ASX and MEDIA RELEASE

4 June 2018

ALKANE
RESOURCES LTD
ABN 35 000 689 216

Dubbo Project: Status

- Estimated 20-year project life (at 1Mtpa plant feed rate).
- Multi-commodity asset with zirconium, niobium, hafnium and rare earths.
- Positioned as independent global supplier outside China.
- All key state and federal approvals and licences required for plant construction and mining commencement have been received and are in place.
- The process flowsheet that would be used in the commercial scale Project plant has been extensively piloted since 2008 using a purpose-built demonstration pilot plant at the Australian Nuclear Science and Technology Organisation (ANSTO) in Sydney.
- The global mining resource of 75+ years at nameplate capacity of 1Mtpa means not only the potential for cash generation for a very long period, but also the potential to expand materially beyond this critical production rate.
- The Project could potentially be successfully implemented as a single 1Mtpa plant (base case) or via two stages of development at 500,000 tonnes per annum (500ktpa) plant feed rate each (staged build).
- Located in Australia near the city of Dubbo in the state of New South Wales, approximately 400km from Sydney, a very stable geo-political jurisdiction with excellent surrounding infrastructure.

Multi commodity miner and explorer, Alkane Resources (ASX: ALK), has completed an engineering and financials review of its zirconium, niobium, hafnium and rare earths project which confirms a viable project of significance. The details of this review are in the following pages of this announcement and should be read in their entirety.

Among key points from Alkane's project review are, that in circumstances where the Project is successfully funded and developed:

- The Project could generate A$4.7 billion free cash flow at the 20 year base case with a forecast capital cost of A$1.3 billion base case build or A$808 million for the stage 1 build.
- Internal rate of return is estimated between 16.1 to 17.5 per cent, depending on whether capital is managed to build the Project in two stages or proceeds to a single 1mtpa plant, with both alternatives confirmed viable.

CONTACT : NIC EARNER, MANAGING DIRECTOR, ALKANE RESOURCES LTD, TEL +61 8 9227 5677

INVESTORS : NATALIE CHAPMAN, CORPORATE COMMUNICATIONS MANAGER, TEL +61 418 642 556

MEDIA : HILL+KNOWLTON STRATEGIES: MARCHA VAN DEN HEUVEL, TEL +61 2 9286 1226 OR +61 468 960 457

The global market for the Dubbo Project's products is undergoing considerable change and continues to evolve rapidly:

- Magnet rare earths are forecast to grow at a 6-10 per cent compound annual growth rate to 2030, primarily driven by demand for electric vehicles.
- Raw material for zirconia products is undergoing significant price rises, with zirconium oxychloride (ZOC), a potential Alkane product, having gone up 80 per cent in the past 18 months.
- There is little rare earth supply entering the market outside of China, even as prices increase, and the forecast demand curves show an ever-widening gap from existing supply options.

Development of the flow sheet for the project has expanded the product range to include high purity zirconia and hafnia, broadening access to growing markets.

Managing Director of Alkane, Nic Earner, said the review confirmed Australia had a significant project, capable of supplying specialty metals globally as an independent source to China.

"The project review details the considerable body of technical work that has occurred on the Dubbo Project. In an external environment of rising commodity prices, interest in the Project's products is increasing as global manufacturers look for both material sources and supply chains outside China." Nic Earner said.

The project review is intended to sharpen current discussions globally with industry participants and funding bodies in Australia, Japan, Korea, USA, Europe and China, with a view to enhancing prospects for a project start.

It is important that investors read the entirety of this document. Investors should be certain to read and consider the Cautionary statements & risk on Page 3, the General disclaimer on Page 4, the summary of risks and uncertainties in Section 8 and the assumptions underlying the financial analysis of the Project in Section 7.

ALKANE
RESOURCES LTD
ABN 35 000 689 216

DUBBO PROJECT: ENGINEERING & FINANCIALS UPDATE

Current as at 31 May 2018

Ground Floor, 89 Burswood Road, Burswood WA 6100, AUSTRALIA (PO Box 4384, Victoria Park WA 6979, AUSTRALIA)

Telephone: +61 8 9227 5677 **Facsimile**: +61 8 9227 8178
www.alkane.com.au mail@alkane.com.au

Alkane Resources Ltd (**Alkane** or the **Company**), through its wholly owned subsidiary Australian Strategic Materials Ltd (**ASM**), is pleased to provide an update on recent engineering studies and financial analyses relating to its Dubbo Project (**Dubbo Project** or **Project**) (100% owned by Alkane).

This announcement consolidates a large body of technical work executed by ASM's Dubbo Project team since the completion of its Front End Engineering Design (**FEED**) study in 2015. The results of that FEED study were described in an announcement to ASX dated 27 August 2015. This study indicatees not only that a lower capital development scenario is achievable, but also that the Dubbo Project has expansion capacity beyond the base case of 1 million tonnes per annum (1Mtpa). The path to development and expansion capability positions the Dubbo Project to be able to take a key role in the global supply of its core products of zirconium and rare earth metals (the latter for use in permanent magnets), as well as contribute to the niobium and emerging hafnium industries. The market for these products is undergoing considerable change and is currently experiencing strong price momentum.

Purpose of this announcement

The primary purpose of this announcement is to provide information on the significant body of engineering and design studies, as well as product development undertaken over recent years in connection with the Dubbo Project (**Project**). The announcement is also intended to provide more detailed information on the proposed product suite for the Project, the markets for its products and to provide an indication of the potential financial outcomes that may eventuate from any successful development of the Project.

The contents of this announcement reflect various technical and economic conditions at the time of writing, or projected future conditions based on an assessment of trends using currently available information. Given the nature of the resources industry, these conditions can change significantly over relatively short periods of time. Consequently, actual results and outcomes are likely to vary (whether more or less favourable) from those detailed in this announcement.

The production targets referred to in this announcement are based completely on ore reserves determined in accordance with the 2012 JORC Code.

Cautionary statements and risks

The announcement contains some statements regarding estimates or future events which constitute forward looking statements. They include indications of, and guidance on, future earnings, cash flow, costs and financial performance (including references to, and statements about, net present values and expected cash flows). 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 may be affected by a range of variables 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 8 of this announcement. Investors should read, and consider, those risks and uncertainties carefully.

Forward looking statements, opinions and estimates included in this announcement are based on assumptions and contingencies. There are material assumptions 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 announcement).

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 announcement will in fact be achieved or prove to be correct.

To develop the Dubbo Project to position the Company to achieve the outcomes indicated in this announcement, a significant amount of funding will be required, most likely from a number of sources (refer Section 7.3 of this announcement). Investors should note that, as at the date of this announcement the Company has not yet secured any funding arrangements required in connection with 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 announcement), 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 7 of this announcement. 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 announcement will not eventuate.

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

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 announcement 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 announcement or any error or omission there from.

This announcement 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 in relation to the contents of this announcement.

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 announcement, or to reflect the occurrence of unanticipated events, except as may be required under applicable securities laws.

Summary of updated business case

Since completion of the FEED study in 2015 the Company has:

- Continued to work with engineering companies and major equipment suppliers to further refine the engineering design and capital and operating costs for the Dubbo Project. This effort has given ASM strong confidence that, subject to receiving financing for the development of the Dubbo Project, not only is building a full-scale facility technically achievable, but a staged-build approach featuring cost-effective modularisation is also a feasible option.
- Continued to develop its product suite, resulting in the confirmation of the project's ability to produce high-purity zirconium oxide (zirconia) and hafnium oxide (hafnia[1]).
- Continued its marketing efforts, as the external market for the Dubbo Project's key zirconia and rare earth products has seen rising demand, tightened supply and resultant increased pricing.

The Company's engineering and financial models for the Dubbo Project have subsequently been updated and show, in circumstances where the Project is successfully funded and developed (see sections 7 and 9 of this announcement for details about relevant assumptions and commentary about funding conditions):

- 18.90Mt ore reserve and 75.18Mt resource[2], giving an estimated 20-year project life (at 1Mtpa plant feed rate) and significant extension and expansion potential.
- The Project could potentially be successfully implemented as a single 1Mtpa plant (base case) or via two stages of development at 500,000 tonnes per annum (500ktpa) plant feed rate each (staged build). The final decision is dependent on customer demand, securing adequate funding for development of the Project and strategic partner requirements. Crucially, the studies also demonstrate the Project's capacity to grow beyond 1Mtpa through the addition of more production trains.
- A technically sound and financially viable Project generating a potential A$4.7 billion[3] in undiscounted free cash flow (base case, pre-tax) over an initial 20-year project life (20YP).
- A forecast capital cost (base case) of A$1,297M[4] with an additional A$124M of sustaining capital over 20YP, giving an estimated Net Present Value (NPV 8%, pre-tax) of A$1,236M and estimated 17.5% Internal Rate of Return (IRR, pre-tax).
- Potential undiscounted free cash flow (staged build, pre-tax) in excess of A$3.9 billion[3], forecast capital cost (staged build) of A$808M for stage 1[5], A$692M for stage 2 (with opportunities to stage further) and an additional A$39M of sustaining capital over 20YP, giving an estimated Net Present Value (NPV 8%, pre-tax) of A$909M and an estimated 16.1% Internal Rate of Return (IRR, pre-tax).

---

[1] As documented in ASX announcement 17 January 2018

[2] As documented in ASX Announcement 19 September 2017 (no material changes in the assumptions used)

[3] Section 7.4 of this document describes the modelling assumption and risks

[4] Section 7.1 of this document details the capital costs

[5] Section 7.1 of this document details the capital costs

The Dubbo Project has many strengths:

- It is located in Australia near the city of Dubbo in the state of New South Wales, approximately 400km from Sydney, a very stable geo-political jurisdiction with excellent surrounding infrastructure.
- All key state and federal approvals and licences required for construction commencement have been received and are in place. Further minor permits and licenses will be required during detailed design, construction and operations phase of the Project.
- The process has been extensively piloted since 2008 using a purpose-built demonstration pilot plant at the Australian Nuclear Science and Technology Organisation (ANSTO) in Sydney. Targeted test work and refinement is ongoing.
- The global mining resource of 75+ years at nameplate capacity of 1Mtpa means not only the potential for cash generation for a very long period, but also the potential to expand materially beyond this production rate.
- It is a poly-metallic orebody with diverse revenue streams.
- It is designed to produce at the project site products of a type and quality that are traded in the global market, and it is therefore not dependent on third party processing to sell its products.
- It has had extensive engineering studies and design undertaken with globally reputable engineering houses and suppliers.

The global market for the Dubbo Project's products is undergoing considerable change and continues to evolve rapidly:

- The global markets for zirconium and rare earths are dominated by China's manufacturing industry. The *Made in China 2025* policy, accompanied by a domestic war on pollution, is expected to have long-term and far-reaching effects. Rising prices and limited supply of zirconium chemicals and rare earths outside China have already led many western manufacturers to start seeking alternative supply sources outside China.
- Zircon derived from mineral sands operations, the primary raw material for zirconia products, is undergoing significant price rises – increasing by 40% in 2017, with further increases in early 2018.
- Prices for zirconium oxychloride (ZOC), the main precursor for high-purity downstream zirconium products and one of the Dubbo Project's primary zirconium products, have increased by 80% in the past year.
- Rare earth permanent magnets (REPM) used in electric motors are the main driver for the global rare earths industry, accounting for 80% by value. They are forecasted to have a compound annual growth rate (CAGR) of 6–10% through to 2030, primarily driven by growth in electric vehicle drive trains.
- The Chinese Government continues to curb illegal mining sources of rare earths, which are estimated to be approximately 30% of China's total output; again, contributing to the shortage of rare earth product in the China domestic and global markets.[6]
- Currently there is little rare earth supply entering the market outside of China, even as prices increase, and the forecast demand curves show an ever-widening gap from existing supply options.

---

[6]IMCOA – Curtin-IMCOA 8 Year Demand & Supply Summary

- Prices for praseodymium/neodymium (known as didymium or PrNd) metal, used in REPM, peaked at US$100/kg in 2017 before falling back, but have increased in early 2018 to around US$70/kg, FOB China.
- The global steel industry is the main driver for niobium consumption, where 90% of all niobium is used as ferro-niobium for high strength low alloy steels. Brazilian company Companhia Brasileira de Metalurgia e Mineração (or CBMM) dominates the market for niobium, with approximately 80% of ferro-niobium supply. Niobium prices have remained stable during the past year.
- The hafnium market lacks transparency, but potential for considerable growth is evident through discussions with current market participants.
- A number of specialist independent industry consultants have provided detailed market assessments for all products; their demand and price curves have informed the revenue estimates for this study.

These changes, together with expected further disruption and anticipated price rises, encourage the Company to believe that there is a price environment arriving in which investment in the Dubbo Project will take place.

Table 1 below summarises the potential financial outcomes in relation to any successful development of the Dubbo Project, subject to various assumptions described in this announcement (see Sections 7 and 9 of this announcement in particular) and on the basis that development of the Project is capable of being fully funded.

Table 1 Summary of Financial Outcomes (real terms, 2018 dollars)

Measure	*Unit*	*1 Mtpa Base Case 20YP*	*Staged Build 20YP*
Production			
Nd	t (as oxide)	17,843	15,720
Pr	t (as oxide)	4,581	4,036
Tb	t (as oxide)	267	236
Dy	t (as oxide)	2,348	2,069
ZrO2	t (as oxide equivalent basis)	317,266	280,210
FeNb	t (Nb metal basis)	38,138	33,652
Hf	t (metal basis)	968	968
Ore Processed	Mt / % of Resource	19.3Mt / 26%	16.7Mt/ 22%
Gross Revenue	A$M	12,768	11,495
Undiscounted Free Cash Flow (pre-tax)	A$M	4,656	3,943
Annual Full Capacity Free Cash Flow (pre-tax)	A$M	323	323
Capital Cost	A$M		
Stage 1		1,297	808
Stage 2		N/A	692
Sustaining		124	39
NPV (8%, pre-tax)	A$M	1,236	909
Project IRR (pre-tax)	%	17.5	16.1

The Dubbo Project is expected to produce a suite of high-value downstream products used in a range of advanced technologies.

- The marketing strategy is based on securing long-term customer relationships, founded on a reliable and secure production base in Australia.
- The initial product range will be complemented by the progressive development of further high-value products in response to customer and market demands.
- ASM will produce a mix of 'base' zirconium products (including ZOC, zirconium basic carbonate and zirconium dioxide) and 'premium' zirconium products (including yttria-stabilised zirconia and low-hafnium zirconium products). At the current time, ASM already has a global marketing and sales agreement in place with UK-based Minchem Limited for zirconium products and seven letters of intent for supply in respect of these products.
- PrNd, Dy, Tb and Y oxide will be separated on site at the Dubbo Project. Other unseparated rare earths contained in the concentrates will be sold on the market. ASM has a MoU with Siemens in place for supply of a number of rare earth products.
- ASM has a joint venture with Treibacher Industrie AG for the production and marketing of ferro-niobium using all niobium concentrate produced by the Dubbo Project.

ASM is actively investigating partnerships or joint-venture opportunities to convert zirconia and hafnia to high-value metals to add further value, above what has been assumed for the purposes of the financial model.

The steps forward for the Dubbo Project from today are:

- Continued development of the hafnium product stream to demonstrate metal production, in order to directly access the largest market for hafnium products (superalloys).
- Detailed engineering of the staged-build option to enable rapid tender and execution, post financing.
- Securing binding offtake contracts for the Project's products to underpin the financing.
- Giving effect to the Company's funding strategy for the Project, which includes negotiating strategic investment by an industry player or national funding body. As mentioned, a significant amount of funding will be required (with Project development having a capital cost of between approximately $1,297 million (for the base case) and $1,500 million (for the staged-build model, staggered across two tranches of approximately $808 million and $692 million). 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 and, as at the date of this announcement, the Company has not yet secured any funding arrangements required in connection with development of the Project. However, having regard to the information available to it and the analysis undertaken (as explained in this announcement), the Company considers that it has a reasonable basis to expect it will be able to fund the development of the Project. See below in Section 7.3 for further detail.

These contracts and investments are currently being discussed globally with industry participants and funding bodies in Australia, Japan, Korea, USA, Europe and China. There is a tension between rising prices of products, project value, project risk, product discounting, national interest and the strategic investment mandate of major industry participants that adds complexity to these negotiations.

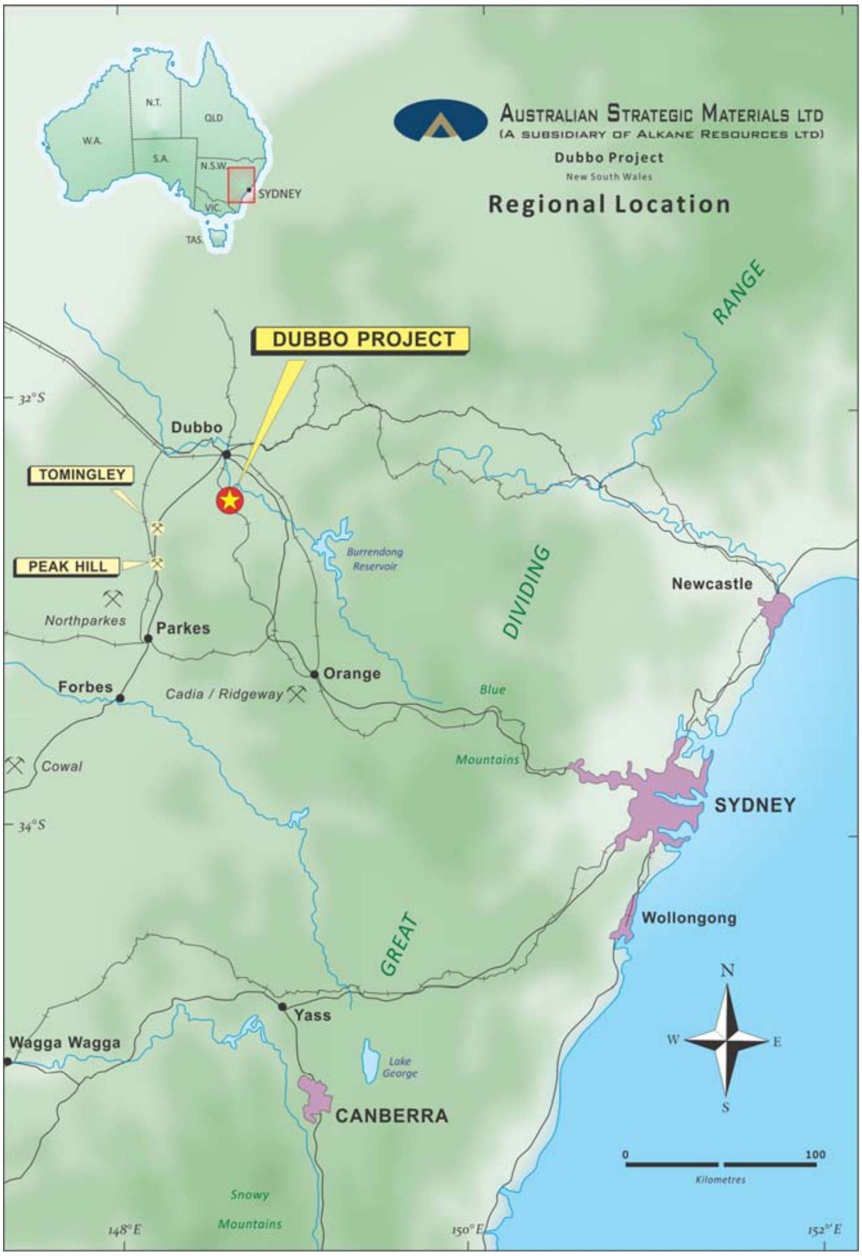
TABLE OF CONTENTS

1. INTRODUCTION

Australian Strategic Materials (ASM) intends to develop the Dubbo Project (Dubbo Project or Project), which is located near the village of Toongi, 25km south of Dubbo in Central Western New South Wales (NSW), Australia, approximately 400km northwest of Sydney. The Dubbo Project is a large in-ground poly-metallic resource of the metals zirconium, hafnium, niobium, tantalum, yttrium and rare earth elements. The project has a mine life potential of 75+ years.

ASM owns 3,456 hectares of land at Toongi, encompassing Mining Lease (ML) 1724, granted on 21 December 2015. ML 1724 includes the ore resource as well as all of the land required for materials processing. With all other material state and federal approvals and licences in place, the Dubbo Project is construction-ready, subject to financing.

Figure 1 Location of the Dubbo Project



At full capacity and once developed, the Dubbo Project mineral processing plant will be capable of receiving 1,000,000 tonnes per annum (1Mtpa) of crushed ore, which will be processed using sulphuric acid leach and solvent extraction recovery to recover zirconium, hafnium, niobium and rare earth products. The process flow sheet has been extensively trialled and proven since 2008 at ASM's demonstration pilot plant (DPP), located at the facilities of the Australian Nuclear Science and Technology Organisation (ANSTO) Minerals in Sydney. The DPP has provided data incorporated in the capital and operating cost estimates, as well as product samples for testing and customer certification.

Following the completion of two Definitive Feasibility Studies (DFS) for the Dubbo Project in 2011 and 2013, the Front End Engineering Design (FEED) was completed by Hatch Pty Ltd in August 2015. ASM then sought to further identify opportunities to maximise value and reduce capex through a series of engineering reviews and options analyses (modularisation and value investigations).

Oil and gas industry modularisation specialists were initially engaged to assess the likely cost impacts of an aggressive modularisation strategy and a repeatable train execution methodology (that is, a staged approach to construction and development). The results from this work were reviewed internally and ASM decided to pursue this strategy in order to provide a lower capital cost of entry to the project. Global minerals and metals processing technology supplier, Outotec Pty Ltd, was engaged under two phases of engineering services to seek process optimisation and study modularisation opportunities. Hatch was also later engaged in parallel to further validate modularisation concepts for specific key parts of the process plant and the likely cost impacts.

The results of all of these work streams, carried out from 2015 through to early 2018, have been combined internally by ASM (and Alkane) to prepare the results described and tabled in this update. They demonstrate the strong potential for a modularised build approach, where the processing plant could be built in two stages, each of half capacity (500ktpa each), utilising some common infrastructure. This would allow the second stage to be built after the first stage is successfully commissioned and market pricing achieved for the products, allowing staging of capital and solid post build cash flow. Ramping the project to full production capacity of 1Mtpa, and subsequent further expansion if possible, is the key to higher project returns and the potential to generate more significant cash flows.

Throughout this same time period, substantial process improvements and optimisation of the flow sheet, particularly in the area of product purity, have been achieved through research at ANSTO (detailed in Section 5.3.1 below). The results from this work have been combined into the capital, operating and revenue estimates in this report (Section 7).

The substantial body of work and analysis undertaken on the Dubbo Project gives ASM a high degree of confidence in its ability to execute and deliver the program described.

2. MINERAL RESOURCES AND ORE RESERVES

2.1 Resources Tables

The Mineral Resources and Ore Reserves for the Toongi deposit, which is the basis of the Dubbo Project, were independently re-estimated by industry consultants Mining One Pty Ltd in 2017 to account for revised estimated operating costs, product revenues and regulatory approved site layouts[7].

The revised estimation took account of the Dubbo Ore Reserve Upgrade[8]; Definitive Feasibility Study[9]; the Front End Engineering Design – FEED[10]; and the Significant Improvements in Capital Cost and Execution Strategy for the DZP – Modular Study[11] to comply with the 2012 edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC 2012).

The revised Mineral Resources and Ore Reserves estimations are summarised in the tables below. Mineral Resources are wholly inclusive of Ore Reserves, which are based on economic parameters applied to the Mineral Resources, reflecting an initial project horizon of 20 years.

Table 2 Dubbo Project Mineral Resources

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

[7] As documented in ASX Announcement 19 September 2017 (no material changes in the assumptions used)

[8] As documented in ASX Announcement 16 November 2011

[9] As documented in ASX Announcement 11 April 2013

[10] As documented in ASX Announcement 27 August 2015

[11] As documented in ASX Announcement 28 October 2016

Table 3 Dubbo Project Ore Reserves

Reserve Category	Tonnes (Mt)	ZrO_2 (%)	HfO_2 (%)	Nb_2O_5 (%)	Ta_2O_5 (%)	Y_2O_3 (%)	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,*

2.2 Geology

The Toongi deposit is centred on a trachyte outcrop that forms one of several alkaline volcanic and intrusive bodies of Jurassic age in the region (formed approximately 205 to 140 million years ago). The elliptical-shaped body has approximate dimensions of 850m east–west by 550m north–south. The deposit forms a low irregular topographic rise and has a depth extent of 115m below surface.

The orebody is dominantly a massive, fine-grained microporphyritic trachyte comprising more than 80% feldspar, albite and aegirine in roughly equal amounts. The remainder of the rock is made up of opaque minerals. Extensive mineralogical studies indicate that the ore minerals contained in the deposit are extremely fine-grained, being less than 100µm in size (and generally less than 10µm), 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). 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 contains uranium and thorium and is classified as a weakly radioactive ore.

2.3 Drilling and Analysis

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

Figure 2 Schematic of Toongi Deposit

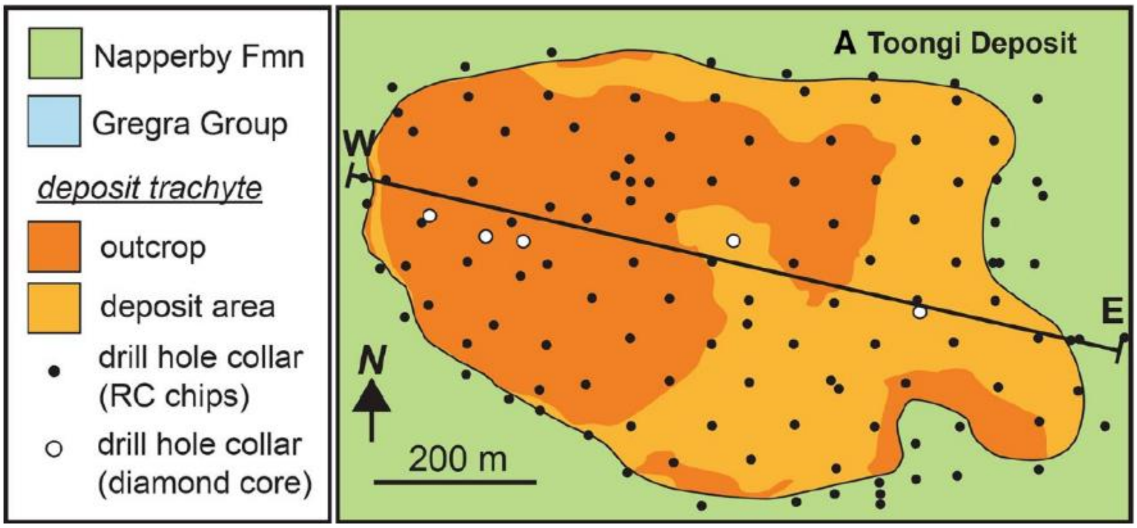
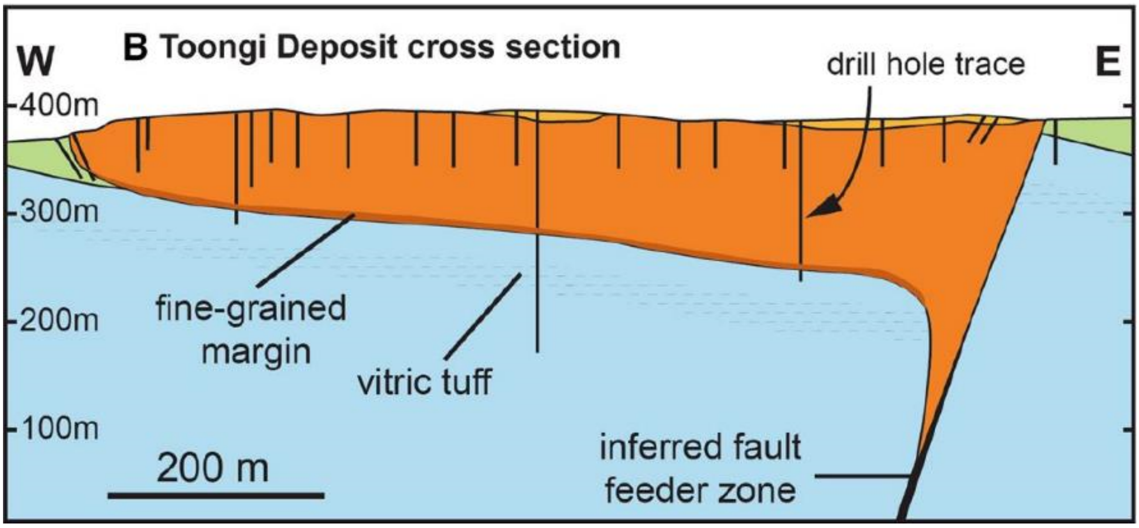


Figure 3 Cross-section of Toongi Deposit



3. UPDATED FEASIBILITY & ENGINEERING

The various studies referred to in this Section 3 have formed the basis for the Company's estimate of various financial metrics attached to development of the Project, including, but not limited to, capital costs, EBITDA and NPV values. These values are subject to a number of assumptions that are described in this announcement, and on the basis that the Company reasonably expects that development of the Project is capable of being fully funded (see specifically sections 7 and 9 of this announcement).

3.1 Engineering Studies

Between 2010 and late 2015 two Definitive Feasibility Studies (DFS) and one Front End Engineering Design (FEED) study were completed to further define the scope and develop the engineering, design and capital and operating costs for the Dubbo Project.

3.1.1 2011 – DFS at 400ktpa (plus 1Mtpa overview) – by TZMI[12]

In September 2011, TZ Minerals International Pty Ltd (TZMI) completed a Definitive Feasibility Study (DFS) for the Dubbo Project at a base case throughput of 400ktpa.

The study estimated capital cost at A$470M, annual operating costs of A$97M, EBITDA of A$92M, an IRR of 16.8% and an NPV of A$181M.

Due to positive changes in the market place for the Dubbo Project's products at that time, TZMI also reviewed at a higher level the impact of developing the project at 1Mtpa throughput. The indicative case for a 1Mtpa plant was at that time compelling, with estimates for capital costs at A$893M, operating costs at A$196M annually, EBITDA of A$312M annually, IRR of 30.2% and an NPV of A$1,207M.

3.1.2 2013 – DFS at 1Mtpa – by TZMI[13]

Building from the previous study, a full DFS at 1Mtpa was completed by TZMI in Q1 2013.

The study reported estimates of capital costs at A$996M, operating costs at $214M annually, EBITDA of A$290M annually, an IRR of 19.3% and an NPV of A$1,235M.

3.1.3 2015 – FEED at 1Mtpa – by Hatch[14]

A full Front End Engineering Design (FEED) study was completed for a 1Mtpa processing facility by Hatch in mid-2015.

Following a post-completion value engineering exercise, a comprehensively prepared study forecast a capital cost of A$1,297M to an estimated accuracy level at ±16%, which included contingency of A$103M. Annual revenue was estimated at A$580M and operating costs at A$260M, delivering an annual EBITDA of $320M and a 20-year NPV of $1,220M and IRR of 17.5%. The estimate was prepared

---

[12] As documented in ASX Announcement 19 September 2011

[13] As documented in ASX announcement 11 April 2013

[14] As documented in ASX announcement 27 August 2015

on an Engineering, Procurement and Construction Management (EPCM) basis, and contained firm pricing for most of the packages from the marketplace.

Several significant process improvements resulted from the FEED study, including improvements for water management and waste treatment, as well as a revamped rare earth circuit to improve recoveries. Projected water consumption and the site footprint were both halved. The design was also modified to provide closer integration and more tailored products to downstream customers and toll treatment partners.

The capital estimate prepared using the results of the FEED study included an estimate for the addition of a hafnium separation circuit. The revenue estimates included hafnium as a revenue source for the project for the first time.

The FEED study remains the main basis of the estimate of the operating and capital costs of the project, the majority of its design and is the preferred method of executing the project.

3.2 Modularisation and Value Investigations

Following completion of the FEED in 2015, ASM moved forward with further investigations into engineering, construction and project delivery strategies, to develop concepts offering potential cost savings and reduced initial capital costs.

In seeking such cost benefits, ASM has investigated four main opportunities:

- Modularisation;
- Process and equipment optimisation;
- Staged construction, i.e. installation of fully functional 'trains'; and
- Capital cost deferment (in favour of increased operating costs)

Explanation for these opportunities follows, as well as details of the actual investigations completed, those currently underway, and those planned for the future.

3.2.1 Modularisation

Modularisation is a project execution concept whereby a process plant, structure or building is designed and engineered to be manufactured and installed in pre-assembled, fully fitted-out, tested and substantially commissioned units of transportable size. The concept is commonly used in the oil and gas industry for space restricted off-shore installations, and over recent years has also been implemented for a wide range of on-shore process facilities.

The modularisation concept is typically adopted by project owners for a variety of reasons. For the Dubbo Project the potential benefits include:

- Minimisation of onsite installation hours, by substituting onsite labour with offsite (or off-shore) fabrication hours, reducing overall costs and potentially reducing onsite risks
- Improved installation schedule
- Substantial offsite testing and pre-commissioning, reducing onsite commissioning time and complexity

- Reduced plant footprint; and
- Reduced requirements for onsite materials storage.

A successful modularisation strategy must take into account (trade-off) the optimised balance of a number of factors, such as:

- Module size and equipment density
- Sea and road transportation and logistics
- Fabrication costs and schedule
- Installation methodology and schedule; and
- Impacts of civil works and foundations.

The use of the concept, however, may also introduce complexities, risks and costs, such as:

- Complex planning and coordination of engineering, fabrication, logistics and onsite construction activities
- Increased requirement for offsite quality and procurement management
- Potential for additional materials and fabrication costs (in fabrication of modules)
- Increase in sea freight and overland transportation costs; and
- Increased offsite laydown and storage areas.

All of the above trade-off and risk factors must be considered and weighed against the standard 'stick-built' construction methodology when determining whether modularisation is a viable option for any one part of the process plant.

From the modularisation work carried out to date it is considered that for the Dubbo Project process plant the adoption of an aggressive modularisation strategy will result in reduced overall capital costs versus a traditional method at the same capacity. These reductions are included in the staged-build cost estimate detailed in Section 7.1 of this document.

3.2.2 Process and Equipment Optimisation

Key equipment suppliers, particularly Outotec, suggested changes to individual items or sections of plant that would add value to the project. These changes have been incorporated into the plant design and estimate.

3.2.3 Staged Construction – Repeatable Train Expansion

Whilst the baseline capacity for the Dubbo Project is for 1Mtpa throughput, the prospect of a staged construction and commissioning of the process plant, and to a lesser extent the supporting non-process infrastructure work, has been investigated.

The concept is centred around staged construction, and the development of a 'repeatable' reduced-capacity train that can be replicated to expand plant capacity. To the greatest extent possible, each successive train is a copy of the initial plant.

The main aim of this stage construction strategy is the reduction of initial capital cost, bringing the project into production with a lower initial commitment. Later expansion becomes a matter of reproducing the initial train as needed, opening a pathway to rapid development and expansion to 1Mtpa capacity (and potentially beyond), with relative speed and without substantial re-engineering.

The physical works of the Dubbo Project can be broadly grouped into two categories:

- Process infrastructure, being the process plant itself; and
- Non-process infrastructure, being the supporting infrastructure that provides access to the site along with necessary services and utilities.

When investigating staged construction for the **process infrastructure**, consideration has been given to identifying the optimal balance between size and cost. Reduction in throughput capacity will in general terms lower the capital cost, as the process equipment can be sized smaller; however, the relationship between equipment size and cost is generally not linear.

As a broad example, the crushing plant sized to process 1Mtpa of ore may cost only 20% more than a plant sized to process 500ktpa, meaning that a repeat of two trains for crushing ultimately costs considerably more than one at 1Mtpa. In such a scenario, a decision may be taken to install a 1Mtpa capacity crushing plant with the initial 500ktpa train.

The balance must be found and the optimal design solution identified; this process has been continuous with regular review as engineering detail increases.

When considering the **non-process infrastructure**, the capacity versus cost equation must also be considered. In some cases, the capacity of the plant may not have a direct impact on the cost of the work. For example, the road and bridge upgrades in the area must be completed and also the sound barrier to the Taronga Western Plains Zoo, regardless of whether a 500ktpa or 1Mtpa plant is built. Services to site such as electricity, water and gas will be needed, and potentially, with consumption reduced, could be sized smaller and save money; but the economy of later upgrades may often deem these initial cost savings not worthwhile.

These considerations are included in the staged-build cost estimate and will continue to be reviewed as the engineering is further detailed.

3.2.4 Capital Cost Deferment

A further line of investigation for reduction of initial capital outlay has been the deferment of capital investment in favour of an increased operating cost solution. Put simply, this means initially leaving out the installation of a part of the process plant or non-process infrastructure by utilising an alternative source or method of performing that function, which is instead paid for as an operating cost.

These trade-offs have been considered and are reflected in the staged-build estimate; they explain in part the difference in capital and operating costs between the two stages (see Sections 7.1 & 7.2).

3.3 Key Outcomes of the Engineering Studies and Value Investigations

The key financial assumptions, estimates and modelling outcomes from the three engineering studies carried out at 1Mtpa have been published previously and are summarised in Table 4 below. In the calculation of capital cost, each study was consistent in contemplation of traditional 'stick-built' construction methodology, and construction and commissioning of the preferred 1Mtpa plant in one campaign.

Table 4 also summarises results for the post-FEED quest for reduction of both the overall and initial capital cost, collectively here called the value investigations. This post-FEED development phase has delivered value in the validation of cost-reduction concepts and development of alternative execution methodologies. Being 'investigations' rather than definitive studies, the resultant definition and range of accuracy of estimates is lower; however, the engineering experience and modularisation expertise that has been leveraged throughout the investigations is considerable.

The resultant estimated price of A$808M for Train 1 and $692M for Train 2 has been based off (adjusted from) both the detailed FEED study capital cost estimate and current budget pricing for the most significant individual components of the process plant. ASM therefore has a higher level of confidence in the veracity of these figures and has committed to ongoing engineering development to further detail and refine the process plant design, based on a modular solution comprising two-trains. This flexible engineering strategy permits rapid execution of either a single or two-train plant (i.e. initial execution at 500ktpa or 1Mtpa rate). Refer to Section 3.4 below for details of the ongoing development work.

Table 4 Outcomes of Engineering Studies and Value Investigations

	DFS 1 – 1Mtpa investigation	DFS 2	FEED	Updated Model	Post FEED Development - Train 1	Post FEED Development - Train 2
Project Capacity	1Mtpa	1Mtpa	1Mtpa	1Mtpa	500ktpa	500ktpa
Capex	A$893M	A$996M	A$1,297M	A$1,297M	A$808M	A$692M
Revenue per year	A$508M	A$540M	A$580M	A$663M	A$397M	A$663M
Opex per year	A$196M	A$214M	A$260M	A$341M	A$202M	A$341M
EBITDA	A$312M	A$290M	A$320M	A$322M	A$195M	A$322M
IRR[1]	30.2%	19.3%	17.5%	17.5%		16.1%
NPV[1]	A$1,207M	A$1,235M	A$1,220M	A$1,236M		A$909M
Product / Process Notes			Includes hafnium	Includes ZOC conversion costs		
Scope Notes					Deferred Capex for: Gas Supply Pipeline Brine Concentrator Crushing system	Includes at 1Mtpa capacity: Gas Supply Pipeline Brine Concentrator Crushing system

[1] *Based on a project cash flow analysis (ie incorporating all capital and operating outflows excluding company taxation), 8% real discount rate for NPV*

While the combined total capex for Trains 1 and 2 exceeds the previous total for the FEED, this is not unprecedented due to the well-understood non-linear relationship between capacity and equipment cost. Additionally, construction and commissioning in two campaigns significantly increases the time-based indirect costs and contingency allowances.

The identification and further development of a viable two-stage construction is considered to be a valuable additional execution option for the Project. See Section 7.1 of this document for the capital costs and expected value to be derived from the Project under the base case and the staged, two train approach.

3.4 Ongoing Engineering Investigation and Development Work

Utilising early contractor involvement principles, Hatch will continue to work in collaboration with ASM to further develop the concepts identified in the value investigations. The focus will be on advancing the modularised two-train (or staged construction) design to the same level as the 1Mtpa FEED. Ultimately, execution documentation for the initial train, including the associated non-process infrastructure, will be prepared in readiness for execution.

Further development to 2Mtpa capacity, and possibly beyond, remains a consideration for the future. A repeatable train design philosophy lends itself to rapid incremental expansion as product demand grows and funding becomes available. Though further study is required, it is expected that future expansion could be achieved at a lower capital cost than the present first two trains. With much of the non-process infrastructure in place, process design will become a matter of incremental refinement, and layouts amended only if required by land or topographical constraints.

3.5 Project Execution

The Dubbo Project has an estimated 27-month program from financing to construction completion, based on the base case (and preferred) execution plan to install a 1Mtpa plant in one campaign (as identified and contemplated by ASM's FEED study in 2015).

3.5.1 Project Execution Planning

The Project Execution Plan (PEP) identified in the FEED study forms the basis of the Company's execution schedule. With assistance from Hatch, ASM will continue detailed execution planning for a modularised design and staged construction focusing in particular on:

- Global Sourcing Strategy
- Project Execution Schedule; and
- Principal's Project Requirements – Scope of Work.

For the FEED study, an Engineering, Procurement, Construction Management (EPCM) delivery for the whole project was contemplated. For the purposes of cost estimating and work packaging, this delivery method will be carried forward; however, it remains only one of a number of possible contract execution options.

3.5.2 Contracting and Procurement Strategy

At the time of financing for development of the Project, where secured, ASM will finalise the contract and procurement strategy to support the required risk profile for the Project, as this will be affected by contractual conditions required by financiers. Hatch will continue to develop procurement documentation in an execution work package structure. This facilitates the later selective grouping of packages and, together with the Principal's Project Requirements document, can be used for either Engineering, Procurement, Construction (EPC), EPCM or ASM directly managed procurement, as required.

3.5.3 Execution Schedule

The modularised design solution adds complexity to the execution schedule. Careful coordination and timing are required for orders and deliveries of equipment to the place of module assembly, and then the modules forwarded to site in an appropriate sequence for construction. Planning is underway and will continue to develop in parallel with the module designs.

Construction is expected to commence with upgrades to the local roads and bridges for increased traffic, and also a sound barrier to reduce traffic noise at the Taronga Western Plains Zoo. These items are critical path activities, and these packages will therefore be amongst the first commitments following finance approval.

3.5.4 Staged Construction

The base case (and preferred) execution plan remains to install a 1Mtpa plant in one campaign; however, this is subject to off-take and finance arrangements. Planning and design is being progressed in connection with the staged construction approach currently being considered, to bring the Train 1 work packages to execution readiness. Financial models assume that Train 2 will be constructed in Years 4 and 5 of Train 1 production. As noted earlier in this report, the deferred capital items are planned for installation at full capacity at Train 2; this continues to be reviewed.

4. PROJECT APPROVALS

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

- 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 1,021Ha of biodiversity offsets in perpetuity.

ASM has lodged a draft Mining Operations Plan (MOP) 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 minor permits and licences that will be required during detailed design, construction and operation phases (which have not yet been obtained) include:

- Water Supply Works and Use Approvals under the NSW *Water Management Act 2000*.
- Water Access Licences under the NSW *Water Management Act 2000*.
- A Section 138 Permit, issued by the Dubbo City Council under the NSW *Roads Act 1993*, for all works affecting classified roads, namely Obley and Toongi Roads.
- 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.

In addition, and 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.

5. OPERATIONS

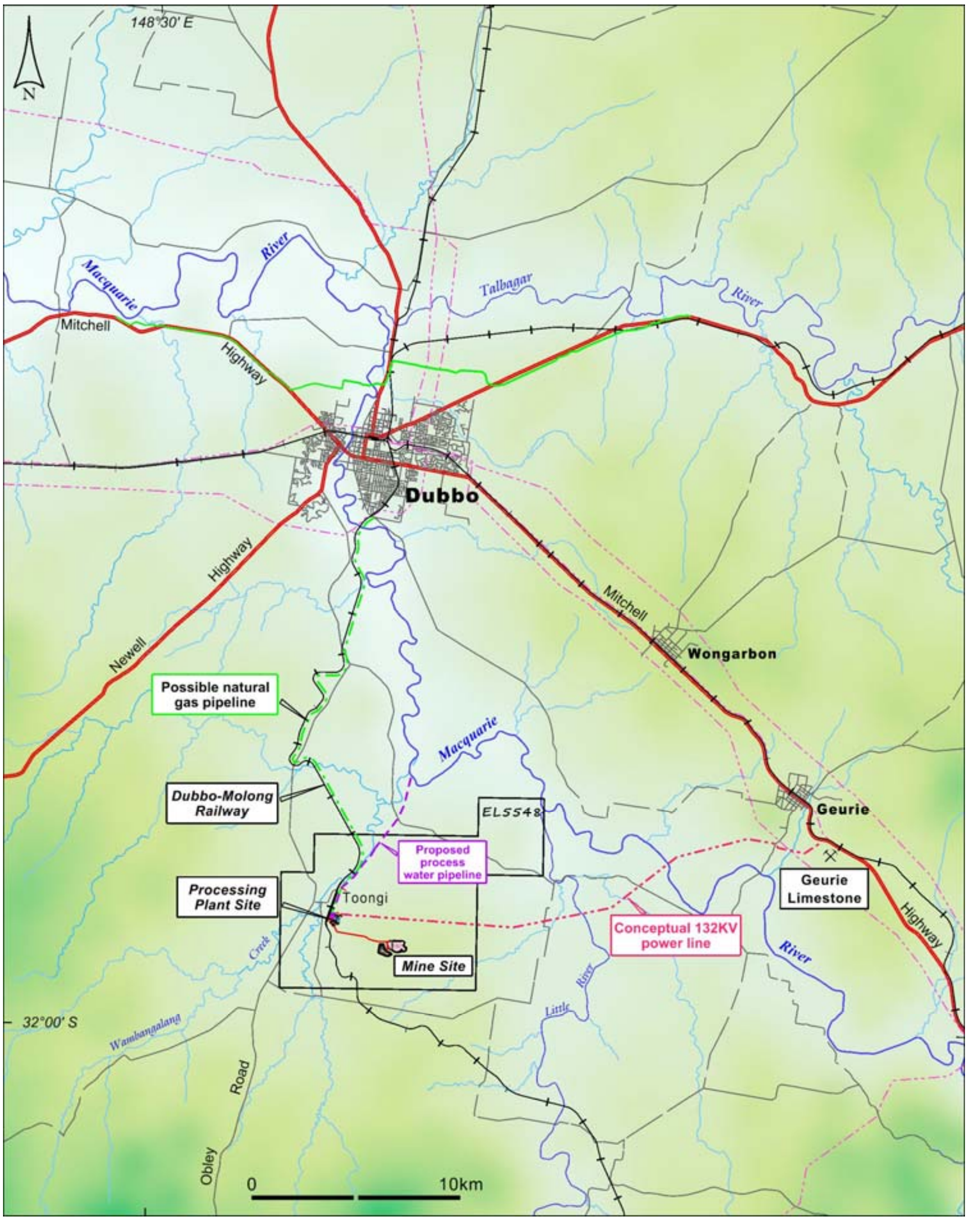
5.1 Operations Overview

At full capacity, the mineral processing plant will be capable of receiving 1,000,000 tonnes per annum (1Mtpa) of crushed ore, which will be processed via a sulphuric acid leach and solvent extraction to recover zirconium, hafnium, niobium and rare earth products.

Sulphuric acid used for leaching will be produced on site using a sulphur burning acid plant that also generates electricity and steam for the process plant. Other reagents will be transported via the public road network. Water will be supplied to the project via pipeline from the Macquarie River and a bore north of the river. Electricity will be supplied via an overhead 132kV line from Geurie 30km to the east of the site.

A small amount of waste rock (weathered material or rock containing insufficient metals for processing) will be extracted and transported to a small waste rock emplacement (WRE) to the southwest of the open cut. The liquid and solid residues from the process plant will be transported and stored in liquid residue storage facilities, solid residue storage facilities and salt encapsulation cells.

Figure 4 Location of the Dubbo Project



5.2 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. Approximately 19Mt of ore will be extracted at a rate of 1Mt per year.

5.2.1 Mining Schedule

The open cut will be developed in two stages, each of approximately 10 years, commencing 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 32m (355m Australian Height Datum/AHD). During the second 10-year period, the eastern half of the orebody will be mined to approximately 360m AHD, with the depth below the natural land surface varying from 15m to 32m. At the end of 20 years, the open cut will cover approximately 40ha, with a long axis (east–west) of approximately 925m and a width (north–south) of approximately 550m. All mining during the 20-year operation will remain above the groundwater table.

5.2.2 Waste Rock Management

Material that is excavated to enable access to the defined ore, or which contains insufficient grades of the targeted minerals, 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.

5.3 Ore Processing and Production

5.3.1 Metallurgical Process Development

The Dubbo Project is based on a large poly-metallic resource of rare metals and rare earth elements. Recovery of metals from the orebody requires metallurgical processing that involves a large number of individual steps. Over many years, Australian Strategic Materials has developed and refined the process flow sheet based on sulphuric acid leaching, followed by solvent extraction recovery and refining.

The commercial potential of the Dubbo Project has been investigated since 1998. A pre-feasibility study completed in September 2000 under the management of industrial mineral consultants, DEMA Pty Ltd, identified the requirements for further study, including the development of a commercially viable process flow sheet and establishment of products with genuine market appeal.

Alkane has been working with the Australian Nuclear Science and Technology Organisation (ANSTO) in Sydney since 2006 to further refine the process flow sheet and conduct process trials. An important step was the establishment of a demonstration pilot plant (DPP) at ANSTO Minerals' Lucas Heights facility in 2008, under the supervision of TZMI. Operation of the DPP has demonstrated the Project's technical viability and informed feasibility studies for capital and operating cost estimates. It continues to assist with further product refinement and provide materials and product samples for market evaluation and assessment.

The initial scope of the Dubbo Project in the late 1990s was to economically extract zirconium and niobium from the ore. This has progressed over time in response to changes in market demand. The value of rare earth elements has increased and the market for particular rare earths, such as neodymium, praseodymium and dysprosium, is becoming increasing more attractive. These changes in market conditions and requirements from potential off-take customers, have driven continuous review and updates to the process flow sheet. Ongoing collaboration with ANSTO has been critical in developing new products and refining the process flow sheet to satisfy these demands.

In 2015, ASM developed a process pathway to recover hafnium (which always occurs with zirconium in nature) from the zirconium circuit, working with ANSTO to produce hafnium products via the

DPP[15]. Previously, the flow sheet incorporated recovery of zirconium, niobium and rare earth products only. The inclusion of a hafnium circuit has had little impact on the overall flow sheet; however, the removal of hafnium (along with other impurities) from the zirconium stream has resulted in higher-purity zirconium products.

As proof of concept for the updates to the flow sheet and to demonstrate capability to produce the required precursors for final products, the DPP was operated for several weeks in 2016. The DPP was configured to allow continuous operation of the front end of the process to separate the individual precursors for zirconium, niobium, hafnium and rare earth products. This campaign was successful in verifying the process flow sheet design.

Work continues with ANSTO to further refine the purity and variety of the final products that can be produced by the Dubbo Project – in particular individual rare earth products and zirconium and hafnium metals. Market research has shown these are of interest to specific customers and improvements to the process flow sheet design have resulted in the capability of producing them at the required market level. The DPP has successfully produced samples for customer evaluation and feedback regarding quality and suitability for their final end-use.

Table 5 summarises some of the A$4M worth of investigative, developmental and pilot plant work that has been completed at ANSTO since 2015.

[15] As documented in ASX announcement 27 August 2015

Table 5 ANSTO Testwork History

Item	Description
	2015
1	Refining of crude niobium concentrate
3	Zirconium Basic Carbonate (ZBC) production
5	ZBC confirmation tests and sample preparation
7	Hafnium pilot plant operation
8	Hafnium recovery development
	2016
3	Integrated pilot plant operation
4	Production of Dehafniated Zirconia (DHZ)
5	Process optimisation for solvent extraction of Zirconium Basic Sulphate (ZBS) and Hafnium Basic Sulphate (HBS)
6	Zr/Hf separation piloting
7	Zr and Hf product recovery optimisation
8	Upgrade of Hf intermediate product
	2017
2	Preparation of Zirconium OxyChloride (ZOC) from ZBC, SZC and ZBS
3	Solvent extraction rare earth separation study
4	DHZ and high-purity Hf separation
5	ZOC process refinement
	2018
1	Production of rare earth chloride liquor
2	ZBD process circuit optimisation

5.3.2 Process Overview

The mined ore is delivered by road to the ROM pad, where it undergoes several stages of crushing and grinding in the comminution circuit. The crushed ore is then dry ground in a ball mill to the optimum particle size for good 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 with chilled water in a leach tank, where the sulphate species formed during the sulphation process (including zirconium, hafnium, niobium and rare earths, along with impurities of iron, aluminium and zinc) are leached into solution.

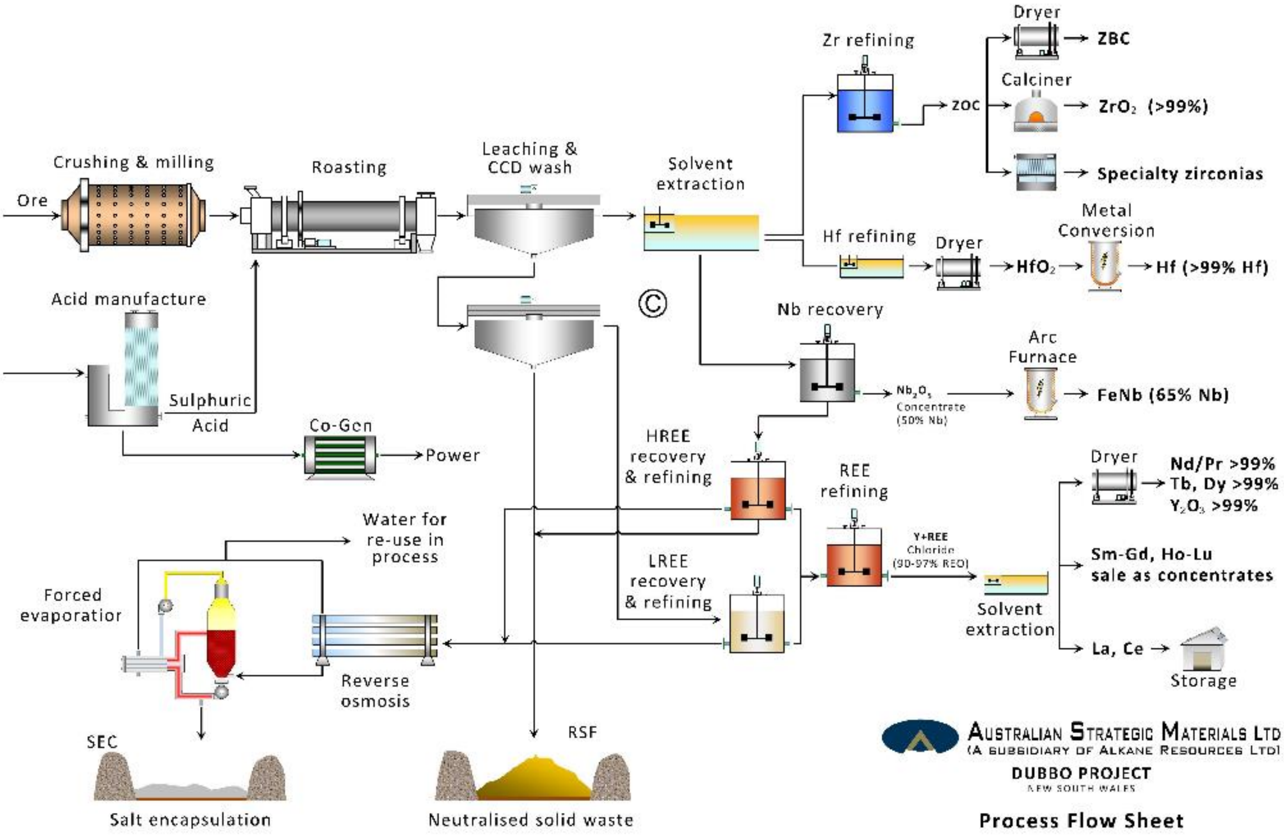
After a nominal time of leaching, the leach slurry is passed through the counter current decantation (CCD) circuit to wash and separate the solids into two liquors: one that comprises the majority of the light rare earth elements (LREE), and a second bearing zirconium/hafnium/niobium/heavy rare earth elements (HREE).

The LREE liquor passes directly from the CCD circuit to the LREE recovery circuit. The remaining liquor passes through several stages of a solvent extraction (SX) circuit, which separates the other metals in solution (zirconium/hafnium, niobium and HREEs):

- Zirconium/hafnium (combined) is recovered from the loaded strip liquor in the first SX stage.
- The raffinate from the first SX cycle is heated to recover a crude niobium-tantalum precipitate, which is then further refined to produce the final niobium product.
- Following niobium recovery, the main process liquor stream is cooled and contacted in the SX plant by the circulated organic flow to recover residual zirconium (zirconium scavenging).
- The remaining process liquor (mainly HREE concentrate) is combined with the LREE concentrates and pumped to a REE SX separation process, which produces final separated REEs in oxide form.
- After recovery and purification, some of the zirconium stream passes through a hafnium removal circuit. Both zirconium and hafnium then enter product finishing and packing circuits.

The process is illustrated in the process flow sheet for the Dubbo Project – Figure 5.

Figure 5 *Process Flow Sheet Schematic*



5.3.3 Process Design and Recoveries

The plant is designed to feed reserve grade ore at a feed rate of 1Mtpa. The design recoveries, as determined through piloting, are given in Table 6 below. Note that the recoveries are expressed as a percentage of the total mass of the element fed into the plant, and the final separation of rare earth oxides assumes a 95% yield in that plant section.

Table 6 Product recovery at 1Mtpa (% of input)

ZrO_2	**HfO_2**	**Nb_2O_5**					
84.40%	25.00%[1]	61.20%					
Rare Earths							
La	**Ce**	**Pr**	**Nd**	**Sm**	**Eu**	**Gd**	
80.10%	69.80%	66.70%	74.50%	51.20%	42.30%	56.90%	
Tb	**Dy**	**Ho**	**Er**	**Tm**	**Yb**	**Lu**	**Y**
47.50%	67.40%	59.30%	74.00%	38.60%	69.90%	26.00%	74.30%

1 Note the hafnium recovery is driven by sales projections and does not represent the maximum possible hafnium recovery.

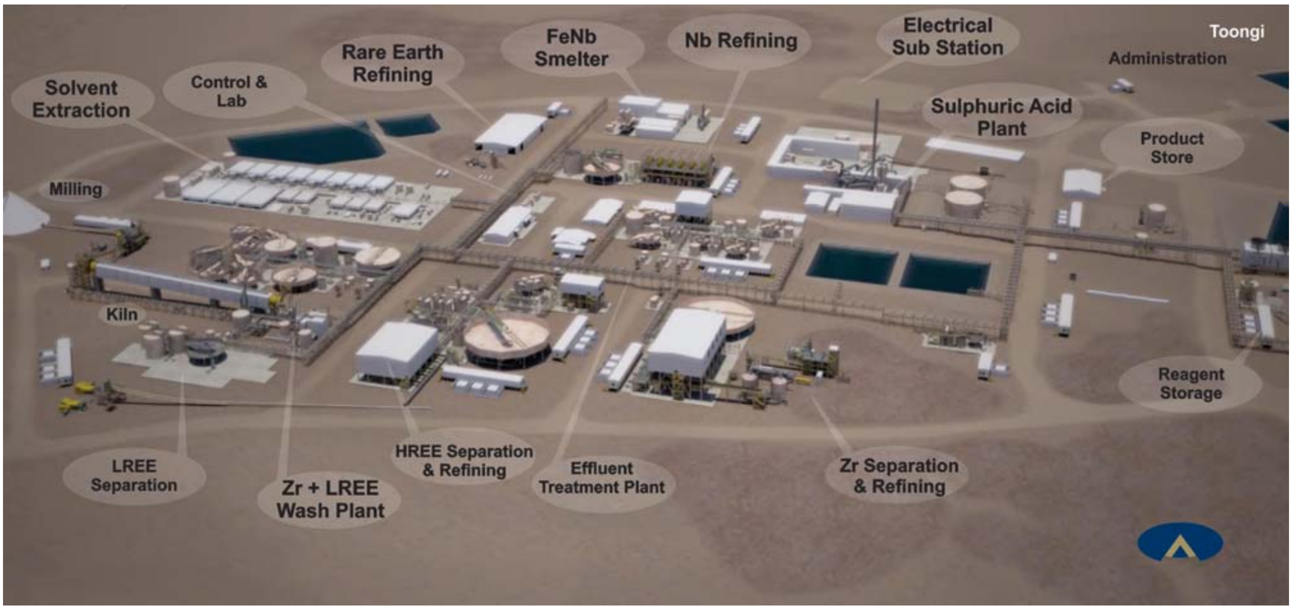
5.3.4 Mineral Processing Facility

The main physical plant process areas that will be built to deliver the above process 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)
- 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 (limestone circuit, chemical storage and handling)
- Sulphuric Acid Plant and Steam Generation
- Site Wide Infrastructure (instrument and plant air, natural gas, sewage and wastewater)

A potential design layout of the Dubbo Project mineral processing facility is shown in Figure 6 below.

Figure 6 Dubbo Project – Mineral Processing Facility design



6. INFRASTRUCTURE, TRANSPORT AND SERVICES

Throughout the Dubbo Project DFS and FEED studies, the scope of the supporting non-process infrastructure has been developed and optimised. Cost estimation and engineering for the project's associated access roads, main road upgrades, supporting utilities, and services and administration facilities have been completed in compliance with the project approval. The scope and status of these activities is described further below and, as described in Section 4, ASM and Alkane will likely require minor permits and licences (not yet obtained) to access and develop a number of these services.

6.1 Site Access and Road Upgrades

The Dubbo Project site will be accessed via local main 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). A secondary gated emergency access road will also be constructed.

6.2 Reagents

Two of the process plant's main reagent consumables are sulphuric acid and limestone. ASM is intending to produce both in-house. 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. Limestone is intended to be quarried from a nearby location at Guerie. This quarry is yet to be approved or developed, so until that occurs the limestone will be purchased externally.

Other reagents will be delivered to site, initially by road. 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 anhydrous ammonia, sodium carbonate, sodium chloride, lime coagulant and flocculant. Sulphur storage and melting plants are also required.

6.3 Water Supply

Operational and construction water will be supplied from the Macquarie River and the Upper Macquarie River Alluvial Aquifer, with existing licenses obtained by ASM providing for around 2 gigalitres annually. A bore and associated pumping station will be located on the northern side of the river, with the pipeline buried under the river using underboring so as to minimise site disturbance. The buried pipeline will continue approximately 7km along an easement to the Dubbo Project site.

Water for construction and processing will be shared and scheduled between the two water sources to minimise impacts on existing groundwater users.

Water is required for construction purposes, in particular the civil and earth works. This work has been identified as a critical early works opportunity to reduce construction indirect costs associated with importing water.

6.4 Gas

Up to 970TJ/year of natural gas is required for the heating of reagents within various circuits of the processing plant. Discussions are underway with the owner and operator of the gas distribution network in NSW to expand the existing gas network to the Dubbo Project site, rather than ASM build and own a gas facility within the Dubbo-Molong rail line easement. Trucking of gas to site is also an option and has been used for the operating cost estimate.

6.5 Power

Incoming high-voltage supply will require the installation of a new single-circuit 132kV overhead transmission line from the existing 132kV feeder to the Dubbo Project main switchyard, plus an additional dual-circuit 132kV overhead transmission line to the Geurie Switching Station.

An easement has been secured by ASM for the route from Toongi to Geurie.

6.6 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 are comprised of:

- 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
- Processing facility administration and plant control room building

Industrial buildings

- Stores warehouse

- Product store
- Maintenance workshop

6.7 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 is able to be filled, closed and rehabilitated independently of the other cells. At maximum production (1Mtpa), approximately 2Mtpa of wet solid residue will be produced, reducing to 1.3Mtpa 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.

7. COSTS AND FINANCIAL ANALYSIS

7.1 Capital Cost Estimate

The capital cost estimate for the base case 1Mtpa is based on the FEED estimate. The staged build estimates are also based on the FEED estimate with adjustments made principally for the anticipated effects of modularisation, the reduced throughput capacity at each train and, in the case of Stage 1 only, deferred capital expenditure.

Table 7 – Capital Costs

Plant Area	***Base Case 1Mtpa (A$M)***	***Stage 1 500ktpa (A$M)***	***Stage 2 500ktpa (A$M)***	***Combined 1Mtpa via Staged Build (A$M)***
Mining, crushing and grinding	28	13	13	26
Roasting and leaching	47	37	35	72
Solvent extraction, product refining and finishing	298	192	153	345
Waste treatment	161	56	100	156
Reagents (incl. acid plant)	199	88	106	194
Infrastructure	247	164	87	251
EPCM, construction facilities and freight	140	132	91	223
Contingency	103	95	83	178
Owners costs and provisions	74	31	24	55
TOTAL	**1,297**	**808**	**692**	**1,500**

Additional notes for the capital cost estimates:

- It is presented in Australian dollars, based on exchange rates at 31 January 2018
- Labour and commodities rates are adjusted to a 31 January 2018 base
- Select pricing estimates sourced by ASM have been used where better rates or equipment specifications have been achieved since FEED

The difference in the base case versus staged-build capital cost is largely due to the duplication of some costs on the building of the second stage as well as the increased cost of design in an extensively modularised plant.

It can also be seen that the indirect costs associated with the stage 1 plant are higher than for stage 2. This is due to the requirement for basic infrastructure in stage 1 that is not required in stage 2 (e.g. major road and bridge upgrades) and less requirement for EPCM work in stage 2 (given the design is largely complete).

The appeal of the staged approach for plant construction is that it requires a lower initial capital investment and is able to demonstrate the capability of the process to produce products on a large scale. It also means any process improvements (such as process efficiencies and cost reductions) can be incorporated into the stage 2 design.

Alkane's and ASM's review of both build scenarios shows that a single 1Mtpa plant installation as the most economically attractive option (that is, the 'base case'). It also suggests that at the forecast prices for the Project's products the 500ktpa process train is the minimum size that would be considered economically viable as a process plant building block.

7.2 Operating Expenditure

7.2.1 Key Parameters

Estimated average operating costs for the project apply to the period following the initial commissioning and ramp-up. These costs were estimated for both the base case and staged-build scenarios.

The operating cost estimate considered the capacity ramp-up of the facility (based on McNulty curves).

The following main components have been included in the preparation of the overall plant operating cost estimate:

- Labour
- Electric power
- Reagents
- Consumables (including fuels – gas and diesel)
- Maintenance
- General and administrative; and
- Product transport.

The plant design availability is 8,000 hours per annum (91.3%), with the exception of crushing, which has an operating availability of 4,964 hours per annum (56.7%).

Mining costs were estimated assuming a contractor mining model. All processing inputs are derived from mass balance and process design criteria established via the studies mentioned previously (Section 5.3). Main reagent costs are based on current supplier quotations. Maintenance costs were factored on capital cost. Federal, state and local government charges and levies are included as appropriate in the cost estimates.

The operating cost estimate has been prepared in Australian dollars.

7.2.2 Staged Plant Cost Estimation and Ramp-up

It is widely known that newly constructed plants and brownfield expansions go through a period of ramp-up to full capacity. An industry-standard method of predicting ramp-up capacity is to compare a project to a set of ramp-up curves, commonly known as McNulty curves after the original study author.

The four types of averaged McNulty start-up curves are defined by the following scenarios:

- **Series 1**: Mature technology used elsewhere. The process has been thoroughly piloted, with complete process development and engineering.
- **Series 2:** Some prototype technology is established; however, it has severe process conditions and incomplete or non-representative pilot testing.
- **Series 3**: As with series 2, but the technology has serious design flaws due to limited piloting (steps missed) and/or feed variability, poor quality during process development, misunderstood feed/mineralogy, and fast-tracked engineering and construction.
- **Series 4:** As with series 2 and 3, but any continuous tests that were run were only to make product. The process has an unusually complex flow sheet with two or more prototype unit operations, downsized equipment to save costs, and misunderstood process chemistry.

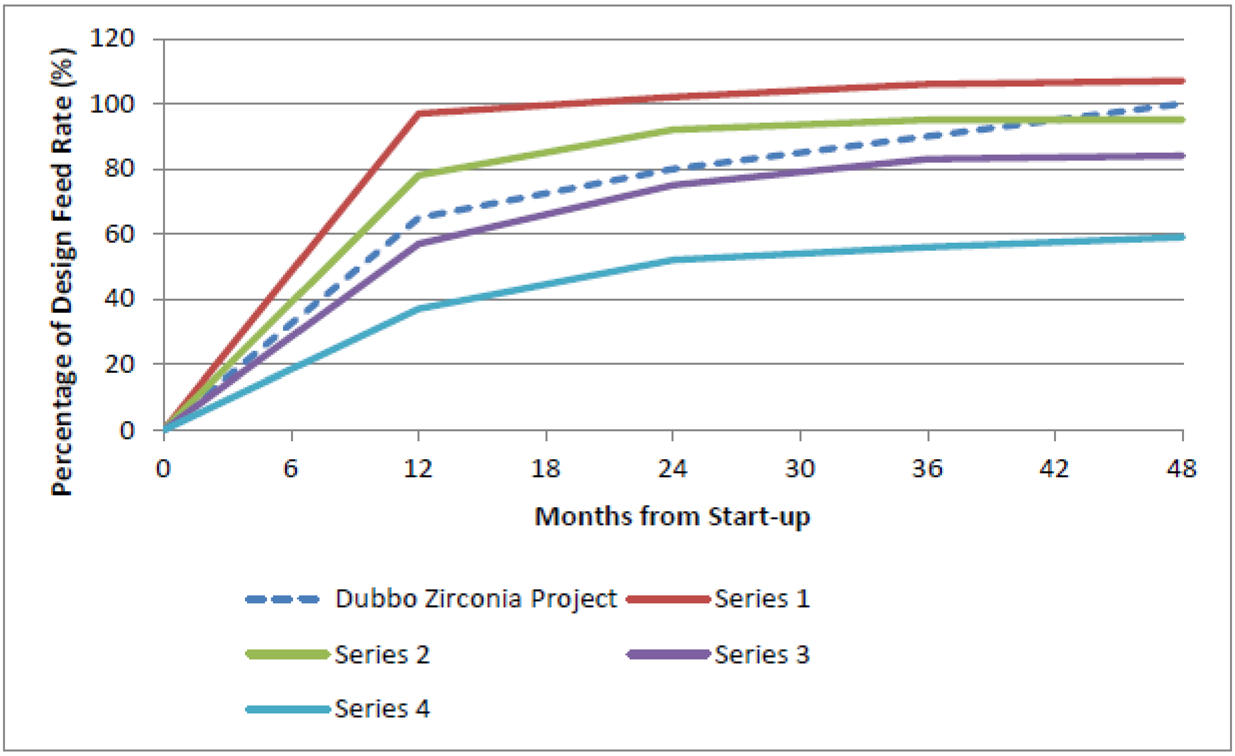
ASM has adopted a staged ramp-up capacity for the first plant build (either 1Mtpa base case or 500ktpa in the staged-build scenario) that is consistent with a series 2 or 3 start-up, followed by a steady increase in feed ore processing rate to 100% after 36 months (Figure 7). This ramp-up relies on the remediation of any design flaws or equipment bottlenecks that would otherwise hinder a series 2 or 3 plant ramp-up.

As any further expansions (such as the second 500ktpa stage, for instance) would be based on an existing operating plant, the ramp-up was considered to be more rapid, reflected by a one-year period to reach 100% operational capacity.

Based on McNulty curves, the staged-plant capacity ramp-up for the project was selected to be:

	Year 1	***Year 2***	***Year 3***	***Year 4***
1 Mtpa and Stage 1 build	0.65	0.8	0.9	1.0
Stage 2 build	0.75	1.0	1.0	1.0

Figure 7 Dubbo Project ramp-up compared to average McNulty Curves



The cost components of the operating cost were also considered and apportioned between fixed and variable during the ramp-up period. This apportioning was made on a nominal basis, in consideration of the nature of the ramp-up activities.

7.2.3 Operating Cost Summaries

Estimated operating costs for the base case 1Mtpa and staged-build scenarios are summarised below:

Table 8 Operating cost summary for two scenarios

	Cost (A$M/year)	
Operating cost item	**Stage 1 (500ktpa)**	**Base case (1Mtpa) and Staged-build post-Stage 2 completion**
Mining	2	3
Labour	29	36
Utilities (Power, Gas)	22	27
Reagents	113	209
Consumables	3	7
Maintenance Materials	8	19
Product Transport	2	5
General and Administration	9	11
Royalties and Selling Costs	13	27
Total	**201**	**344**

Note that Stage 2 of the process plant construction achieves the full 1Mtpa capacity. As such, the operating cost estimate and breakdown for the 1Mtpa base case are the same as for the stage 2 case.

7.2.4 Individual Opex Cost Components

Mining

The mining operation is expected to be relatively straightforward, with minimal overburden removal required and a mobile digger used to mine the ore once it has been blasted. A small fleet of trucks would be used to transport the mined ore to the crusher. The small fleet size and relatively shallow pit depth results in a low operating cost estimate for mining.

Labour

The labour costs were estimated through development of a detailed organisation chart for the Dubbo Project operation. This organisation chart is populated with personnel to cover specific roles, including process plant operation, maintenance, technical and administration to meet the requirements of the operation.

Personnel costs were based on the base salaries for each role, estimated according to the level of seniority, experience and category for each respective role. The base salaries reflect the experience of Alkane Resources in operating process plant facilities in the Central Western NSW region.

Utilities (Power, Fuel Gas)

The process plant electric power load is estimated from the mechanical equipment list. Electric drive sizes were derived from equipment supplier input, the Hatch in-house database for specific equipment packages, or calculated based on the mass balance flow data. Power supply is based upon the provision of electricity from the grid. The electric power costs exclude power generation from the sulphuric acid plant steam turbines, which are noted as a 'cost credit' in the overall operating cost summary.

Natural gas consumptions were provided by equipment suppliers or estimated based on similar equipment calculations. It is assumed that liquid fuel delivery would be used for the stage 1 plant. The gas supply pipeline would be installed for the stage 2 plant.

Reagents (Chemicals)

Reagent consumptions are based on the process mass balance at the supplied concentrations noted, with the criteria for each reagent backed up by test work conducted as part of the study, or test work previously conducted by ASM. Reagent prices were built-up by ASM with input from suppliers for reagent purchase costs. The major costs are caustic soda, sulphur and soda ash, which account for 56% of the total reagent costs.

Consumables

Consumables estimates are based on the process mass and energy balance, the consulting engineer in-house database for equipment-specific requirements, and equipment supplier input. The base case (1Mtpa plant) was used for these costs, and the staged-plant consumptions and costs were factored-in in consideration of the ramp-up for the process plant.

Maintenance

Maintenance cost estimates for the process plant have been based on a fixed percentage of the total direct capital cost for each area. The maintenance percentage varies, depending on the type of equipment and process conditions of operation in each area.

The percentage values have been developed based on experience with similar operations and equipment. The values represent averaged maintenance costs over the first few years of operation, and account for years of standardised maintenance and years with typical major maintenance. Where higher maintenance costs are expected in any one particular year, these costs are averaged over the first few years.

The maintenance costs only include equipment replacement, repair and refurbishment costs. The maintenance labour costs are captured in the overall labour costs.

General and Administration Costs

A number of general and administration costs are allowed for in the operating cost estimate, based on experience from projects of a similar size and nature.

Transport

Transport cost estimates incorporate the cost to bring raw materials to site, the cost to transport products from site and the costs to transport materials or waste within the plant site. The costs are based on all-in rates for transportation trucks, truck maintenance, fuel and labour.

The solid and liquid transport costs have been built up based on estimates provided by general truck transport contractors in NSW. The transport costs are based on product transportation between site and the Port Botany, NSW. These costs exclude product packaging costs, which are captured under consumables. Handling and loading labour costs are covered under labour operating costs.

Royalties and Selling Costs

Royalties are levied by the New South Wales Department of Planning and Energy, Resources and Energy at the rate of 4% of the ex-mine value less allowable deductions.

Selling costs comprise sales and marketing agency fees for certain products.

7.3 Funding Options and Strategy

A detailed financial model and discounted cash flow analysis has been prepared in order to support the economic viability of the Dubbo Project. The Company believes that it has reasonable grounds for the assumptions contained in the financial model and discounted cash flow, and those assumptions present a balanced view of the potential value of a funded Dubbo Project. Certain assumptions or projections, particularly those underpinning revenue, are inherently difficult to make due to the complexity in the underlying drivers and the need to provide those projections over a long period of time, i.e. the initial 20-year project life. Key inputs and assumptions are set out at Section 7.4 of this document to allow analysts and investors to calculate project valuations based on their own revenue assumptions, should they be different to those used by the Company. An analysis of the sensitivity of material key assumptions on the valuation has been included in Section 7.4.8 to assist investors and analysts.

The Company has engaged the services of Sumitomo Mitsui Banking Corporation (SMBC), a global banking and financial services company, to provide financial advisory services and to assist with arranging the debt financing for the Project. SMBC has provided a range of relevant advisory services to Alkane and ASM.

The Company also intends to appoint equity capital market specialist advisors that have significant experience in raising funds for projects of the size and nature of the Dubbo Project to assist with any equity component of the required funding package.

It is important to note that no funding arrangements have yet been put in place. However, the Company maintains an open dialogue with financial institutions that have experience in funding projects like the Dubbo Project. Formal discussions will commence once off-take contract negotiations are sufficiently advanced, such that counterparties and key contract terms become clear. Having regard to the information available to it and the analysis undertaken, the Company considers that it has a reasonable basis to expect it will be able to fund the development of the Project in the manner described in this announcement, although there is no certainty that this will occur in any particular timeframe, or at all.

The Company recognises that securing off-take on commercially acceptable terms for a material proportion of production is essential to successfully fund the Project. Product off-take is particularly important for the markets that the Dubbo Project will supply, in the absence of financial derivatives to manage the quantity and price risk relating to projected revenues. The strength of product off-take counterparties and the key contractual terms will assist in expanding the range of financing solutions and driving down the financing costs. As previously disclosed, Alkane has already secured a global marketing and sales agreement for zirconium products with UK-based Minchem Limited, a joint venture with Treibacher Industrie AG for the production and marketing of ferro-niobium, a memorandum of understanding with Siemens Ltd for supply of a number of rare earth products, and range of other letters of intent for the supply of zirconium products. The Company and ASM continue to explore and pursue arrangements with potential off-take counterparties, with a view to securing binding arrangements that will, in turn, bolster the business case to secure financing for development of the Project.

ASM's proposed financing strategy for the Dubbo Project will include, but will not be limited to, the following:

1) Securing long-term off-take contracts on commercial terms with financially robust counterparties
2) Seeking partnerships through project investment with strategic parties (potentially off-take partners) aligned with the long-term interests of Alkane's shareholders
3) Securing a fully funded solution appropriate for the development of the Project; and
4) Seeking to minimise potential dilution to existing Alkane shareholders.

It is likely that funding for the Project will be sought from a number of sources.

Prioritised potential funding solutions being sought by the Company include:

1) **Sale of Project Interest to Strategic Investor:** The Company continues to meet with potential product off-take partners and investment funds with mandates targeting investment in the key products of the Dubbo Project, organisations considered to have the best strategic alignment with the Company.
2) **Export Credit Agencies (ECAs):** The Company continues to liaise with ECAs from potential off-take partner countries, as well as engineering, equipment supply and construction partners, recognising that the different financial metrics and investment outcomes applied by ECAs to support their national interest is best suited to provide part of the funding solution for a project like the Dubbo Project. The ability to secure ECA funding will depend upon, amongst other factors, whether it is a national priority to secure sources of supply for the products that the Project will produce for the off-take counterparties and/or whether it is in the national interest to assist engineering and equipment service providers awarded contracts to construct the Project.

3) **Traditional Debt and Equity Structures:** The Company continues to keep financial institutions informed about the Dubbo Project and its markets to enable the greatest spread of available funds with investors (debt and equity) that understand the markets and their dynamics to enable expedited execution once conducive market conditions and sufficient off-take contracts are in place.

4) **Other Debt or Financing Structures:** The Company recognises that it may be necessary to look beyond traditional sources of debt finance to expand the pool of funds available. Sources such as prepaid off-take contracts, royalties and product streaming and equipment leasing or off-balance sheet funding arrangements (e.g. BOOT).

The Company's current market capitalisation is ~A$144M (as at 29 May 2018). The Company anticipates that, as further developments with the Project are made and announced to ASX, its market capitalisation may be higher, incorporating a higher proportion of the assessed value of the Project as a result of the Company having further de-risked the Project through securing off-take contracts and potentially a sale of a Project interest. Any market capitalisation increase that occurs may potentially reduce the dilution from further equity raisings, and form the basis for securing larger amounts of funding from third party financiers, improving the potential ability of the Company to secure finance that will enable the Dubbo Project to be brought into production. The Company also maintains a strong balance sheet, with no debt. Maintaining this strong balance sheet position, as the Project develops over time, would also assists in positioning Alkane and ASM to secure the required funding, as described in this announcement.

Alkane has a high-quality Board and management team, comprising highly experienced and respected resource executives, with extensive finance, commercial and capital markets experience.

Despite the comments above, there remains the risk that the Project is not fully funded or that funding is secured, in which case the financial outcomes that the Company is targeting may not be achieved.

7.4 Financial modelling and evaluation

The financial model start date assumes financing is in place and allows 27 months for detailed engineering, design and construction. Investors should refer to Section 7.3 of this announcement for a discussion about funding requirements in connection with the Project. Commissioning is included in the first year of operations. All expenses incurred prior to securing financing and commencement of detailed engineering and design, including any remaining engineering and design activities or any additional value optimisation activities undertaken, are treated as sunk costs.

The key assumptions used for the financial modelling and evaluation for the base case 1Mtpa scenario and the modular staged-build scenario are outlined in Table 9 and further described in this Section 7.4.

Table 9 Key assumptions for financial model and evaluation

Parameter	Units	Assumption
Exchange Rate	A$1:US$	0.75
Discount Rate (Post Tax, Real)	%	8.0

7.4.1 Mining Schedule and Ore Grades

The financial model assumes a mining and processing rate of 1Mtpa at the Reserve grade (or 500ktpa for the first stage of a staged-build execution method).

7.4.2 Production Ramp-Up

As discussed in operating costs above, the production ramp-up is based on standard McNulty curves. The ramp up used is given in Table 10 below.

Table 10 Production ramp-up

Parameter	Units	Assumptions	
		1Mtpa	Staged
Production Ramp Up*			
Stage 1			
Production Year 1	%	65.0	32.5
Production Year 2	%	80.0	40.0
Production Year 3	%	90.0	45.0
Production Year 4	%	100.0	50.0
Stage 2			
Production Year 5	%	N/A	50.0
Production Year 6	%	N/A	87.5
Production Year 7	%	N/A	100.0

** % of 1Mtpa full-capacity production.*

7.4.3 Product Mix, Production and Sales Volumes

The financial model assumes that all production is sold in the year produced. In addition, the remaining rare earths are sold as a concentrate. See Section 9 below for further detail about the basis for these assumptions as to sales volumes.

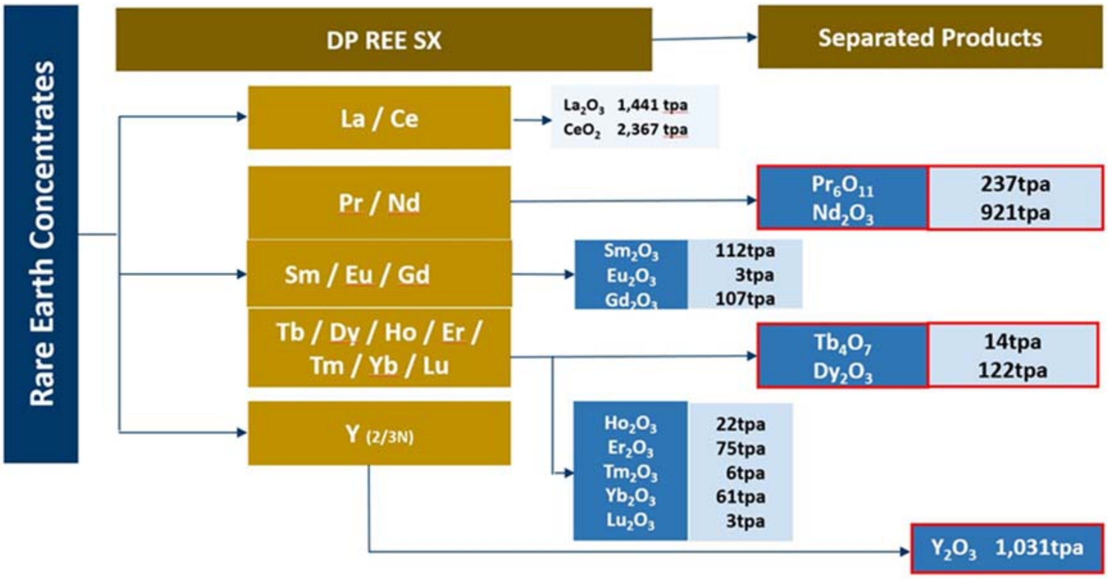
Table 11 Product tonnage

Product	Unit	Year 1*	Year 2*	Year 3*	Year 4 on*
Base Zirconia Products (priced as ZOC)	tonnes (ZrO_2)	9,792	11,841	11,519	10,205
*Premium Zirconia Products***	tonnes (ZrO_2)	500	1,000	3,077	6,153
Total Zirconia Products	**tonnes**	**10,292**	**12,841**	**14,596**	**16,358**
Hafnium Metal	tonnes (Hf)	33	40	45	50
Niobium Metal	tonnes (Nb)	1,287	1,582	1,773	1,966
Rare Earth Oxides					
Praseodymium	tonnes	155	190	213	237
Neodymium	tonnes	603	740	831	921
Terbium	tonnes	9	11	12	14
Dysprosium	tonnes	79	97	109	122
*Yttria***	tonnes	674	828	854	877
Total Rare Earth Oxides	**tonnes**	**1,520**	**1,866**	**2,019**	**2,169**

** Production year. Refer Table 10 for production ramp up profile.*

*** Yttria consumed in the production of stabilised zirconia products is reflected in the quantity of stabilised zirconia in the table above.*

Figure 8 Separated rare earth product tonnages



7.4.4 Product Price and Revenues

Table 12 below lists the key products, assumed long-term average pricing per internal forecasts and revenue for 1Mtpa full-production facility. In generating these internal product pricing forecasts, the Company had regard to detailed market assessments provided by a number of specialist independent industry consultants for all products. See section 9 below for further detail about the basis for these pricing assumptions.

Table 12 Key products, forecast pricing and revenue

Product	Unit	Price	Unit	Revenue[*1]
Base Zirconia Products (priced as ZOC)	US$/kg	10.00	US$M's	102.0
Premium Zirconia Products	US$/kg	21.00	US$M's	129.1
Average Zirconia Price	**US$/kg**	**14.13**	**US$M's**	**231.1**
Hafnium Metal	**US$/kg**	**600.00**	**US$M's**	**30.0**
Niobium Metal	**US$/kg**	**33.35**	**US$M's**	**65.6**
Rare Earth Oxides				
Didymium (NdPr)	US$/kg	90.00	US$M's	104.8
Terbium	US$/kg	650.00	US$M's	9.0
Dysprosium	US$/kg	325.00	US$M's	39.4
Yttria	US$/kg	10.00	US$M's	8.8
*Other Rare Earth Products [*2]*			US$M's	9.0
Total Rare Earth Revenues			**US$M's**	**171.0**
Total Revenues			**US$M's**	**497.7**
Total Revenues[*3]			**A$M's**	**663.6**

[*1] *Revenue for 1Mtpa production facility at steady state production rates after ramp-up.*

[*2] *Other rare earth products include low-value sales of lanthanum oxide, cerium oxide and heavy and light rare earth concentrates.*

[*3] *Long-term average exchange rate A$1:US$ 0.75*

7.4.5 Product Recoveries

Product recoveries used in the financial model are as per those detailed in Section 5.3.3 (Table 6) above.

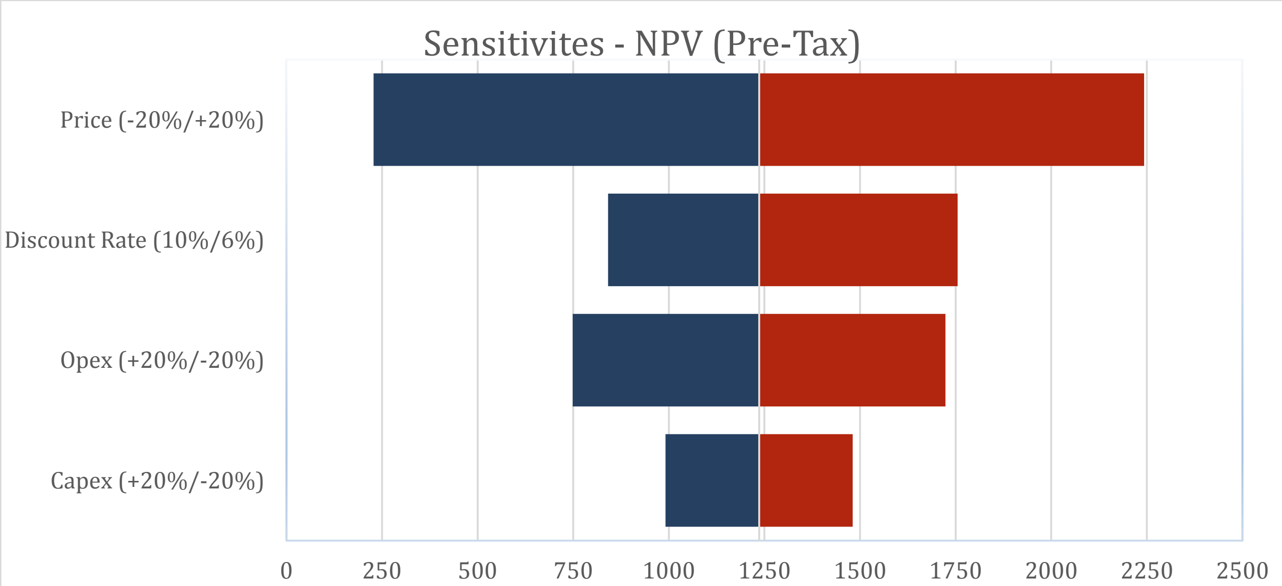
7.4.6 Operating Cost Ramp-Up

An estimation of the composition of fixed and variable costs for each type of operating expense has been used to determine the ramp-up of operating costs, in addition to the physical ramp-up of production.

7.4.8 Financial sensitivity

The potential financial impact of changes to some of the key assumptions or projections are shown below.

Figure 9 Sensitivity analysis (A$ NPV on X-Axis)



As would be expected with any positive NPV project with high free cash flow generated (given the assumptions made) the NPV is most sensitive to changes in price, and therefore revenue.

An exchange rate sensitivity has not been included as the final mix of currencies for non-Australian dollar denominated operating costs and capital costs will be determined as part of the contract award process. The price sensitivity approximates the impact of commensurate movements in the exchange rate on revenues.

8. MATERIAL RISKS

There are a number of risks, both specific to Alkane and of a general nature, which may, either individually or in combination, affect the future operational and financial performance of Alkane, the development of its Project as described in this announcement, and the value of its shares.

The risks set out below are not, and should not be considered to be, an exhaustive list of all the risks relevant to the proposed development of the Project, and an investment in Alkane generally. Alkane, however, considers that these risks represent key risks to the proposed development of the Project, and an investment in Alkane generally. Additional risks and uncertainties that Alkane is unaware of, or that Alkane considers to be immaterial, may also become key risks that can adversely affect Alkane's operational and financial performance in the future and ability to ultimately develop the Dubbo Project to production. These key risks are general in nature and regard has not been had to the investment objectives, financial situation, tax position or particular needs of any investor.

Securing funding and future capital requirements

In order to develop the Project as described in this announcement, Alkane will, in the future, need to secure a significant amount of funding. This funding will likely come from a range of sources, some of which are described in Section 7.3 of this announcement. The Company considers that it has a reasonable basis to expect it will be able to fund the development of the Dubbo Project, however, this cannot be guaranteed, and Alkane may not be able to secure the required level of funding either at the present time, or in the future.

Any additional equity raising conducted by the Company may be dilutive to its shareholders, or may be undertaken at lower share prices than the then market price, or may involve restrictive covenants which limit the Company's operations and business strategy. Debt financing, if available, may involve restrictive covenants that may limit the Company's operations, business strategy and its other financing and operating activities.

Product/commodity prices and currency fluctuations

Alkane’s revenues and cash flows will be derived from the sale of its product. As such, the Company's financial performance is exposed to fluctuations in commodity price. Commodity prices may be influenced by numerous factors and events that are beyond the control of Alkane, and Alkane cannot provide any assurance as to the prices it will achieve for its 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.

Alkane's revenues and costs (including any potential debt funding it may receive) may be sensitive to currency fluctuations. Accordingly, the value of its business may be affected by fluctuations in currency exchange rates.

Exploration and Ore Reserves and Mineral Resources estimate risk

Despite the mineral Ore Reserve and Resources being JORC 2012 compliant, there is a risk that the ore grade and tonnes recovered are different to that modelled. In addition, Ore Reserves and Mineral

Resources are expressions of judgement based on industry practice, experience and knowledge and are estimates only. Estimates of Ore Reserves and Mineral Resources are necessarily imprecise and depend to some extent on interpretations which may prove inaccurate. No assurance can be given that the estimated Ore Reserves and Mineral Resources are accurate or that the indicated level of ore will be produced.

Mine development risk

Whilst the mining operation is small with a low strip ratio and pit depth, there is a risk that the mining operation is delayed during operations. In addition, future development of a mining operation is dependent on a number of factors, including those matters identified in this Section 8.

When the Company commences production, its operations may be impacted by a variety of risks that are beyond its control, including environmental hazards, industrial accidents, technical failures, labour disputes and climatic conditions. No assurance can be given that the Company will achieve commercial viability through the development or mining of the Project.

Construction delays and cost overruns

As the Dubbo Project requires a large construction effort, there is a risk of cost overrun in construction. To the extent that construction activities are delayed, this may impact the total development costs, and the timing and amount of revenue derived from the operation. This may have an adverse effect on the Company. Some of the impact of this risk is realised by the provision of a contingency on financing, as well as the level of detail in engineering and the type of contracts awarded.

Ability to achieve product recoveries, production targets and meet ramp-up assumptions

The Dubbo Project has had extensive piloting and design. As with all operations being built in full scale versus pilot scale, there is risk that the product recoveries and ramp-up will not be met as assumed. There can also be no guarantee that anticipated tonnages (and grades) of ore will always be achieved during mining and production. Even in circumstances where such tonnages are achieved, there is no guarantee that they will be sufficient to sustain a profitable operation.

Product sales agreements

Any product sales agreements reached by Alkane for the sale of its products will have the risks usually associated with contracted counterparties. Alkane will be seeking to enter into binding off-take agreements with various counterparties for the sale of the products derived from the Project.

There is no guarantee that Alkane will be able to reach agreement on terms satisfactory to it for the sale of products. If Alkane cannot reach satisfactory terms, this may have an adverse effect on the Company's future revenues.

Penetration of premium product markets

The Dubbo Project assumes that premium pricing will be received for some if its zirconium products with time. It is a risk that, with increased competition, changing customer demand or other market risks, the premium pricing will not be achieved as modelled.

Technological advances and disruption

The viability of the Dubbo Project, and the metrics detailed in this announcement, assumes that there will be suitable demand for its products. There is a risk that technological advances (and any resulting market disruption) may reduce the demand for the products derived from the Dubbo Project, and resultant sales and pricing will not be achieved as modelled.

Regulatory approvals, licences

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. Approvals, licences and permits required to comply with such laws may, in some instances, be subject to the discretion of the applicable government or government officials and, in some cases, the local community. To the extent such approvals are required and not retained or obtained in a timely manner or at all, this may have an adverse effect on Alkane.

Adverse changes to government policy and legislation

The Dubbo Project and all mining and minerals processing assets in Australia are subject to changes in government policy and legislation. These can result in increased costs to the company or restrictions on its activities.

Environmental risks

Mining (and exploration) can be potentially environmentally hazardous, giving rise to potentially substantial costs for environmental rehabilitation, damage control and losses. Alkane is subject to environmental laws and regulations in connection with its operations, and could be subject to liability due to risks inherent in its activities, including unforeseen circumstances.

Reliance on key personnel

Alkane's success depends, in part, on its ability to attract, retain and motivate suitably qualified personnel, including its executive officers, senior management and other consultants, and for these personnel to operate effectively. The inability to access and retain the services of a sufficient number of qualified staff could be disruptive to the Company's business development and could materially adversely affect its operating results.

Reliance on joint venture partners and contractors, and counterparty risk

The financial performance of Alkane is exposed to potential failure to perform by counterparties to its contractual arrangements. This includes a risk of failure or default (financial or otherwise) by a participant to any joint venture to which Alkane is, or may become, a party. This may also lead to adverse financial consequences for Alkane and there can be no guarantee that the Company would be able to recover the full amount of any loss through legal action.

General economic risks

General economic conditions in Australia, and any other future jurisdictions that the Company may operate in, may have an adverse effect on Alkane's business activities and on its ability to fund those activities. Economic factors include, but are not limited to, new legislation, tax reform, changes in investor interest, inflation rates, interest rates, currency exchange rates, changes in political and economic policy, terrorism or other hostilities, and other factors outside the control of Alkane.

Landholder and title risk

Alkane owns all of the land on which the Dubbo Project will be located. However, mining licences are granted subject to various conditions and failure to comply with conditions may lead to forfeiture. Any forfeiture or detrimental events in respect tenure may have an adverse effect on Alkane.

Competition

Alkane competes with other companies internationally. Some of these companies have greater financial and other resources than Alkane and, as a result, may be in a better position to compete for future business opportunities. There can be no assurance that Alkane will be able to compete effectively with these companies in the future.

Insurance availability

The Company maintains insurance coverage as determined appropriate by its board and management, but no assurance can be given that it will continue to be able to obtain such insurance coverage at reasonable rates (or at all), or that any coverage it obtains will be adequate and available to cover all relevant claims.

Claims, liability and litigation

Alkane may have disputes with counterparties in respect of major contracts, or may be exposed to customer or environmental, occupational health and safety or other claims. The Company may incur costs in defending or making payments to settle any such claims, which may not be adequately covered by insurance or at all. Such payments may have an adverse impact on either or both of the Company's profitability and financial position.

9. PRODUCTS & MARKETING

9.1 Overview

The Dubbo Project intends to supply significant quantities of zirconium and rare earth materials (the latter predominantly for use in permanent magnets), as well as contribute to the niobium and emerging hafnium industries. The global markets for most of these products are largely dominated by China's vast manufacturing industry and its integrated domestic supply chains. However, changes within China's manufacturing sector suggest the period of low prices and oversupply is now over for rare earths and zirconium materials in particular.

Announced in 2015, the *Made in China 2025* policy is expected to have long-term and far-reaching effects. The policy aims to move Chinese industry away from low-value, polluting industries to manufacturing for higher-value, downstream markets. The Chinese Government has already embarked upon a 'war on pollution', leading to stricter enforcement of environmental laws across the sector.

The impacts of this policy, implemented in the form of new environmental regulations, inspections and audits, are already being seen – particularly in the rising prices of rare earth magnet and zirconium materials supply chains external to China. The zirconium materials market has also seen instances of inability of supply to non-Chinese customers.

As an operation that is both independent of China and traditional supply sources, the Dubbo Project represents an alternative strategic potential source of these materials that are in high demand for a range of existing and future technologies.

9.2 Markets and Price Considerations

9.2.1 Zirconium

The global zirconium market (not including the direct zircon market) is forecast by the Roskill Consulting Group[16] to reach 203ktpa 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.

Rapid price increases and supply disruptions for Chinese zirconium materials in the past year have highlighted supply risks and significantly increased demand for alternative supply sources. China currently dominates 75% of global zirconium supply, and 95% of zirconium chemicals, but depends exclusively on import zircon as the source of zirconium units.

[16] Ref - Roskill- ASM commissioned report

Zirconium oxychloride (ZOC) is the main precursor used for high-purity downstream zirconium products, and prices have increased by 80% in the past year. Fused zirconia is the other main zirconium product category, where Chinese prices have doubled in the past year. ZOC prices (36% ZrO_2) are now at US$2,750/t, FOB (free on board) China (US$7,600/t ZrO_2), while fused zirconia is US$5,400/t, FOB China. China's increased focus on environmental pollution and compliance is expected to lead to further supply disruption, while higher prices for raw materials and process chemicals are expected to add further pressure to costs.

Reduced zircon production from older mines due to declining ore grades is also pushing up production costs for producers, as more ore is mined to recover less zircon. Zircon prices increased by 40% in 2017 and have increased further in early 2018. Reduced availability of premium zircon is also affecting fused zirconia production, where low impurities are required for the fusion process. (Zircon with low levels of uranium and thorium is especially needed to produce fused zirconia with less than 500ppm combined uranium and thorium.)

The Dubbo Project will produce a mix of 'base' and 'premium' zirconium products, where the premium products include higher-value yttria-stabilised zirconia and low-hafnium zirconium products. The base zirconium products will include zirconium oxychloride (ZOC), zirconium basic carbonate (ZBC) and zirconium oxide, which are expected to dominate sales during the first few years of operations. It is assumed that base zirconium prices will average US$10.00/kg over the first 20 years of operations, with lower prices in the first few years and higher prices in later years.

Premium zirconium products, including higher-value zirconium chemicals and zirconium oxides, will also be continuously developed to complement the base zirconium products. This will increase average zirconium prices over time. Yttria-stabilised zirconia products will include powders for different applications and functional products such as milling media. It is assumed that yttria-stabilised zirconia products will be within the range of US$20-40/kg over the first 20 years of operations, with product sales commencing in year three after commissioning.

Low-hafnium zirconia is another premium zirconium product to complement the zirconium product range; it will be introduced at commissioning and progressively increased during production ramp-up. It is assumed that the average price for low-hafnium zirconia products will be within the range of US$18-25/kg over the first 20 years, with some of this material being blended with other zirconium products or converted to zirconium metal.

The Company and ASM has adopted an optimistic approach to determining projected penetration into the premium zirconium markets; however, pricing discounts have also been reflected in the Company's and ASM's models to achieve that level of penetration and sales. Potential market penetration for the premium products includes, but is not limited to, the following risks:

- Ramp-up slower than expected or not achieved in full;
- Higher discounting required;
- Retaliation from existing suppliers;
- Increased product returns and/or warranty issues if products not up to specs (e.g. performance);
- Inability to secure low-hafnium zirconium off-take; and

- Changes in market requirements or substitution for other materials.

This will result in increased sales of base zirconium products such as ZOC, and lower total revenue and return.

9.2.2 Rare Earths

China dominates the global rare earths market (US$3-5 billion), with its integrated downstream manufacturing industry from mining through to intermediate and finished products. IMCOA[17] estimates China's share of global supply was 85% in 2017, while its internal consumption was 70% of global supply, leaving just 15% of global supply available for export.

Rare earth permanent magnets (REPM) are the main driver for the global rare earths industry at present, accounting for 30% of the market by volume – but 80% by value. The magnet rare earths include neodymium, praseodymium, samarium, dysprosium and terbium. High growth rates for REPMs in electric motors – used in electric vehicles, robotics and other applications – is expected to lead to shortages by 2020, with limited new sources of supply available in China or elsewhere. (With the demand/supply balance driven by REPMs, this causes some (non-magnet) rare earth elements to be in oversupply.)

Other market factors include the *Made in China 2025* policy to maximise downstream processing into finished products. This is likely to reduce supplies of rare earth oxides, metals, and magnets available for export, with leading companies seeking independent REPM supply chains outside China. China's commitment to stamp out illegal rare earths production could also reduce supply and support prices, as it faces mounting costs to rehabilitate rare earths mines across China. IMCOA estimates US$20-30 billion is required for a national rehabilitation exercise, which it assumes will be passed on in time through higher prices.

Prices for praseodymium/neodymium (known as didymium or PrNd) metal have increased in early 2018, with the current price around US$65/kg, FOB China. This follows a significant increase in 2017, where PrNd metal prices touched US$100/kg, before falling back at the end of the year. It is assumed the prices of PrNd oxide will average US$90/kg over the first 20 years of Dubbo Project production. Similarly, it is assumed that average prices for dysprosium oxide will be US$325/kg and terbium oxide US$650/kg during the first 20 years of production.

It is assumed that PrNd, Dy, Tb and Y oxide will be separated on site at the Dubbo Project. Other unseparated rare earths contained in the concentrates will be sold on the market and are forecast to result in an average of US$9 million per year in revenue over the first 20 years of production. ASM will continue to investigate options around separation of these additional rare earths on site, or third-party toll-processing alternatives.

The Dubbo Project's estimated full-capacity output of 1.3ktpa of magnet rare earth oxides represents approximately 3% of 2016 demand.

[17] IMCOA – Curtin-IMCOA 8 Year Demand & Supply Summary

Roskill Consulting Group[18], Adamas Intelligence[19], Argus Metals[20] and IMCOA have each provided in-depth market and price analyses for rare earths – these include medium- and long-term price forecasts. Price forecasts used in this document are based on forecasts from these independent companies, plus internal ASM forecasts. In the case of the magnet rare earths, it is assumed 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 around 89% of total rare earths revenue and is the primary focus of the rare earths marketing effort.

9.2.3 Niobium

The global steel industry is the main driver for niobium consumption, where 90% of all niobium is used as ferro-niobium for high strength low alloy (HSLA) steels for the construction and automotive sectors. Minor additions of niobium to steel can greatly increase strength, leading to weight and cost savings.

The total niobium market was approximately 60kt in 2016, dominated by Brazil's Companhia Brasileira de Metalurgia e Mineração (CBMM), with approximately 80% of ferro-niobium supply. This dominance has also historically provided market stability, as CBMM has adjusted supply against demand.

Niobium prices have remained stable during the past year, with spot prices for 66% ferro-niobium at around US$36/kg in warehouse Rotterdam.

At full capacity, the Dubbo Project will produce 1,967tpa of niobium via a joint venture with Treibacher Industrie AG (TIAG). This volume represents only 3% of global production.

The TIAG joint venture will produce ferro-niobium as its primary niobium product at a purpose-built ferro-niobium facility on site at the Dubbo Project. It is assumed the average ferro-niobium (FeNb) price will be within the range of US$35.00-45.00/kg during the first 20 years of production, with an average of US$33.35/kg assumed for the contained niobium metal over the first 20 years of production.

9.2.4 Hafnium

The nuclear industry has been the main source of hafnium for the past 70 years, owing to the need to remove hafnium from zirconium used in fuel assemblies for nuclear reactors. Zirconium permits clear passage for neutrons to maintain efficient reaction in a nuclear reactor, but hafnium interferes with this by absorbing the neutrons (and hafnium is therefore often used as part of the control rods in a nuclear reactor). With a current total market value of about US$70 million, the hafnium market is one of the smallest markets for minor metals, yet it offers some of the best prospects for future growth.

---

[18] Roskill Ref- ASM commissioned report

[19] Adamas 'Rare Earths Market Outlook to 2025'

[20] Argus Rare Earths Annual

Roskill[21] estimates hafnium metal demand was 67t (79t HfO_2) in 2016, and forecasts a base case demand of 112t (132t HfO_2) by 2026 and 160t by 2036 (189t HfO_2). The Dubbo Project is one of the few sources of hafnium that could meet this anticipated demand and is also independent of the nuclear industry.

Currently the greatest demand by volume is for hafnium metal, and ASM is actively investigating partnerships or joint-venture opportunities to convert hafnium oxide to hafnium metal. In recent years, global research and development has focused on the ferroelectric and thermoelectric properties of hafnium oxide; commercial applications of these would see escalating demand for hafnium oxide.

With its small size and supply concentrated in the hands of few companies, the hafnium market is opaque with limited reference information available. Current prices for hafnium crystal bar are approximately US$900-1,200/kg, depending on zirconium content. The Dubbo Project will produce hafnium according to identified demand, yet it has the capability to supply in excess of 100 tonnes per annum. This should provide end-users with confidence for stable and increased supply.

The primary hafnium products recovered from the Dubbo Project zirconium stream will be hafnium oxychloride (HOC) and hafnium oxide (HfO_2). However, it is anticipated that hafnium metal will be produced as the primary marketable product through strategic relationships or joint ventures. An average hafnium metal price of US$600/kg is assumed for the first 20 years of production, with a forecast range of US$500-700/kg.

Forecast penetration into the hafnium market is aggressive and pricing reflects discounts to achieve sales. Potential market penetration for hafnium products includes, but is not limited to, the following risks:

1) Inability to secure relationship with metal technology provider
2) Economic research and development not progressing
3) Ramp-up slower than expected or not achieved in full
4) Higher discounting required; and
5) Retaliation from existing suppliers.

[21] Roskill Ref- ASM commissioned report

9.3 ASM product range

ASM will produce a suite of zirconium, hafnium, rare earth and niobium materials in the form of chemicals, powders and metals. These products will be available in a range of standard and customised specifications, based on market requirements.

9.3.1 Zirconium products

ASM's zirconium range will include high-purity zirconium chemicals and a range of zirconium oxide (zirconia) powders.

High-purity zirconium chemicals (≥ 99.5% ZrO_2):

- ***Zirconium oxychloride (ZOC)*** – ZOC is the key chemical precursor used to produce most downstream zirconium chemicals and chemical zirconia.
- ***Zirconium basic carbonate (ZBC)*** – ZBC is one of the most important zirconium chemicals derived from ZOC. It is used in many applications in its own right or is converted directly to zirconia or stabilised zirconia for a range of uses.

Zirconium oxide/zirconia (≥ 99.5% ZrO_2):

- ***High-purity monoclinic (unstabilised) zirconia powders*** in a range of surface areas and particle sizes

Premium zirconium products

- ***Low-hafnium zirconium oxide (<100 ppm HfO_2)*** – A special high-purity grade of zirconium oxide has been developed for producing zirconium metal required in the nuclear industry. This premium zirconia product attracts a significant price premium over other grades containing hafnium.
- ***Yttria-stabilised zirconia powders and products*** – Yttrium and zirconium can be combined to produce premium yttria-stabilised zirconia powders and products for a range of applications and markets. This includes zirconia milling media, which is used across a wide range of applications to reduce and control particle sizes.
- ***Zirconium metal*** – Conversion of zirconium oxide to zirconium metal is a small but high-value application for zirconium oxide, with growing demand for industrial applications and the nuclear industry (hafnium-free). ASM is investigating options to produce zirconium metal through strategic partnerships or joint ventures, which could add further value and revenues. No revenue from zirconium metal is assumed.

9.3.2 Hafnium products

ASM will supply high-purity hafnium chemicals and oxides (>99.8% HfO_2), containing low levels of zirconium (up to 99.9% $Zr+HfO_2$). The Dubbo Project will become a major new source of this critical element, which can be converted to metal or used in chemical or oxide form.

Hafnium chemicals (>99.8% HfO_2):

- ***Hafnium oxychloride (HOC)*** – High-purity hafnium oxychloride can be used as a source of hafnium to produce other hafnium chemicals or complexes, or converted to high-purity hafnium oxide.

Hafnium oxide (HfO_2) (>99.8% HfO_2):

- ***High-purity hafnium oxide*** has an increasing range of applications due to its specific ferroelectric and thermoelectric properties. However, it is primarily used as the precursor for hafnium metal, which it is mostly consumed by superalloys. The zirconium content in hafnium oxide can be changed according to the application requirements.

Hafnium metal (Hf):

- Globally, most hafnium is consumed in metal form, so ASM is investigating options to produce hafnium metal through strategic partnerships or joint ventures to maximise value capture. It is assumed that most hafnium revenue will come from hafnium metal.

9.3.3 Ferro-niobium products

ASM will produce ferro-niobium (FeNb) in the form of crushed ingots with a composition of ~65% Nb via a joint venture with Treibacher Industrie AG. The main market for ferro-niobium is the steel industry, where it is used in high strength low alloys (HSLA) steels for the construction and automotive sectors.

9.3.4 Rare earth products

ASM will produce a suite of separated rare earth oxides for up to 15 rare earth elements. The primary focus will be the elements used in rare earth permanent magnets, which will account for over 80% of rare earths income.

The main magnet rare earths are praseodymium and neodymium. These will be recovered at the Dubbo Project as praseodymium/neodymium (PrNd or didymium) oxide; the PrNd oxide will be unseparated at project start-up, but may be separated into praseodymium oxide and neodymium oxide at a later time according to market requirements.

The other rare earths produced by the Dubbo Project, dysprosium oxide and terbium oxide, will be separated at site, as will yttrium oxide. Other rare earths will initially be sold as unseparated concentrates.

Magnet rare earths:

- Praseodymium/Neodymium (PrNd) oxide
- Dysprosium (Dy) oxide
- Terbium (Tb) oxide

Other rare earths:

- Samarium (Sm) oxide
- Europium (Eu) oxide
- Gadolinium (Gd) oxide
- Lutetium (Lu) oxide
- Yttrium (Y) oxide
- Unseparated lanthanum and cerium concentrates

Rare earths and zirconium:

- A number of value-added products combining zirconium and rare earth oxides are under active development or consideration by ASM.

9.4 Marketing Strategy

The Dubbo Project is expected to produce a suite of high-value downstream products used in a range of advanced technologies by leading companies worldwide. The path to development positions the Dubbo Project to be an important global source of critical zirconium, rare earth and hafnium materials.

ASM's marketing strategy is based on securing long-term customer relationships, founded on a reliable and secure production base in Australia. The Dubbo Project will also provide a strategic alternative to existing supply chains, enabling companies to significantly reduce existing supply chain risks. 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 zirconium, hafnium and rare earths.

The initial product range will be complemented by the progressive development of further high-value products in response to customer and market demands. This includes the production 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-life products to develop new income streams.

9.4.1 Zirconium products marketing

ASM has an exclusive worldwide marketing, sales and distribution agreement with Minchem Limited (Minchem) for all zirconium materials produced by the Dubbo Project. Minchem is a technical ceramics marketing and manufacturing business that has been involved in zirconium chemicals and zirconium oxide products for over 40 years. Minchem is based in England and has a global reach in the zirconium industry. ASM currently has Letters of Intent (LoI) from seven companies for supply of zirconium chemicals covering 30% of the base case output, which also equates to 60% of the stage 1 output if a staged build occurs.

9.4.2 Rare earths products marketing

ASM will market rare earths products directly to end-users, particularly for the manufacture of rare earth magnets, or via existing marketing relationships according to market requirements. ASM has a current Memorandum of Understanding (MoU) with the large international industrial group Siemens Ltd for supply of a number of rare earth products. There are numerous discussions with customers in Europe, US, Japan, Korea and China for supply of rare earth products.

9.4.3 Niobium products marketing

ASM has a joint venture with Treibacher Industrie AG (TIAG) for the production and marketing of ferro-niobium using niobium concentrate from the Dubbo Project. TIAG is a privately owned international metal alloy and chemical products company based in Althofen, Austria. The joint venture will produce ferro-niobium using TIAG's proprietary technology at the Dubbo Project site in Australia to produce over 3,000 tonnes of FeNb. This will utilise all of the niobium concentrate produced by the Dubbo Project.

9.4.4 Hafnium products marketing

ASM will market hafnium products directly to end-users, and is investigating options to produce hafnium metal through strategic partnerships or joint ventures to maximise value capture. Most hafnium demand is for hafnium metal, so ASM is seeking involvement in metal manufacture and marketing as a long-term goal.

10. COMMUNITY AND EMPLOYMENT

10.1 Community Engagement

The Dubbo Project is a major new project to be developed in the rural Central Western region of New South Wales (near Dubbo). Since developing the Peak Hill Gold Mine project in 1993 and the Tomingley Gold Mine in 2013 (currently in operation) in the same region, ASM's parent company Alkane has successfully engaged with local communities. Through these projects, Alkane has established a positive regional presence and built long-standing local relationships, successfully accommodating local community requirements to operate with positive community impact.

Building upon this long-standing regional presence, ASM has consulted and communicated proactively with the community during development of the Dubbo Project. All impact studies conducted by ASM and adopted in the Environmental Impact Statement 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 establishment of the Dubbo Project Community Consultative Committee, and maintains a strong local presence to keep the community informed of project status and changing community impacts.

10.2 Employment

Historically, Alkane has successfully developed its regional projects sourcing locally based workers and contractors. It is therefore expected that a substantial proportion of the Dubbo Project construction and operations workforce will be filled by local people and those choosing to relocate to Dubbo permanently. It is expected Dubbo Project construction will attract a workforce of up to 450 persons over the two-year construction schedule.

Following construction, the facility will be operated by a team of approximately 250 people, comprising chemical engineers, metallurgists, mechanical and electrical engineers supervising tradespeople and other operators. 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.

The large task of supplying reagents to site will require dozens of transport workers, creating spin-off employment opportunities for service companies and tradespeople.

10.3 Toongi Pastoral Company

ASM has established the Toongi Pastoral Company to manage the residual farmland and biodiversity offset areas associated with the Dubbo Project. This is overseen by a professional farm manager employed to execute the business plan. Nine farmhouses are located within the project footprint; these are tenanted to maintain the fabric of the Toongi community, which has a focal point at the Toongi Hall and Recreation Reserve immediately neighbouring the project.

11. TECHNICAL GLOSSARY

ANSTO = Australian Nuclear Science and Technology Organisation

BOOT – Build Own Operate Transfer

Capex = Capital expenditure

ECI = Early Contractor Involvement

EPC = Project delivery method whereby a contractor carries out engineering, procurement and construction for a price

EPCM = Project delivery method where consultant (engineer) carries out engineering, procurement and construction management for a fee

FEED = Front End Engineering Design

IRR = Internal rate of return

tpa = Tonnes per annum; generally referring to the quantity of mined ore feed for the plant per year

REPM = Rare earth permanent magnet

ROM = Run of Mine; raw ore as extracted from the mine and delivered to the processing plant

Opex = Operational Expenditure