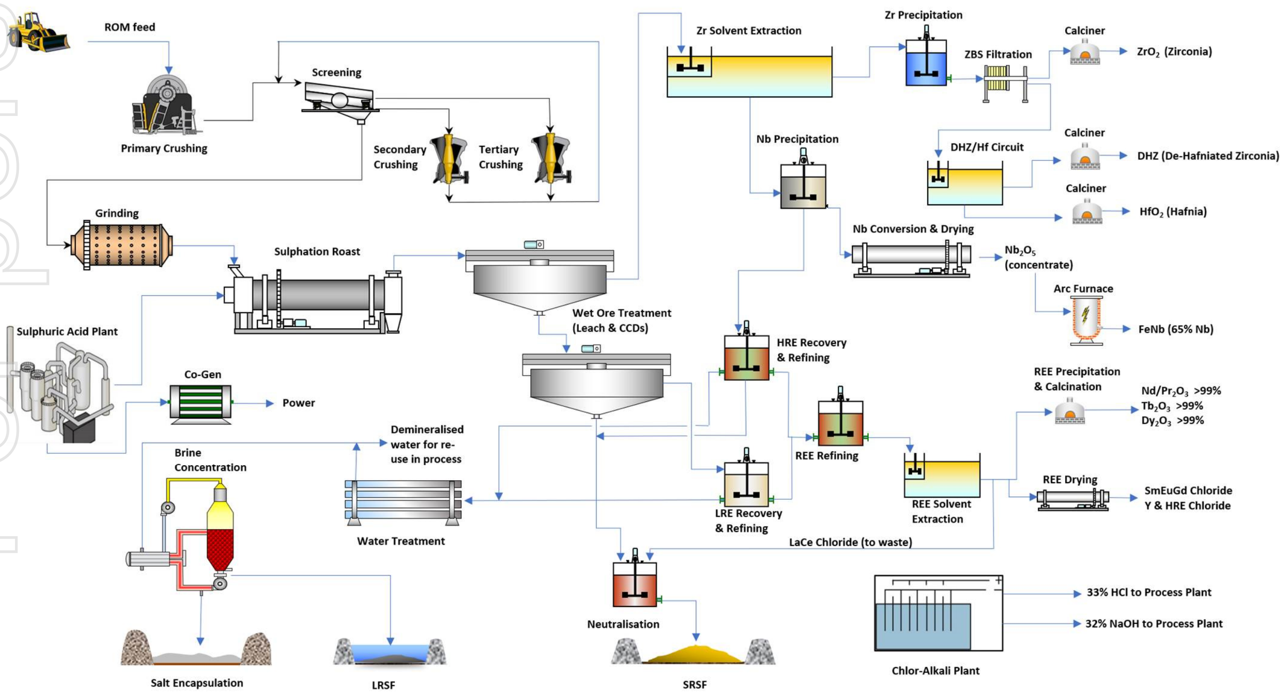
Dry ground ore is then mixed with concentrated sulphuric acid and roasted to form sulphated solids. These solids are cooled and mixed counter-current decantation (CCD) No.2 overflow in a leach circuit. The sulphate species formed during the sulphation process (including zirconium, hafnium, niobium and rare earths, along with impurities of iron, aluminium and zinc) are solubilised.

After leaching, the leach slurry is passed through the CCD circuit to wash and separate the leach discharge slurry into two liquors; one that comprises the majority of the light rare earths (LRE), and a second bearing zirconium, hafnium, niobium, and/or heavy rare earth (HRE).

The LRE liquor passes directly from the CCD circuit to the LRE recovery circuit. The remaining liquor passes through several stages of solvent extraction (SX) and purification circuits, which separate the other metals in solution (zirconium, hafnium, niobium and HREs). Zirconium, hafnium and niobium solutions are precipitated and oxidised for final products. The purified LREs and HREs are combined and pass through several stages of rare earth element (REE) solvent extraction, which separates the rare earths (solutions of Nd / Pr, Y, Tb, Dy, LaCe, SmEuGd and remaining HREs). The solutions are then either dried or oxidised as final products.

The process flowsheet is illustrated in Figure 9, with the final products identified.

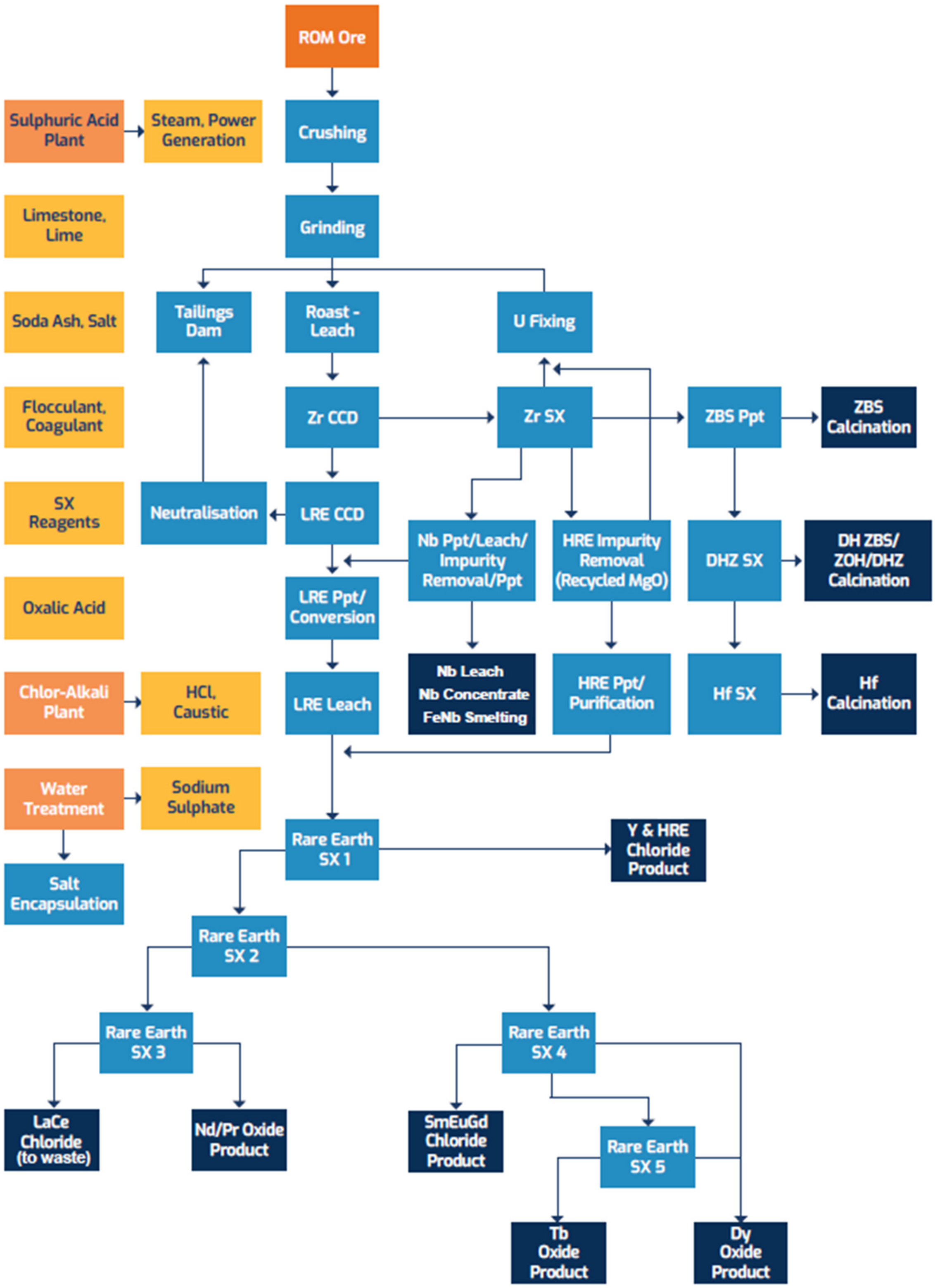
Figure 9 - Schematic Diagram



8.2 Process Block Flow Diagram

The process flow sheet is summarised in Block Flow Diagram shown in Figure 10.

Figure 10 - Process Flow Sheet



8.3 Process Description

Ore is presented to the crushing plant for crushing and screening to a particle size suitable for dry grinding. The crushing plant will be located with the process plant facilities. The ROM ore is trucked to the process plant and either dumped directly into the ROM ore bin or onto the crushed ROM ore stockpile. The crushed ore is milled and dried and then mixed with sulphuric acid and roasted to form sulphated solids. The sulphated solids are quenched to extract zirconium (containing hafnium), niobium and rare earth sulphates, as well as impurity elements into solution. The leach slurry is washed in two stages of CCD thickeners, each stage comprising four thickeners. The CCD circuit separates the LRE bearing solution from the zirconium, niobium and HRE solution.

Separation of zirconium and HRE takes place in the **Zr solvent extraction (Zr SX) circuit**.

Zirconium is recovered from the loaded strip liquor in a batch precipitation process. The liquor is contacted with sodium chloride solution and soda ash to precipitate zirconium basic sulphate (ZBS), which is filtered. The majority of the ZBS filter cake (containing hafnium) is then calcined and bagged for transportation.

A portion of ZBS filter cake is directed to the **dehafniated zirconia (DHZ) and hafnium circuit** for the production of dehafniated zirconia and hafnia (HfO_2) products. ZBS is redissolved and fed to the DHZ solvent extraction circuit to separate hafnium. DHZ is recovered and purified through several stages to produce dehafniated zirconium oxychloride which is calcined to DHZ before packaging.

Hafnium is recovered from the DHZ SX raffinate. The liquor is concentrated and fed to the hafnium solvent extraction circuit to separate hafnium from waste effluent. Hafnium-rich liquor is refined in a similar process to the DHZ refining circuit, to produce hafnium oxychloride (HOC) which is calcined to produce hafnia (HfO_2) product and packaged.

Niobium is recovered from the Zr SX primary extraction raffinate. The liquor is contacted with sodium sulphate at elevated temperatures to precipitate niobium in solution as niobium oxide. The precipitate is thickened prior to being washed and filtered with process water and hydrochloric acid solutions batch-wise to reject impurities. The niobium filter cake is mixed with calcium chloride and calcined to reject phosphorus and tin. The calcined product is milled, impurities removed in a hydrochloric acid leach, and niobium precipitates recovered on a belt filter. The niobium precipitate is calcined, cooled and the calcined product is stored in the Ferroniobium Smelter Feed Silo. The product is then passed through the Nb Product Screen for separation of fines and oversize from the smelter feed. The niobium is combined with iron and smelted to produce a ferroniobium metal at approximately 65% contained Nb. The metal product is cooled and packaged for transport. The smelter will be a vendor-supplied package and will include raw materials receiving and storage, crucible preparation, batch reaction, primary sorting and slag crushing, primary cooling, metal product handling and storage.

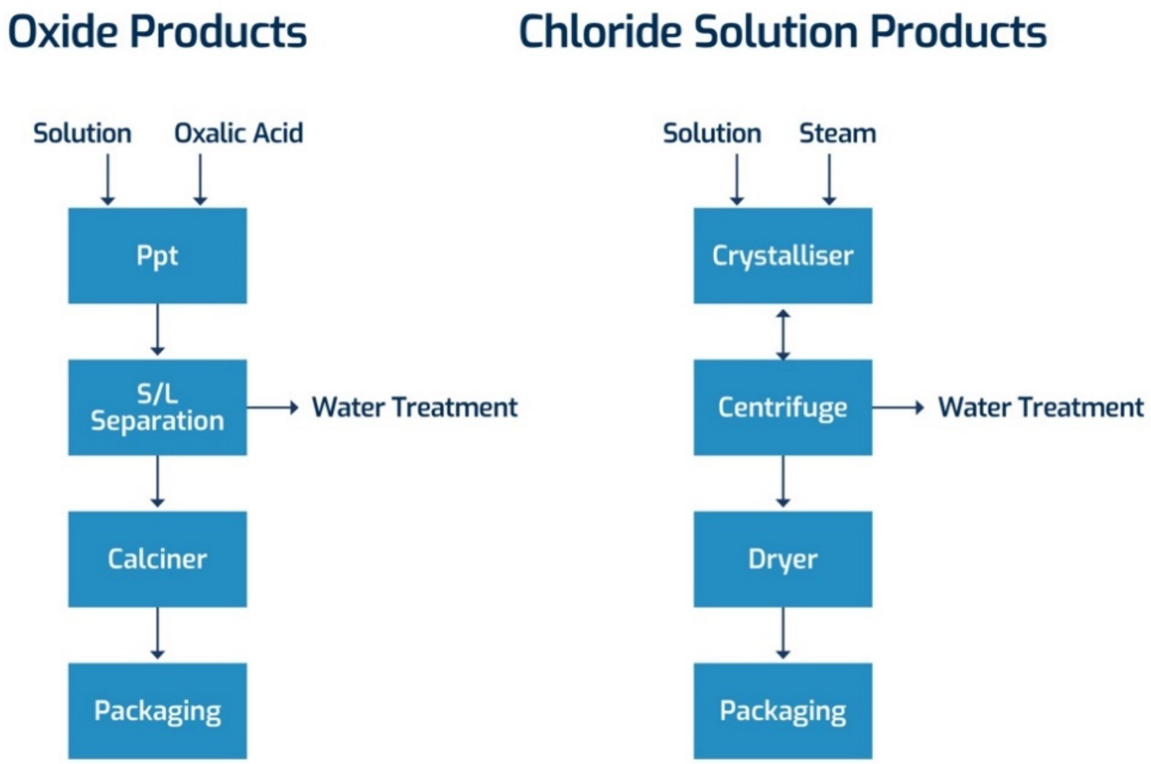
HREs are recovered from the Zr SX secondary extraction raffinate. The solution also carries impurities such as iron, aluminium and zinc, which are precipitated out prior to HRE purification. The HREs in the HRE-rich liquor are precipitated with sodium carbonate to form HRE carbonate precipitates. The precipitates are leached in sulphuric acid and filtered. The filter cake is then transferred to the rare earth double sulphate precipitation area.

The LREs are recovered from the LRE CCD Wash. Overflow from the LRE pregnant leach solution (PLS) clarifier is contacted with sodium sulphate solution to precipitate rare earths in solution as light rare earth double sulphates (LREDS).

Sodium chloride (salt) is added to the HRE filter cake, and the mixture is heated with the direct injection of steam to produce heavy rare earth double sulphates (HREDS). LREDS thickener underflow is added to the mixture, washed with sodium sulphate and filtered to produce a combined rare earth element double sulphate. Caustic is then added to convert the double sulphate precipitates to hydroxide precipitates. The precipitate is selectively leached with hydrochloric acid and filtered to produce the REE chloride product.

The REE chloride product solution is treated in a series of solvent extraction circuits to separate the various final rare earth products into separate solution products. The circuit produces concentrated liquors containing La/Ce chloride, Y + HRE chloride, SmEuGd chloride, Dy chloride, Tb chloride, and Nd/Pr chloride. The NdPr, Dy and Tb products are precipitated from solution using oxalic acid. The precipitates are filtered and calcined to produce final oxide products. The Y+HRE and SmEuGd products are treated in crystalliser circuits to produce final chloride products, which are filtered and dried. The present low economic value LaCe chloride solution will not be refined to a product; however, the process plant layout will be designed such that a refining circuit for a LaCe product can be retrofitted in the future. Figure 11 outlines the REE processing steps required to produce solid REE products.

Figure 11 - Rare Earth Refining



Effluent waste solutions are treated through neutralisation, purification, and membrane-filtration plants. Hf waste streams are treated separately, acidified, and neutralised with the high-salts liquor waste sent directly to the brine concentrator feed.

The softened effluent is pH adjusted and treated in an ultrafiltration (UF) plant to remove solids. A portion of UF permeate is directed to the nanofiltration plant as required to produce a concentrated rejects stream bearing sodium sulphate, which is recycled to the sodium sulphate make-up to reduce reagent demand. The permeate from the nanofiltration plant contains sodium chloride and is directed to the salt make-up, with the excess combined with the remaining UF permeate and sent to the reverse osmosis (RO) plant. The RO plant produces a permeate, which is recycled as process water, and an RO retentate, which feeds the brine crystalliser. The crystalliser recovers high-quality distillate for recycle as condensate (boiler feed water, demineralised plant feed) or process water, and produces waste salts for storage.

Any radionuclides (e.g., uranium and thorium) present in the initial ore report to the solid residue storage facility (SRSF) after undergoing an acidic "fixing" process prior to neutralisation.

Sulphuric acid is produced on-site using a sulphur burning acid plant, which also generates steam for the process plant.

Hydrochloric acid and sodium hydroxide are produced on-site via a chlor-alkali plant.

8.4 Final Product Suite

The product suite will include:

1. Zirconia (ZrO_2, produced from calcining ZBS)
2. Dehafniated Zirconia (DHZ)
3. Hafnium Oxide (HfO_2)
4. FerroNiobium (65% Nb)
5. Nd/Pr Oxide (solid)
6. Tb Oxide (solid)
7. Dy Oxide (solid)
8. SmEuGd Chloride (solid)
9. Y + HRE Chloride (solid)

8.5 Product Recoveries

The work completed during the Optimisation Study identified opportunities to increase product recoveries. Along with flowsheet optimisations, one major improvement includes changes to the rare earth Iron Removal Circuit which significantly lowered precipitation losses of REE to the iron and aluminium residue. A comparison of the overall Dubbo Project products recoveries between the 2018 ASX Release[7] and the current 2021 flowsheet is shown in Table 5. The recoveries are expressed as a percentage of the total mass of the element fed into the plant.

[7] ASM ASX and Media Release – "Information Memorandum & Demerger Booklet" dated 29 July 2020

Table 5 : Recovery Comparison between 2018 ASX Release and Current 2021 Flowsheet

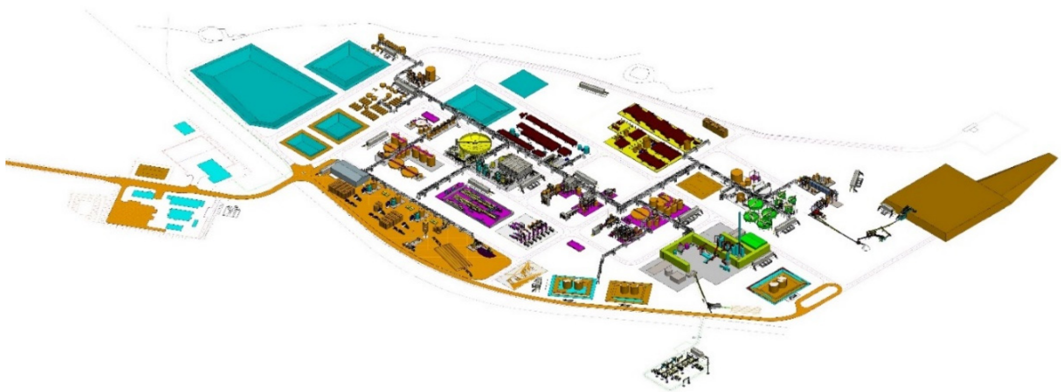
Element	2018 ASX Release Recovery (%)	2021 Recovery (%)
ZrO_2	84.4[1]	85.2[1]
DHZ		
Hf	25.0[2]	63.5[2]
Nb	61.2	57.9
La_2O_3	80.1	82.6
CeO_2	69.8	54.1
Pr_6O_{11}	66.7	82.4
Nd_2O_3	74.5	82.4
Sm_2O_3	51.2	79.8
Eu_2O_3	42.3	73.4
Gd_2O_3	56.9	73.7
Tb_4O_7	47.5	75.2
Dy_2O_3	67.4	76.7
Ho_2O_3	59.3	73.7
Er_2O_3	74.0	74.0
Tm_2O_3	38.6	67.6
Yb_2O_3	69.9	65.6
Lu_2O_3	26.0	63.0
Y_2O_3	74.3	62.6

1. *Total recovery to both ZrO_2 and DHZ.*
2. *The Hf recovery represents the overall recovery to both the Zr and Hf products. The actual production of Hf (as HfO_2) is deliberately constrained to an annual target of 30 tonnes. HfO_2 production could be significantly higher if required, by adjusting the initial size of the DHZ Circuit.*

8.6 Mineral Processing Facility

This section provides an overview of the process plant and the flow of materials. The preliminary design layout of the Dubbo Project Process Plant is shown in Figure 12.

Figure 12 - Dubbo Project Process Plant



The main plant process areas are:

- Comminution (crushing and grinding),
- Sulphation Roast (roasting, off-gas treatment, acid recovery, alkali scrubbing, de-misting and solids removal),
- Wet Ore Treatment (roast quench, counter current decantation washing),
- Zirconium Solvent Extraction,
- Product Recovery and Handling (zirconium, hafnium, niobium and rare earths),
- Waste Treatment (chloride and sulphate effluent neutralisation and treatment, reverse osmosis plant, solid waste residue treatment, brine concentrator evaporation),
- Water Services (raw water, process water, demineralised water, cooling water, fire water, potable water),
- Reagents (storage and handling),
- Sulphuric Acid Plant and steam generation,
- Chlor-alkali Plant for HCl and NaOH generation, and
- Site-Wide Infrastructure (instrument and plant air, natural gas, sewage and wastewater).

The overall project site is shown in Figure 13 indicating the location of the process plant, SRSF, Mine pit, haul road, Waste stockpile, salt encapsulation cells, biodiversity offset areas and site access. The process plant layout can be seen in more detail in Figure 14.

Figure 13 - Overall Dubbo Project Site

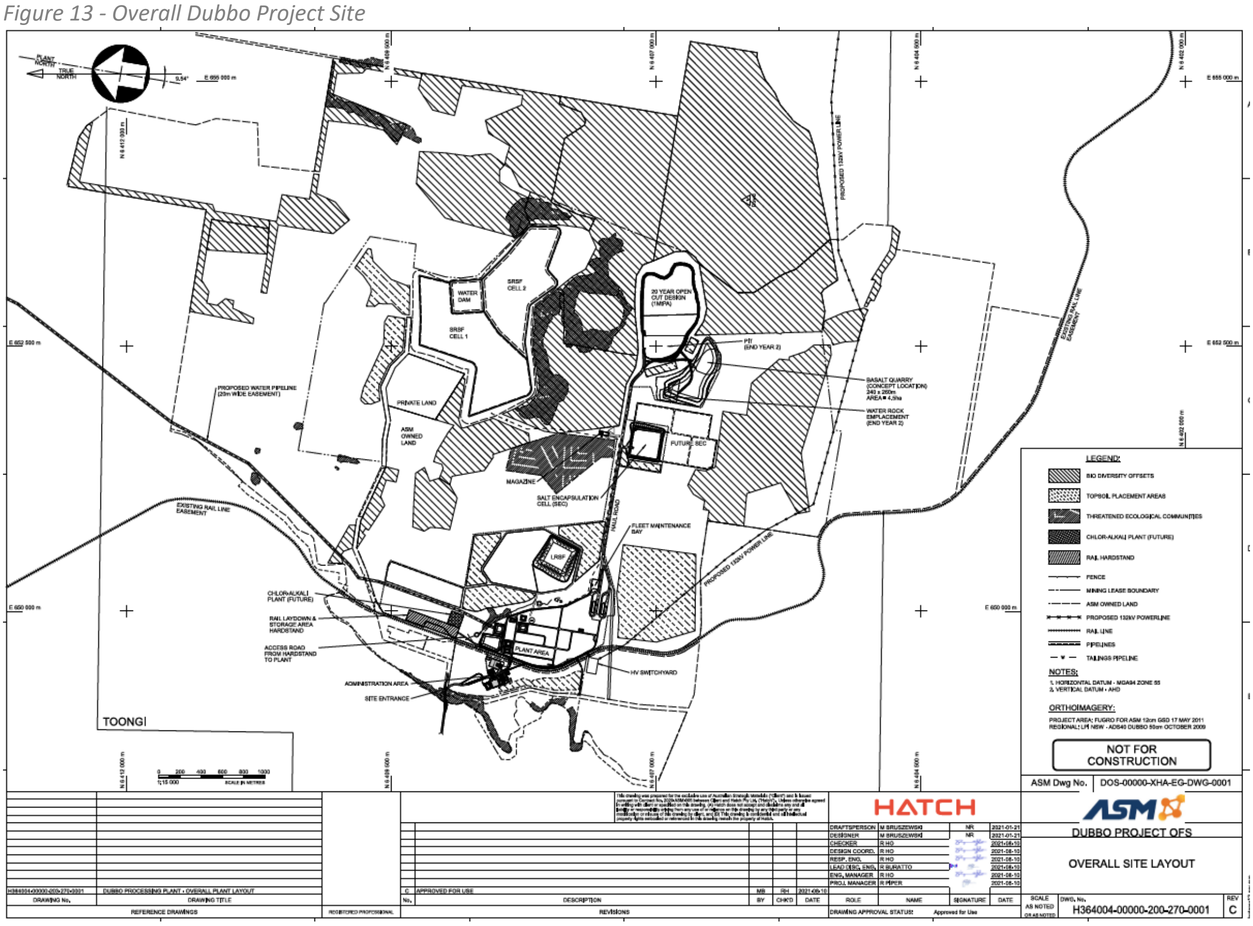
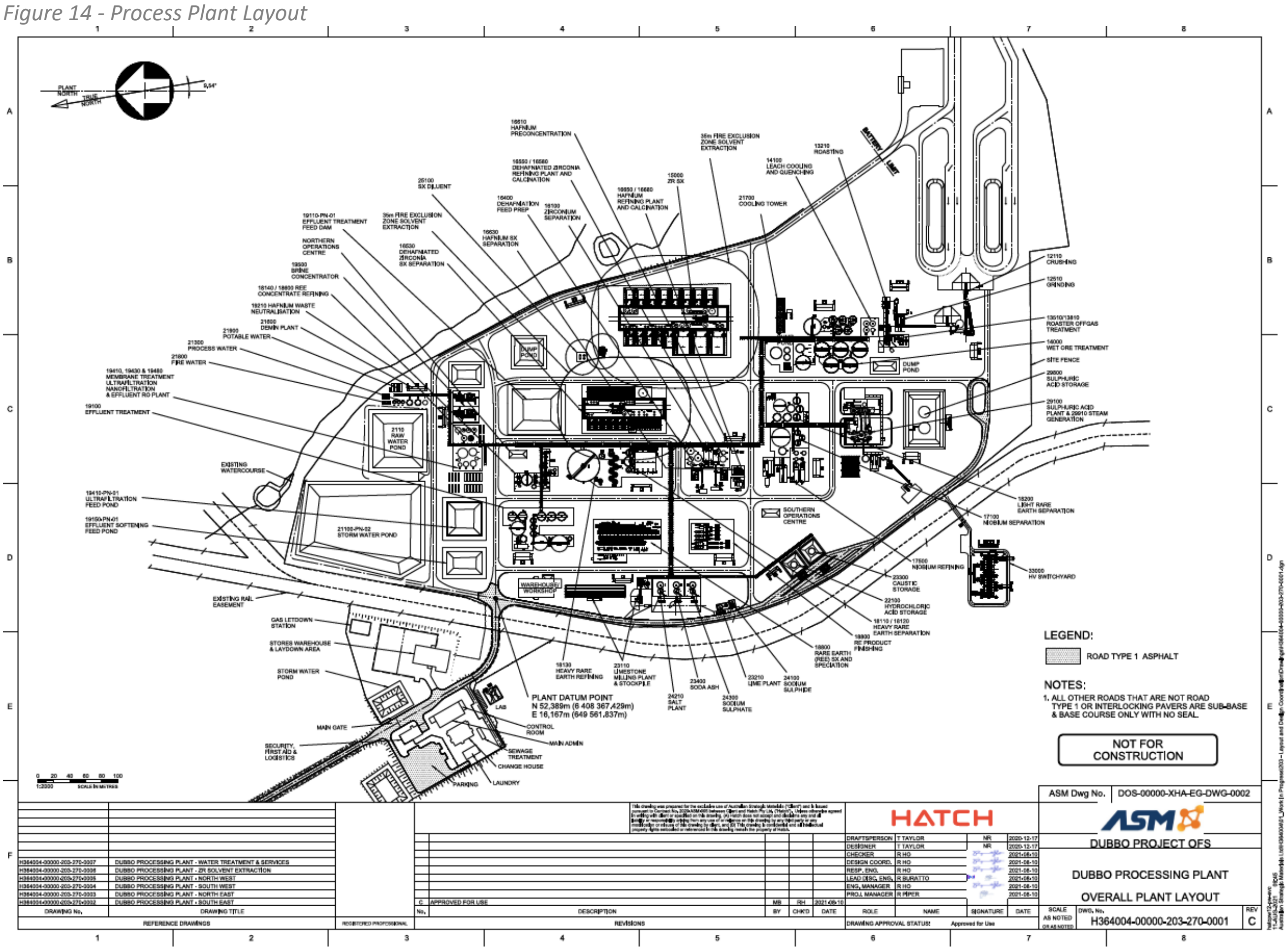


Figure 14 - Process Plant Layout



9 Infrastructure and Services

9.1 Key Points

The project supporting infrastructure and services include off-site and on-site access roads, reagent supply and handling, rail, water supply, fuel gas, power, site buildings and process waste facilities have been further developed during the Optimisation Study. The Optimisation Study work has further confirmed the design requirements and availability of supply resulting in:

- confirmation of the project operational water requirements,
- ASM purchase of the water licences and water allocation for the full operational requirement,
- power grid connection point and supply options well advanced,
- fuel gas connection and supply options well advanced with a point of supply at site incorporating pipeline into supply pricing,
- major road and rail transport routes confirmed,
- available access to major ports,
- logistics requirements defined, and
- reagent supply sources and transportation defined.

9.2 Site Access and Road Upgrades

The Dubbo Project site will be accessed via existing local roads (Obley Road and Toongi Road), with a new single carriageway turn-out to be constructed leading to the site entrance. These roads will transport all traffic to and from the site and accommodate increased traffic volumes at shift changes. Site-based Road design will facilitate the separation of heavy vehicles (carrying bulk commodities, reagents and products) from light vehicles (carrying employees and visitors) where possible. A secondary gated emergency access road will also be constructed.

The planned road improvements include the upgrade of several bridges and the installation of a sound barrier adjacent to the Taronga Western Plains Zoo. These works have been designed and costed into the project.

9.3 Reagents

Most reagents necessary for the operations will be delivered via rail (except for limestone and quick lime which will be delivered by truck from local suppliers).

Sulphuric acid will be produced in a dedicated sulphur-burning plant located on-site. Waste heat from the acid plant will be used to co-generate electricity.

Hydrochloric acid and caustic will be produced via the chlor alkali plant. A small percentage of caustic will also be delivered via rail. Reagent handling, storage and mixing facilities are significant infrastructure requirements, and form an important aspect of the process plant. Reagent bulk storage is provided for sulphuric acid, hydrochloric acid, solvent extraction reagents and caustic. Reagent bulk storage and mixing facilities are provided for salt, sulphur, sodium carbonate, sodium chloride, limestone, lime, coagulants and flocculants.

Storage and handling of bulk delivered reagents will be developed at the port which will allow for vessel unloading and transfer to dedicated storage facilities. Bulk containers and Isotainers will be loaded at the port and loaded on trains for transport to the project site. Smaller quantities of reagents will also be delivered in Bulka bags and Isopods loaded in sea containers.

9.4 Rail

A substantial portion of the freight required to operate the Dubbo Project will be delivered by rail. This will enable ESG benefits and HSE risk mitigation including the removal of large quantities of process reagents from NSW roads, where otherwise significant numbers of trucks would interact with cars. The rail solution will also deliver operating cost savings.

The reinstatement of the rail line from Dubbo to the project site has been investigated and costed by C.R. Rail (Zero 05 Pty Limited). The rail will be designed and constructed to meet the required engineering, NSW Government authorities and Operational Safety and Compliance Standards. The use of rail is included in the current Dubbo Project approvals.

9.5 Water Supply

Operations and construction water will be supplied from the Macquarie River and the Upper Macquarie River Alluvial Aquifer. The project was approved for up to 4 GL of water per annum but expects to use approximately 1.5 GL of water per annum. ASM has already purchased water licenses for approximately 2 GL per annum.

The recent Optimisation Study has incorporated major operational water savings into the project via the increasing capacity of the Brine Concentrator. This has reduced the project water requirements to approximately 1.5 GL per annum.

The project will complete a bore and associated pumping station on the northern side of the river, with a pipeline bored under the river to minimize site disturbance. The buried pipeline will continue for approximately 7 km along an easement to the Dubbo Project site receiving dam.

Water for construction and processing will be shared and scheduled between the two water sources to minimize impacts on existing groundwater users. Establishment of water for construction purposes, including civil, concrete and earth works is critical for the project execution. Establishment of the permanent water supply has been identified as a critical early works opportunity to reduce construction indirect costs associated with importing water.

9.6 Gas

Natural gas is needed in the process plant for roasting, heating and calcination. Connection into the local supply network and pipeline route to the mine site has been developed and is included in the current project permitting. Gas connection to the regional network and supply is currently included in the project costing as a build-own-operate (BOO) arrangement with the gas supplier. Additional pipeline and infrastructure capital required to deliver the gas from the existing network to the Dubbo project site will be borne by the gas supplier and recouped in the gas supply price.

9.7 Power

The mine will be powered via a 132kV overhead power transmission line originating at the Geurie switch yard and terminating at the mine main switchyard adjacent to the process plant. A transmission line easement has been secured by ASM for the route from Toongi to Geurie.

Grid connection works have been initiated with the grid operator. Renewable power options are also being investigated with interested third parties and may form part of the project development through a BOOT model.

9.8 Site Buildings

Project site buildings will accommodate personnel working on operational, logistics, and administrative tasks, and the servicing and repair of plant and machinery.

Administration buildings comprise:

- main administration buildings,
- security/logistics/training/emergency services building,
- dispersed satellite cribs proximate to operator workstations,
- laboratory,
- change house,
- bulk linen laundry and storage building, and
- processing facility administration and plant control room building.

Industrial buildings comprise:

- stores warehouse,
- product store, and
- maintenance workshop.

9.9 Process Waste Storage Facilities

The wet solid residue (slurry) produced by the plant will be treated then stored and dried in a solid residue storage facility (SRSF). The SRSF will comprise a series of cells, double-lined to prevent leakage, where each cell can be filled, closed and rehabilitated independently of the other cells. At design production (1 Mtpa), approximately 2 Mtpa of wet solid residue will be produced, reducing to 1.3 Mtpa after drying.

The liquid residue from the processing plant will be chemically treated and neutralised, before being passed through a brine concentrator, which will produce solid salts through forced evaporation of water. The salts will be stacked and stored in covered salt encapsulation cells. The salt encapsulation cells will also incorporate a double-lining system with a leak-detection layer in-between.

10 Project Implementation

The Dubbo Project execution phase is expected to be a 27-month program from the availability of execution funding and commencement of detailed design through to the completion of construction. As part of the FEED, the execution program will be further optimised to maximise modularisation of key work packages.

10.1 Contracting Strategy

During the FEED phase, ASM in conjunction with supporting contractor(s) will finalise the contract and procurement strategy to support the required risk profile for the Project. ASM anticipates this may be affected by contractual conditions required by financiers. ASM will continue to develop project execution documentation using the execution work package structure already detailed and updated in the Optimisation Study. The finalisation of key work packages and the integration with large engineering and construction companies will form the next phase of the project execution and contract strategy. This approach will facilitate the later selective grouping of packages and, together with the defined Project Requirements, can be used for multiple contracting strategies.

The Optimisation Study considered a delivery strategy incorporating:

- Engagement of a contractor(s) for FEED, detailed engineering, procurement, supply, construction and commissioning,
- Project readiness activities to enable the production of the necessary supporting documentation and major supply agreements for the Final Investment Decision (FID) by the board of ASM,
- supply contracts for the majority of the main plant items,
- services contracts as required to support the site and execution of the works,
- construction contracts as required, and
- negotiation and execution of binding heads of agreement with major utility, consumable and service providers.

The final contracting and delivery strategy will be developed in line with the project financing requirements and will include significant modularisation in partnership with engineering and construction companies.

10.2 Construction Management Planning

The approach to be used as part of the optimisation regarding construction management considers:

- The construction works involved in the project including the project construction scope and boundaries,
- The construction and site management scope, approach, and methodologies focus on:
  - horizontal discipline-based construction packages with selected packages allocated as either lump-sum-turnkey (LSTK) or design and construct (D&C).
  - construction zones that separate the construction work into definable geographical or package-based areas, and
  - modularization of plant and equipment.

10.3 Project Execution Schedule

The project execution schedule covers the implementation of the Project, via the FEED and Execution Phases through to full plant commissioning and includes:

- commencement of the Implementation Phases,
- completion of the process test work and finalise the plant process design,
- preparation, submission, and approval of an addendum to the Environmental Impact Statement,
- completion of project execution planning including the finalisation of the Project Execution Plan and associated management plans,
- completion of FEED,
- completion of pre-conditions and offsite infrastructure development,
- execution phase commencing with detail design immediately following completion of FEED engineering arising out of plant-wide design review,
- detail design and engineering phase,
- procurement phase,
- site establishment and the construction phase; and
- commissioning including pre-commissioning of specific process units and then full plant commissioning leading to hand-over.

10.4 Key Milestones

The Project Implementation will commence on the award of the EPC/EPCM contract: The remaining key project milestones include:

- Commence FEED,
- EIS modification approval,
- Complete FEED,
- FID,
- Commencement of Detailed Design,
- Procurement and contract award,
- Site Establishment,

- Process Plant Construction complete,
- Handover for Wet commissioning, and
- Ramp Up.

11 Capital and Operating Costs

11.1 Overview

The capital cost of the Dubbo project is estimated at AUD 1,678 million consisting of:

- Direct capital of AUD 1,307 million,
- Indirect capital of AUD 208 million, and
- A contingency of AUD 163 million.

Average annual operating costs are AUD 287 million.

11.2 CAPEX

11.2.1 Basis of estimate

The Capital cost estimate is built on the estimate produced by Hatch during the Optimisation Study[8] and updated during recent work completed by ASM and other consultants to produce the current base case capital estimate for the Dubbo project. The Capital costs have been estimated to an AACE class 3 level of accuracy (±30%) and are based on:

- Engineering designs to a sufficient level to allow the generation of quantities for earthworks, concrete, structures, mechanical, electrical and control equipment,
- Budget pricing responses from major suppliers,
- Escalated historical pricing on minor packages,
- Mobile equipment budget costs from suppliers, and
- Infrastructure costs from third-party consultants and suppliers including rail, water, power and fuel gas.

11.2.2 Capital Cost Estimate

The overall Optimisation Study Go Forward Case capital cost for the Dubbo Project is estimated at AUD 1,678 million and summarised in Table 6.

[8] HATCH, Final Study Report, Australian Strategic Materials Dubbo Project Optimisation FS H364004, August 2021

Table 6 : CAPEX Comparison

	2018 ASX Release 1 Mtpa (AUD M)	2021 Optimisation Study Go Forward Case 1 Mtpa (AUD M)	Comments
Mining, Crushing and grinding	28	44	2021 includes Owner mining in CAPEX, 2018 Mining, Drill & Blast Contract model
Roasting and Leaching	17	34	2021 Roast specification changed for latest test work. Addition of Roaster feed prep equip, Offgas acid recovery & cleaning additions.
Solvent extraction, product refining and finishing	329	342	2021 - Flow sheet optimisations. Product recovery improvements. Product Suite changes/additional REE products
De-Hafniated Zirconia (DHZ) SX	30	117	2021 DHZ plant further defined and priced
Waste treatment (Incl. SRSF, Filtration, Brine Conc)	161	215	2021 Water treatment including Brine Concentrator capacity increased to reduce water consumption
Reagents, Water, SAP, Chlor Alkali Plant	197	250	2021 Inclusion of chlor-alkali plant on site offset by reduced reagent, handling and transport costs
Electricity	77	117	2021 Addition power infrastructure for plant increases. DHZ SX, chlor-alkali
Site Wide Infrastructure	98	116	2021 General rates increase. Plant Mobile Equip added.
Offsite Infrastructure	72	72	2021 - Rail added (OPEX savings & HSE improvements). 2021 Gas removed (BOO option). Neutral to CAPEX
EPCM	90	104	2021 EPCM includes Home Office/Detail Design costs.
Temp Construction Facilities	24	27	2021 Includes additional construction facilities for an increase in overall plant and equipment
Spares and First Fills	26	27	2021 Increase for larger plant and equipment
Owner's costs and provisions	45	50	2018, Includes the cost of MTO/quantity growth in the indirect provisions and Owner's costs. 2021 MTO growth amounts are included in the direct cost for each WBS area, 50 million is all Owner's costs.
Contingency	103	163	Generally higher contingency due to larger overall project cost.
TOTAL	**1,297**	**1,678**	

11.3 OPEX

11.3.1 Basis of Operating Cost Estimate

The operating cost estimate is built on the estimate produced by Hatch[9] and ASM during the Optimisation Study and updated during the recent work completed by ASM and other consultants. The operating cost estimate is based on mining and processing of 1.0 Mtpa of ore to produce a suite of products listed in Table 7.

Table 7 : Dubbo Project Product Summary

Dubbo Products	Production Quantity Metric Tonnes per Annum (t/a)
Zirconia (ZrO_2, produced from calcining ZBS)	13,500
Dehafniated Zirconia (DHZ)	2,500
Hafnium Oxide (HfO_2)	30
FerroNiobium (65% Nb)	2,650
SmEuGd Chloride (solid)	454
Nd/Pr Oxide (solid)	1,342
Y + HRE Chloride (solid)	1,180
Tb Oxide (solid)	22
Dy Oxide (solid)	142
TOTAL:	**21,820**

The main constituents of the operating estimate include:

- mining costs,
- operations and maintenance labour,
- electric power,
- reagents,
- consumables (including natural gas),
- maintenance,
- general and administration,
- contracts and consultant services,
- product transport,
- waste transport of salts generated by the brine concentrator to the Salt Encapsulation Facility, and
- cost credit from electricity generation within the Sulphuric Acid Plant.

The Operating estimate has been prepared based on the following parameters:

- estimate base date of the first quarter of 2021,
- target accuracy of -15% to +15%,
- reagent and consumable quantities calculated from detailed simulation modelling of the process design criteria and flowsheets,
- applicable equipment operating cost estimates (e.g., power, consumables),

[9] HATCH, Final Study Report, Australian Strategic Materials Dubbo Project Optimisation FS H364004, August 2021

- reagent and consumables costs from suppliers,
- organisation chart determined by ASM, and labour rates provided by HR consultant,
- General, administration and consulting expenses, and
- maintenance costs based on a fixed percentage of the total mechanical equipment cost in each area varied to reflect the type of equipment and process conditions of operation in the area.

11.3.2 Operating Cost Estimate

Table 8 shows the operating cost calculated in 2021 and 2018. The major Optimisation Study Go Forward Case adjustments to the operating costs include:

- the addition of a chlor-alkali plant (to eliminate the requirement to import HCl resulting in a subsequent 60% reduction of caustic imports along with reductions in operating costs due to reduced transport and handling of dangerous goods),
- alternative iron removal circuit (for improvement in rare earth product recovery),
- removal of the Cerium / Lanthanum RE product, reducing operating and capital costs, and
- the inclusion of the Ferroniobium Smelter facility.

Table 8 : Optimisation Study Go Forward Case Average Annual Operating Costs Summary

			Optimisation Study Go Forward Case				
Category	ASX Release Base Case 1 Mtpa *(AUD M)*	*2021 Optimisation Study (AUD M)*	*Chlor-alkali Plant (AUD M)*	*Alternate Iron Removal (AUD M)*	*RE Product Deletion (AUD M)*	*Fe Nb Smelter (AUD M)*	**Optimisation Study Go Forward Case *(AUD M)***
Mining	**3**	6.8					**6.8**
Labour	**36**	41.4					**41.4**
Power	**27**	28.3	8.0				**35.5**
Fuel Gas		32.3			-0.7		**31.7**
Reagents	**209**	189.6	-63.1	8.5	-6.0	**5.5**	**134.5**
Consumables	**7**	7.2	1.0		-0.8		**8.2**
Maintenance	**19**	9.6	1.5		-0.3	**0.3**	**11.1**
Product Transport	**5**	4.6			-0.2		**4.5**
General and Administration	**11**	8.7					**8.7**
Contracts and Consultant Services	**0**	4.1					**4.1**
TOTAL (Million per Annum)	**317**	**333**	**-52.6**	**8.5**	**-7.9**	**5.8**	**287**

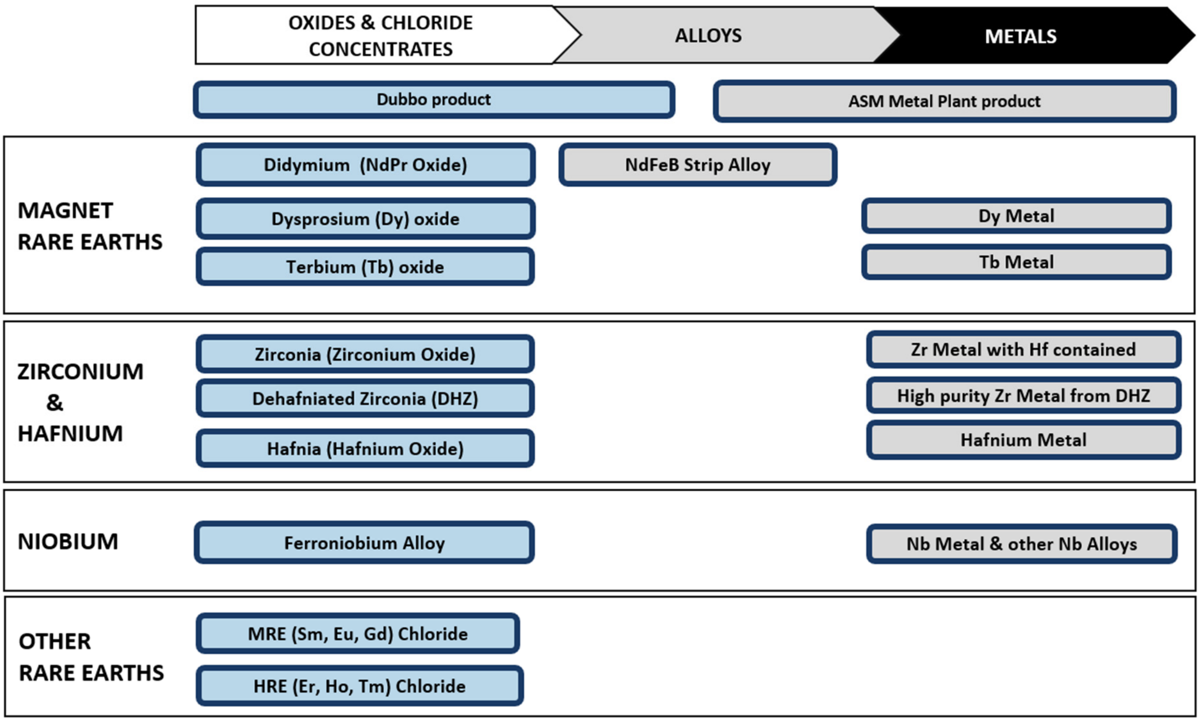
12 Marketing

The Dubbo Project will produce a suite of critical elements which are at the forefront of advanced technologies driving global decarbonisation and electrification megatrends. With the commissioning of the Dubbo Project and the application of ASM's metallisation process, ASM will be uniquely positioned to deliver fully integrated, sustainably sourced, supply solutions to customers in key applications that will be essential to achieving the planet's climate neutrality goals.

12.1 ASM's Mine to Metal Advantage

The Dubbo Project product suite and value-added metals products are shown in Figure 15:

Figure 15 - Dubbo Project Product Suite and Value-Added Metals Products



The Dubbo Project's magnet rare earth oxides (neodymium, dysprosium and terbium oxides) and zirconium, hafnium and niobium products can all be refined into high-purity alloys, metals, and powders. Together with the company's Korean Metal Plant (KMP), the Dubbo Project is a pillar of ASM's integrated 'mine to metal' strategy that will avoid discounting associated with only producing and selling separated oxides and intermediaries.

12.2 Dubbo's Polymetallic Edge

One of the key advantages of the Dubbo Project is that revenue is spread across four main product groups which are used in a diverse range of applications and industries. Figure 16 shows the percentage of revenue and product volume each product group contributes to the project. This provides a natural hedge against market dynamics, limiting the exposure to any single market. It also grants the Dubbo Project a position in the first quartile of the cost curve (on a ZrO_2 equivalent basis) as high-value co-product credit revenues.

Figure 16 - Product Volumes v Product Revenue (Distribution by Commodity)

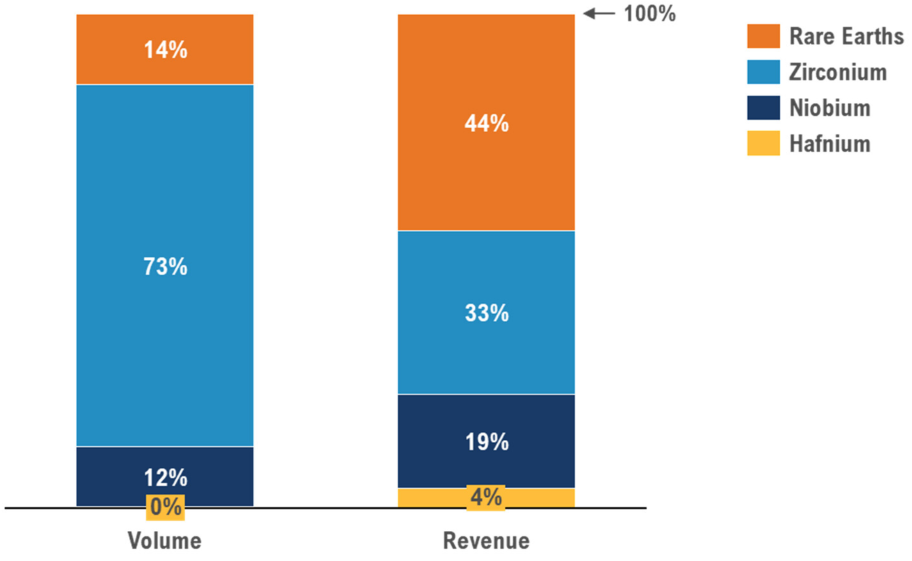


Table 9 : Long Term Real Price assumptions used in the 2021 Optimisation Study

Dubbo Products	Unit	LT Price (REAL)	Price Basis
Zirconium, Niobium, Hafnium products[10]			
Zirconia (ZrO_2, produced from calcining ZBS)	US$/kg	$10.00	100% ZrO_2
Dehafniated Zirconia (DHZ)	US$/kg	$30.00	100% ZrO_2
Hafnium Oxide (HfO_2)	US$/kg	$1,010	100% Hf
Ferroniobium (FeNb)	US$/kg	$45.00	100% FeNb
Rare Earth Products[11]			
Nd - Neodynium Oxide	US$/kg	$105.70	Nd_2O_3 (2N5)
Pr - Praseodymium Oxide	US$/kg	$97.5	Pr_6O_{11} (2N5)
Dy - Dysprosium Oxide	US$/kg	$578.50	Dy_2O_3 (2N5)
Tb - Terbium Oxide	US$/kg	$1456.30	Tb_4O_7 (4N)
Sm – Samarium oxide	US$/kg	$2.30	Sm_2O_3 (3N)
Eu – Europium oxide	US$/kg	$42.60	Eu_2O_3 (5N)
Gd – Gadolinium oxide	US$/kg	$42.80	Gd_2O_3 (4N)
Ho - Holmium	US$/kg	$118.50	Ho_2O_3 (2N5)
Er - Erbium	US$/kg	$34.40	Er_2O_3 (2N5)

[10] Price assumptions are informed by the Independent Market Research Reports for Zirconia (March 2018) and Hafnium (June 2017) provided by Roskill Consulting Group Ltd and Roskill's 16th edition Niobium Outlook report published in 2020. Independent zirconium marketing experts Minchem also provided technical advice on the product pricing differentials for different zirconium product options

[11] Price assumptions are informed by the Independent Market Research Reports provided by Roskill Consulting Group Ltd for Rare Earths (February 2018) and Adamas Intelligence in their April 2021 Rare Earth Magnet Market Outlook update April 2021

12.3 Providing a differentiated supply alternative

Global markets for several Dubbo Project products are heavily reliant on materials extraction, processing and refining capacity based in China. There is strong customer support for new sources of secure supply that reduce dependence on a single country, a concern that extends to niobium where much of the world's supply originates from Brazil. In addition, the Chinese Government's 14th five-Year Plan, which places growing importance on ecological and environmental protection, is expected to result in an end to oversupply and low international prices in many critical raw material markets, as domestic processing capacity closures likely precede export restrictions. Simultaneously the reorganisation of the magnet rare earth industry since 2018 has further increased already elevated geopolitical risk to a country with an oligopolistic position in the global production of REEs.

The Dubbo Project will produce a suite of high-value downstream products, providing a strategic alternative to existing supply chains and enabling companies to significantly reduce both business and geopolitical risk. This is especially true for advanced economies in Europe, North America, and North Asia, where there is a high dependence on supply from China for REEs, zirconium and hafnium materials.

12.4 Delivering sustainability and security

The Dubbo Project will be an important source of critical rare earth elements (REEs), zirconium and hafnium materials into international markets expected to experience strong compound annual growth rates (CAGRs) due to global decarbonisation and electrification megatrends. At the same time, growing ESG concerns are leading many companies to question the legitimacy of processing expanding quantities of raw materials in jurisdictions where pollution controls are known to be less stringent, especially for minerals like zircon sands which contain increasing levels of radioactive elements uranium and thorium (U+Th). The Dubbo Project has virtually no U+Th and already possesses all the necessary state and federal approvals and licenses to become one of the few sites producing separated REEs in Australia.

12.5 The Dubbo Project Marketing Strategy

ASM's marketing strategy is based on securing long-term customer relationships, founded on a reliable and sustainable production base in Australia. The Dubbo Project intends to supply significant quantities of rare REEs processed to NdFeB strip alloys at KMP, predominately for use in permanent magnets. The project will also produce two premium zirconia products, as well as ferroniobium and hafnium products.

The initial product range will be complemented by the progressive development of further high-value options in response to customer and market demands. This could include the formulation of specialty chemicals or the conversion of chemicals to powders or metals, as well as the production of functional products. In the future, there will also be opportunities to recover and recycle elements from end-of-first-use applications to develop new revenue streams.

12.6 Rare Earth Elements (REEs)

Rare earth permanent magnets (REPMs) are the main growth driver for the global REEs industry at present, accounting for 60% of the market by volume – but 90% by value. The magnet rare earths include neodymium, praseodymium, samarium, dysprosium, and terbium. Strong expected CAGRs for REPMs used in commercial and passenger electric vehicle traction motors, wind power generators and consumer appliances are expected to lead to sustained and increasing raw material deficits, with limited new sources of supply available in China or elsewhere. By contrast, production from the Dubbo Project would be sufficient to produce REPMs annually to power approximately 1 million electric vehicles.

Industry consultants Adamas Intelligence estimate that 64% of total REE oxides were mined in China in 2020, while a European Commission study concluded that after processing China's share of global REEs supply rises to 86%. Other structural market developments in the last decade include the Made in China 2025 policy to maximise downstream processing into finished products. This is likely to reduce supplies of REE oxides, metals, and magnets available for export. Simultaneously China's commitment to stamp out illegal REEs production is expected to also reduce supply and support prices, as it faces mounting costs to rehabilitate REEs mines across the country.

In the case of the magnet rare earths, it is anticipated that continued strong growth in demand for neodymium, praseodymium, dysprosium and terbium oxides will exceed supply and support prices over the first 20 years of Dubbo Project production. Magnet rare earths revenue represents over 90% of Dubbo's total revenue from Rare Earth products.

NdPr, Dy and Tb oxides will be separated on-site. The Dubbo Project's estimated output of 1.5 ktpa of magnet rare earth oxides represents approximately 2% of 2020 demand. Other unseparated REEs contained as chlorides will also contribute to REEs revenues. ASM will continue to investigate options around separation of these additional REEs on-site as well as third-party toll-processing alternatives.

12.6.1 REEs Products

ASM will produce a marketable suite of three separated REEs oxides and two dried chlorides. The primary focus will be the elements used in REPMs, which will be shipped for processing to metal and neodymium iron boron (NdFeB) strip alloys at the company's KMP, predominately for use in permanent magnets.

The main magnet rare earths are praseodymium and neodymium. These will be recovered at the Dubbo Project as an unseparated NdPr oxide at project start-up but may be separated into Pr and Nd oxides later according to market requirements. The other magnet rare earths produced by the Dubbo Project, Dy and Tb oxides, will be separated at the site. Magnet rare earths are expected to account for over 90% of total revenues from the sale of REEs oxides.

Other rare earths will initially be sold as unseparated dried chlorides.

Magnet rare earths

Neodymium/Praseodymium (NdPr) oxide (≥ 99.5% $Pr_6O_{11}Nd_2O_3$) - a light REE oxide (also known as didymium oxide) that will be shipped to KMP for the manufacture of NdFeB alloys.

Dysprosium (Dy) oxide (≥ 99.5% Dy_2O_3) - a Heavy REE oxide that will be shipped to KMP for the manufacture of high-temperature-performance NdFeB alloys.

Terbium (Tb) oxide (≥ 99.5% Tb_4O_7) - a Heavy REE oxide that will be shipped to KMP for the manufacture of high-temperature-performance NdFeB alloys.

12.6.2 REEs Products Marketing

Magnet rare earth oxides from the Dubbo Project will be processed at KMP to NdFeB alloys for sale directly to manufacturers and end-users of REPMs. With the imminent start-up of the NdFeB production line at KMP, the customer base for the Dubbo Projects magnet rare earth oxides products will be well established years in advance of the Dubbo Project being fully commissioned.

12.7 Zirconium

The global zirconium market (not including the direct zircon market) is forecast by the Roskill Consulting Group to reach 203 ktpa by 2026, with the highest growth rates predicted for high-purity zirconium chemicals. At full capacity, the Dubbo Project will account for about 8% of global supply of zirconium materials, making it a significant long-term alternative source of these sought-after products.

Zirconium oxychloride (ZOC) is the most traded zirconium material. ZOC prices are now at US$3,830/t (36% ZrO_2) ex-works China[12], this is equivalent to US$10,639/t on a 100% ZrO_2 basis. China's increasing focus on environmental pollution and compliance is expected to lead to further consolidation of supply, while higher prices for zircon sand is expected to add further upward pressure to costs.

Prices for zircon sand have risen by 26% in 2021[13]. As importantly, reduced ore quality is also affecting fused zirconia production, where low levels of radionuclides are required for the fusion process (premium zircon with low levels of U+Th is necessary to produce fused zirconia with <500 ppm U+Th to meet international standards for transportation and usage of the finished product).

The eudyalite mineralisation of the Dubbo Project enables the production of a zirconia product that contains virtually no U+Th. This is expected to be particularly sought after by fused zirconia producers battling rising radionuclide impurities from existing zircon sands suppliers.

The Dubbo Project will also produce a higher value, dehafniated zirconia (DHZ) suitable for producing nuclear grade zirconium metal and other zirconium alloys. Pricing information on hafnium free zirconium is very limited as the main western producers of zirconium metal formulate their own hafnium free zirconia in-house and do not trade this material in the open market.

12.7.1 Zirconium Products

Dubbo Project production will initially consist of two zirconium products - a calcined, low-hafnium zirconia and calcined zirconia. ASM continues to assess further options to add to the zirconium materials product suite.

Low-hafnium zirconium oxide / DHZ (≥ 99.5% ZrO_2, <100 ppm HfO_2) - a special, high-purity grade of zirconia developed for producing zirconium metal required in the energy industry. This zirconia attracts a significant price premium over other grades containing hafnium.

Zirconium oxide (≥ 99.5% ZrO_2) - zirconia produced from calcining zirconium basic sulphate (ZBS) with applications in both chemical and fused zirconia markets. The very low U+Th content of this

[12] Argus Metals International Daily reports 28 October 2021
[13] Argus Metals International Daily Reports, 04 January 2021 and 28 October 2021

product will make it increasingly necessary for use by fused zirconia producers with the rising scarcity of premium zircon.

12.7.2 Zirconium Products Marketing

The Zirconia products produced at Dubbo can also be further processed into zirconium metals at KMP. This product optionality will allow ASM to establish long term contracts with a diverse set of customers for different end-use applications.

12.8 Niobium

The global steel industry is the main driver for consumption, where more than 90% of all niobium is used as ferroniobium in high-strength low-alloy steels for the oil and gas, construction, and automotive sectors. Minor additions of niobium to steel can greatly increase strength to weight ratios with resulting cost savings and emissions reductions. While ferroniobium dominates as the largest segment for niobium consumption, the accelerating electric vehicle market presents significant upside potential for niobium usage with the development of niobium oxide anode material that can safely reduce battery charge times by up to 20% compared to graphite-based designs.

12.8.1 Niobium Product

Ferroniobium (min 65% Nb) - a standard grade ferroniobium suitable for usage in high-strength low-alloy steels in the construction and automotive sectors.

12.8.2 Niobium Product Marketing

ASM is progressing discussions with various counterparties interested in securing long term offtake agreements as part of the company's 'mine to metal' strategy.

12.9 Hafnium

The Dubbo Project is one of the few independent sources of hafnium (independent of the nuclear industry) available to meet the anticipated increase in demand over the next decade.

The major application for hafnium is as an alloying element in nickel-based superalloys, used to improve high-temperature stability and creep resistance in both aircraft and industrial gas turbines. The metal is also used in the control rods of nuclear reactors, in metal-organic catalysts, semiconductors and high-temperature plasma cutting. In addition, new applications in electric vehicles and reusable spacecraft, where rocket nozzles contain as much as 10% hafnium, present opportunities for growth with the accelerating megatrends of decarbonisation and electrification. Hafnium usage is currently supply constrained so that the Dubbo Project will produce according to identified demand, yet it has the capability for output in excess of 100 tpa. This should provide end-users with confidence for stable supply and increased availability to help develop the market.

The hafnium product recovered from the Dubbo Project zirconium stream will be a calcined hafnium oxide (HfO_2), a 'hafnia'. Similar to Dubbo’s zirconium and niobium products, there is significant value-adding potential to produce hafnium metal or other hafnium products such as hafnium tetrachloride ($HfCl_4$) consumed in the semiconductor industry as part of the ASM’s 'mine to metal' strategy.

12.9.1 Hafnium Product

Hafnium oxide (HfO_2) (up to 99.8% HfO_2 + balance Zr) - ASM will supply a high-purity hafnia containing low levels of zirconium. The Dubbo Project will become a major new source of this critical element used in an increasing range of applications for its specific ferroelectric and thermoelectric properties, which although it can be used in oxide form is intended for conversion to metal utilising the company's proprietary Ziron Tech metallisation technology. The zirconium content in hafnium oxide can be changed according to the application requirements.

12.9.2 Hafnium Product Marketing

ASM will market the Dubbo Project hafnia product directly to end-users as well as undertake market development activities to evolve opportunities in new applications.

13 Financial Analysis

13.1 Financial Modelling and Evaluation

ASM has prepared a detailed financial model to assess the financial and economic parameters and to confirm the overall economic viability of the Dubbo Project (**Financial Model**). The discounted cash flow analysis has been undertaken based on the updated technical work and changes to the Dubbo Project product suite and externally sourced long-term pricing assumptions that have been adopted by the ASM board for this report. The Company has reviewed the inputs to the Financial Model and believes that it has reasonable grounds for the assumptions included, albeit that some of the assumptions are inherently difficult to assess and forecast with accuracy. Key inputs and assumptions underpinning the Financial Model have been set out in this report, where appropriate incorporating a comparison against the last published update on the Dubbo Project in the 2018 ASX Release, which occurred when ASM was a subsidiary of Alkane Resources (e.g., before the demerger of ASM in 2020).

13.2 Key Inputs and Assumptions - Economic

The Financial Model incorporates the following key economic assumptions in Table 10.

Table 10 : Key Assumptions

Parameter	Optimisation Study Go Forward Case	2018 ASX Release	Changes adopted in 2021 Summary
Exchange Rate (A$:US$)	0.75	0.75	unchanged
Discount Rate (Real, post-tax %p.a.)	8.0%	8.0%	unchanged
Corporate Tax Rate (%)	30%	30%	unchanged
Product Pricing	See Section 12	See 2018 ASX Release	Updates to long term pricing forecasts from external consultants

ASM has sourced long-term pricing assumptions for its revised product suite from leading external industry consultants, as set out in Section 12 of this report.

13.3 Modelled Mine Life

The reportable JORC 2012 compliant resource for the Dubbo Project, incorporating Measured, and Inferred Resources has been estimated at 75.2 Mt, as outlined in detail in Section 5 of this report. The Proved Ore Reserves, estimated at 18.9 Mt, are a subset of this global resource. An independent review, undertaken by Mining One, as part of the 2021 technical work, re-confirmed the Proved Ore Reserves based on the revised economics for the Dubbo Project summarised in this report. There has been no update to the estimate of reserves (see Annexure A).

The 2018 Study incorporated a 20-year mining scenario which under the Base Case scenario assumed the mining of 26% of the global resource. ASM considers there to be a reasonable prospect that mining beyond this amount will be undertaken over the life of the Dubbo Project. Additional mining could take place either through an expansion of the Dubbo Project processing capacity beyond 1.0 Mtpa during the mine life or through an extension of the mine life – or both.

13.4 Key Inputs and Assumptions – Capital Estimates

13.4.1 Construction Capital

The capital cost estimate of the Dubbo project is AUD 1,678 million as described in section 11.

13.4.2 Sustaining Capital

In addition to construction capital expenditure, the Financial Model incorporates sustaining capital in each of the years following the initial construction period. An estimate of $16.4m per annum in sustaining capital has been assumed, although ASM recognises that there will be significant variance in sustaining capital expenditure from year to year as specific components are replaced or refurbished.

The total quantum of sustaining capital over the 20-year operation totals approximately $330m. The assumptions in the 2021 summary provide for significantly more sustaining capital than the $124m of sustaining capital assumed in the 20-year project life adopted for the 2018 Summary.

13.5 Ramp Up

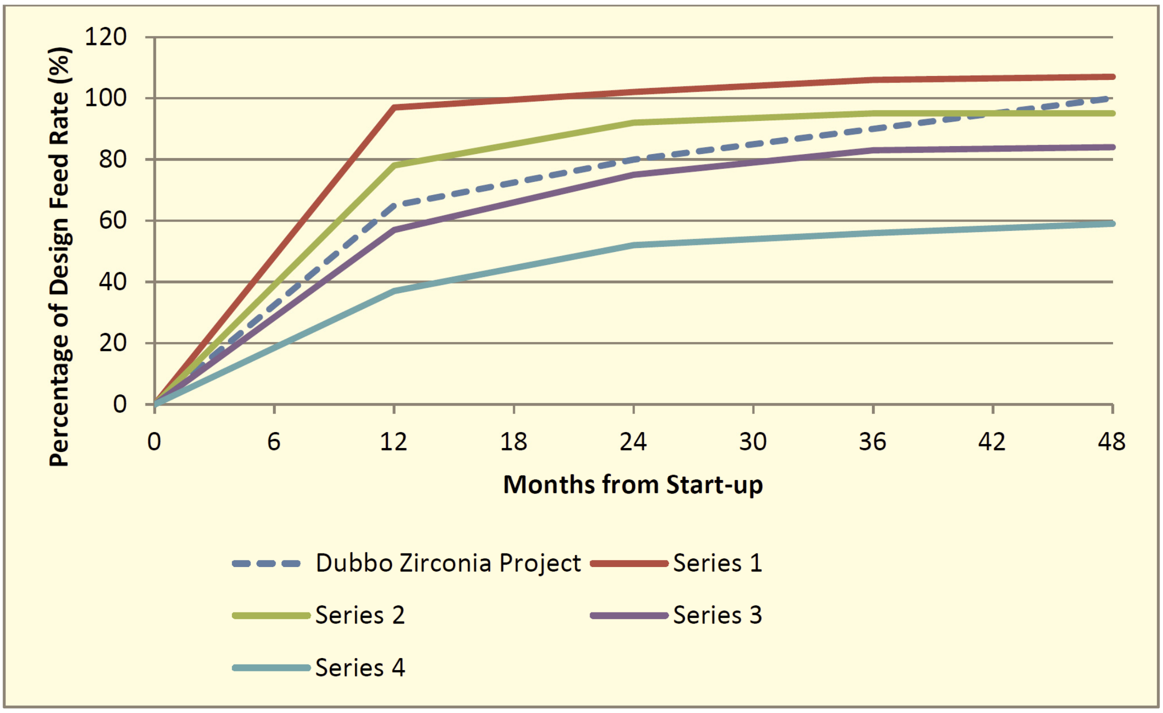
The estimated plant operating throughput ramp up from start-up to nameplate processing of ore is shown in the ramp-up summary in Table 11.

Table 11 : Process to Ramp-Up to Name-plate Capacity

Parameter	Months from Plant Start-up			
	12 months	24 months	36 months	48 months
Feed Rate as % of Nameplate	65%	80%	90%	100%
Feed Ore Throughput (tpa)	650,000	800,000	900,000	1,000,000

The proposed Dubbo Project feed ore ramp-up is compared to the McNulty averaged start-up curves from operating plant experience in Figure 17.

Figure 17 – Project Ramp-up Curve Comparison



The 4-types of averaged McNulty[14]start-up curves are defined as:

- Series 1: Mature technology used elsewhere, thorough piloting, complete process development and engineering.
- Series 2: Some prototype technology, severe process conditions, incomplete or non-representative pilot testing.
- Series 3: As with series 2, but with limited piloting (steps missed) and/or feed variability, poor quality during process development, feed/mineralogy misunderstood, engineering and construction fast tracked. Serious design flaws.
- Series 4: As with series 2 and 3, but if continuous tests were run, they were only to make product, unusually complex flow sheet with two or more prototype unit operations, equipment downsized to save costs, process chemistry misunderstood.

ASM have adopted a philosophy for the Dubbo Project start-up consistent with a series 2 or 3 start-up followed by a steady increase in feed ore processing rate to 100% after 48 months. This ramp-up relies on the remediation of any design flaws or equipment bottlenecks that would otherwise hinder a series 2 or 3 plant ramp-up.

13.6Key Outputs from Financial Modelling

Based on the Financial Model with the key input parameters as described above, the key outputs of the Financial Model are summarised in Table 12.

[14] Minimization of Delays in Plant Start-Ups, McNaulty, T.P., "Plant Operator's Forum 2004: Things that Actually Work!"

Table 12 : Key Outputs from Financial Modelling

Key Outputs (AUD $'000)	2018 ASX Release (20 Years)	2021 Financial Model (20 Years)
Gross Revenue	12,768	15,802
Total undiscounted pre-tax Free Cash Flow	4,656	7,442
Annual Free Cash Flow (full ramp up)	323	425
Pre-tax Project IRR %	17.5%	23.5%
Post-tax Project IRR %	Not released	20.1%
Pre-Tax NPV	1,236	2,361
Post-tax NPV	Not released	1,581

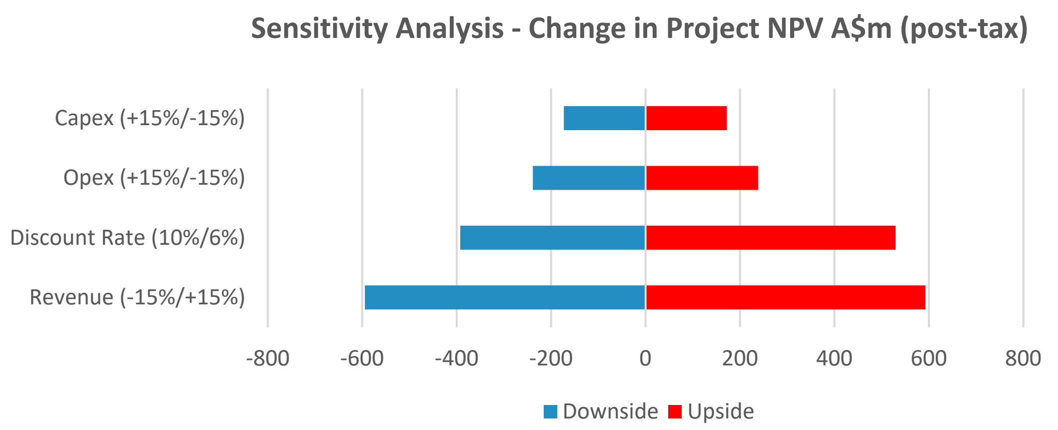
Some of the material changes driving the material improvement in project economics between the 2018 and 2021 key outputs in Table 12 are summarised as follows:

- Simplification of the zirconium processing circuit eliminating the steps to produce zirconium oxychloride (ZOC) as a saleable product (lower CAPEX, lower OPEX) – IRR improved.
- Inclusion of a chlor-alkali plant on site (higher CAPEX, lower OPEX, HSE Benefits) – IRR improved.
- Inclusion of rail spur to the site (higher CAPEX, lower OPEX, HSE benefits) – IRR improved.
- Inclusion of iron removal circuit (higher CAPEX, lower OPEX, ESG benefits) – IRR improved.
- Inclusion of a brine concentrator (higher CAPEX, lower OPEX, HSE benefits).
- Inclusion of a FeNb smelter (higher CAPEX, higher OPEX, increased product revenue) – IRR improved.
- Revised revenue assumptions to reflect 2021 expectations for long term pricing of key products (higher revenue) – IRR improved.

13.7 Sensitivity Analysis

Figure 18 outlines the change in NPV from the Financial Model based on changes to key inputs – capital costs, operating costs, discount rate and revenue (product pricing). The analysis is based on the 20-year case presented in the first column of Table 11.

Figure 18 - Sensitive Analysis



As expected, the Financial Model NPV is most sensitive to long term product pricing assumptions (revenue).

13.8 Strategic Partner Process

Since separate listing, ASM's primary focus for strategic partners has been in South Korea. The company has met with relevant government agencies, industrial conglomerates, product end-users, engineering companies and financial investors regarding potential collaboration and investment in the Dubbo Project. The company has also progressed discussions with other corporate and government agencies outside of South Korea.

In July 2021, ASM executed a Framework Agreement with a consortium of South Korean private equity partners. As detailed in the announcement, this conditional agreement involved a consortium fund comprising financial and strategic investors providing US$250m of equity funding in exchange for a 20% interest in the Dubbo Project holding company (Australian Strategic Materials (Holdings) Pty Ltd). The agreement envisages that following the completion of due diligence and formal establishment and capitalisation of the Consortium Fund, detailed agreements concerning equity, offtake, debt financing and engineering construction will be progressed jointly between ASM and the Consortium Fund. On the 6th of October 2021, ASM announced delays in the due diligence timetable due to Covid19 travel restrictions[15].

13.9 Government Funding Agencies

ASM continues to engage with Australian and overseas government funding agencies, including several South Korean government funding agencies. These agencies, including export credit agencies and development banking agencies, recognise the benefits to industrial supply chains of constructing additional resource projects capable of supplying rare earths and other critical materials given the increasing importance of these materials in electronics, power generation and storage, aerospace, defence and other growth industries.

As part of these discussions, government agencies are demonstrating increasing awareness of the funding challenges facing new critical materials projects. Among these challenges are the relatively high construction costs, particularly for processing plants in these specialised sectors compared to other mining projects, and the lack of transparent and liquid exchange-traded markets for the products which commercial debt financiers often require during the credit assessment process.

Numerous governments, including Australia, South Korea, Japan, the USA and several European, have made public policy announcements indicating a strategic need to incentivise and facilitate new critical minerals projects[16]. Several government agencies have articulated to ASM an openness and intention to provide credit support or direct funding to projects producing critical minerals including key rare earth products, and ASM continues to engage directly with several agencies in relation to support in financing the Dubbo Project.

ASM considers it has reasonable grounds to expect that debt financing will be available for the Dubbo Project, recognising that financing will be reliant on the ability of ASM, together with any

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[15] ASM ASX and Media Release – "Dubbo Project Finance Update" dated 06 October 2021
[16] Australian Government – Department of Industry, Science, Energy and Resources Website, https://www.industry.gov.au/funding-and-incentives/supporting-critical-minerals-projects-in-australia current as of 30 November 2021

strategic partners, to secure offtake contracts for its core products that meet the financing requirements of these financiers. No legally binding funding commitments have been made at the date of this release, and ASM cannot be certain funding commitments will be forthcoming.

In June 2021, Export Finance Australia (EFA) issued a letter of support to ASM outlining conditional finance support for the Dubbo Project of AUD $200m.

Certain of the government funding agencies have indicated a mandate that extends to considering equity or quasi-equity investment structures in either listed or project vehicles. ASM's strategy is to progress its strategic partner discussions and then consider the opportunity and/or need to extend the equity funding initiatives to include these agencies as required, likely on equivalent terms to those negotiated with strategic partners.

13.10 Commercial Bank Project Finance

ASM has had and continues to have, discussions with Australian, South Korean and global project finance banks concerning the provision of project finance for the Dubbo Project. ASM has appointed ANZ Bank as a debt financial advisor to assist with the procurement of both government agency and commercial bank debt finance. Based on discussions to date, ASM expects that most of the commercial bank debt procured during the Dubbo Project financing process will rely (in part or entirety) on credit support provided by government agencies such as ECAs.

13.11 Korean Metals Plant (KMP)

ASM is currently constructing and commissioning the KMP that will operate processing third-party feedstock. Alternatively, ASM may be able to procure debt financing against the KMP and apply the proceeds towards the Dubbo Project financing.

13.12 Other Financing Discussions

ASM is prioritising the progression of the Framework Agreement announced in July 2021 as its core funding strategy to raise capital for the Dubbo Project development, however it notes that other initiatives such as listed equity issuances, sale of project interests to other investors, equipment leasing, royalties and streaming, convertible debt instruments, offtake pre-payment structures represent other options that may be considered and progressed in the future as part of the overall funding strategy.

As of the date of this report, the market capitalisation of ASM approximates A$1.6 billion[17]. While subject to specific and general risks, ASM considers that (i) the successful progression of the Framework Agreement into binding detailed agreements and introduction of a major industrial company as a strategic investor into the Dubbo Project, (ii) the execution of offtake contracts for key products from the Dubbo Project, (iii) the progression of the process towards the procurement of significant debt financing and/or (iv) the successful commissioning of the South Korea Metals Plant could provide material catalysts for ASM's share price traded on the ASX.

[17] As of 06 December 2021

14 Material Risks

ASM has developed a project risk register via risk workshops and reviews over several years with the latest review of project risks completed during the Optimisation Study. Figure 19 shows the comparison of the identified project implementation risk scores for the risks scores at the time of identification versus the residual risk score after the application of the risk mitigation controls.

Figure 19 - Project Implementation Risk (Current v Residual)

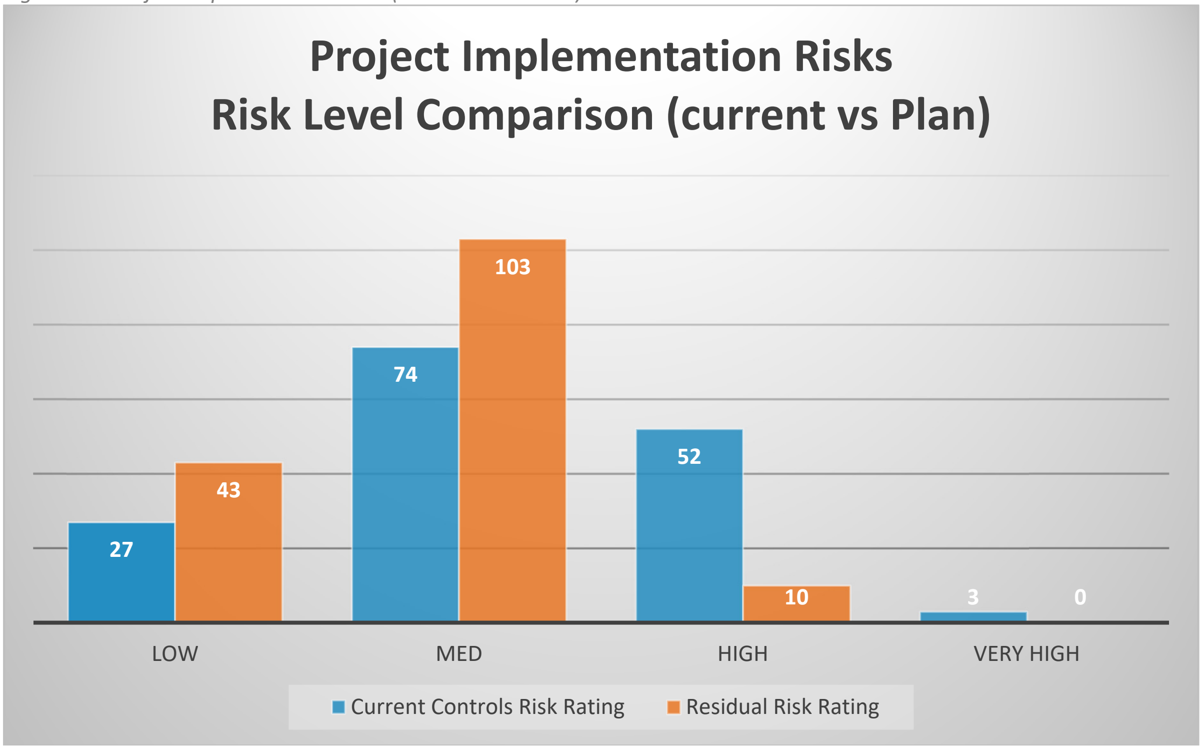

Table 13 : Project Implementation Risk Scores v Categories

Project Implementation Risks (Band with Current & Planned Controls)					
Current Risk Level	**Low**	**Medium**	**High**	**Very High**	**Totals**
Corporate & Finance	7	39	3	0	**49**
Environment & Community	21	6	1	0	**28**
MET and Process Plant	7	35	2	0	**44**
Mining	1	0	2	0	**3**
Offsite Infrastructure	0	3	0	0	**3**
Operations	1	6	2	0	**9**
Permitting	4	5	0	0	**9**
Site Infrastructure	0	1	0	0	**1**
HR	0	3	0	0	**3**
Geology	0	0	0	0	**0**
TSF	2	3	0	0	**5**
Utilities	0	2	0	0	**2**
TOTAL:	**43**	**103**	**10**	**0**	**156**

A summary of the key project risks is outlined below including mitigation controls and general status:

- **Transport and Logistics of Dangerous Goods**. The Dubbo operations require a significant number of reagents that are classed as dangerous goods and will need to be handled and transported from the receiving port to the site. During the Optimisation Study, ASM has identified opportunities to reduce the number of dangerous goods to be transported to the site via manufacturing some reagents at the site and moving the dangerous goods over the state and local roads onto the rail.
- **Solid Residue Storage Facility**. Inadequate design and or poor construction quality assurance may result in a dam failure or leakage into the groundwater. The engineering and design have mitigated identified risks associated with the current geotechnical, tailings characterisation and dam design. Final design and risk mitigation activities including construction management and quality assurance planning will be completed during the FEED phase.
- **Mining development and operation**. Whilst the mining operation is small with a low strip ratio and pit depth, there is a risk that the mining operation is impacted by a variety of events, including environmental hazards, industrial accidents, technical failures, labour disputes and climatic conditions. ASM will adopt typical mining practices in accordance with NSW mine safety regulations and relevant operation and risk management procedures.
- **Ore processing performance**. The Dubbo Project processing flow sheet has a large number of unit processes that are integrated into a complete processing facility. Production rates may be lower should there be delays in commissioning and bringing the plan up to full capacity. ASM has run multiple pilot test work programs and continue these programs to ensure that circuits with the flowsheet are tested and requirements for stable operation are understood and transferred to the plant design. ASM has also allowed for a 4-year ramp-up period in the current business case.
- **Product / Commodity pricing and Currency**. Product revenue and cash flow will be derived from the sale of products. Changes in commodity prices may have a positive or negative effect on the Company's profit margins, project development and production plans and activities, together with its ability to fund those plans and activities. ASM has within its flow sheet and its downstream metallisation process abilities to respond to changing market conditions to manage this area of risk.
- **Capital Cost**. The Dubbo project capital cost is calculated against the level of engineering complete to date and the advice from major suppliers, contractors, and commodity markets. The current capital estimate has been determined by Hatch to be at an AACE class 3 level. However, the market forces for labour and material may increase the overall cost of the project. ASM has completed a Quantitative Risk assessment of the CAPEX and implementation schedule which has resulted in the assignment of a project cost and schedule contingency. ASM will continue to refine the Project CAPEX and schedule through the FEED phase through the adoption of key work package modularisation of the project before a final investment decision is made.
- **Permitting and Approvals**. The Dubbo Project is subject to the laws of Australia and the State of New South Wales. These laws include those relating to mining, development, permit and licence requirements, environment, industrial relations, land use, water, native title and cultural heritage, land access, and mine safety and occupational health. ASM has received the required approvals to commence the project. Since the Environmental Protection Licence was issued the project has been optimised and adjusted to suit the business requirements. ASM is currently completing a modification application that defines the minor changes to the site and optimisation outcomes including reductions in water

consumption, transport of dangerous goods and general traffic on the local and regional roads.

- **Pandemic**. COVID19 or similar outbreaks may affect the construction and or operation of the Dubbo Project, resulting in delays in construction and manufacture on-site and at vendors premises nationally and internationally. ASM will include a pandemic management plan within the suite of plans to be included in the Project Execution Plan and procedures. ASM will also assess the ability to use multiple jurisdictions to minimise the country risk and modularise the project build to reduce site labour requirements. Project implementation teams will also be located to ensure proximity to the work within Australia and Internationally, mitigating the impact of any potential border restrictions.

There are also significant opportunities for the Dubbo project to investigate and implement, including:

- **Full Mining Services Contractor**. The current mining philosophy is an owner model with a Drill and blast Contractor. A complete service Mining, drill and blast contractor option will be assessed for potential environmental and cost-saving benefits.
- **Renewable Power Supply**. ASM is investigating options for the supply of renewable power via the existing Dubbo regional power grid and in discussions with other parties to build own and operate Hybrid power facilities to supply the project and the region.
- **Major Utilities BOO Option**. Utilities including fuel gas and rail have the potential to be a build own operate supply option which will reduce the overall project CAPEX at put the point of supply at the project site and remove liabilities for construction and operation from ASM. The analysis of these options was commenced during the Optimisation Study and will be further developed during the FEED phase.
- **Major Vendor Packages**. The Dubbo Project processing facilities consist of several large Vendor packages. These packages are well suited for a lump sum turnkey (LSTK) contract strategy and consolidation of packages under a single vendor. ASM has engaged with several vendors during the Optimisation Study to obtain pricing under these terms and or a path to achieve an LSTK approach for each package identified. Engagement with major LSTK package vendors is in progress and will continue through the FEED phase.

Glossary

Acronym	Description
AACE	American Association of Cost Engineering
ACCU	Australian carbon credit units
ASM	Australian Strategic Materials Ltd, the Company and subsidiary companies
ANSTO	Australian Nuclear Science and Technology Organisation
BOO	Build Own Operate
BOOT	Build Own Operate Transfer
CCD	counter-current decantation
Capex	Capital expenditure
Ce	cerium
D&B	Drilling and Blasting
DHZ	Dehafniated zirconia
DPE	NSW Department of Planning and Environment
Dy	dysprosium
ECI	Early Contractor Involvement
EIS	Environmental Impact Statement
Enhanced Project Addendum	Enhanced Dubbo Addendum prepared by ASM as an addendum to the Optimisation Study
EPC	Project delivery method whereby a contractor 'wraps' the project and is responsible for engineering, procurement and construction of the delivered result for a fixed price
EPCM	Project delivery method where consultant (engineer) assists the principal to identify and manage contracts to enter with various suppliers who will then carry out the works to deliver the project. The consultant will be provided with a management fee
Er	erbium
ERF	Emissions Reduction Fund
ESG	Environment, Sustainable and Governance
Eu	europium
FEED	Front End Engineering Design
FEL	Front end loader
Gd	gadolinium
Hf	Hafnium
HfO_2	Hafnia
Ho	holmium
HOC	hafnium oxychloride
HRE	Heavy Rare Earth
IRR	Internal rate of return
KMP	Korean Metals Plant
La	lanthanum
LRE	Light Rare Earth
LREDS	light rare earth double sulphates
LRSF	Liquid residue Storage Facility
Lu	lutetium
Nb	niobium
Nd	neodymium

OPEX	Operational Expenditure
Optimisation Study	The Optimisation Study issued by Hatch Engineering
Optimisation Work	Outcomes derived from the combination of the Optimisation Study and the Enhanced Project Addendum
pH	Potential of hydrogen. The measure of pH is a scale used to specify the acidity or basicity of an aqueous solution. Acidic solutions (solutions with higher concentrations of H+ ions) are measured to have lower pH values than basic or alkaline solutions.
Pr	praseodymium
RC	Reverse Circulation
REPM	Rare earth permanent magnet
REE	Rare Earth Element
RO	Reverse osmosis
ROM	Run of Mine; raw ore as extracted from the mine and delivered to the processing plant
SEG	(SmEuGd)
Sm	samarium
SRSF	Solid Residue Storage Facility
SX	Solvent Extraction
Ta	tantalum
Tb	terbium
Tm	thulium
tpa	Tonnes per annum; generally referring to the quantity of mined ore feed for the plant per year
TPC	Toongi Pastoral Company
TSF	Tailings Storage Facility
UF	ultrafiltration
WRE	waste rock emplacement
Y	yttrium
Yb	ytterbium
ZBS	zirconium basic sulphate
ZOC	Zirconium oxychloride
Zr	Zirconium
Zr SX	Zr solvent extraction

Annexure A

Criteria	JORC table
Section 1 – Sampling Techniques and Data	
Sampling techniques JORC Code explanation	The deposit was primarily sampled via reverse circulation chip samples from reverse circulation drill holes and half core samples based on geological considerations within diamond drill holes drilled on an average 50m x 50m grid through the deposit. The samples were typically taken on 1m intervals through the deposit. The holes were orientated to ensure drill intersections were approximately perpendicular to the dip and strike of the mineralisation lenses and overall geological package which is generally flat lying. Diamond core and reverse circulation drill samples were crushed and assayed for ZrO_2, HfO_2, Nb_2O_5, Ta_2O_5, Y_2O_3, La_2O_3, CeO_2, Th, U, Nd_2O_3, Dy_2O_3, Er_2O_3, Eu_2O_3, Gd_2O_3, Ho_2O_3, Lu_2O_3, Pr_6O_{11}, Sm_2O_3, Tb_4O_7, Tm_2O_3 and Yb_2O_3 via a combination of Pressed Powder XRF, mixed acid digest ICPMS and NAA (Neutron Activation) methods.
Drilling techniques	A total of 127 drillholes holes have been used to estimate the Toongi Resources, of these a total of 4 were surface diamond holes and 123 were reverse circulation holes. The diamond core size drilled was predominately with standard tube NQ2 sized core. All diamond core was orientated.
Drill sample recovery	The diamond core drill recovery was monitored using a combination of the drillers run sheets, core block markings and manual piecing together of core and measurement. Any core loss was noted within the logging sheets. Core recovery averaged >98% through the ore intervals. Recovery of the RC samples were not routinely recorded however samples were weighed of the subset of samples that were sent for metallurgical test work, these weights were in line with expectations from the size of hammer used.
Logging	All diamond core and reverse circulation chips were logged for geological and geotechnical characteristics. Rock type, alteration style and sulphide mineral content were logged by a site geologist. The logging was sufficient to enable creation of detailed geological model that supports the resource estimate.
Sub-sampling techniques and sample preparation	HQ2 sized diamond core was marked up and cut in half with a diamond core saw. The right side of the core as sampled according to 1m intervals selected by the site Geologist. Sample fillets were also taken from the core holes where half core samples were not taken. The RC samples were poured through a riffle splitter after the sample was circulated from the drill face through a cyclone and into a large plastic bag. The methodology of selecting half core via geological intervals guarantees that the core samples are representative. The reverse circulation drilling samples are collected on 1m intervals so there is no selectivity bias with these. The sample sizes vary from material sourced from the core samples given the varying sample lengths. The RC samples are generally 5-10 kg. The sample sizes are appropriate given the relatively even distribution of base metal grades within the deposit
Quality of assay data and laboratory tests	Analabs Perth, Analytical Services (WA), ALS (Brisbane), Ultra Trace Pty Ltd and Becquerel Laboratories have all completed assaying of the Toongi mineralisation at various stages. Standard and duplicate samples were assessed for the 2000 and 2001 drilling samples. The results of these samples indicate that there are no known material biases in the original Toongi assay dataset.
Verification of	Several campaigns of duplicate sampling were completed, the majority of the results for these samples indicate an acceptable correlation with the original assay

sampling and assaying	determinations. Reference standards were also used to ensure accuracy within the laboratory assaying protocols, as with the duplicates these samples show sufficient accuracy to confirm the validity of the original assay dataset. Data was entered into a central database and then validated by a series of validation checks to ensure erroneous data was not saved into the resource database.
Location of data points	The GDA94 grid system was used as the grid reference for the Toongi deposit. All holes were surveyed using a differential GPS survey system. The topography surface is represented by a wireframe file. The surface covers the complete Toongi deposit area. The surface is an accurate representation of the actual topographic surface at the site.
Data spacing and distribution	The Toongi deposit has been drilled on an average spacing of 50 x 50m along the strike of the ore domain. This drill spacing provides evidence of the mineralized zone continuity for the purposes of resource estimation. No sampling compositing was necessary in the initial diamond drilling or RC drilling however compositing of raw assay data was completed in preparation for the resource estimation process.
Orientation of data in relation to geological structure	The majority of RC drill holes were orientated to provide an approximate perpendicular intersection angle with the main mineralized zone. No sampling bias is assessed as being caused by the drilling orientation.
Sample security	Samples were supervised by either the drill crew, field assistant or geologist and at all times. Given the low-grade rare-earth oxide nature of the deposit sample security was not assessed as a significant risk.
Audits or reviews	No audits have been undertaken
Section 2 – Reporting of Exploration Results	
Mineral tenement and land tenure status	The Toongi deposit is located within ML1724 that is located within EL5548. The license areas area current
Exploration done by other parties	All work completed by Australian Strategic Materials Ltd (formerly known as Australian Zirconia Ltd) or associated parties
Geology	The deposit consists of rare earth oxide mineralisation disseminated within a trachyte sill that occurs within the sedimentary units of the Jurassic Napperby Formation.
Drill hole Information	A list of each resource drillhole location and downhole survey is located as an appendix 2 and 3 to this table in the demerger document[18].
Data aggregation methods	The exploration results reported for the Toongi deposit were included assay intervals for ZrO2 and an extensive suite of rare earth oxide grades. No cutting of high grades was completed when reporting as exploration results
Relationship between mineralisation widths and intercept lengths	The typical drill sample interval is 1m in length, the average thickness of the mineralized zone 30m, there are no issues with reporting the results based on this. The drillholes intercepted the mineralized lenses at an approximately perpendicular angle. All exploration results were reported as downhole thicknesses.
Diagrams	See Appendix 4 of the demerger document for a location plan of all drill collars used in the resource estimate[19].

[18] Proposal to demerge – Australian Strategic Materials Ltd, Demerger Booklet, released by Alkane on 17 June 2020

[19] Proposal to demerge – Australian Strategic Materials Ltd, Demerger Booklet, released by Alkane on 17 June 2020

Balanced reporting	Exploration data is not being reported here
Other substantive exploration data	Exploration data not being reported here. No other data to report
Further work	Further infill drilling will be required within the deposit area with a view to upgrading inferred resources to either indicated or measured categories.
Section 3 – Estimation and reporting of mineral resources	
Database integrity	The survey, sampling and logging data was electronically imported into the resource database. A visual check was also made of the drill traces, assay and logging data in the 3D environment of Surpac to ensure that results correlated between drillholes and were in line with the geological interpretation and mineralization continuity.
Site visits	A site visit was completed by Stuart Hutchin in October 2016 where the Toongi site and core samples located within the core storage facility were inspected.
Geological interpretation	The confidence in the overall geological interpretation is high given the regular distribution of the trachyte sill and 50m x 50m drill coverage over the deposit that have defined the sill edges in all directions. The mineralisation occurs disseminated throughout the trachyte sill. Grades are relatively consistent however the grain size of the host trachyte does have a minor effect on grade variability, there is also some enrichment of grades in the vicinity of the trachyte contact.
Dimensions	The strike length of the mineralised domain modelled is approximately 500m long by 400m wide with an average thickness of 30m. The resource domain is located from near the surface topography and extends to a depth of 50m below surface.
Estimation and modelling techniques	The resource model was constructed using Surpac software. Mineralised domain wireframes were constructed using the geology boundary of the trachyte to guide the interpretation. A minimum domain thickness of 5m was used, this corresponds to the minimum practical mining width within an open pit mining scenario. After review of the assay dataset statistics, it was assessed that no top cutting was valid or required for the Toongi mineralisation. A composite file was created using a composite length of 1m. The median sample length within the assay dataset is also 1m. Variograms for each attribute were created for the modelled domain with the results of these used to assist with estimation of resources. An ordinary kriged estimate was run for ZrO_2, HfO_2, Nb_2O_5, Ta_2O_5, Y_2O_3, La_2O_3, CeO_2, Th and U. For the other oxides where assay data was not available for all holes an inverse distance estimate was run. The estimation process was validated by comparing global block grades with the average composite grades, visual checks comparing block grades with raw assay data, volume checks of the ore domain wireframe vs the block model volume and comparison of the ordinary kriged results with an inverse distance estimate. The validation steps taken indicate that the block estimates are a realistic representation of the source assay data and that they block model volumes are valid in comparison to the modelled interpretation.
Moisture	The resource tonnages have been estimated on a dry basis.
Cut-off parameters	Given the very even grade distribution within the deposit applying resource cut-off was not assessed as necessary, the grade tonnage curves of ZrO_2 % and TREO% demonstrate this.
Mining factors or assumptions	The resources have been estimated using a minimum thickness of 5m for the domain shape, this minimum thickness therefore accounts for any dilution in zones that are less than this thickness. The proposed mining method is via open

	pit mining techniques, the model parameters are therefore deemed to be suitable for this type of potential mining operation.
Metallurgical factors or assumptions	A detailed metallurgical test work program has been completed including the construction and running of a pilot plant. The metallurgical process, including capital and operating costs, is well understood. A detailed Front End Engineering Design report has been completed.
Environmental factors or assumptions	An Environmental Impact Statement has been prepared and approved covering all aspects of environmental impacts for the proposed project. Development Approval has been granted by the NSW Government.
Bulk density	The bulk densities for the ore and waste rock types were estimated using the Archimedes method, that is (Dry Weight / (Dry Weight – Wet Weight). A density of 2.49 was assigned to the fresh ore material.
Classification	The resources have been classified according to the drill density and the modelled continuity of both the thickness and grade of the mineralized zones in the view of the competent geologist. Measured and Indicated blocks have been reported for the resource. The resource classification is deemed appropriate in relation to the drill spacing and geological continuity of the mineralized domains.
Audits or reviews	Stuart Hutchin has visited the Toongi site in 2016. The review involved a high-level assessment of the exploration potential.
Discussion of relative accuracy/ confidence	The resource estimate is deemed to be an accurate reflection of both the geological interpretation and tenure of mineralization within the deposit.
Section 4 – Estimating and Reporting of Ore Reserves	
Mineral Resource estimate for conversion to Ore Reserves	The Mineral Resources are reported inclusive of the Mineral Resources used to define the Ore Reserves. The sub-celled Mineral Resource block model named 'toongi_model_dec16.mdl' was used for the pit optimisation. This model was produced by Stuart Hutchin of Mining One in December 2016. The Mineral Resource Estimate of this block model was reported in accordance with the JORC Code.
Site visits	Ievan Ludjio visited the site 2nd of March 2017 and has met with relevant ASM personnel and the consultants.
Study status	A Definitive Feasibility Study (DFS), prepared by TZ Minerals International Pty Ltd (TZMI), was completed in 2013 which built on previous studies prepared by TZMI in 2011 and SNC Lavalin in 2002. Subsequent studies and reports have been prepared by Hatch Pty Ltd in 2015, and then GHD in 2017. The Maiden Ore Reserves Report was issued in 2017. The recent study, Optimisation Feasibility Study, completed by ASM in September 2021 which leads to this updated Ore Reserves Estimate, October 2021.
Cut-off parameters	As the deposit is polymetallic, a block value script using all relevant parameters was used to code a block value into the resource model. Each block needs to have a block value greater than zero for it to be included in the Ore Reserves. For the price assumptions please see section "Costs" below.
Mining factors or assumptions	The Dubbo Project (DP) is a polymetallic zirconia, hafnium, niobium, and rare earth metals deposit. It is planned that the operation uses front end loaders and articulated trucks along with a fleet of auxiliary equipment. This proposed mining method is appropriate for the style and size of the mineralisation. As DP consists of a simple bulk massive style deposit with no internal waste, a mining recovery of 100% and mining dilution of 0% has been assumed. Pit slope geotechnical parameters:

<table>
<tr><td></td><td><table><tr><th>Parameter¤</th><th>Value¤</th></tr><tr><td>Batter·Angle¤</td><td>55°¤</td></tr><tr><td>IRSA¤</td><td>40°¤</td></tr><tr><td>Berm·width¤</td><td>8m·¤</td></tr><tr><td>Bench·Height¤</td><td>10m¤</td></tr></table>No Inferred material has been included in optimisation and/or Ore Reserves reporting.</td></tr>
<tr><td>Metallurgical factors or assumptions</td><td>Ore is crushed and screened with the dry ground ore then mixed with sulphuric acid and roasted to form sulphated solids. The sulphated solids are subjected to quenching to extract zirconium, niobium and rare earth sulphates as well as impurity elements leaching in the water into solution. The leach slurry is washed in two stages of
counter current decantation (CCD) thickeners, each stage comprising four thickeners. The CCD circuit separates the light rare earth (LRE) bearing solution from the zirconium/niobium/heavy rare earth (HRE) solution. Separation of zirconium, niobium and HRE takes place in the solvent extraction (SX) circuit.
The various products are then separated and refined in separate treatment circuits to produce the zirconium and niobium products and intermediate products for the heavy rare earth and light rare earth products.

Metallurgical Recoveries:<table><tr><td>Lanthanum Oxide</td><td>82.6%</td></tr><tr><td>Cerium Oxide</td><td>54.1%</td></tr><tr><td>Praseodymium Oxide</td><td>82.4%</td></tr><tr><td>Neodymium Oxide</td><td>82.4%</td></tr><tr><td>Samarium Oxide</td><td>79.8%</td></tr><tr><td>Europium Oxide</td><td>73.4%</td></tr><tr><td>Gadolinium Oxide</td><td>73.7%</td></tr><tr><td>Terbium Oxide</td><td>75.2%</td></tr><tr><td>Dysprosium Oxide</td><td>76.7%</td></tr><tr><td>Holmium Oxide</td><td>73.7%</td></tr><tr><td>Erbium Oxide</td><td>74.0%</td></tr><tr><td>Thulium Oxide</td><td>67.6%</td></tr><tr><td>Ytterbium Oxide</td><td>65.6%</td></tr><tr><td>Lutetium Oxide</td><td>63.0%</td></tr><tr><td>Yttrium oxide</td><td>65.6%</td></tr><tr><td>Zirconium Oxide</td><td>85.2%</td></tr><tr><td>Hafnium Oxide</td><td>70.1%</td></tr><tr><td>Niobium Oxide</td><td>57.9 %</td></tr></table></td></tr>
<tr><td>Environmental</td><td>An Environmental Protection Licence (EPL 20702) was issued in March 2016 by the NSW Environment Protection Authority. This licence allows ASM to undertake Scheduled Development Works for the establishment of the Dubbo Project.
To minimise impacts on the endangered Pink-tailed Worm-Lizard, the Stage 1 of the open pit will be mined in two separate cutbacks. The western section of the open pit will be mined in the first 10 years with the eastern portion mined in the following 10 years. Extraction of both ore and waste will occur by bench, in line with the mining phases defined to address the environmental concerns.</td></tr>
<tr><td>Infrastructure</td><td>In order for mining, processing and product transportation to be undertaken, in addition to the standard infrastructure requirements, the following off-site infrastructure and other site features would first need to be established:
Upgrades and construction of road and bridges network including curve realignment, pavement upgrades and upgrades to creek crossings on Obley and Toongi Roads;</td></tr>
</table>

	• Installation of a Western Plains Zoo noise barrier along a 1 km section of the Obley Road; • Installation of a pumping station located at the Macquarie River and a 7 km water pipe to deliver raw water to the site; • A natural gas pipeline within the Toongi-Dubbo Rail and Gas Pipeline Corridor; • Construction of a range of water management and retention structures within the DP site • Reinstatement of the Dubbo to Toongi rail line for reagent transport from Newcastle and product transport.
Costs	Costs used in the determination of the Ore Reserves have been sourced from the following documents: • Project Capital Estimate – provided by ASM and Glastonbury Mining Services Pty Ltd 'Dubbo Project: Mining Feasibility Study – Owner Operator Model, 2021' • Site General & Administration – provided by ASM, (Report ASM DP Economic Model OFS Enhanced DOS-00000-ASM-FI-MOD-0001 210917) October 2021 • Processing (excluding SRSF costs) – provided by ASM, (Report ASM DP Economic Model PFS Enhanced DOS-00000-ASM-FI-MOD-0001 210917) October 2021 • Mining Costs – Glastonbury Mining Services Pty Ltd 'Dubbo Project: Mining Feasibility Study – Owner Operator Model, 2021'
Revenue factors	For cost assumptions see section above – "Costs" ASM employs specialist consultants and specific industry contacts to maintain an interactive product pricing regime. The assumed commodity prices, reported in the ASM DP Economic Model OFS Enhanced DOS-00000-ASM-FI-MOD-0001 210917 EDR with ref spreadsheet has been used. The following commodity prices were used (values are in USD/kg): Praseodymium Oxide $97.50 Neodymium Oxide $105.70 Samarium Oxide $2.30 Europium Oxide $42.60 Gadolinium Oxide $42.80 Terbium Oxide $1,456.25 Dysprosium Oxide $578.50 Holmium Oxide $118.50 Erbium Oxide $34.40 Ytterbium Oxide $17.50 Lutetium Oxide $800.00 Yttrium oxide $7.30 Zirconia $10.00 Dehafinated Zirconia (DHZ) $30.00 Hafnium Oxide (as 100% Hf) $1,010.00 Ferroniobium metal (65% Nb) $45.00
Market assessment	The output of the various products planned to be produced by DP, is large enough to provide an alternative source of these critical metals, without being too large to affect the supply and demand balance. Markets for each of the DP products are separate but related and have experienced high annual growth rates of between 7%-10%. The high growth rates are due to the rapid industrial and social development of countries such as China, where GDP is growing strongly and the intensity of use of critical metals is increasing from a low base compared to western industrialised economies.
Economic	The costs used in the economic valuation are based on detailed studies mentioned in the "Costs" section of this table. They all have a level of confidence to be included in the Ore Reserve as per the requirements listed in the 2012 JORC Code.

	The inputs that inform the economic analysis include all foreseeable operating and capital costs, resulting in a positive NPV for the Ore Reserve. A discount rate appropriate to the size and nature of the organisation and deposit has been used in the determination.
Social	As part of the 2012 DFS, a study on the social impact of the project determined that the project would have an overall beneficial impact on the surrounding local communities.
Other	All government agreements and approvals required to realise the Ore Reserves are current and will be in place until the end of mine life.
Classification	The Ore Reserves classification is based on the JORC 2012 requirements. The basis for the classification was the Mineral Resource classification and economic cut-off grade.
Audits or reviews	No Ore Reserve audits have been carried out, however Internal Peer Review has been carried out as part of this Ore Reserves Estimate
Discussion of relative accuracy/ confidence	The most significant factors affecting confidence in the Ore Reserves are: • Although previous DFS's and other studies have been prepared to a sufficient level of confidence, variation in the capital, operating costs, and market fluctuations will have an impact on the project economics. Traditionally as a result of their similar chemical properties, REE metals are extremely difficult to separate from each other. The technical metallurgical assumptions may differ once the plant is operating affecting the project economics.