SCANDIUM INTERNATIONAL MINING CORP.

Lycopodium
Brisbane, QLD, Australia

FEASIBILITY STUDY - NYNGAN SCANDIUM PROJECT
Bogan Shire, NSW, Australia

NI 43-101 Technical Report

Prepared For:
Scandium International Mining Corp.

Prepared By:
Maxel Rangott, B.Sc, FAusIMM
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Dr. Nigel Ricketts, B.Eng (Chem), PhD (Metallurgy), MAusIMM, CP (Metallurgy)
Dr. Geoffrey Duckworth, B.Eng (Chem), M.Eng.Sc, PhD, FIChemE, MIEAust, FAusIMM, RPEQ 2702
Timothy David Rowles, B.Sc., M.Sc. MAusIMM CP (Enviro), RPEQ 10166

Effective Date: April 15, 2016
Report Date: May 4, 2016
Revision: 0

Effective Date and Certificates

The Effective Date of this technical report is 15 April 2016.

The Report Date of publication of this technical report is 4 May, 2016.

Following are signed and dated Certificates of Qualifications of the persons responsible for the report.

Certificate of Qualified Person – Maxel Rangott, Fellow, AusIMM

I, Maxel Franz Rangott, B Sc, 3 Barrett Street, Orange, NSW, Australia, do hereby certify that:

- I am employed as Director of Rangott Mineral Exploration Pty. Ltd., of Orange, NSW, Australia, specializing in geological consulting and exploration contracting for a wide variety of clients, and have been so employed since 1987.

- This certificate applies to the Technical Report, titled "Feasibility Study - Nyngan Scandium Project" with an effective date of 15 April, 2016.

- I graduated with a Bachelor of Science degree from the University of Sydney, NSW, Australia. I am a current Member & Fellow of the Australasian Institute of Mining and Metallurgy, a Member of the Mineral Industry Consultants Association, and a Member of the Australian Institute of Geoscientists. I have read the current definition of a "Qualified Person" ("QP") as set out in NI 43-101, and state that by virtue of my education, membership in professional associations, and past relevant work experience, I fulfil the requirements to be a QP for the purposes of NI 43-101.

- I have personally visited the Nyngan project site on numerous occasions over the last 10 years, but have not done so in conjunction with the issuance of this Report, within the last 6 months.

- I am responsible for Sections 4 to 9, and 23. I contributed in the areas covered by these Sections in the Summary, Section 1, and Sections 11, 12 and 14 as well.

- I am independent of the issuer, as defined by the test in section 1.5 of NI 43-101.

- I have had prior involvement with the property that is the subject of this Technical Report, in that I was the QP on the March 2010 property resource report titled, "NI 43-101 Technical Report on the Nyngan Gilgai Scandium Project, Jervois Mining Limited, Nyngan, New South Wales, Australia". I was also QP on the Preliminary Economic Assessment Report, titled "Amended Technical Report and Preliminary Economic Assessment on the Nyngan Scandium Project, NSW, Australia" with an effective date of October 10, 2014.

- I have read NI 43-101 and Form 43-101F1 and all of the Sections of the Technical Report for which I am responsible, and those sections have been prepared in compliance therewith.

- As of the date of this certificate, to the best of my knowledge, information and belief, the sections referenced above contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated: 4 May, 2016.

Signed: Maxel Rangott.

Maxel Rangott, FAusIMM

Certificate of Qualified Person – Stuart Hutchin, B.Sc (Geology), MAusIMM, MAIG CP (Geo)

I, Stuart Hutchin, B.Sc (Geology), MAusIMM, MAIG CP (Geo), Level 9, 50 Market Street, Melbourne, Victoria, Australia, do hereby certify that:

- I am employed as Geology Manager for Mining One consultants of, Melbourne, Victoria, Australia, specialising in mining engineering consulting, contracting for a wide variety of clients, and have been so employed since 2011.

- This certificate applies to the Technical Report, titled "Feasibility Study - Nyngan Scandium Project" with an effective date of 15 April, 2016.

- I graduated with a Bachelor of Science degree Applied Geology from the University of South Australia, Australia. I am a current member of the Australasian Institute of Mining and Metallurgy (MAusIMM) and the Australian Institute of Geoscientists (MAIG). I have read the current definition of a "Qualified Person" (QP) as set out in NI 43-101, and state by virtue of my education, membership in professional associations, and past relevant work experience, which spans over 17 years in the field of exploration, 3D modelling, resource estimation and mine geology in both open pit and underground projects, I fulfil the requirements to be a QP for the purposes of NI 43-101.

- I have conducted a site visit to the Nyngan site on October 15, 2015, in conjunction with issuance of this report.

- I am responsible for Sections 10 to 12 and 14 of this Report. I contributed in the areas covered by these Sections in the Summary, Section 1, as well.

- I am an independent of the issuer, as defined by the test in section 1.5 of the NI43-101.

- I have read the NI43-101 and Form 43-101F1 and all of the sections of the Technical report for which I am responsible, and those sections have been prepared in compliance therewith.

- As of the date of this certificate, to the best of my knowledge, information and belief, the sections referenced above contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated: 4 May, 2016

Signed:

Stuart Hutchin, B.Sc (Geology), MAusIMM, MAIG CP (Geo)

Certificate of Qualified Person – Dean Basile, B Eng. (Mining), GDipAppF&I, MAusIMM CP (Min)

I, Dean Basile, B.Eng.(Mining), GDipAppF&I, MAusIMM CP(Min), Level 9, 50 Market Street, Melbourne, Victoria, Australia, do hereby certify that:

- I am employed as a Principal Mining Engineer for Mining One consultants of, Melbourne, Victoria, Australia, specialising in mining engineering consulting, contracting for a wide variety of clients, and have been so employed since 2008.

- This certificate applies to the Technical Report, titled "Feasibility Study - Nyngan Scandium Project" with an effective date of 15 April, 2016.

- I graduated with a Bachelor of Engineering in Mining from Ballarat University, Australia. I am a current member of the Australasian Institute of Mining and Metallurgy (MAusIMM CP Min). I have read the current definition of a "Qualified Person" (QP) as set out in NI 43-101, and state by virtue of my education, membership in professional associations, and past relevant work experience, which spans over 20 years in the field of mine design, planning, reserves, technical and operational management with multiple companies and projects, I fulfil the requirements to be a QP for the purposes of NI 43-101.

- Stuart Hutchin attended site on October 15, 2015 as a representative of Mining One confirming that it is a "greenfield site", the existing landscape and relevant infrastructure was representative of the electronic topographic data provided and sited representative drill core.

- I am responsible for Sections 15 and 16 of this Report. I reviewed and contributed in the areas covered by these Sections in the Summary, Section 1, as well.

- I am an independent of the issuer, as defined by the test in section 1.5 of the NI43-101.

- I have had prior involvement with the property that is the subject of this Technical Report, in that I was QP on the Preliminary Economic Assessment Report, titled "Amended Technical Report and Preliminary Economic Assessment on the Nyngan Scandium Project, NSW, Australia" with an effective date of October 10, 2014.

- I have read the NI43-101 and Form 43-101F1 and all of the sections of the Technical report for which I am responsible, and those sections have been prepared in compliance therewith.

- As of the date of this certificate, to the best of my knowledge, information and belief, the sections referenced above contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated: 4 May, 2016.

Signed:

Dean Basile, B.Eng.(Mining), GDipAppF&I, MAusIMM CP(Min)

Certificate of Qualified Person – Nigel Jeffrie Ricketts, MAusIMM CP (Metallurgy)

I, Nigel Jeffrie Ricketts, of 453 George Holt Drive, Mt Crosby, QLD, Australia do hereby certify that:

- I am a metallurgist recognised as a Chartered Professional by the Australasian Institute of Mining and Metallurgy (AusIMM), employed as Technical Director of Altrius Engineering Services and have been so employed since August 2014. I have recent and relevant experience with metallurgical test work, process development and engineering design of process plants designed to process nickel and scandium-bearing laterites during previous employment as Consulting Manager with AMEC Minproc Pty Ltd.
- This certificate applies to the Technical Report, titled "Feasibility Study - Nyngan Scandium Project" with an effective date of 15 April, 2016.
- I undertook undergraduate studies in Metallurgy from the South Australian Institute of Technology, graduating in 1985. I also was awarded a PhD from the Department of Chemical Engineering of Monash University in Melbourne, Australia in 1992. I am a current member of the Australasian Institute of Mining and Metallurgy (Member Number 106413) and have been awarded the status of Chartered Professional (CP) in the field of Metallurgy from the AusIMM. I have read the current definition of a "Qualified Person" as set out in NI 43-101 and state that by virtue of my education, membership in professional associations and past relevant work experience, I fulfill the requirements to be a "Qualified Person" for the purposes of NI 43-101.
- I have conducted a site visit to the Nyngan site on December 7, 2015, in conjunction with issuance of this report.
- I am responsible for Section 13. I contributed in the areas covered by this section in the Summary, Section 1 as well.
- I am independent of the issuer, as defined by the test in section 1.5 of NI 43-101.
- I have had prior involvement with the property that is the subject of this Technical Report, in that I was QP on the Preliminary Economic Assessment Report, titled "Amended Technical Report and Preliminary Economic Assessment on the Nyngan Scandium Project, NSW, Australia" with an effective date of October 10, 2014.
- I have read NI 43-101 and Form NI 43-101F1 and all sections of the Technical Report for which I am responsible and those sections have been prepared in compliance therewith
- As of the date of this certificate, to the best of my knowledge, information and belief, the sections referenced above contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated: 4 May, 2016.

Signed:

AusIMM
THE MINERALS INSTITUTE
CHARTERED PROFESSIONAL
METALLURGY
Nigel Ricketts

Dr Nigel Ricketts, MAusIMM CP (Metallurgy)

Certificate of Qualified Person – Dr Geoffrey Duckworth, B.Eng (Chem), M.Eng.Sc, PhD, FIChemE, MIEAust, FAusIMM, RPEQ 2702

I, Dr Geoffrey Duckworth, B.Eng (Chem), M.Eng.Sc, PhD, FIChemE, MIEAust, FAusIMM, RPEQ 2702, 163 Leichhardt Street, Spring Hill, Queensland, Australia, do hereby certify that:

- I am employed as a Senior Consultant - Process for Lycopodium Minerals Pty Ltd of Brisbane, Queensland, Australia, specialising in minerals processing engineering consulting, contracting for a wide variety of clients, and have been so employed since 2008.

- This certificate applies to the Technical Report, titled "Feasibility Study - Nyngan Scandium Project" with an effective date of 15 April, 2016.

- I graduated with a Bachelor of Chemical Engineering from RMIT and a Masters Degree and PhD in Mining and Metallurgy from the University of Queensland, Australia. I am a current fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM). I have read the current definition of a "Qualified Person" (QP) as set out in NI 43-101, and state by virtue of my education, membership in professional associations, and past relevant work experience, which spans over 40 years in the field of process design, project development, commissioning and technical management with multiple companies and projects, I fulfil the requirements to be a QP for the purposes of NI 43-101.

- I have conducted a site visit to the Nyngan site on December 7, 2015, in conjunction with issuance of this report.

- I am responsible for Sections 2, 3, 17 to 22 and 24 to 27 of this Report. I contributed in the areas covered by these Sections in the Summary, Section 1, as well.

- I am an independent of the issuer, as defined by the test in section 1.5 of the NI43-101.

- I have had no prior involvement with the property that is the subject of this Technical Report.

- I have read the NI43-101 and Form 43-101F1 and all of the sections of the Technical report for which I am responsible, and those sections have been prepared in compliance therewith.

- As of the date of this certificate, to the best of my knowledge, information and belief, the sections referenced above contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated: 4 May, 2016.

Signed:

Dr Geoffrey Duckworth, B.Eng (Chem), M.Eng.Sc, PhD, FIChemE, MIEAust, FAusIMM, RPEQ 2702

Certificate of Qualified Person – Timothy David Rowles, B.Sc., M.Sc. MAusIMM CP (Enviro), RPEQ 10166

I, Timothy David Rowles, B.Sc., M.Sc. MAusIMM CP (Enviro), RPEQ 10166, Level 1, 36 Cordelia Street, South Brisbane, Queensland, Australia, do hereby certify that:

- I am employed as a Regional Manager (Queensland) for Knight Piésold Pty Ltd of South Brisbane, Queensland, Australia, specialising in tailings and mine waste management consulting, contracting for a wide variety of clients, and have been employed by Knight Piésold since 1999.

- This certificate applies to the Technical Report, titled "Feasibility Study - Nyngan Scandium Project" with an effective date of 15 April, 2016.

- I graduated from the Royal School of Mine at Imperial College, London with a Bachelor of Science in Environmental Geology in 2006. I graduated from the University of Manchester with a Masters Degree in Earth and Environmental Science in 2008. I am a registered professional engineer Queensland (Environmental) RPEQ No. 10166. I am a current member of the Australasian Institute of Mining and Metallurgy (Member Number 227249) and have been awarded the status of Chartered Professional (CP) in the field of Environmental from the AusIMM. I have read the current definition of a "Qualified Person" (QP) as set out in NI 43-101, and state by virtue of my education, membership in professional associations, and past relevant work experience, which spans over 17 years in the field of tailings and waste management design, planning, technical and operational management with multiple companies and projects, I fulfil the requirements to be a QP for the purposes of NI 43-101.

- I have conducted a site visit to the Nyngan site on December 1, 2015, in conjunction with issuance of this report.

- I am responsible for Sections 18.1 and 18.6 to 18.8 of this Report. I contributed in the areas covered by these Sections in the Summary, Section 1, as well.

- I am an independent of the issuer, as defined by the test in section 1.5 of the NI43-101.

- I have had no prior involvement with the property that is the subject of this Technical Report.

- I have read the NI43-101 and Form 43-101F1 and all of the sections of the Technical report for which I am responsible, and those sections have been prepared in compliance therewith.

- As of the date of this certificate, to the best of my knowledge, information and belief, the sections referenced above contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated: 4 May, 2016

Signed:

Mr Timothy David Rowles, B Sc. M.Sc. MAusIMM CP (Enviro), RPEQ 10166

NYNGAN SCANDIUM PROJECT

DEFINITIVE FEASIBILITY STUDY

NATIONAL INSTRUMENT 43-101 TECHNICAL REPORT

3185-000-GEREP-0001

Table of Contents

Table of Contents

Table of Contents

Table of Contents

Table of Contents

Table of Contents

NYNGAN SCANDIUM PROJECT

DEFINITIVE FEASIBILITY STUDY

NATIONAL INSTRUMENT 43-101 TECHNICAL REPORT

3185-000-GEREP-0001

Table of Contents

TABLES

Table of Contents

Table of Contents

Table of Contents

1.0 SUMMARY

1.1 Introduction and Statement of Objectives of the Technical Report

This report, entitled “Feasibility Study - Nyngan Scandium Project” (the “Technical Report”, or the Report), has been prepared for Scandium International Mining Corp. (SCY, or the Company), a Canadian TSX-listed mining company (TSX:SCY.To), headquartered in Sparks, Nevada, USA. SCY owns 80% of EMC Metals Australia Pty Ltd (EMC-A). EMC-A is an Australian company, headquartered in Queensland and is 100% owner of the Nyngan Scandium Project (the Project), located in NSW, Australia.

The Company formally changed its name from EMC Metals Corp. (EMC) to Scandium International Mining Corp. in November 2014, to better reflect the purpose and strategic direction of the Company. Activity and reporting on this project prior to that name change, done in the name of EMC, as may be identified in this Technical Report, is synonymous with SCY.

The Company requested Lycopodium Minerals Pty Ltd (Lycopodium) of Brisbane, Australia to complete this Technical Report to report on the results of a feasibility study on the Project (the Feasibility Study or the DFS). This Technical Report has been independently compiled for SCY in the form prescribed under National Instrument 43-101 – *Standards of Disclosure for Mineral Projects* (“NI 43-101”) by Lycopodium.

This Technical Report presents an update to the measured and indicated resource (M&I Resource) previously reported in the Amended Technical Report and Preliminary Economic Assessment of the Nyngan Scandium Project, NSW, Australia (the PEA), originally announced in October 2014. The Technical Report further establishes the initial Mineral Reserve on a portion of the M&I Resource associated with the Nyngan property and presents new engineering and economic disclosures on the proposed development of the Nyngan Scandium Project.

The Technical Report on the overall economics of the Nyngan Scandium Project has been designed to a Class 2 Definitive Feasibility Study level, with an overall standard of accuracy of +15%/-5%.

This Feasibility Study is the first study commissioned by SCY to employ a continuous high pressure acid leach system (HPAL) to the front end of the Project processing flowsheet. The Company has previously explored atmospheric leaching, high temperature atmospheric leaching (Acid Bake), and finally, batch HPAL as employed in the PEA. Continuous pressure leaching systems, employing constant feed into an autoclave, are the systems typically used in large lateritic resource processing plants, most analogous to nickel processing, often with co-product cobalt circuits. This process tends to be the most efficient in minimising acid consumption, achieving the best overall product recovery, and ultimately with the lowest production cost. It has been applied in numerous lateritic resource metal recovery plants over +20 years, with commercial success. That said, this Project is sized very much at the small end of the spectrum to employ a continuous HPAL process. The Technical Report results support the choice, particularly with review of the results of earlier processing techniques on this Resource, and at this scale.

This Technical Report incorporates information from other reports previously completed for SCY, in particular:

- NI 43-101 Amended Technical Report and Preliminary Economic Assessment on the Nyngan Scandium Project, NSW, Australia, prepared for EMC by Larpro, of Toowong, Qld, Australia, Effective Date- October 10, 2014.

- Nyngan Scandium Project Study, prepared for EMC management by SNC-Lavalin of Brisbane, Australia, February 2012.

- Scandium Recovery From Gilgai Laterite Ores by Acid Curing, Baking, Leaching, Solvent Extraction, and Precipitation, prepared for EMC management by Roberts & Schaefer Company, of Sandy, Utah, July 2010.

In addition to these reports on the project, SCY has commissioned a number of metallurgical test work programs with various independent groups, over the previous six years dating back to 2010, the results of which were all considered in this Technical Report.

This Technical Report has been developed in accordance with the Canadian Institute of Mining (CIM) guidelines for such Technical Reports to accomplish the following objectives:

- Define the economic viability of the Nyngan Scandium Project, and present a single investment option for consideration.

- Obtain a reasonable certainty of process, production, revenue, scope, time and cost.

- Develop a document that will support further development decisions by the Project sponsors, and support further funding for those advanced studies

- Establish a baseline for both Project execution and operations

1.2 DFS Financial Highlights

A summary of the key financial results from the DFS is presented in Table 1.1.

NOTE: All dollar figures are expressed in United States Dollars (US$) unless otherwise noted and all tonnes references are intended to be metric tonnes, throughout the report.

Table 1.1 Key Financial Parameters

Summary Nyngan Scandium Project Key Project Parameters	NI 43-101 DFS Result
Capital Cost Estimate (US$ M)	$87.1
Average Plant Feed Grade (ppm Sc)	409
Resource Processed (tpy)	71,820
Mill Recovery (%)	83.7%
Oxide Production (kg per year)	37,690
Scandium Oxide (Scandia) Product Grade	98-99.9%
Annual Cash Operating Cost (US$ M)	$21.0
Unit Cash Cost (US$/kg Oxide)	$557
Oxide Price Assumption (US$/kg)	$2,000
Annual Revenue (US$ millions)	$75.4
Annual EBITDA (US$ millions)	$49.5
NPV (10%i) (After Tax)	$177.5
NPV (8%i) (After Tax)	$225.4
IRR (%) (After Tax)	33.1%
Payback (years)	3.3

1.3 Property Description and Location

The Nyngan project site is located approximately 450 km northwest of Sydney (flight distance), NSW, Australia and approximately 25 km (road distance) due west from the town of Nyngan, a rural town of approximately 2,100 people. The project site is accessed from the Barrier Highway, a paved two lane all-weather road connecting the town of Nyngan with Cobar. The project site is located 5 km south of Miandetta, off the Barrier Highway and is situated in flat countryside classified as agricultural land. Local area land use is predominantly wheat farming and livestock grazing.

Mining has historically been and continues to be a feature of the local economy. The closest current mining operation to the town of Nyngan is the Tritton copper mine, located approximately 45 km to the northwest. The Tritton resource has been in near-continuous operation for over 23 years, initially developed in 1992 as the Girilambone copper mine and processing plant, which closed in 2001. Straits Resources Limited (ASX:SRQ) reopened the mine as the Tritton Copper mine in 2004. The mine is currently operating, and Straits Resources has taken new partners and renamed itself Aeris Resources Ltd. (ASX:AIS). Aeris Resources recently announced a positive feasibility study and initiation of a 3+ year extension on operations referred to as the Murrawombie U/G Copper Mine Project, augmenting production in Q4 FY16. The town of Cobar, 120 km west of the

Nyngan property, has been host to copper mining since 1870, where the CSA Mine is currently in operation producing copper and silver, owned and operated by Glencore.

The most significant mining project under development (A$1bn capex) in the area is the Dubbo Zirconium Project, owned by Alkane Resources Limited (ASX:ALK), approximately 165 km southeast of the town of Nyngan, which will produce zirconia and a range of rare earth products.

1.4 Project Geology and Resources

The general area is dominated by Cainozoic alluvium of the Bogan River floodplain (part of the Murray-Darling River Basin) with minor colluvium and outcrop. The Gilgai intrusive complex underlies the Nyngan property, covered by 8 to 40 m of alluvial material, and is almost certainly the source of the scandium, nickel, cobalt and precious metals in the regolith. The Gilgai complex is an Alaskan type ultramafic complex, crudely concentrically zoned, and made up of a range of rock types including hornblende monzonite, hornblendite, pyroxenite, olivine pyroxenite to dunite / peridotite and is believed to be of Ordovician age. The intrusives are included within the “Fifield Platinum Province”.

The Nyngan scandium resource is located in a highly weathered (ultramafic) zone, where the weathering profile can extend to a depth of more than 60 m. This highly weathered zone exhibits a fairly typical laterite profile, with hematitic clay just under the alluvium, followed by limonitic and saprolitic clays, weathered bedrock and fresh bedrock. The bulk of the scandium resource resides in the limonite and saprolite material.

The original resource was established on the Nyngan property in 2010. That original resource was based on 2005 and 2006 drill programs conducted and supervised by Jervois Mining Ltd., consisting of 72 aircore holes in to the laterite body supplemented by assays of sample pulps from seven historic holes, to delineate a scandium resource.

In 2014 and 2015, EMC Metals (Australia) Pty. Ltd. drilled an additional 33 aircore holes and three diamond core holes to validate the resource and provide superior sample material for further assessment. The Company also drilled six geotechnical core holes in the general resource area, four of which passed through the laterite profile and provided assays and data for specific gravity (SG) calculations.

The total drill program history has generated a new property resource, now incorporating all recent drill and assay data. The full data base has been digitised and used Whittle 4-X resource calculation software to arrive at a new resource estimate, as shown in Table 1.2.

Table 1.2 2016 Updated Nyngan Project Mineral Resource Estimate

Nyngan Project Resource Summary (100ppm Sc cut-off)	Revised Resource (1)(2) (effective date: April 15, 2016)		Previous Resource(1) (effective date: Feb. 9, 2010)	
	Resource (tonnes)	Grade (ppm Sc)	Resource (tonnes)	Grade (ppm Sc)
Measured Resource	5,690,000	256	2,718,000	274
Indicated Resource	11,230,000	225	9,294,000	258
Total Resource	16,920,000	235	12,012,000	261
NOTE: (1) Mineral Resources that are not Mineral Reserves do not have demonstrated viability (2) Mineral Resources are inclusive of Mineral Reserves				

The 20-year Project plan will utilise approximately 1.45 million tonnes of limonite resource from the total measured and indicated categories, albeit at a grade higher than the average resource grade shown in Table 1.2 for the combined limonite and saprolite resource.

1.5 Mineral Reserve Estimates

The DFS confirms positive economics on a portion of the mineral resource to a sufficient level of accuracy to establish a mineral reserve on the portion of the resource mined and processed in the 20 year DFS. The reserve was prepared by evaluating the resource using Whittle-4X optimisation software. Economic and physical inputs were validated to identify the optimised pit shells in two mining pits, both a part of the 20 year mine plan. The mineral reserve is shown in Table 1.3.

Table 1.3 Mineral Reserve - Nyngan Scandium Project

Nyngan Project Reserve Summary	Mineral Reserve (effective date: April 15, 2016)	
	Reserve Tonnes	Grade (ppm Sc)
Proven Reserve	794,514	394
Probable Reserve	641,915	428
Total Reserve	1,436,429	409
NOTE: Reserve strip ratio is 3.42 (waste/reserve tonnes)		

1.6 General Project Description

The Nyngan Scandium Project is designed as a small surface mining operation, recovering approximately 75,000 t of limonite ore from the resource per year, at an average strip ratio of 3.37:1 waste to ore. The average limonite scandium head grade to the mill facility over 20 years is 409ppm. The mill facility will size the input material, heat and apply sulphuric acid to pre-treat the material, and feed the acidified ore into a continuous autoclave (HPAL) system. Downstream systems will then recover scandium from the autoclave leachate, using solvent extraction (SX), oxalate precipitation, and calcination, to generate a finished scandium oxide product, grading 98 to 99.9% Sc_2O_3.

The Project development and commissioning schedule includes a one year construction period, commencing in 2017, with initial commissioning in late 2017, wet commissioning in the first two months of 2018, and a total 24 month ramp-up period to reach nameplate capacity of 75,000 tpy ore throughput and approximately 38,500 kg of scandium oxide product per year.

The mine plan generates slightly different tonnages and grades by year, so most of the annual capacities and cost / revenue figures in this DFS are presented as 20 year averages. Key operating parameters are presented in Table 1.4.

Table 1.4 Key Operating Parameters

Summary Nyngan Scandium Project Key Operating Parameters	NI 43-101 DFS Result
General	
Life of Mine Production (years)	20
Average Mill Head Grade (ppm Sc)	409
Production Parameters	
Average Process Plant Throughput (tpy)	71,820
Average Process Plant Throughput (tpd)	240
Initial Production Year	2018
Ramp-up Rate (months to nameplate)	24
Mill Recovery (%)	83.7%
Mill Availability (%)	85.6%
Scandium Oxide Production (kg per year)	37,690
Scandium Oxide Product Grade	98-99.9%
Cash Modeling Parameters	
CapEx in Discount Year	2017 & 2018
Production in Discount Year	2018
Initial Discount Year	2017
Working Capital (US$M)	$2.0
Sustaining Capital	yes
Contingency (US$M)	$8.3
Effective Overall Contingency (%)	10.5%
Price or Cost Escallation?	None
Tax Rate	30.0%
A$/US$ Exchange Rate	$0.70

1.7 Mining Activity Detail

Mining activity is planned on a relatively small scale, based on the size of the overall operation. The resource is surface mineable, employing open cut mining techniques in two separate pits. A contractor will be employed for the mining earthworks and will be responsible for the provision of excavation including grade management, pit and ramp formation and haul road and dump management. The contractor will employ a hydraulic excavator to remove overburden and expose the top of the mineralisation. All in-pit material has been identified as free dig material, and no drilling and blasting is planned or required. Dozer assist will be used to excavate the limonite in flitches of 2.5 m, with thinner lenses being mined as grade control dictates. Approximately 75,000 tonnes of ROM feed will be won from the two pits each year, utilising a campaign mining schedule, approximately three to four times annually. From these campaigns, mill feed ore will be mined, stockpiled and covered on a ROM pad adjacent to the process plant, on an as required basis.

Waste material will be hauled to the site infrastructure work as required, including surface ponds, roads, and the Residue Storage Facility (tailings pond). Mineralised waste will be deposited on a dedicated mineralised waste dump.

1.8 Process Plant Detail

While the project resource contains both limonite and saprolite resource material, the DFS contemplates a process plant that will only receive limonite mill feed. Limonite resources sit above saprolite in the deposit, are more heavily weathered, and exhibit significantly higher scandium grades. Limonite tends to require more vigorous process inputs to liberate scandium than saprolites. Process test work suggests that autoclave systems work well on either resource type, but specific process parameters are different enough to prevent optimisation of a mill feed that is a mix of the two types. Best results would require distinct process runs to optimise recovery from each ore type.

While the Company has done work on optimum recovery of scandium from saprolite resources, that work is not a part of this DFS. The mine plan and project design has been careful not to sterilise or in any way prevent the Company from utilising the deeper saprolite resources at some point in the future.

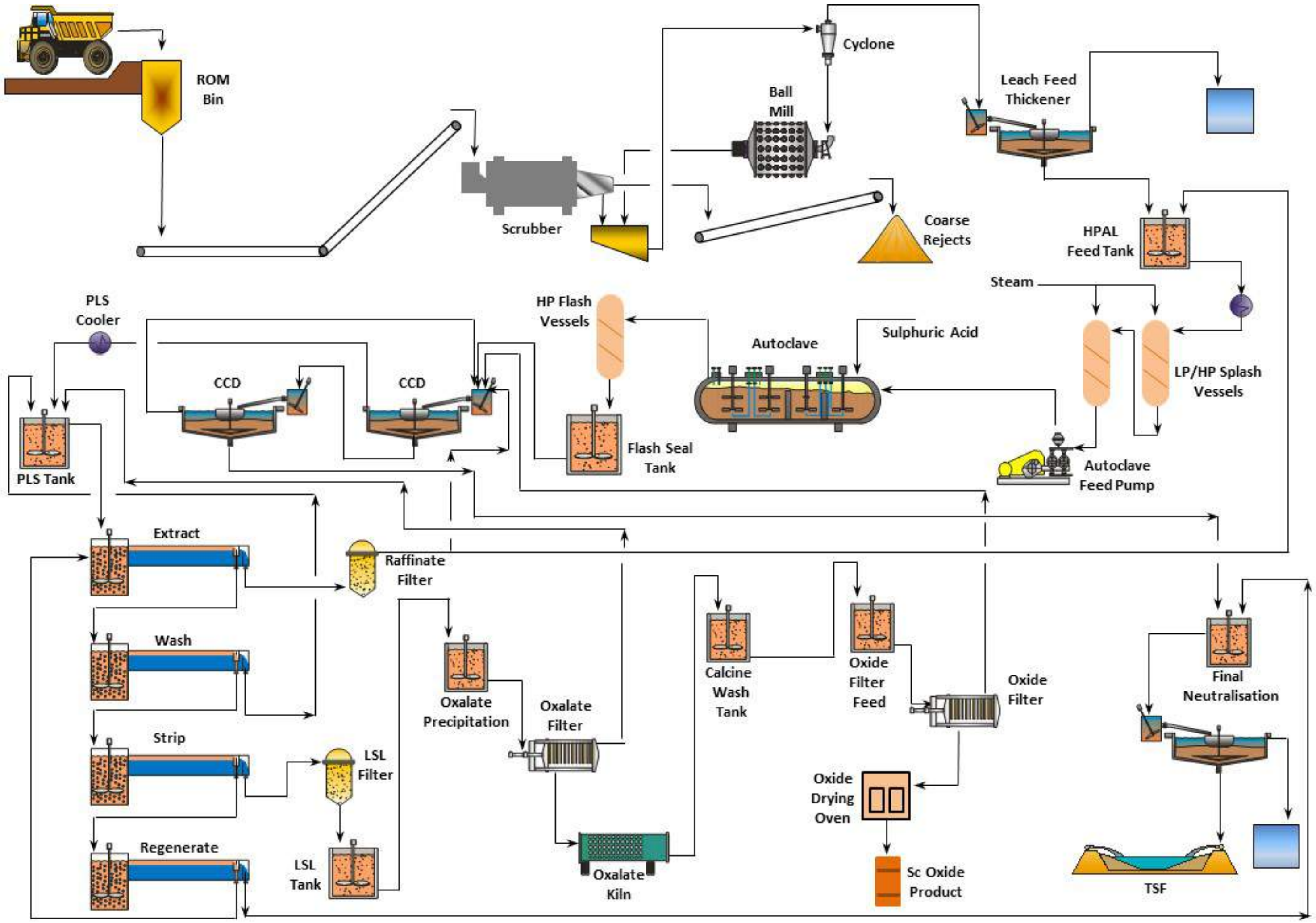
The process flowsheet can be summarised by the following sequential activities / circuits:

- Recovery of ore from mined stockpiles using a front end loader.
- De-agglomeration of the ore in a drum scrubber.
- Grinding the ore using a closed circuit ball mill to a P_{80} of 75µm.
- Thickening of ground ore to 38% solids.
- High Pressure Acid Leaching (HPAL) of ore through a continuous 3-stage preheat, autoclave, 3-stage letdown circuit.

- Counter current decantation (CCD) to remove entrained scandium from the leach residue.
- Solvent extraction of scandium bearing pregnant leach solution (PLS) from the CCD circuit to produce a Loaded Strip Liquor (LSL).
- Precipitation and filtration of scandium oxalate from the LSL.
- Calcination of the scandium oxalate solids, followed by washing and filtration.
- Drying and drumming of the final scandium oxide product.
- Neutralisation of the residual solids from the CCD circuit.
- Thickening of the neutralised solids, followed by pumping to the residue storage facility (RSF).

A schematic overall process flow diagram depicting the unit operations incorporated in the selected process flowsheet is presented in Figure 1.1.

Figure 1.1 Schematic Overall Process Flow Diagram



1.9 Project Infrastructure

The general infrastructure in the vicinity of the project site is good. The town of Nyngan is close enough and large enough to represent a suitable location for staff / families. The Barrier Highway runs directly past the project, within 5 km of the plant site. Adequate water supply is available for the project via raw water supply line/s, which are ultimately sourced from the Burrendong Dam, located 230 kms to the southeast. This water pipeline is owned and operated by the water board at Cobar, and runs alongside the Barrier Highway, close to site. Grid electrical power, in the form of separate 132kV, 66kV and 33kV lines, all run within 5 km of the site. This existing general infrastructure is available to the project, but specific additional site infrastructure will need to be built, including:

- An all-weather unsealed two lane access road from the Barrier Highway to the plant site, approximately 5 km in length.
- An all-weather unsealed haul road between the mine and the process plant.
- Connection from the existing 33kV overhead powerline running adjacent to the Barrier Highway to the plant site.
- A fibre-optic network within the process plant for communications with connection to the National Broadband Network via high speed wireless link.
- Raw water supply line to the plant site connected to the existing Cobar Water Board supply lines running adjacent to the Barrier Highway.
- A residue storage facility (RSF) comprising a HDPE lined, dual cell, paddock style facility with a perimeter embankment around all sides of the facility constructed in stages over the life of the project.
- An external decant pond to allow supernatant water to be kept at a minimum practical level in the RSF.
- An evaporation pond to dispose of high salt streams from the process plant.
- A raw water storage pond with 15 ML storage capacity.
- A process plant area event pond to capture any spills or run-off from the process plant area.
- A sediment pond for the process plant and RSF areas to capture run-off.
- A sediment pond for the mining area to capture run-off.
- A flood protection bund / levee bank around the process plant, RSF area and mining area to prevent external floodwater ingress.

- Plant site buildings and facilities, which will include an administration building, carpark, process plant laboratory, a combined workshop / warehouse building a combined electrical switchroom / control room, and a covered reagent storage facility.

A dedicated accommodation camp will not be constructed for either the construction or operational phases of the project. Use will be made of existing facilities in the surrounding area.

1.10 Environmental Studies, Social or Community Impact

The results of the environmental studies may be summarised as follows.

- **Air quality:** No significant impacts are expected. Mining / plant operations will be required to ensure suitable emissions and dust control standards are met.

- **Biodiversity:** No significant impacts are expected. Management has committed to measures in the Environmental Impact Statement (EIS) and a Biodiversity Offset Strategy, incorporating a Biodiversity Offset Area of 64hectares.

- **Surface water:** No significant impacts are expected. Management has committed in the EIS to operating a zero-discharge site, and to the following actions addressing surface water quality and containment:

    - the active areas of the Project Site are bunded to exclude a 1 in 1000 year ARI rainfall / flood event

    - all water containing chemicals or salt is retained and used for processing operations or evaporated from the Evaporation Pond

    - all water containing suspended sediment is captured and, if discharge is required, tested prior to discharge.

- **Traffic and transportation:** No significant impacts are expected. Management has committed in the EIS to construct the Site Access Road and Intersection to the relevant standards, and to implement measures to monitor and manage driver fatigue.

No other environmental impacts of significance have been identified.

1.11 Project Permitting Requirements

The Proposal would require the following permits, consents, leases, licences and approvals:

- Development Consent under Division 4.1 of the *Environmental Planning and Assessment Act 1979*.

- An Environment Protection Licence under Section 47 of the *Protection of the Environment Operations Act 1997*.
- A Mining Lease under the *Mining Act 1992*.
- A Water Supply Works and Use Approval and Water Access Licence issued by the DPI – Water under the *Water Management Act 2000*.
- A Section 138 Permit under the *Roads Act 1993*.
- An approval from the NSW Dams Safety Committee for the design and construction of the Residue Storage Facility, Evaporation Pond and External Decant Pond.
- A high voltage connection agreement under the *Electricity Supply Act 1995*.
- A range of approvals / construction certificates for infrastructure within the Project Site.

Because the Project capital cost exceeds A$30M, it is considered a 'State Significant Development", as defined by Schedule 1 of the ***State Environmental Planning Policy*** for NSW. The Minister for the NSW Department of Planning and Environment holds approval authority to grant a Development Consent on the Project, based on a project-specific Environmental Impact Statement (EIS), which has been filed in April 2016. Development Consent, along with various required permits and rights, represent a multi-agency process which supports the granting of a Mining Lease from the Division of Resources and Energy (Department of Industry). That said, the attitudes and support of the local Nyngan community to the project are very important, and will be considered by all decision makers in this process. A range of community and government agency consultations has been undertaken by the Company, at both State and local levels, including the first of several planned public town hall meetings in the town of Nyngan. No significant issues or objections have been identified during the consultation process to date.

1.12 Mine Closure Requirements

The DFS presents a 20 year project plan which utilises only a portion of the total resource, in fact less than 20% of the limonite resource and 10% of the entire resource. It is likely that the project will have an option to extend and not close in year 21, 2038, based on commercial circumstances at that time, but not based on resource constraints.

The DFS assumes the Residue Storage Facility will be fully rehabilitated in 2038 (year 21), because it has reached a practical size limit by that point in time. The estimated cost of that work is US$5.2M, including a 15% contingency. No other reclamation expenditure has been included in the project cash flow.

The EIS does contemplate a list of actions, in the event the project is closed after 20 years operation. Those actions include fencing mine pits, reclaiming some but not all of the water catchment facilities, clearing off the process plant and buildings in the event another industrial use is not found at that time, removing levee bunds on the site, and of course a similar reclamation of the Residue Storage Facility (tailings pond) to that contemplated in the DFS. The EIS does contemplate that the event storage pond, a sediment pond and the access road be left in place, but the area would be left suitable either as an industrial site, or for resumption of agricultural activity, which is its current use today

1.13 Key Research and Investigations

Successful development, operation and realisation of financial returns from this Project will depend specifically on execution in two key areas of the development plan:

- Achieve processing plant targets to separate scandium from the resource within the financial and functional parameters outlined in the plant design, and

- Establish markets for scandium oxide which are not possible to empirically demonstrate in today's supply-limited marketplace.

The Company has invested in significant investigations in both of these areas.

Process Flowsheets

Final DFS process plant flow sheets have been based on metallurgical test work on several different flow sheet options, involving multiple independent testing facilities to seek and verify operating parameters that are viable and effective. Key metallurgical laboratories and tasks include:

- SGS Lakefield (Canada). High pressure acid leaching test work was conducted on limonite, saprolite and combinations of the two, sourced from the Nyngan laterite deposit, using both 2 L and 20 L batch autoclaves. Multiple test programs from 2011 to present. This group also conducted work on the chemistry and settling properties of leach residue before and after neutralisation.

- Hazen Research (Colorado). Conducted extensive test work on an acid-bake roasting process followed by water leaching. While the acid-bake work was not relevant to this report, Hazen did produce process solutions for subsequent solvent extraction and scandium recovery test work. This included a continuous solvent extraction pilot plant campaign which formed the basis of subsequent SX test work at Nagrom Pty Ltd (Brisbane). Hazen also conducted pioneering work on the precipitation of scandium oxalate from solution using oxalic acid.

- CSIRO (Australia). This Australian governmental R&D group conducted test work on the acid bake process to produce solutions for subsequent downstream processing. They also conducted solvent extraction test work on a range of organic extractants, and examined the oxalate precipitation process. This formed the basis for subsequent test work at Nagrom Pty Ltd (Brisbane).

- Nagrom Pty Ltd. (Brisbane). Laboratory conducted solvent extraction test work, both on a batch basis and a semi-continuous basis with laboratory scale mixer settler units using a synthetic feed solution. The loaded strip liquor from the solvent extraction pilot plant was used for scandium oxalate precipitation and calcination trials. The procedures to produce 99.9% scandium oxide were developed during this campaign, and in fact produced 99.87% oxide in a single pass system.

Extensive use was made METSIM process software modelling capability in this DFS, as was done in the PEA in 2014. METSIM was applied as a tool to validate various process variants and options, all based on actual independent test work results that SCY was able to provide from prior studies. The final METSIM result on the DFS was a fully convergent model, with various recycle and bleed streams considered and quantified, and included a mass and water balance for the process. From these quantities, a mechanical equipment list compliant with the mass balance was produced as the basis for capital cost estimation. The model also provided reagent and consumable quantities that were used as the basis for the operating cost determination. The model also provided guidance for test work solutions where synthetic solutions were used.

Marketing Scandium Oxide

The Company has signed a three year off-take agreement with a knowledgeable aluminum alloy group, intent on making master alloy and aluminum alloys with scandium. This off-take is the only known signed off-take in the market presently. The Company has also commissioned an independent marketing study on the ten year supply / demand outlook for scandium (the Outlook), and likely pricing trends during that timeframe - 2016 to 2026. While the Company considers the Outlook to be confidential, and has no intent to release the document to the public, Lycopodium has reviewed the contained price forecast and supply / demand projections and confirms it is consistent with the sales and marketing objectives presented in this DFS. Some key details of this marketing study are specifically identified in Chapter 19 (Marketing) in this Technical Report.

1.14 Project Capital Cost

The capital cost estimate for the Project is US$87.1M. The capital cost estimate is provided at an accuracy level of +15%/-5%. A summary of the initial capital estimate is shown in Table 1.5.

Table 1.5 Total Project Initial Capital Cost

Nyngan Project Capital Cost Summary (millions)	Initial Project Capital Cost (US$M)
Mining Capital	
Pre-Stripping Cost	$1.72
Vehicles/Site Equipment	$1.26
Mining Subtotal	$2.98
Processing Plant Capital	
Process Plant Mechanicals	$40.96
Site Infrastructure	$25.95
Construction Costs	$3.91
EPCM Costs	$10.41
Owners Costs	$2.93
Process Plant Subtotal	$84.16
Total Project Capital Cost	$87.14

1.15 Project Operating Cost

Operating costs were estimated annually, based on the quantity of mill feed delivered by the mining plan to the processing plant.

Mining costs were based on contractor bids, although activity rates remained fixed throughout the 20 year project timeframe. Mining costs showed variation based on tonnage delivered, substantial annual waste removal variances, haul distances, and pit depth as mining advanced over the term of the project. Mining costs also included both a fixed and an ancillary component of cost which did not vary by mine output. The mine plan builds a considerable low grade mill feed stockpile of 620,000 t over the 20 year mine life. This resource material is above the 100ppm economic cut-off value and is stored for future processing. The costs of this stockpiled resource material is expensed through costs and cash flow in the timeframe costs are incurred.

Plant operating costs also varied by year, due to small changes in annual mill feed quantities beginning in 2020 (year 3). Processing plant costs were segregated into fixed and variable components. The variation in annual plant feed was the primary cause for annual differences in processing plant costs.

The fixed versus variable cost components did affect sensitivity analysis calculations. They were also important in the first two years of partial production, in the ramp-up to nameplate capacity.

The ramp-up provided for 35% of nameplate throughput (26,250 tonnes) in production year 1 (2018) and 80% of nameplate throughput (60,000 tonnes) in production year 2 (2019). The respective scandium oxide product output figures during those years was

13,300 kg and 30,900 kg, respectively. This two year ramp-up to nameplate capacity was determined based on the commissioning experience of other HPAL plants of similar general design, built and brought online in the last 15 years. All of these benchmarking examples were nickel plants processing lateritic ores, all but one were initial installations, and all were of much bigger size than the Nyngan processing plant.

Recognising the year by year variation in output and costs for the processing plant, operating costs have been presented throughout this Technical Report on a 20 year average basis. The averages absorb the effects of the ramp-up period, and account for the difference in average throughputs compared to nameplate capacities. That comparison is illustrated in Table 1.6.

Table 1.6 Comparison of Production Averages to Nameplate Targets

Nyngan Project Production Comparison 20 Year Averages to Nameplate	Comparison of Averages to Target Nameplate Levels					
	Average 2018-2022	Average 2023-2027	Average 2028-2032	Average 2033-2037	20 Year Average	Nameplate Target
Annual Mill Feed (Tonnes)	62,099	75,049	75,049	75,090	71,821	75,000
Annual Oxide Product (kg)	31,683	38,229	38,389	42,474	37,694	38,500
Scandium Head Grade to Mill	392	397	398	440	409	400

Operating cost details are presented in Table 1.7.

Table 1.7 Operating Cost

Nyngan Project OpEx Mine/Process Expense	Average Annual Cost US$ M	Unit Cost/ Processed Tonne US$/tonne	Unit Cost/ Oxide kg US$/kg
Mining Costs			
Stripping Cost	$0.5	$7.49	$14.27
Mining Costs	$0.8	$10.96	$20.88
Total Mining Costs	$1.3	$18.45	$35.15
Processing Cost			
Labor Cost	$5.9	$82.19	$156.60
Utilities Costs	$2.2	$29.99	$57.15
Reagents	$7.1	$98.24	$187.19
Consumables	$0.6	$8.02	$15.29
Maintenance	$1.6	$22.80	$43.44
General	$0.16	$2.23	$4.24
Total Processing Costs	$17.5	$243.48	$463.92
General Costs			
Tailings Pond Costs	$1.1	$15.60	$29.72
Site G&A Costs	$0.6	$7.82	$14.90
Consultants & Marketing	$0.5	$6.76	$12.88
Total General Costs	$2.2	$30.18	$57.50
Annual Cash Operating Cost	$21.0	$292.10	$556.57

The majority of operating cost information was supplied in Australian Dollars (A$), and converted to US$ at a conversion rate of US$0.70 = A$1.00.

1.16 Sensitivities to Finance and Operating Variances

The project is more sensitive to changes in product prices and exchange rates than to most other 10% variances. In Table 1.8, dramatically lower pricing is explored, showing the Project maintains a minimum 15% IRR on a 40% price shortfall. However, a standard 10% pricing variation to US$1,800 /kg would reduce IRR to 29.0%. Similarly, for a change in the Australian exchange rate assumption by 10% unfavorable to US$0.77, the IRR falls to 29.6%. A 10% loss in recoveries represents a particularly serious impost on any mining operation and this plant is no exception, where a drop to 75% recoveries decreases the IRR to 28.8%. Generally, these significant negative variations do not in any case represent a severe degradation to the return on capital for the project.

Table 1.8 Project Sensitivity to Product Pricing Changes

Project Financial Sensitivity to Product Price	Constant Dollar (after Tax) Project NPV at Various Discount Rates and Various Oxide Product Prices (US$)					
Product Price (US$/kg)	**$1,200**	**$1,500**	**$2,000**	**$2,500**	**$3,000**	**$3,500**
Constant Dollar						
Net Present Value (US$ M)						
6% Discount	**$82.4**	**$159.7**	**$287.6**	**$414.9**	**$542.2**	**$669.4**
8% Discount	**$55.1**	**$119.3**	**$225.3**	**$330.9**	**$436.3**	**$541.7**
10% Discount	**$34.3**	**$88.3**	**$177.5**	**$266.1**	**$354.7**	**$443.1**
Internal Rate of Return (IRR)	**15.2%**	**22.4%**	**33.1%**	**42.8%**	**52.0%**	**60.6%**

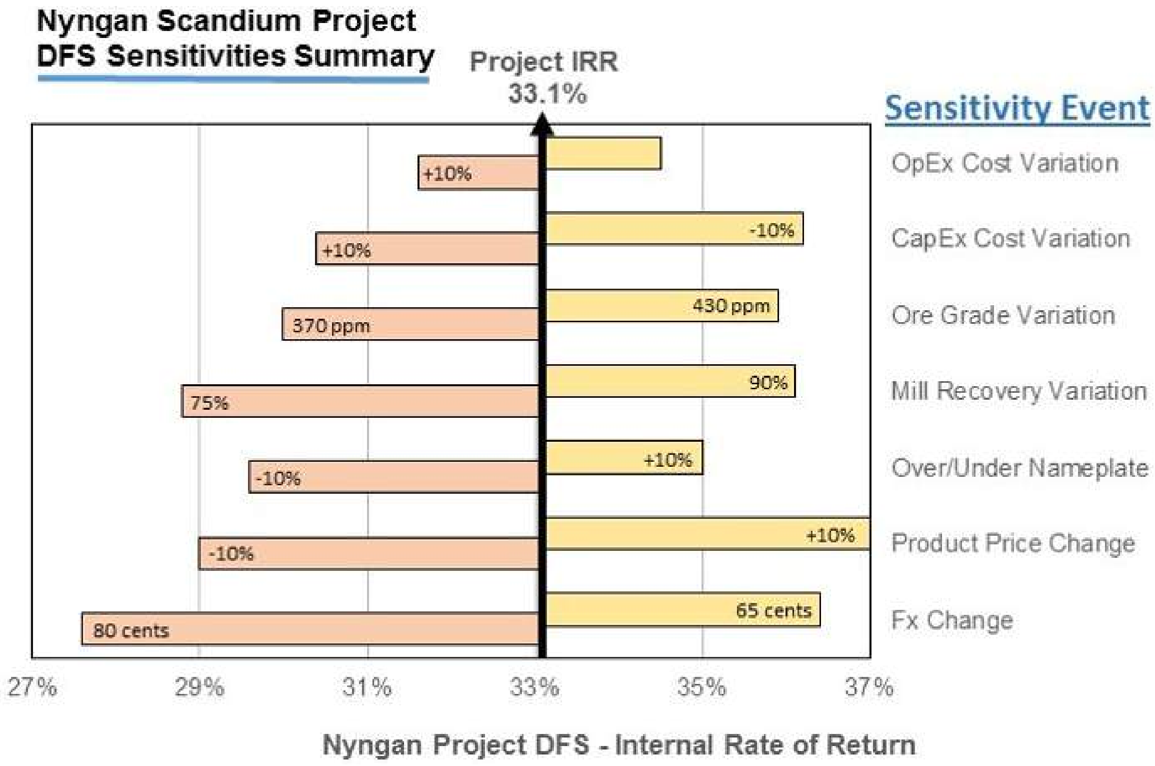
Table 1.9 Project Sensitivity to Financial Parameter Changes

Sensitivity to Financial Parameters	NPV (10%i) US$ M	IRR (%)
Feasibility Study Result	**$177.5**	**33.1%**
Operating Cost Sensitivity		
Cost Increase (10%)	**$166.3**	**31.6%**
Cost Decrease (10%)	**$188.7**	**34.5%**
Price Sensitivity		
Lower Realised Oxide Price (10%)	**$142.0**	**29.0%**
Higher Realised Oxide Price (10%)	**$212.9**	**37.0%**
Capital Cost Sensitivity		
Higher Capital Cost (10%)	**$169.6**	**30.4%**
Lower Capital Cost (10%)	**$185.4**	**36.2%**
Fx Sensitivity ($0.70)		
US$/A$ @ $0.80	**$150.3**	**27.6%**
US$/A$ @ $0.75	**$163.9**	**30.2%**
US$/A$ @ $0.65	**$191.3**	**36.4%**

Table 1.10 Project Sensitivity to Operating Parameters

Sensitivity to Operating Parameters	NPV (10%i) US$ M	IRR (%)
DFS Result	**$177.5**	**33.1%**
Mill Recoveries (83.7%)		
Recovery Decrease (75%)	**$140.7**	**28.8%**
Recovery increase (90%)	**$204.2**	**36.1%**
Mill Availability (85.6%)		
Availability Decrease (82%)	**$169.4**	**32.2%**
Availability Increase (90%)	**$187.1**	**34.1%**
Initial Ramp to Capacity (2 Years)		
Slower Production Ramp (3 Years)	**$163.5**	**30.0%**
Faster Production Ramp (1 Year)	**$199.1**	**40.3%**
Ore Grade Sensitivity (409ppm)		
Lower Plant Feed Grade (370ppm)	**$148.8**	**30.0%**
Higher Plant Feed Grade (430ppm)	**$201.1**	**35.9%**
Over/Under Design Capacity		
Lower Throughput by 10%	**$147.3**	**29.6%**
Lower Throughput by 20%	**$117.0**	**26.0%**
Higher Throughput by 10%	**$200.0**	**35.0%**

Figure 1.2 Key Sensitivities to Operating Variances



1.17 Interpretation and Conclusions

This Technical Report details the engineering and study work undertaken to apply continuous high pressure acid leaching of the Nyngan scandium resource and subsequent processing to produce a scandium oxide product. The basis for the design generally follows the path of established nickel laterite plants. That said, this plant design and flowsheet are purpose-built by Lycopodium and Altrius Engineering Services to address the unique differences presented by scandium, as directed by dedicated metallurgical test work in a number of key areas. The batch flowsheet design used in the PEA for this project has been superseded and clearly improved by the continuous system in this DFS. Overall scandium recovery levels are acceptable, and product purity has increased substantially, without the need for multiple purification steps to meet the highest grades demanded in the marketplace.

Resource definition is at a suitable level for study work at this accuracy level. The first Reserve has been established on the resource as well. While the current process plant design is suitable for the limonite portion of the resource only, this fact highlights the level of flowsheet tuning that has been applied in this Technical Report. The 20-year mine plan is predominantly within limonite resource at the measured category, and that measured resource is twice the size needed to complete a 20 year project at current design volumes.

The financial model includes provisions for sustaining costs, owner's costs, working capital, and a significant closure cost allowance.

The US$2,000 /kg sale price for scandium oxide that has been used is conservative, based on current prices. Market discussions with potential end users has indicated that it is likely that the presence of a large, reliable producer in a stable Western democracy will enable an increase in scandium use without a significant price reduction. The scandium pricing and demand assumptions in this Technical Report are supported by an independently prepared marketing study, researched by authors with significant career experience in the aluminium alloy industry.

The financial returns on the Project indicate a positive, development opportunity. The short payback period (3.3 years) and ability to service debt should support leverage financing, and the underlying profitability, the possibility of expansion based on un-assigned resources, and a nascent market for scandium should be attractive to equity investors.

1.18 Recommendations

The Project demonstrates a viable process flow sheet, and modelled economic analysis has been shown at the DFS level to be attractive. The conclusions of the Technical Report are positive, and the recommendation is therefore to proceed to project finance and execution.

Marketing efforts should be continued with the goal of developing further offtake arrangements

Detailed engineering should be initiated as soon as practicable on the continuous autoclave system with a preferred supplier, to ensure proper and optimal design parameters and manage delivery timing on this long-lead key plant component.

In parallel with early detailed engineering, some additional metallurgical test work is recommended in order to further optimise the processing flowsheet and operating conditions.

2.0 INTRODUCTION

2.1 Introduction

The purpose of this Technical Report is to determine the potential viability of mining lateritic materials from the Nyngan property in New South Wales (NSW), Australia, and processing resource material to extract and purify scandium, as scandium oxide (Sc_2O_3), at final product grades suitable for sale.

2.2 Terms of Reference and Purpose of Report

This Technical Report has been compiled by Lycopodium Minerals Pty Ltd (Lycopodium), Brisbane, Australia, from the sections prepared and signed off by the six Qualified Persons (QPs – identified below) at the request of SCY, in order to prepare a Canadian National Instrument NI 43-101 compliant Economic Assessment on the Nyngan Scandium Project, Nyngan, NSW, Australia.

The qualified persons (QPs) who signed off on each item in this Technical Report are as follows:

- QP: Maxel Rangott (Rangott Mineral Exploration Pty. Ltd.), responsible for report Sections: 1, 4 to 9 and 23.
- QP: Stuart Hutchin (Mining One), responsible for report Sections: 1, 10 to 12 and 14.
- QP: Dean Basile (Mining One), responsible for report Sections: 1, 15 and 16.
- QP: Dr Nigel Ricketts (Altrius Engineering Services), responsible for report Sections: 1 and 13.
- QP: Dr Geoff Duckworth (Lycopodium Minerals Pty Ltd), responsible for report Sections: 1, 2, 3, 17 to 22, and 24 to 27.
- QP: Tim Rowles (Knight Piésold Pty Ltd), responsible for report Sections: 1, 18.1 and 18.6 to 18.8.

This document provides a Technical Report on the Nyngan Scandium Project (also referred to as “Nyngan”), prepared according to NI 43-101 guidelines. Form NI 43-101 F1 was used as the format for this Report.

A summary of the QP site visits and areas of responsibility is detailed in Table 2.1.

Table 2.1 Summary of QP Site Visits

Qualified Person	Site Visits	Report Sections of Responsibility (or Shared Responsibility)
Maxel Rangott	None w/in 6 months	Chapters 4 – 9, 23 (plus 1)
Stuart Hutchin	October 15, 2015	Chapters 10 – 12, 14 (plus 1)
Dean Basile	None	Chapters 15 - 16 (plus 1)
Dr. Nigel Ricketts	December 7, 2015	Chapter 13 (plus 1)
Dr. Geoffrey Duckworth	December 7, 2015	Chapters 2 - 3, 17 - 22, 24 - 27 (plus 1)
Timothy Rowles	December 1, 2015	Chapter sections in 18 (plus 1)

2.3 Effective Dates

The Effective Date of this report is 15 April 2016. The other dates for critical information used in this report are:

- The Mineral Resource Estimate was completed on 29 January 2016.
- The process engineering and economics were completed on 15 April 2016.

There were no material changes to the scientific and technical information of the Project between the Effective Date and signature date of this Report.

2.4 Definitions

Certain key definitions applied in this Technical Report are defined in the CIM Definition Standards, as most recently updated on 10 May 2014. Those CIM definitions are as follows:

Mineral Resource

Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories. An Inferred Mineral Resource has a lower level of confidence than that applied to an Indicated Mineral Resource. An Indicated Mineral Resource has a higher level of confidence than an Inferred Mineral Resource but has a lower level of confidence than a Measured Mineral Resource.

A Mineral Resource is a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction.

The location, quantity, grade or quality, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling.

NOTE: Material of economic interest refers to diamonds, natural solid inorganic material, or natural solid fossilised organic material including base and precious metals, coal, and industrial minerals.

The term Mineral Resource covers mineralisation and natural material of intrinsic economic interest which has been identified and estimated through exploration and sampling and within which Mineral Reserves may subsequently be defined by the consideration and application of Modifying Factors. The phrase ‘reasonable prospects for eventual economic extraction’ implies a judgment by the Qualified Person in respect of the technical and economic factors likely to influence the prospect of economic extraction. The Qualified Person should consider and clearly state the basis for determining that the material has reasonable prospects for eventual economic extraction. Assumptions should include estimates of cut-off grade and geological continuity at the selected cut-off, metallurgical recovery, smelter payments, commodity price or product value, mining and processing method and mining, processing and general and administrative costs. The Qualified Person should state if the assessment is based on any direct evidence and testing.

Interpretation of the word ‘eventual’ in this context may vary depending on the commodity or mineral involved. For example, for some coal, iron, potash deposits and other bulk minerals or commodities, it may be reasonable to envisage ‘eventual economic extraction’ as covering time periods in excess of 50 years. However, for many gold deposits, application of the concept would normally be restricted to perhaps 10 to 15 years, and frequently to much shorter periods of time.

Inferred Mineral Resource

An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and grade or quality continuity.

An Inferred Mineral Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and must not be converted to a Mineral Reserve. It is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with continued exploration.

NOTE: An Inferred Mineral Resource is based on limited information and sampling gathered through appropriate sampling techniques from locations such as outcrops, trenches, pits, workings and drill holes. Inferred Mineral Resources must not be included in the economic analysis, production schedules, or estimated mine life in publicly disclosed Pre-Feasibility or Feasibility Studies, or in the Life of Mine plans and cash flow models of developed mines. Inferred Mineral Resources can only be used in economic studies as provided under NI 43-101.

There may be circumstances, where appropriate sampling, testing, and other measurements are sufficient to demonstrate data integrity, geological and grade / quality continuity of a Measured or Indicated Mineral Resource, however, quality assurance and quality control or other information may not meet all industry norms for the disclosure of an Indicated or Measured Mineral Resource. Under these circumstances, it may be reasonable for the Qualified Person to report an Inferred Mineral Resource if the Qualified Person has taken steps to verify the information meets the requirements of an Inferred Mineral Resource.

Indicated Mineral Resource

An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit.

Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing and is sufficient to assume geological and grade or quality continuity between points of observation.

An Indicated Mineral Resource has a lower level of confidence than that applying to a Measured Mineral Resource and may only be converted to a Probable Mineral Reserve.

NOTE: Mineralisation may be classified as an Indicated Mineral Resource by the Qualified Person when the nature, quality, quantity and distribution of data are such as to allow confident interpretation of the geological framework and to reasonably assume the continuity of mineralisation. The Qualified Person must recognise the importance of the Indicated Mineral Resource category to the advancement of the feasibility of the project. An Indicated Mineral Resource estimate is of sufficient quality to support a Pre-Feasibility Study which can serve as the basis for major development decisions.

Measured Mineral Resource

A Measured Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with confidence sufficient to allow the application of Modifying Factors to support detailed mine planning and final evaluation of the economic viability of the deposit.

Geological evidence is derived from detailed and reliable exploration, sampling and testing and is sufficient to confirm geological and grade or quality continuity between points of observation.

A Measured Mineral Resource has a higher level of confidence than that applying to either an Indicated Mineral Resource or an Inferred Mineral Resource. It may be converted to a Proven Mineral Reserve or to a Probable Mineral Reserve.

NOTE: Mineralisation or other natural material of economic interest may be classified as a Measured Mineral Resource by the Qualified Person when the nature, quality, quantity and distribution of data are such that the tonnage and grade or quality of the mineralisation can be estimated to within close limits, and that variation from the estimate would not significantly affect potential economic viability of the deposit. This category requires a high level of confidence in, and understanding of, the geology and controls of the mineral deposit.

Modifying Factors

Modifying Factors are considerations used to convert Mineral Resources to Mineral Reserves. These include, but are not restricted to, mining, processing, metallurgical, infrastructure, economic, marketing, legal, environmental, social and governmental factors.

Mineral Reserve

Mineral Reserves are sub-divided in order of increasing confidence into Probable Mineral Reserves and Proven Mineral Reserves. A Probable Mineral Reserve has a lower level of confidence than a Proven Mineral Reserve.

A Mineral Reserve is the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined or extracted and is defined by studies at Pre-Feasibility or Feasibility level as appropriate that include application of Modifying Factors. Such studies demonstrate that, at the time of reporting, extraction could reasonably be justified.

The reference point at which Mineral Reserves are defined, usually the point where the ore is delivered to the processing plant, must be stated. It is important that, in all situations where the reference point is different, such as for a saleable product, a clarifying statement is included to ensure that the reader is fully informed as to what is being reported.

The public disclosure of a Mineral Reserve must be demonstrated by a Pre-Feasibility Study or Feasibility Study.

NOTE: Mineral Reserves are those parts of Mineral Resources which, after the application of all mining factors, result in an estimated tonnage and grade which, in the opinion of the Qualified Person(s) making the estimates, is the basis of an economically viable project after taking account of all relevant Modifying Factors. Mineral Reserves are inclusive of diluting material that will be mined in conjunction with the Mineral Reserves and delivered to the treatment plant or equivalent facility. The term 'Mineral Reserve' need not necessarily signify that extraction facilities are in place or operative or that all governmental approvals have been received. It does signify that there are reasonable expectations of such approvals.

'Reference Point' refers to the mining or process point at which the Qualified Person prepares a Mineral Reserve. For example, most metal deposits disclose mineral reserves with a "mill feed" reference point. In these cases, reserves are reported as mined ore delivered to the plant and do not include reductions attributed to anticipated plant losses. In contrast, coal reserves have traditionally been reported as tonnes of "clean coal". In this coal example, reserves are reported as a "saleable product" reference point and include reductions for plant yield (recovery). The Qualified Person must clearly state the 'reference point' used in the Mineral Reserve estimate.

Probable Mineral Reserve

A Probable Mineral Reserve is the economically mineable part of an Indicated, and in some circumstances, a Measured Mineral Resource. The confidence in the Modifying Factors applying to a Probable Mineral Reserve is lower than that applying to a Proven Mineral Reserve.

NOTE: The Qualified Person(s) may elect to convert Measured Mineral Resources to Probable Mineral Reserves if the confidence in the Modifying Factors is lower than that applied to a Proven Mineral Reserve. Probable Mineral Reserve estimates must be demonstrated to be economic, at the time of reporting, by at least a Pre-Feasibility Study.

Proven Mineral Reserve (Proved Mineral Reserve)

A Proven Mineral Reserve is the economically mineable part of a Measured Mineral Resource. A Proven Mineral Reserve implies a high degree of confidence in the Modifying Factors.

NOTE: Application of the Proven Mineral Reserve category implies that the Qualified Person has the highest degree of confidence in the estimate with the consequent expectation in the minds of the readers of the report. The term should be restricted to that part of the deposit where production planning is taking place and for which any variation in the estimate would not significantly affect the potential economic viability of the deposit. Proven Mineral Reserve estimates must be demonstrated to be economic, at the time of reporting, by at least a Pre-Feasibility Study. Within the CIM Definition standards the term Proved Mineral Reserve is an equivalent term to a Proven Mineral Reserve.

Feasibility Study

A Feasibility Study is a comprehensive technical and economic study of the selected development option for a mineral project that includes appropriately detailed assessments of applicable Modifying Factors together with any other relevant operational factors and detailed financial analysis that are necessary to demonstrate, at the time of reporting, that extraction is reasonably justified (economically mineable). The results of the study may reasonably serve as the basis for a final decision by a proponent or financial institution to proceed with, or finance, the development of the project. The confidence level of the study will be higher than that of a Pre-Feasibility Study.

The term proponent captures issuers who may finance a project without using traditional financial institutions. In these cases, the technical and economic confidence of the Feasibility Study is equivalent to that required by a financial institution.

3.0 RELIANCE ON OTHER EXPERTS

3.1 Introduction

The QP authors have relied on the environmental work undertaken by R.W. Corkery of Orange, NSW, Australia, for EMC Mining Australia Pty Ltd, and Scandium International Mining Corp, and the lack of discovery of any serious archaeological or social limitations to property development for mining or mineral processing. The authors are aware of the Environmental Impact Statement (EIS) document, written and compiled by R.W. Corkery, and recently filed with the NSW Department of Planning and Development, in April 2016. The authors are familiar with the conclusions of the EIS, in in certain cases have been involved with and contributed to or reviewed its contents in detail. The EIS document is further supported by a Specialist Consultants Study Compendium, representing various independent environmental specialist reviews of specific elements of the Nyngan property development plan.

The conclusions of the EIS state the following:

> "In light of the conclusions included throughout this *Environmental Impact Statement*, it is assessed that the Proposal could be constructed and operated in a manner that would satisfy all relevant statutory goals and criteria, environmental objectives and reasonable community expectations."

The QP authors have, with respect to this Technical Report, relied on the work and conclusions contained in the EIS with regard to all environmental matters, but most specifically Chapters 1 (Executive Summary), 18 (Project Infrastructure) and 20 (Environmental Studies, Permitting, and Social and Community Impact).

4.0 PROPERTY DESCRIPTION AND LOCATION

4.1 Property Location

The Nyngan scandium deposit lies 20 km west-southwest of the town of Nyngan, New South Wales (NSW), approximately 450 km northwest of Sydney. The property is 5 km southeast of the hamlet of Miandetta, off the Barrier Highway that connects Nyngan to Cobar as shown schematically in Figure 4.1.

Figure 4.1 Location of Nyngan Scandium Property

The drive from the town of Nyngan to the property takes approximately 20 minutes. The area can be reached via the paved Barrier Highway and Gilgai Road which allow year round access, but access to the site itself is along clay farm tracks making access in wet conditions difficult. Several of the Crown Roads in the area are in the process of being closed or offered for sale, and one in particular would make a superior choice to provide access to the property directly from the highway, with minimum impact on local land owners. Discussions on securing this asset are currently underway.

The resource site is located at geographic coordinates MGA zone 55, GDA 94, Latitude – 31.6130S, Longitude 146.9306E, Map Sheets 1:250k – Cobar (SH/55-14) and 1:100k Hermidale (8234).

4.2 Mineral Titles

The scandium resource is held under the mineral title – Exploration Licence (EL) No. 8316 (Block Number 3132, units d, e, j, k and Block No. 3133, unit f) EL 8316 is surrounded by two other titles held by EMC Metals Australia Pty. Ltd. (EMC-A). EL- 6096 (five units) and ELA (application for an exploration licence) - 5232 (six units). EMC-A also holds Exploration Licence 7977 at Honeybugle, 25 kms to the south. Each of the EL's and the ELA are backed by a A$10,000 environmental bond, in a form of a cash collateralised security deposit with the Department of Industry and Trade, NSW. They also have minimum annual spend requirements. The exploration tenements are not subject to any other environmental liabilities, other than to reclaim any drilling impacts on the land, and safely reclaim all drill holes.

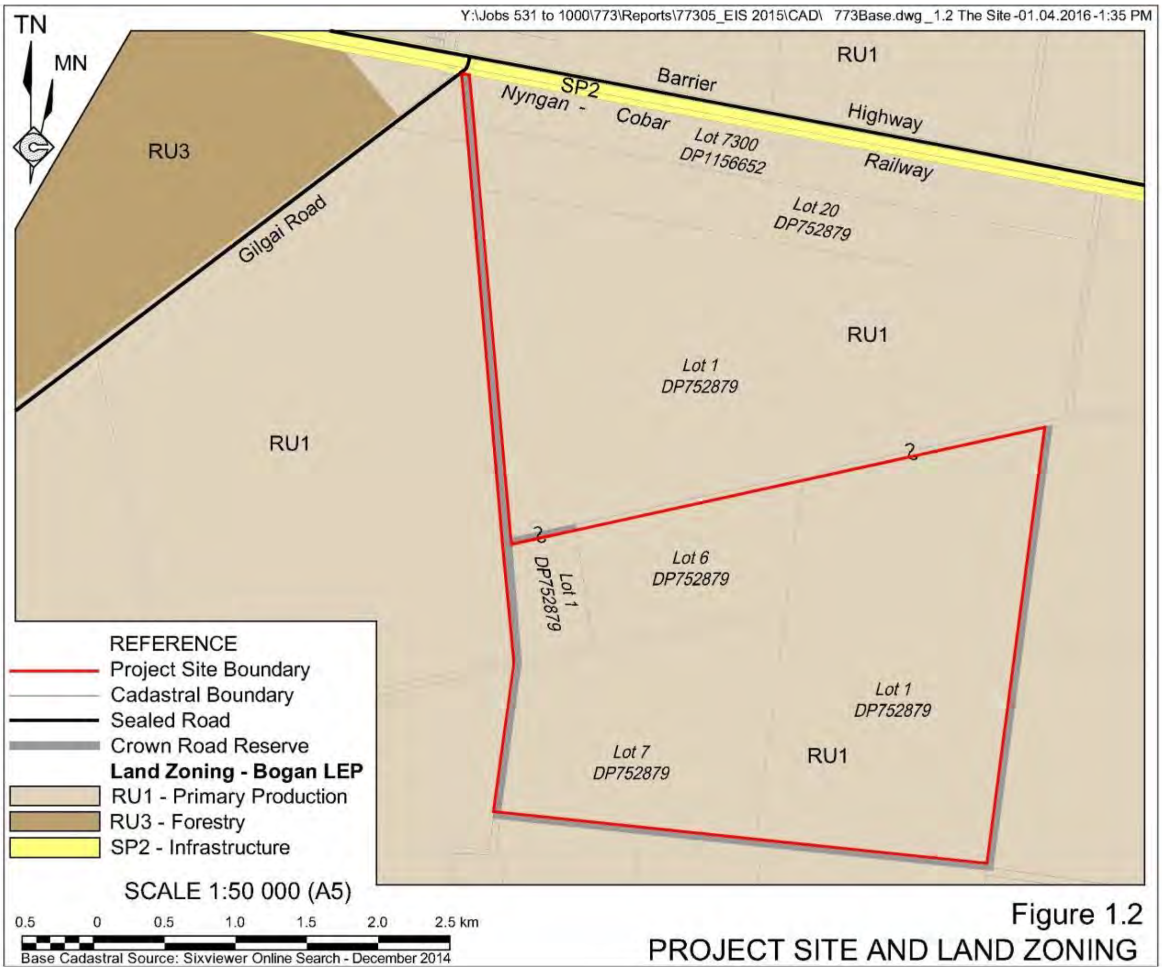
The combined area of the exploration tenements covering the Nyngan scandium project is almost 50 square km. The main resource area (at a lower cut-off of 100 ppm Sc) covers approximately 2.0 square km.

The Exploration Licences allow the licence holder to conduct exploration on private land (with landowner consents and signed compensation agreements in place) and public lands not including wildlife reserves, heritage areas, Nature Reserves or National Parks. The scandium resource is fully enclosed on private agricultural land.

The local administrative body with property taxation jurisdiction is the Bogan Shire Council, Nyngan, NSW. Annual property rates, subject to annual assessment, are A$828 and payable to the Bogan Shire Council Offices on or before 31 August each year.

The freehold property boundaries are defined by standard land survey techniques undertaken by the Lands Department and currently presented in the form of Cadastral Deposited Plans (DP) and Lots. The total surface (freehold) ownership, directly on top of the resource, is 800 acres, and covers approximately 70% of the resource and 100% of the anticipated footprint of combined planned mining areas and processing facilities. The defined Sc resource lies within Lot 1 and Lot 7, DP 752 879. EMC-A is currently negotiating with a landowner for purchase of relevant parts of Lot 1.

Figure 4.2 Location of Resource By Cadastral Deposited Plan (by Lot)



In order to develop the property into a mining operation, EMC-A must seek and be granted a series of approvals and operating licenses, most significantly a Mining Lease (ML) from the NSW Division of Resources and Energy (Department of Industry), and a Development Consent from the Minister of the Department of Planning and Environment.

The Nyngan Project qualifies as a State Significant Development, as defined by Schedule 1 of the State Environmental Planning Policy (State and Regional Development) 2011. As a State Significant Development (>A$30M capex), operating approvals are reviewed, granted, and managed by multiple governmental agencies, coordinated by the Minister of the Department of Planning and Environment.

This process begins with the submission of a completed Environmental Impact Study (EIS), which is considered the foundation document for any developer considering a mining project in NSW. The EIS is submitted to the Department of Planning and Environment, along with a request for a Development Consent. The EIS is reviewed for adequacy, and placed on public exhibition, for comment and scrutiny for 30 to 60 days, while simultaneously undergoing multi-agency review and consideration.

Once the Development Consent is granted, there are a number of operating licenses and approvals that are required from various regulatory agencies to construct and operate a mining operation in NSW.

The key license approvals are:

- An Environment Protection Licence.
- A Mining Lease.
- Water Supply Works and Use Approval and Water Access Licence.
- A Section 138 Permit issued by the Bogan Shire Council, for construction of the intersection of the Site Access Road and Gilgai Road.
- An approval from the NSW Dams Safety Committee for the design and construction of the Residue Storage Facility.
- A high voltage connection agreement with Essential Energy.

The timeframe for completion of these reviews and granting of licenses is not fixed, and is dependent on the results of the adequacy review of the EIS including the extent of the questions that may arise from the project review, and the available resources in government to address the review itself. General estimates of the overall development review and approval process time frame range from six to nine months, with some proposals taking longer, particularly larger proposals, or proposals with more community and environmental impacts to consider. With completion of all governmental reviews and approvals, the Project can be expected to receive operating rights which encompass a project footprint that corresponds to the resource and process plant area.

The ML has a two-year expiry on advancement to operations, in that EMC-A has two years from ML grant to initiate plant and mine construction.

The Nyngan property is subject to five separate royalty agreements, four based on revenue and one based on pre-tax profit. The details on these royalties are as follows:

- Revenue-Based Royalties, Levied on Revenue (less freight):
  - **Jervois Mining Limited Royalty**. 1.7% of actual sales prices on oxide, subject to a 10 tpy minimum once production commences, and a 12 year time period to expiry.
  - **Lenders Royalty**. 0.2% of actual sales prices on oxide, subject to a cap of US$370,000 total payout, expected to be approximately 2.5 years of production.

- **New South Wales Mineral Royalty**. 4% on actual sales prices, but refining, processing, and freight costs may be deductible for calculation of royalty payable. The royalty runs in perpetuity.

- **Jennings Royalty**. A 0.7% royalty payable on actual sales prices of scandium products or other mineral products, net of any freight costs. The royalty runs in perpetuity.

• NPI's – Net Profit Royalties, levied on Pre-Tax Income:

- **Plumbum & Canateal Royalty**. 1.5% on actual sales prices, but all costs of production are allowable deductions, so this is a percentage on earnings before tax. The royalty runs in perpetuity.

The property does not have any existing environmental liabilities that would burden the project, either in operation or in closure. Other sections of this report do address environmental flora and fauna matters and the Company's plans on closure and salvage of site facilities and assets at the end of mine life.

No other significant factors are known that would affect access, title or the right or ability to perform work on the property at this time.

5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

5.1 Topography, Elevation and Vegetation

The topography is mildly undulating to flat elevated plateaus at an average elevation of 173 m above sea level. The area is overlain with alluvial red clays which display 'Gilgai-type' swelling characteristics.

Historically the area was predominantly dry eucalypt and native pine woodland. Large areas of original woodlands have been permanently altered through the removal of pine for timber, the clearing of trees and shrubs for grazing by livestock and the invasion of woody weeds.

5.2 Climate and Length of Operating Season

The Nyngan area climate is generally described as sub-arid. The highest mean summer temperatures of 34°C usually occur in January. Winter mean minimum temperatures of 16°C typically are recorded in July. In summer, temperatures can reach 40°C, while winter low temperatures can occasionally reach 0°C during night time. These extremes are relatively rare, and would pose no limitations on mining or processing operations.

The mean maximum (summer) rainfall of 51 mm occurs in January and the mean (winter) rainfall minimum of 27 mm in September. Nyngan is generally under a sub-tropical to tropical influence from the north of the continent. The operating season for a mining operation can be all year round, provided all-weather gravel roads with appropriate drainage are constructed for access.

5.3 Access to Property

The town of Nyngan, New South Wales (NSW) lies on the Mitchell Highway, northwest of Dubbo, which is the largest regional community in proximity to the project area. To reach EMC's Nyngan property from the town of Nyngan, the most direct route is via the Barrier Highway, which intersects the Mitchell Highway at the western end of the town of Nyngan. The hamlet of Miandetta lies approximately 22 kms from Nyngan, along the Barrier Highway. At Miandetta, the highway intersects Gilgai Road. The Nyngan property is approximately 5 km south west on the Gilgai Road (paved), accessible through private roads and Crown roads, which are all weather roads but not paved. The property is not visible from the Gilgai Road.

5.4 Surface Rights

EMC-A has purchased approximately 800 acres of land (freehold) which encompasses most of the scandium resource on the property. The surface rights are managed by Hetherington Exploitation and Mining Title Services Pty. Ltd., Sydney, NSW on behalf of EMC-A.

5.4.1 Access Roads and Transportation

The township of Nyngan is accessed by the Barrier and Mitchell Highways, both paved all-weather inter-State two lane highways. There is a single track rail line used for hauling grain and sulphide concentrates from mines at Cobar that runs through Nyngan to the eastern seaboard ports, and past the Nyngan property, approximately 5 km from the resource area.

5.4.2 Power Supply

The closest major electricity substation is located in the regional city of Dubbo, NSW, approximately 170 km from the Nyngan property. A high voltage power line (132 kV) runs parallel to the Barrier Highway from Nyngan to Cobar, and passes within 4 km of the resource area. Domestic power lines also run along the Gilgai Road.

The largest solar farm in Australia has recently been constructed in the area as well. The owner and operator, AGL (ASX Ticker:AGK) has completed construction of a 102 MW fixed (non-tracking) solar photovoltaic installation directly adjacent to the Barrier Highway, approximately 10 km from Nyngan and 20 km from the Nyngan property. The facility was completed in mid 2015, and formally opened in January 2016. The installation will generate 360,000 MWh of electric power per year, and include a transformer station to tie directly into the existing 132 kV Nyngan-Cobar high voltage transmission line.

5.4.3 Town of Nyngan

The town of Nyngan has a population of 2,073 (shire population 3,076), and has a regional hospital, primary through tertiary school systems and several restaurants and hotels, although rooms are not plentiful. The town hosts the local governmental offices of the Bogan Shire, and caters to the road traffic travelling between Cobar and Dubbo. It is estimated that approximately 12 to 20% of the population either works or services mining projects in the area. The primary regional industry is agriculture, with wheat the predominant crop.

The AGL solar construction project has brought over 300 local jobs to the community, and required the company to construct a mess / accommodation facility to support the project during construction and commissioning.

Travel times by car from the town of Nyngan to both Dubbo and Cobar are each about 1.5 hours. Dubbo's population is about 40,000, is considered the crossroads of NSW, and supports a regional population of over 130,000. Cobar is slightly larger than Nyngan (town population estimate 3,817, shire 4,700) and is both an historic and current mining community with copper-lead-zinc and gold mining that began in the 1880s.

5.4.4 Water Supply

The project will require almost 200 mega-litres (ML) of water per annum. This water can be sourced from two possible areas:

1. Underground water from the Lachlan Fold Belt.

2. From an existing storage reservoir (Burrendong Dam on the Macquarie River).

EMC-A plans to apply for an allocation from the Burrendong Dam. Water is released from the dam and flows to the township of Nyngan via the Macquarie River, a 68 km irrigation channel and finally into the Bogan River near Nyngan. A pumping station then pumps the water via two existing parallel pipelines which supply Cobar some 120 km away. These pipelines follow the Barrier Highway and are within 5 km of the Nyngan Project. A modest off-take would be required to provide water to the project.

5.4.5 Port

The nearest port facility is at Newcastle, NSW, located approximately 500 km from the property via the paved State highway system, capable of transporting heavy equipment to site, and supporting continuous all-weather transport of process inputs for the project.

5.4.6 Buildings and Ancillary Facilities

There are currently no buildings or ancillary facilities on the site.

5.4.7 Manpower

Adequate skilled labour for technical and hourly staff is available in Nyngan, Cobar and other regional communities. The Nyngan community has the room and infrastructure in place to expand to meet the demands of growing local business, although at present there is not a ready supply of housing available for rent or purchase. The major solar project recently constructed involved as many as 300 construction staff. A mining project such as Nyngan Scandium would likely require a similar solution, on a much smaller scale during construction, and the solar project facility may represent a timing opportunity for EMC-A to use established facilities after completion of that project.

6.0 HISTORY

6.1 Origins of the Name 'Gilgai'

The Nyngan scandium property had been commonly also known as the Gilgai scandium property, as it was referred to during numerous drilling phases and owners through the 1980s and 1990s. The word is Aboriginal in origin, and means 'small water hole'. Gilgais form where heavily clayed soils swell and crack, creating shallow depressions that capture and retain water in small pools. Gilgais are further encouraged by areas with pronounced wet and dry seasons, and were important water sources for native Australians, range animals, and early pastoral farmers and graziers.

The prospect was named by M. Rangott in 1987, and came from the Parish of Gilgai, County of Flinders, as the prospect lies within that Parish. The name was later applied by geologists and exploration groups to the significant local buried geologic formation, known as the Gilgai Complex, a zoned Alaskan-type intrusive that is host to nickel, cobalt, platinum and scandium.

EMC refers to the property as either the Nyngan scandium property or the Nyngan Scandium Project, reserving the Gilgai name as a title for the broad geologic formation associated with the property and the scandium resource.

6.2 Past Exploration and Development

The first systematic exploration in the region was by Selection Trust in the late 1970s, targeting base metal and gold mineralisation. Work included mapping, rock chip sampling and the drilling of seven percussion drill holes. The results returned were not deemed encouraging by Selection Trust, however values of up to 1.16% nickel were reported from nearby alpine serpentinites.

North Broken Hill Ltd. took up a number of tenements in the late 1970s and early 1980s initially to look for tin, but later for ultramafic sulphide mineralisation. To the south of the Nyngan property, in the Honeybugle area, they conducted regional exploration including the drilling of 52 auger holes (287 m) on Pangee Road and at the Pangee Road Pits.

Lachlan Resources N.L., as manager of the "Platsearch Group" explored for PGE mineralisation in the late 1980s, relinquishing the ground in 1993. Airborne and ground magnetic surveys were used to locate and delineate the intrusive "Alaskan-style" ultramafic complexes considered to be prospective for PGE mineralisation, modelled initially on the platinum bearing Tout (Syerston) intrusive complex near Fifield, then on the Kars Complex near Condobolin. Broad-spaced rotary air-blast (RAB) drilling identified a platiniferous zone at the western end of the large Gilgai complex, under alluvial cover. A follow-up program included detailed ground magnetic surveys and RAB drilling at 25 m x 50 m spacing over an area of 400 m x 500 m. A total of 134 RAB holes for a cumulative 6,779 m were drilled. Two inclined diamond holes were also completed, each 250 m deep. Assay results from the diamond drilling program showed peak values of 1.53 g/t Pt, and revealed an iron-rich phase with abundant magnetite and minor sulphides including pyrite, pyrrhotite, and chalcopyrite. Jervois Mining Limited later sampled the stored core from one of the holes, including three samples from the iron-rich phase. The five samples were submitted to Bequered Laboratories for Neutron Activation Analysis, which gave 108, 104, and 110 g/t scandium as shown in Table 6.1.

Table 6.1 Select Lachlan Assay Results

Select Sample Assays From Lachlan RAB Drill Program				
Sample Number	**Depth (m)**	**Pt (ppm)**	**Sc (ppm)**	**Rock Type**
27132	109-110	0.34	55.1	Dunite/Olivine Pyroxenite (minor veins)
27142	119-120	1.09	65.4	Olivine Pyroxenite (minor veins)
27229	296-207	<0.05	108	Magnetite Pyroxenite (pegmatite veins)
27262	239-240	0.11	104	Magnetite Pyroxenite (pegmatite veins)
27264	241-242	0.06	110	Magnetite Pyroxenite (pegmatite veins)

Anaconda (NSW) Pty. Ltd. acquired exploration title to the area in 1999, and concentrated on searching for nickel / cobalt enrichment in laterites overlying serpentinite and the Gilgai Complex. Regionally, Anaconda completed some 31 km of ground magnetic traversing and drilled 54 reverse circulation (RC) holes, totalling 2,302 m. Further work was planned by Anaconda but was not carried out, and the property was relinquished in 2001.

Jervois Mining Limited was conducting exploration in the general area at about the same time as Anaconda, and obtained the sample pulps from Anaconda's RC drill program in 2003, after Anaconda relinquished the exploration area. Jervois further analysed the drill samples for other minerals, including scandium. These initial assay results confirmed significant scandium enrichment in the Gilgai laterites.

During 2006, Jervois completed an RC program on the property, drilling 64 holes for a total of 2,638 m. This drilling result allowed a resource to be generated, compliant with both NI 43-101 and the JORC Code, which was completed by Douglas McKenna and Partners during 2010.

In February 2010, EMC Metals entered into a joint venture earn-in agreement with Jervois to deliver a feasibility study on the Nyngan Scandium Project, within two years. At the two year anniversary (February 2012), a dispute developed between the parties which ultimately concluded in a private and binding settlement in early 2013. The terms of the settlement required EMC Metals to pay Jervois a cash sum over an 18 month period through to June 2014, in return for the transfer of 100% of the Nyngan Scandium Project, including the land and mineral licence rights, to EMC Metals. EMC Metals was also required, as part of the settlement, to pay Jervois an NSR royalty of 1.7% on scandium produced during the first 12 years of production, and to accept assignment of an existing NSR royalty (technically a net profits interest) on the property that Jervois had signed to obtain the property years earlier.

As of October 2014, all payments due on the settlement agreement between the parties were made, and formal transfer of exploration tenements and freehold land rights associated with the Nyngan scandium property was completed.

7.0 GEOLOGICAL SETTING AND MINERALISATION

The area is dominated by Cainozoic alluvium of the Bogan River floodplain, which is part of the broader Murray-Darling River Basin with minor colluvium and outcrop. Immediately to the east of the project area, the Palaeozoic basement is onlapped by the southern margin of part of the Mesozoic aged Surat Basin, known as the Coonamble Embayment. The Cainozoic sediments cover both major geological domains, in some cases to depths of more than 100 m. There is evidence of varying degrees of laterisation in the area.

The area is located within the western-most north-south structural zone of the Lachlan Fold Belt, which is known as the Girilambone Structural Zone. It is composed of Cambrian-Ordovician metasediments and minor basic volcanics and is known as the Girilambone Group, and it is intruded by numerous mafic and ultramafic bodies of similar age and by middle Silurian granite and volcanics.

Within EMC-A’s exploration licences, the Gilgai and Honeybugle intrusive complexes are Alaskan-type complexes made up of a range of lithologies from hornblende monzonite, hornblendite, pyroxenite and olivine pyroxenite to dunite-peridotites. The complexes are included within the ‘Fifield Platinum Province’. The Gilgai complex is covered by 8 m to 50 m of Tertiary to Recent age alluvial material, with alluvium detected to 85 m depth near the northern margin of the complex (to the north of the defined resource).

Scandium levels appear to be highest in the pyroxenite and olivine pyroxenite phases of the complexes, so these rock types are considered to be the main bedrock sources for the scandium mineralisation in the laterites. The highest scandium grades occur in the limonitic laterite units, overlying or close to the pyroxenite source rocks.

8.0 DEPOSIT TYPE

The Nyngan scandium resource is located within a limonitic and saprolitic tertiary age laterite profile, covered by 12 to approximately 25m of Cainozoic alluvium. A fairly typical laterite profile is developed at the prospect:

- Hematitic clay.
- Limonitic clay.
- Saprolitic clay.
- Weathered bedrock.
- Fresh bedrock.

The resource is centred over the more mafic phases of the zoned Gilgai ultramafic complex. Weathering persists to more than 65 m depth at the northern margin of the resource.

8.1 Mineralisation

A geological interpretation plan has been previously prepared, based on bedrock intersections in both recent and previous drilling. Because of the weathered nature of the drill cuttings, the geological plan must be considered interpretive. The igneous rock types which have been encountered are:

- Pyroxenite.
- Olivine Pyroxenite.
- Hornblende Pyroxenite.
- Hornblendite.
- Magnetite Pyroxenite.
- Dunite.
- Monzonite.

There is a suggestion of a layered trend of the complex in a NW-SE direction (this is supported by the magnetic pattern). These trends reflect a broadly concentric zonation of lithologies (mafic lithologies in the centre becoming intermediate in moving out from the “core”) in the complex. There also appears to be a zone of stronger alteration in the (south) centre of the zone where abundant magnetite and mica (phlogopite) occur.

9.0 EXPLORATION

9.1 Surveys and Investigations Done For/By SCY or EMC

No exploration work on or around the Nyngan scandium property was conducted prior to 2010, by or on behalf of the Company. The property was known to have a scandium resource at the time the company formed its interest in the property and the project.

9.2 Surveys and Investigations Done by Others

Previous shallow RAB drilling (60 holes in 1988 to 1989) on the Nyngan property searching for platinum, revealed a large concealed laterite body over an area of more than 1,000 m x 500 m. The titleholder, Platinum Search N.L., subsequently drilled two 250 m inclined diamond core holes to test the platinum grades in the olivine pyroxene.

Between 1999 and 2001, two traverses of RC drill holes were drilled by Anaconda NSW Pty. Ltd., specifically exploring for nickel on the Nyngan property. Jervois made the initial discovery of the presence of scandium from NAA analysis that they had carried out on samples of core from one of the 1989 Platinum Search core holes.

In September 2005, as part of a regional air core drilling program, Jervois Mining Limited drilled five vertical aircore holes (NA49 to NA53 inclusive) along an east-west fence line through the centre of the laterite body. Results from this drilling suggested that a major resource of scandium was present at Nyngan.

Jervois Mining Limited subsequently drilled 69 vertical aircore holes in 2006 (total 2,638 m), and proved up an initial JORC resource at the prospect.

The holes were geologically logged (one metre intervals), weighed and magnetic susceptibility readings taken. Chip tray samples were prepared for each drill hole. All intervals below the alluvial overburden were sampled and dispatched for assay (except for two holes, NA55 and NA89, which penetrated monzonite and sediments respectively). All sample residues, except alluvium, were transported to a secure, locked shed in Nyngan and stored for use in future metallurgical test work.

10.0 DRILLING

10.1 Drill Program Overview

While the Nyngan property has been drilled by numerous prior owners since the early 1980s, the target was never for scandium, and consequently none of the early holes were assayed for scandium. Jervois Mining Limited (Jervois) initiated the scandium interest at Nyngan by re-assaying a section of Platinum Search drill core in 2003, which served to identify the presence of scandium on the property.

An NI 43-101 Resource was first established in 2010, based on drill work commissioned by Jervois in 2006 (68 holes). Jervois conducted a second drill program in 2008 (nine holes) which served to provide material for metallurgical test work. The assays from this second drill program were not included in the 2010 resource estimate, or the updated 2016 resource estimate.

During 2014 and 2015, EMC-A conducted two drilling programs, completing a total of 33 air core holes for 1,323 m and three diamond holes for 129 m. In addition, one diamond geotechnical hole was extended through the laterite profile to bedrock. The 2014 to 2015 drilling data was combined with the earlier drilling information, and used to form the 2016 NI43-101 resource estimate.

10.2 Initial 2006 Drilling Program - Procedures

The 2006 air core drilling program was performed by Competitive Drilling Services Pty. Ltd. of Blayney NSW. The rig used was a Schramm 450, hole diameter 3½" (89 mm) and the compressor had a capacity of 350 psi and 600 cfm. The program drilled a total of 2,638 m in 68 holes. A subsequent nine hole program was completed in 2008, in order to obtain sample material for research and development. The assay results from this second program were not subsequently included in any resource estimates, although the assay results were consistent with the resource defined by the earlier (2006) program.

All air core drilling was vertical – the lithotype intersection lengths are close to true 'stratigraphic' widths.

Rangott Mineral Exploration Pty Ltd employees were present and participated / supervised the drill contractor in the field work on both drill programs, in 2006 and in 2014 to 2015.

10.3 EMC-A 2014 to 2015 Drilling Program - Procedures

During October 2014 and October 2015, EMC-A completed two resource drilling programs on the Nyngan property. A total of 33 air core drill holes and three diamond holes were completed within the measured and indicated scandium laterite resource area. The aim of the drilling was twofold:

1. To further validate the previous air core drilling results done in 2006, with additional air core close infill drilling, particularly where the feasibility study was planning production pits.

2. To provide a large number of diamond core samples from a sufficient geographic area of the measured scandium resource area for laterite and lithological characterisation, grade validation, and specific gravity (SG) measurements.

Both the air core and diamond drilling activities utilised the same UDR650 drilling rig.

The air core drilling used a nominal 120 mm (2014) and 110 mm and 125 mm diameter aircore bits (2015) with 100 mm rods and an additional compressed air source to maximise sample recovery, and to minimise blockages through the drilling and cyclone system of the drilling rig. Sample returns passed through a standard cyclone into a clean plastic bulk bag for each metre drilled. The bulk bag was delivered to the sampling and logging crew who were employees of Rangott Mineral Exploration Pty Ltd. The air core drilling was completed by an experienced driller with at least 20 years of drilling experience and extensive experience drilling lateritic deposits in NSW.

The diamond drilling program used a standard PQ (83 mm / 3¼") diamond drilling configuration with a triple tube set up to maximise recovery and the condition of the recovered core. While recovery was variable in the alluvial overburden (improving during the program), recovery of laterite, saprolite and saprock was excellent and usually was 100% for most drilling runs of up to three metres in length. The recovered core was marked with a driller's line and placed into plastic PQ diamond core trays. Core mark up, recoveries and geological logging was completed on site before transport to RME's Orange premises. At RME the core was stored in a locked up warehouse and placed on core racks where specific gravity measurements were taken. A number of short intervals of core were selected from each diamond hole and weighed wet and immersed. The core was then dried in a locked gas-fired dryer and then re-weighed and weighed immersed. Each interval was identified with an aluminium tag placed in the core tray and also in the aluminium tray used to move and dry each piece of core individually. After the specific gravity measurements were completed the core was returned to the core trays ready for splitting and sampling.

In addition to the air core and diamond drill work, one large diameter (48.65 m) PQ geotechnical core hole (MP-BH01) was drilled to bedrock between the two planned initial pit areas. This hole intersected 20 m of limonitic laterite. SG determinations on core from this hole were incorporated in to the average SG figures used in the resource calculations but the assay data were not.

10.4 Drill Recoveries and Drilling Conditions

The 2006 drill program suffered some progress delays, caused by blockages in the head take-off tube, especially in gravel overburden. Except for occasional hard hematite (hole NA85 was abandoned due to hard hematitic ground), the laterite zone generally allowed good drilling and recovery. A hammer bit (4¾" = 121 mm diameter) was used in one hole (NA100) due to hard ground.

The 2014 to 2015 drill program results were similar, in that the alluvial gravels were the area where productivity was reduced. Sample recovery during the air core drilling program was satisfactory. Diamond core recoveries were determined by accurate length measurements taken on the drill core recovered during drilling. The recovery of diamond drill core during the program was very good except for several intervals in the overlying alluvial gravels.

Moisture was not a problem for either the 2006 or the 2014 to 2015 air core drilling programs, as surface drilling conditions were dry, with only minor water encountered. The hematitic and limonitic laterites intersected were also generally dry with good recoveries. Saprolite intersected was dry to moist and sticky, with some minor impact on recoveries, however recovery overall was good. Diamond core quality from the 2014 to 2015 campaign was excellent from the three diamond holes and the core was mostly competent and recovered in solid lengths.

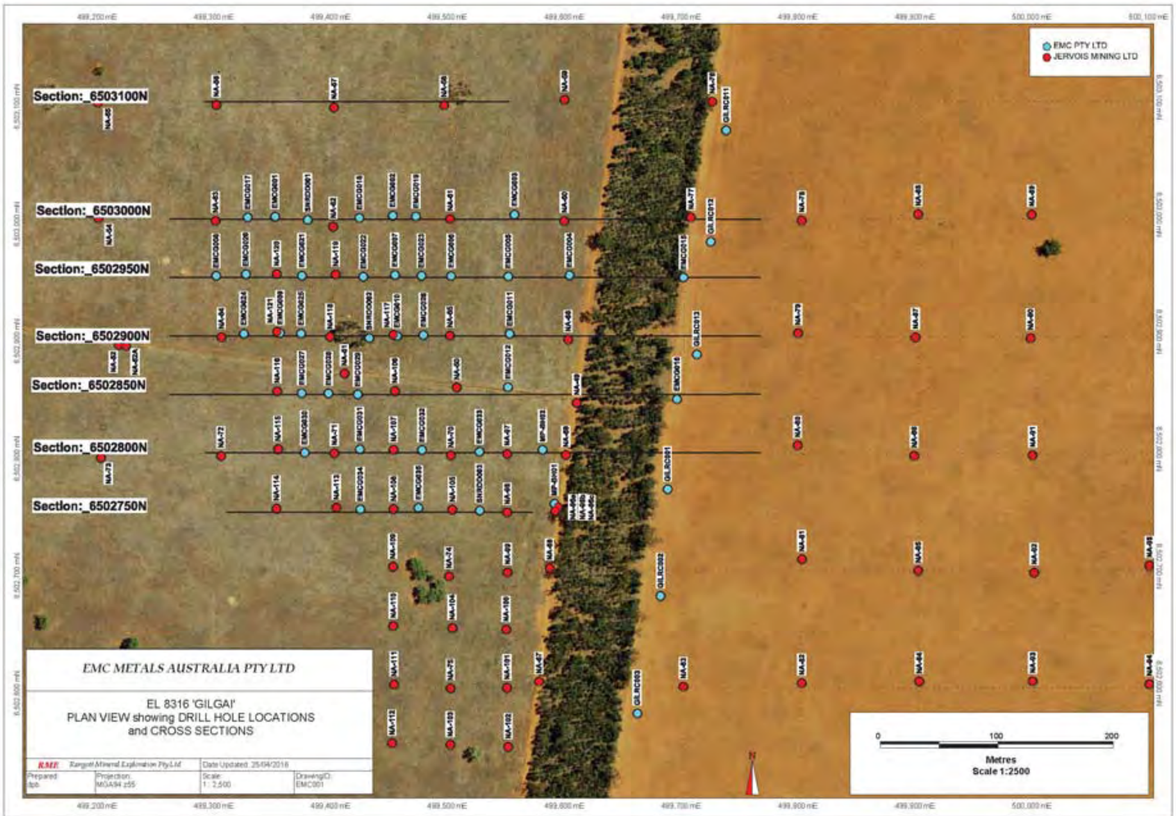
10.5 Drill Collar Surveying and Locations

The 2006 program completed each hole by capping it with a blast hole plug about one metre down from the collar and backfilling. The hole's position was then surveyed using a Garmin GPS12 XL instrument and a marker pin with drill hole number was placed in the collar location. At the end of the drilling program, Consulting Surveyors, Langford and Rowe of Dubbo completed a controlled survey of the drill hole collars using a Leica Differential (RTK and static) system.

The 2014 to 2015 program completed each hole similarly, and then located both air core and diamond drill hole collars with a Trimble GeoExplorer 6000 differential GPS meter. The data was post-processed, and has 10 cm vertical and horizontal accuracy. All coordinates were reported in Map Grid of Australia (MGA94) Zone 55 projection.

The collar plan for the holes included in the Resource is shown in Figure 10.1.

Figure 10.1 Total Drilling Program – Collar Plan



10.6 Establishing Higher Confidence in Proposed Mining Location

The 2014 to 2015 air core program was designed to provide infill to the existing 100 m x 100 m and 50 m x 50 m spaced areas of the resource. The objective of this program was to provide 50 m x 25 m spaced holes, particularly in the higher grade section of the resource, to confirm continuity of grade and thickness of the mineralised horizon at that drill spacing and to provide information on the future grade control requirements for the deposit.

The three diamond holes were drilled primarily for geotechnical information.

The most recent air core program also confirmed that the laterite portion of the resource has the higher scandium grades, when compared to typical scandium grades occurring in the saprolite intervals. The limonite and saprolite intervals do vary in thickness laterally, and the grade also varies. Ground water and below surface topography are suggested as significant in determining the grade of scandium in these intervals.

10.7 Relevant Samples – 2014 and 2015 Drilling Results

Refer to Table 10.1 and 10.2 for the significant intervals relating to the 2006 and the 2014 to 2015 drill programs. All widths are considered true as the holes were drilled vertically. The results are calculated using a 100ppm cut-off for the interval grade.

Table 10.1 2006 Drill Program Assay Results by Hole

Nyngan Scandium Property - 2006 Drill Program Resource Drill Results (68 hole Results)											
Hole Number	From m	To m	Width m	Sc Grade ppm	Section CDA	Hole Number	From m	To m	Width m	Sc Grade ppm	Section CDA
NA-52A	22	30	8	348	499200E	NA-101	16	40	24	260	499550E
NA-54	19	45	26	184		NA-100	14	32	18	248	
						NA-99	13	34	21	219	
NA-72	17	21	4	179	499300E	NA-98	14	40	26	236	
NA-64	15	31	16	350		NA-97	15	31	16	235	
NA-63	15	53	38	248							
NA-56	24	49	-14	174		NA-67	15	28	13	252	499600E
						NA-68	14	41	27	183	
NA-114	18	25	7	268	499350E	NA-96C	16	40	24	193	
NA-115	14	24	10	346		NA-69	14	34	20	182	
NA-116	14	23	9	242		NA-49	16	42	26	242	
NA-121	14	28	14	412		NA-66	13	40	27	389	
NA-120	14	40	26	366		NA-60	15	53	38	262	
NA-113	15	17	2	235	499400E	GILRC003	15	25	10	385	499650E
NA-71	12	33	21	257							
NA-51	12	24	12	495		NA-83	14	19	5	211	499700E
NA-118	14	33	19	401		GILRC002	14	55	-30	197	
NA-119	13	40	27	267		GILRC001	11	22	11	176	
NA-62	13	50	37	279		GILRC013	14	48	-28	330	
NA-57	49	65	16	240		GILRC012	34	61	27	383	
						NA-77	20	47	27	248	
NA-112	17	29	12	168	499450E						
NA-111	16	29	13	287		NA-82	15	20	5	227	499800E
NA-110	14	40	26	299		NA-81	13	42	29	177	
NA-109	14	35	21	186		NA-80	31	62	31	359	
NA-108	14	27	13	257		NA-79	22	53	-27	285	
NA-107	14	28	14	274		NA-78	18	46	-16	194	
NA-106	16	24	8	169							
NA-117	15	36	21	342		NA-84	14	28	14	290	499900E
						NA-85	17	20	3	201	
NA-103	18	26	8	294	499500E	NA-86	28	53	25	410	
NA-75	14	35	21	251		NA-87	41	58	17	191	
NA-104	13	40	27	268							
NA-74	13	40	27	277		NA-93	20	30	10	212	500000E
NA-105	15	35	20	173		NA-92	24	32	8	147	
NA-70	16	35	19	357		NA-91	44	60	16	202	
NA-50	18	30	12	261							
NA-65	16	39	23	316		NA-95	26	42	16	126	500100E
NA-61	16	34	18	259							
NA-58	31	51	20	246							

Table 10.2 2014-15 Drill Program Assay Results by Hole

Nyngan Scandium Property - 2014-15 Drill Program Resource Dill Results (36 hole Results)											
				Scandium Grade						Scandium Grade	
Hole Number	From m	To m	Width m	ICP ppm	Fusion ppm	Hole Number	From m	To m	Width m	ICP ppm	Fusion ppm
EMCG001	15	28	13	179	213	EMCG021	15	38	22	228	349
EMCG002	16	43	27	229	282	EMCG022	15	38	23	220	324
EMCG003	14	61	47	235	281	EMCG023	15	32	17	203	330
EMCG004	12	47	35	172	189	EMCG024	15	33	18	208	298
EMCG005	13	43	30	161	189	EMCG025	15	30	15	247	336
EMCG006	17	36	19	309	391	EMCG026	16	35	19	284	339
EMCG007	15	36	21	196	269	EMCG027	15	29	14	249	315
EMCG008	15	39	24	188	249	EMCG028	14	36	22	258	303
EMCG009	14	30	16	262	335	EMCG029	14	34	20	300	356
EMCG010	15	35	20	325	440	EMCG030	15	31	16	285	343
EMCG011	14	32	19	222	247	EMCG031	14	32	18	324	428
EMCG012	14	39	25	170	191	EMCG032	16	30	14	235	282
EMCG015	24	62	38	236	292	EMCG033	17	36	19	300	348
EMCG016	11	26	15	209	316	EMCG034	17	30	13	153	170
EMCG017	15	48	33	170	239	EMCG035	15	23	8	130	141
EMCG018	15	41	26	202	241	SNRDD001	15	22	7	433	479
EMCG019	18	39	21	303	355	SNRDD002	13	47	34	232	285
EMCG020	15	36	21	255	341	SNRDD003	14	44	30	240	252
NOTE: ICP method is ME-ICP assay with 4 acid digestion, Fusion method is ICP-06 assay with fusion preparation											
Section CDA's for all holes in this table range from 499,300E to 499,700E											

Select cross sections of the drilling results are shown in Figures 10.2 to 10.8.

Figure 10.2 Gilgai Drilling – Cross Section 6502750N ± 25m

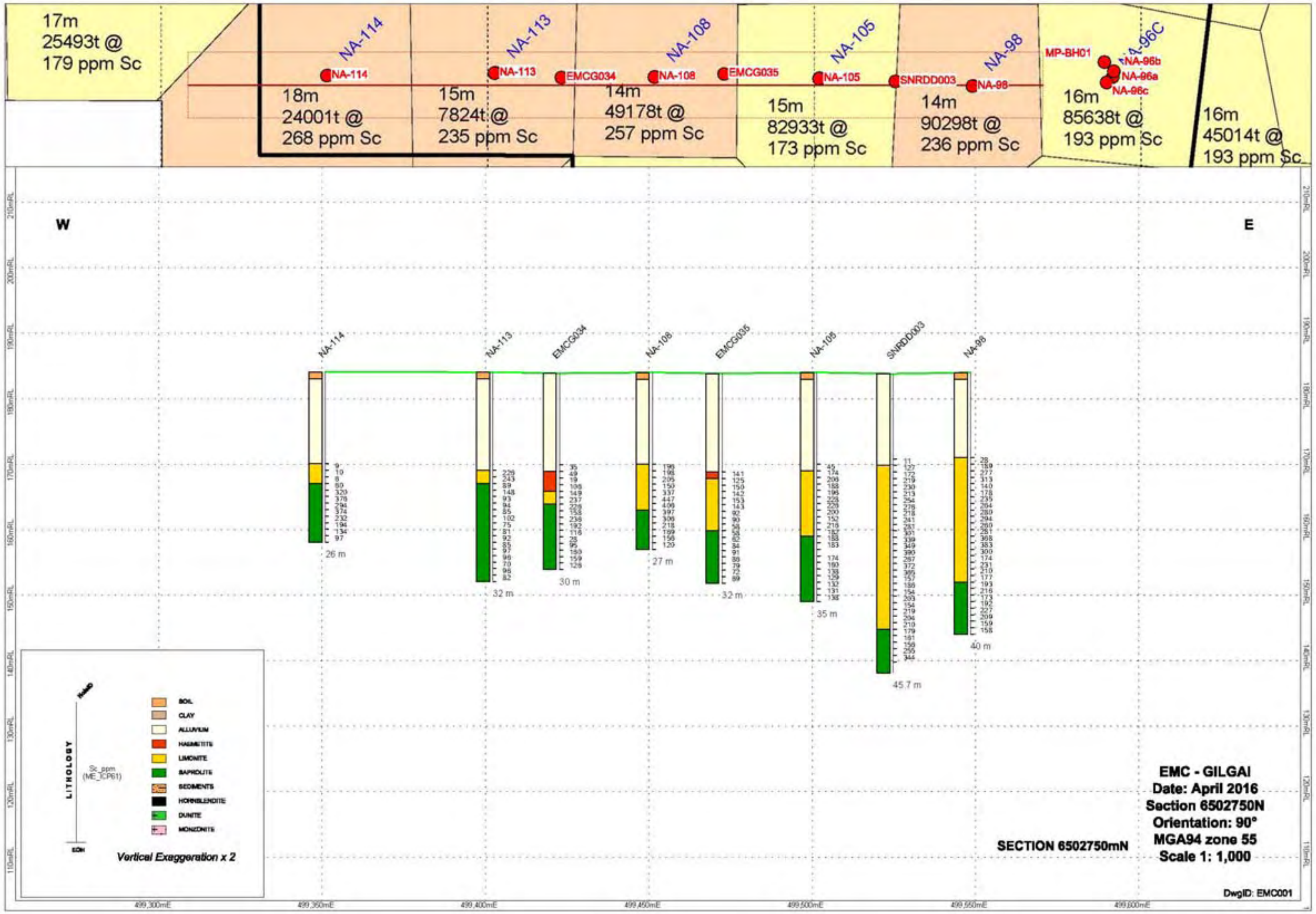


Figure 10.3 Gilgai Drilling – Cross Section 6502800N ± 25m

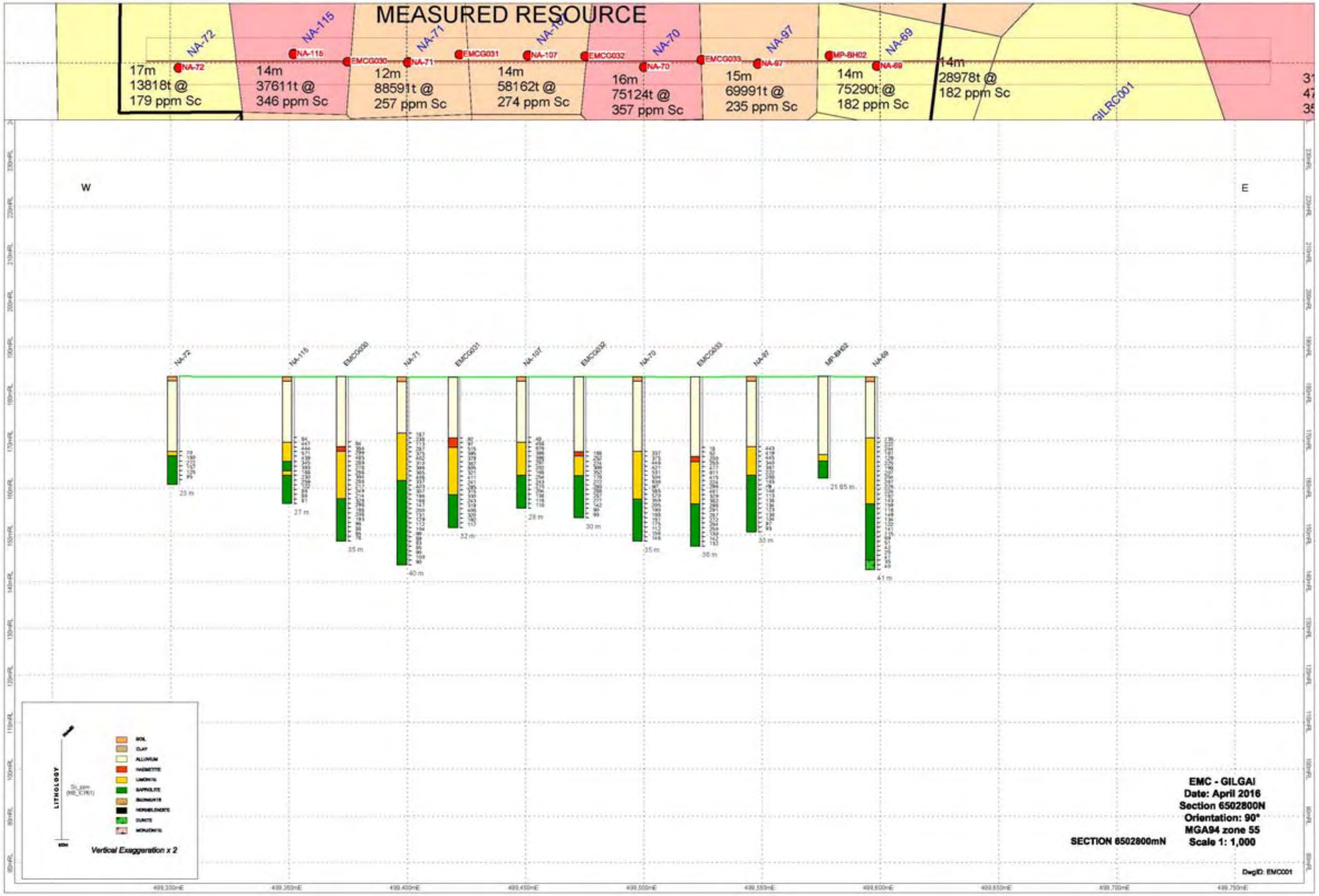


Figure 10.4 Gilgai Drilling – Cross Section 6502850N ± 25m

Figure 10.5 Gilgai Drilling – Cross Section 6502900N ± 25m

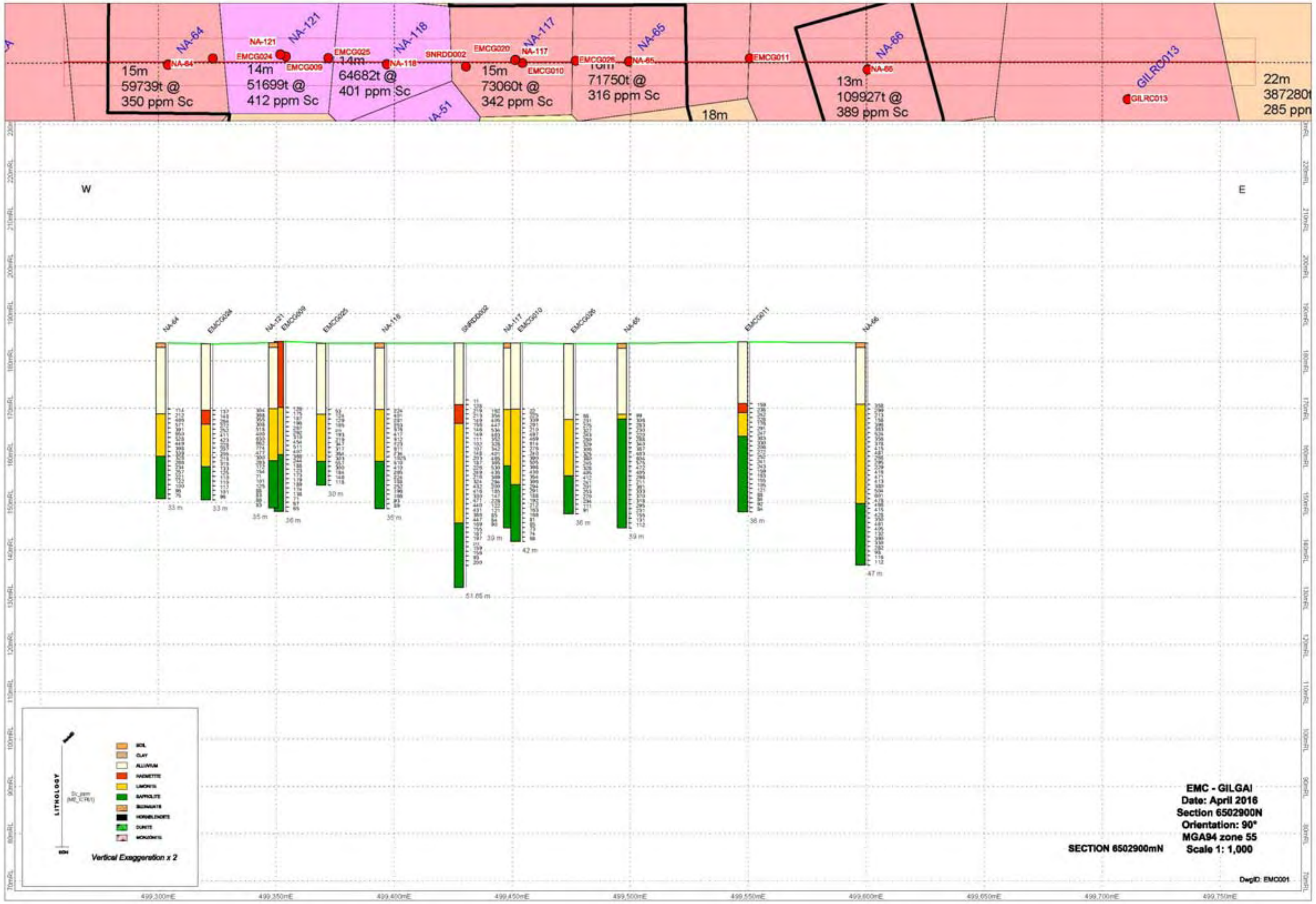


Figure 10.6 Gilgai Drilling – Cross Section 6502950N ± 25m

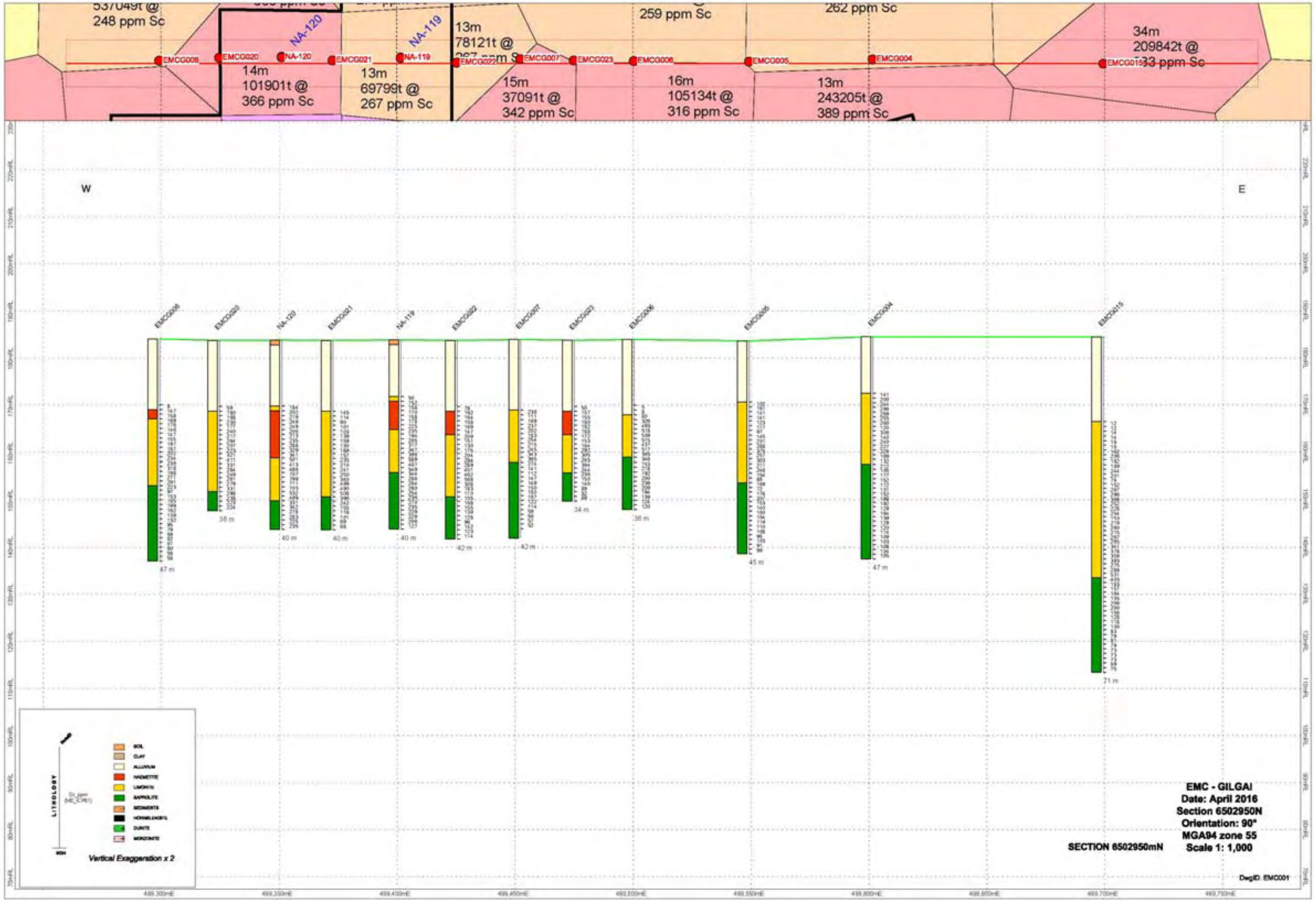
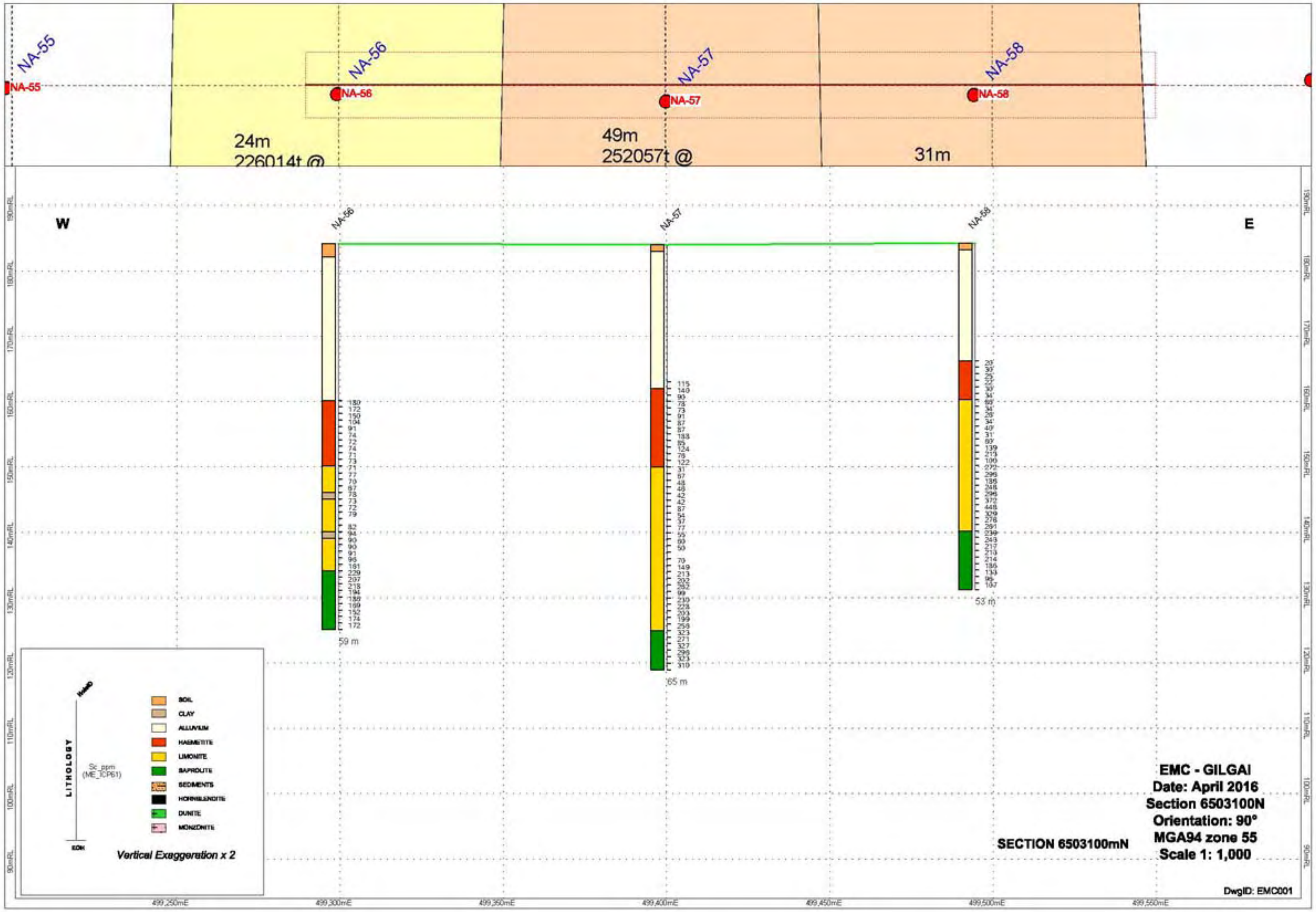


Figure 10.7 Gilgai Drilling – Cross Section 6503000N ± 25m

Figure 10.8 Gilgai Drilling – Cross Section 6503100N ± 25m



10.8 Specific Gravity Determinations

As described in Section 10.3, in-situ (wet-weight basis) and dry-weight basis specific gravity determinations were made on sections of core from holes SNRDD-001, 002, and 003. Four determinations were made on alluvium, four on hematitic laterite, 58 on limonitic laterite, 27 on saprolitic material, and three on bedrock.

In addition, dry-weight determinations only were made on core from geotechnical hole MPBH-01, including three sections of alluvium, 16 of limonitic laterite, nine of saprolitic material and one of bedrock. The data was combined to calculate average specific gravity figures, the ranges of specific gravity values and average moisture contents for each lithotype. These are summarised in Table 10.3. The "dry-weight" SGs were used in the resource calculations.

Table 10.3 Specific Gravity and Moisture Content Determinations

Rock Type	**Average Insitu SG** (wet weight basis)	**Average Dry Weight SG** (dry weight basis)	**Dry Weight SG Range**		**Average Moisture Content (%)**
			Low	**High**	
Alluvium	2.06	2.02	1.86	2.21	13.6
Hematite	2.42	2.24	2.12	2.38	13.3
Limonite	2.18	1.88	1.56	2.62	16.6
Saprolite	1.85	1.64	1.24	2.66	19.6

11.0 SAMPLING PREPARATION, ANALYSES AND SECURITY

11.1 Sample Recovery Methods - General

The Nyngan property resource has proven itself very amenable to air core drilling, based on depth, material characteristics, and overall efficiencies in applying this drill technique. While some sample recovery risk is inherent in any drilling technique, air drilling techniques require care in certain specific areas to minimise potential error. The application of this drill technique is common in laterite mineralisation, and is the drill technique of choice in the NSW lateritic belt. The combination of available reverse-circulation drill rigs, the use of high air flow rates, and a competent, experienced drill operator resulted in acceptable resource sample recoveries from this technique.

Maintaining and observing consistency in sample weights is a good basic indicator of driller performance in the resource. The weights of the bulk (1 metre interval) samples were generally in the target range of 11 to 15 kg, with only occasional deviation to lower or higher weights.

In damp or wet stratigraphy (particularly the leached saprolite), sample weights did often drop below 10 kg, possibly due to returns sticking to the internal walls of the rod string and the pipe work leading to the cyclone, to the walls of the cyclone itself, or possibly remaining in the drill hole behind the bit. The main effect of this was likely some 'smearing' (contamination) of assay values across subsequent sample intervals, which might in turn affect average grades as observed in the lower level saprolite lithology. This is considered unlikely to have had any material effect on the overall grade of each lithology in the resource model.

11.2 Sample Recovery Methods – 2006 Drill Program

The 2006 drill program sampling method (Competitive Drilling Services Pty. Ltd.) collected initial samples through a cyclone mounted directly on the drilling rig, individually captured, at one metre intervals, in large plastic bags (bulk sample bags). These large bags were individually weighed, and magnetic susceptibility readings taken.

Each hole was geologically logged by sieving material from each of these large bags, into smaller sample bags of 1 to 2 kg each (assay sample bags). The smaller samples were collected for analysis using a metal scoop by hand. Reference chip samples were also taken for each drill hole. The air was expelled from the small bags, the tops folded down several times, and sealed with heavy-duty staples. All drill intervals below the alluvial overburden were sampled in this manner, generating an individual assay sample bag for each.

The small plastic assay sample bags were packed into labelled larger plastic bags for ease of shipment and better protection against damage, and transported to a secure shed in Nyngan at the end of each day, where they remained locked until the end of the drilling program. Shortly after the end of the program, all of the assay sample bags were loaded onto pallets, shrink-wrapped and sent to the Australian Laboratory Services Pty Ltd's (ALS) assay facility in Orange by commercial road transport, a distance of 315 km by road, for mineral assay.

Approximately a week after the completion of the drilling program, concurrently with rehabilitation of the drill sites, all of the large bulk sample bags, except those of alluvium or metasediments, were transported to a locked, secure shed owned by Jervois, for long-term secure storage.

At a later date, Jervois personnel retrieved a limited number of the stored one metre bulk samples, and using a riffle splitter, split off new samples for analysis, to check against those samples collected by scoop. The scandium assay values for the split samples corresponded closely to those of the scooped samples sent earlier for assay to ALS in Orange.

The 2006 program bulk sample bags were subsequently retrieved by Rangott Mineral Exploration personnel, and placed in a secure storage facility managed and controlled by Rangott Mineral Exploration Pty Ltd, in Orange, NSW (RME).

11.3 Sample Recovery Methods – 2014 to 2015 Drill Program

The 2014 to 2015 drill program (Drillit Consulting Pty Ltd) sampling method was similar to the earlier 2006 program. Bulk pre-numbered sample bags were delivered from the drilling rig cyclone to the sampling crew by the driller's offsider. The driller signalled to the offsider when each metre had been drilled and the sample from each metre was downloaded into the bulk bag while attached to the outlet of the cyclone. The pre-numbered bulk bags were available for each metre drilled, and were used to eliminate cross contamination and splitting issues encountered by the use of buckets or bins. Careful checking of metres drilled was undertaken after every 10 m drilled and tallied with the bulk bags that were placed in lines of 20 m.

Each hole had both pre-numbered plastic bulk and calico assay bags, marked with pre-determined depths based on the expected final depth of each hole and depth of alluvium. Sample numbers were designated by the hole number and depth interval to eliminate sampling errors with sequential numbering. Spare plastic and calico bags were also available in case a drill hole was drilled deeper than expected.

Alluvium was not sampled, however it was collected into a bulk bag on a metre basis and stored at each drill site for future reference. Due to variability of the depth of alluvium in each hole, the decision to commence splitting and sampling was based on the visual identification of laterite in the bulk bags (during drilling, with special attention taken close to the anticipated laterite contact). In some cases, a further check of the bulk samples resulted in additional sampling of intervals where mixed alluvium-laterite was encountered.

Each bulk bag was weighed on delivery by the driller's offsider on a set of Wedderburn high capacity scales. A tare weight was programmed into the scales. Sample weights for each metre drilled, excluding alluvium were recorded during the operations bulk sample weight sheets. The bulk bags were lined up ready for splitting after weighing was completed. Alluvium bags were not weighed and were lined up in the designated bulk bag area for each drill hole.

When laterite was identified in the bulk bags, the corresponding pre-numbered plastic bulk and calico assay bags were attached to a three tier splitter. The plastic bulk bag from the corresponding interval was then emptied into the splitter. On completion of each hole and the splitting off of a duplicate sample (one per hole), all calico assay bags were collected into polyweave bags and sealed with a cable tie. The polyweave bags were stored in locked premises before being transported, as one lot, to RME's premises in Orange where blanks, standards and high grade check pulps were inserted into the bags. The assay bags were then shipped by RME to ALS in Orange, NSW, for mineral assay. At all times, the assay samples were either supervised by RME personnel or secured in locked premises.

One metre reference chip samples were taken for each hole during the sampling and splitting operation with a small sample retrieved from the split bulk bag via a sample spear. Minimal dry sieving was undertaken with a representative sample collected for each metre and spooned in to a pre-labelled 20-compartment plastic chip tray. A sample sheet, brief geological log (lithology only) and cross section was updated during the splitting and sampling operations for each hole in conjunction with the collection of chip tray samples. As a general observation, once the laterite-alluvium contact was intersected, no further alluvium was encountered, and splitting and sampling operations were continuous from that point to the end of each hole (EOH). EOH was determined by assessment of the amount of hard saprolite or saprock present during sieving. After the weighing, splitting and sampling and drill chip collection the numbered bulk sample bags were placed in lines of 20 and folded over.

Specific actions were taken to maintain sampling accuracy and minimise contamination of individual samples at the drill site, for both bulk and assay samples. The cyclone was cleaned before the drilling of each hole and was inspected regularly during the drilling. After blockages, the drill rods and hoses were flushed with air to remove potential contamination. The drilling of at least 15 m of alluvium cover in each hole was also thought to be effective at removing contamination from hole to hole. Clean blank bags were only used on the cyclone with the collection of bulk air core samples on a metre basis. The three tier splitter was thoroughly cleaned between the splitting of one metre samples. After completion of drilling, the air core bulk sample bags were either transported back to Orange or stored in a fenced bag farm at the Nyngan property site. The holes stored at the Nyngan site were re-sampled for the purposes of keeping archive samples from those holes. The archive sampling was completed during the drilling program using a sample spear and plastic bags sealed with cable ties.

Diamond core sampling followed a different protocol, tailored to the different technique. After initial logging (at the drill site) of the diamond drill core, coherent 10 to 20 cm long pieces of core were selected for subsequent specific gravity (SG) determinations. The individual cores had their top and bottom depths marked on them, they were then wrapped in cling-wrap to reduce moisture loss, and were returned to their positions in the core trays. The core trays were securely strapped in to the trays of two RME vehicles and an RME industrial trailer, and transported to Orange, to RME's storage facility, in two lots. At Orange, the trays were unloaded and stored in RME's locked warehouse.

After the specific gravity measurements and all other logging activities were completed, the diamond core was split and sampled by RME personnel. The majority of the core was split with the use of a paint scraper, hammer and chisel and in some cases a historic core splitter. The more competent core was cut with a diamond core using minimal water flow to minimise core loss. Duplicate intervals were identified before splitting and cutting. After splitting and cutting the ½ core was sampled on a metre basis and where duplicate intervals were indicated, a ¼ core sample was included in the main sample stream at the end of the sampling interval in each hole.

11.4 Assaying and Analytical Procedures

All samples, from both drill programs, were sent to the same assay laboratory for sample preparation, ALS Laboratories in Orange, NSW. This facility has extensive experience with NSW laterites and was considered highly experienced and knowledgeable with regard to the nature of the local material represented at Nyngan.

The 2006 drill assays were delivered to the ALS facility in Orange, NSW, where pallets of samples were stored for several days prior to sample preparation. ALS dried the samples and pulverised them in accordance with their PUL-23 protocol, described below:

> *"A sample up to 3 kg is ground in a ring mill pulveriser using a standard low-chrome steel ring set. If the sample is >3 kg, it is split prior to pulverizing and the remainder may be retained or discarded. Samples too coarse to be put directly into a pulverizing mill, or where the particle size needs to be reduced before a representative split can be taken are crushed and split prior to pulverizing. The remainder may be saved or dumped at the client's request."*

From the pulverised material, two 150 g sub-samples were taken, and sent to the ALS head office facility in Brisbane. The PUL-23 method has a specified grind size of 85% less than 75 µm. The remainder and majority of the samples were analysed by ALS in Orange.

The bulk of the assays, conducted by ALS Orange, were analyzed by Technique ME-MS62s, a single-element trace level method. A 0.25 g aliquot of the sub-sample was digested using a standard "four acid" method consisting of perchloric, nitric, hydrofluoric and hydrochloric acids (regarded as a "near-total" decomposition), and the solution was then analyzed by Inductively Coupled Plasma - Mass Spectrometry, with a lower detection limit for scandium of 1ppm and an upper limit of 500ppm.

Samples which assayed ≥500ppm scandium were re-analysed by Technique ME-ICP61. This method uses the same four-acid ("near-total") digestion method with a similar 0.25 g aliquot, with Inductively Coupled Plasma Atomic Emission Spectroscopy determination of scandium with a lower detection limit of 1ppm and an upper limit of 10,000ppm (1%). This technique also analyses for a range of elements.

The two small batches of samples assayed by the Brisbane ALS Head Office were analysed by Technique ME-ICP AES, Inductively Coupled Plasma-Atomic Emission Spectroscopy, specifically type OG-62. A 0.4 to 0.5 g aliquot of the sub-sample was similarly subjected to a four-acid digestion, then analysed for a range of elements (which included scandium), with a lower detection limit for scandium of 1ppm.

The results of the two different laboratory tests and techniques was not divergent, and indicated little preference for one technique over the other-with respect to scandium assay accuracy or repeatability. Where a full suite of element assays are desirable, the multi-element result from ME-ICP61 technique was considered desirable and was adopted in later assay work.

In 2014, ALS and Rangott Mineral Exploration Pty Ltd, discovered a tendency for the traditional four-acid digestion technique to either incompletely digest scandium or to re-precipitate scandium prior to final assay, thereby subsequently generating an understatement of scandium present in the following assay step. The tendency was more pronounced in limonitic and hematitic clays than in saprolitic clays, and more significant in laterites exceeding 100ppm. ALS believes this is a result of premature precipitation of CaF_2 in the test tubes during digestion. This concern has been further reinforced by results from a lithium borate fusion digestion technique to replace the four-acid digestion step, followed by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) for assay. The fusion-ICP process is referred to as Technique Sc-ICP06, and it consistently generates scandium assays noticably higher in the Nyngan resource. Other groups, specifically assaying lateritic clays for scandium using ALS laboratories in Australia, are finding similar results.

The analytical process for Sc-ICP06, as described by ALS, is as follows. A small sample (0.1 g) is fused in 12:22 flux, which is a mixture of 12 parts lithium tetraborate and 22 parts lithium metaborate. The fusion is carried out in a graphite crucible at 1,000°C. The resultant glass (solidified from cooling the melt) is dissolved in dilute acid and made to volume of 100 ml. There is no visible undissolved sample residue after the fusion, although sometimes there is a small amount of graphite powder from the crucible. Once the fused sample is dissolved into the liquid acid, the solution is then assayed for scandium by ICP-AES.

The Company notes that fusion digestion results generally deliver higher scandium assays than the four-acid digestion method, traditionally used in nickel and cobalt assay work, where the Sc content is >100ppm. The Company believes the fusion technique generates a truer assay result, and intends to rely on and utilise fusion digestion techniques going forward to support mine planning and advanced economic and development studies. The fusion results were the only assay results used in the updated 2016 resource with regard to the 2014 to 2015 drill program. The assays on the 2006 drill program, also a part of the updated 2016 resource, are only available in ME-ICP61 as completed in 2006, and were included in that form as previously applied to earlier resource estimates.

The 2014 to 2015 drill samples were assayed using two independent techniques, ME-ICP61 and Sc-ICP06 (fusion) analysis, to determine and compare the scandium content and to also obtain the multi-element content of each sample. ALS in Orange did the initial sample preparation work, while ALS Brisbane did the assay work, in the same manner as the 2006 assay work was completed. A comparison of the two assay techniques, over all 33 air core holes and all three diamond core holes in the 2014 to 2015 program, showed a 25% higher scandium assay result with a lithium borate fusion assay system (weighted average over all assays and one metre lengths).

ALS / Orange dried and weighed the received assay samples, and pulverised the entire sample to 85% passing 75 microns or better (technique PUL-21). 50 g bags of the pulps were then split off and sent to the ALS laboratory at Stafford in Brisbane, Queensland for analysis.

ALS / Brisbane analysed the pulps for scandium, nickel, cobalt, chromium, iron, magnesium, manganese, aluminium and calcium, using Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) after a four acid digestion (technique ME-ICP61). The results were also repeat-tested, only for scandium, using a lithium borate fusion digestion technique, followed by similar ICP-AES assay. The lower detection limit for scandium using either technique is 1ppm. RME included one commercial standard sample and three high-grade scandium pulps from previously analysed batches, for quality control; and also included one duplicate sample from each hole in the batch. For internal quality control, ALS / Brisbane added additional standard samples (for repeat analyses), blank samples and duplicate samples to the batch.

11.5 Laboratory Certification

None of the assay samples used to support the mineral resource estimate contained in this report were prepared for analysis by any employees or subcontract personnel of EMC-A or by Jervois Mining Limited. All assay samples, from all drill programs included in the resource estimate, were prepared by Australian Laboratory Services Pty. Ltd. (ALS).

The ALS staff are supported by a Quality Management System (QMS) framework which is designed to highlight data inconsistencies sufficiently early enough in the process to enable suitable corrective action to be taken in time to meet reporting deadlines. The QMS framework follows ISO 17025:2005 for laboratory analysis. The ALS Laboratories used by EMC-A are certified by NATA. ALS is completely independent of EMC-A and its Parent, SCY.

11.6 Quality Control – Duplicates, Blanks, and Standards

Both the 2006 drill program and the 2014 to 2015 drill program utilised duplicate assay pulps, and followed the practice of inserting blanks and standards into the assay process.

Rangott Mineral Exploration personel were present in supervisory roles on both programs, and ALS followed these quality control steps as well, and provided certificates to verify the practice. Specific detail is provided on the 2014 to 2015 program, as follows:

Every hole in this program (36) had a duplicate inserted, at a random depth. The duplicate was selected semi-randomly from either laterite and saprolite lithologies with preference given to intersections from the anticipated Sc ore zones. The bulk one metre sample was split and sampled using the same procedure used during the sampling of all aircore drill holes. The duplicate interval was recorded on the sample sheet and backed up with a permanent label on the relevant bulk bag (DUP or *). The duplicate sample calico bag sent for assay was designated by the hole number and the suffix 'X2', so that the laboratory had no indication of the depth interval of the duplicate.

A blank sample consisting of Tertiary Basalt crusher dust was inserted before each duplicate sample and designated with the hole number and suffix 'X1'.

Duplicate intervals for the diamond drill holes were pre-selected and included laterite and saprolite lithologies. One duplicate each was selected for diamond drill hole SNRDD001 and SNRDD002, while two duplicates were selected for diamond drill hole SNRDD003. During the splitting and sampling process, when a duplicate interval was reached, the core was split into ¼ cores. The duplicate intervals were recorded and sampled into a separate calico bag with a sample number designated with the hole number and a false depth interval at the end that hole.

The duplicate results demonstrated that the results were repeatable with only three duplicate samples varying by more than 5%, when the duplicate result was compared to the result for the corresponding interval. These duplicate results included EMCG018, 29 to 30 m, difference of +5.79%, EMCG025, 24 to 25 m, difference of +6.02% and SNRDD003 20 to 21 m, difference of -7.81% (see Table 11.1 for duplicate results).

Table 11.1 2015 Duplicate Samples

Collar	Drill Type	Sample Type	From (m)	To (m)	Duplicate Result Sc ppm	Interval Result Sc ppm	Difference %
EMCG017	Aircore	Duplicate	36	37	309	313	1.28
EMCG018	Aircore	Duplicate	29	30	407	432	5.79
EMCG019	Aircore	Duplicate	23	24	354	362	2.21
EMCG020	Aircore	Duplicate	20	21	321	322	0.31
EMCG021	Aircore	Duplicate	23	24	266	273	2.56
EMCG022	Aircore	Duplicate	23	24	291	288	-1.04
EMCG023	Aircore	Duplicate	21	22	322	325	0.92
EMCG024	Aircore	Duplicate	22	23	380	390	2.56
EMCG025	Aircore	Duplicate	24	25	468	498	6.02
EMCG026	Aircore	Duplicate	16	17	296	295	-0.34
EMCG027	Aircore	Duplicate	23	24	383	390	1.79
EMCG028	Aircore	Duplicate	23	24	257	251	-2.39
EMCG029	Aircore	Duplicate	21	22	494	504	1.98
EMCG030	Aircore	Duplicate	24	25	312	306	-1.96
EMCG031	Aircore	Duplicate	20	21	508	527	3.61
EMCG032	Aircore	Duplicate	21	22	187	193	3.11
EMCG033	Aircore	Duplicate	23	24	439	430	-2.09
EMCG034	Aircore	Duplicate	22	23	270	267	-1.12
EMCG035	Aircore	Duplicate	22	23	104	105	0.95
SNRDD001	Diamond	Duplicate	20	21	272	266	-2.26
SNRDD002	Diamond	Duplicate	42	43	213	204	-4.41
SNRDD003	Diamond	Duplicate	20	21	290	269	-7.81
SNRDD003	Diamond	Duplicate	30	31	356	356	0.00

A number of certified standards and high grade Sc laterite reference duplicate pulps were inserted into the aircore sample stream submitted to ALS Laboratories in Orange, NSW. The two certified standards used (see Table 11.2), included Oreas 45d and Oreas 45e (see Table 11.2).

Three high grade reference duplicate pulps were also used and were obtained from bulk drill samples from another high grade scandium laterite deposit in NSW for which Sc had been determined by analytical methods ME-ICP61 and Sc-ICP06 (fusion) (ALS Laboratories) and Neutron Activation method INAA (ActLabs Canada). The high grade reference duplicate sample numbers are HGSR-1, HGSR-2 and HGSR-3. These are not certified standards; they are essentially reference duplicate samples.

Table 11.2 2015 Standard (Reference) Samples

Sample No.	RME Analytical Batch Number	Drilling Program	Sample Description	Sample Internal Number	OREAS Standard Certified value (ICP-OES, ICP-MS)	Sc-ICP06 (Fusion) previous results	ME-ICP61 result	Sc-ICP06 (Fusion) result	Difference % Comparing certified value and Sc-ICP06 result
10968	RME/EMC/012	Aircore	Reference Sample	HGSR-2		674	451	708	5.04
10969	RME/EMC/012	Aircore	Reference Sample	HGSR-3		611.6	488	627	2.52
10970	RME/EMC/012	Aircore	Certified Standard	OREAS 45d	49.3		51	51	3.45
10971	RME/EMC/012	Aircore	Reference Sample	HGSR-3		611.6	464	638	4.32
10972	RME/EMC/012	Aircore	Reference Sample	HGSR-2		674	466	685	1.63
10973	RME/EMC/012	Aircore	Certified Standard	OREAS 45e	93		83	92	-1.08
10974	RME/EMC/013	Diamond	Reference Sample	HGSR-1		628	585	624	-0.64
10975	RME/EMC/013	Diamond	Reference Sample	HGSR-3		611.6	550	609	-0.43
10976	RME/EMC/013	Diamond	Certified Standard	OREAS 45e	93		76	90	-3.23
10977	RME/EMC/013	Diamond	Certified Standard	OREAS 45d	49.3		49	48	-2.64
10978	RME/EMC/014	Diamond	Certified Standard	OREAS 45d	49.3		49	48	-2.64
10979	RME/EMC/014	Diamond	Reference Sample	HGSR-1		628	599	634	0.96
10980	RME/EMC/014	Diamond	Reference Sample	HGSR-3		611.6	465	620	1.37
10981	RME/EMC/014	Diamond	Certified Standard	OREAS 45e	93		90	87	-6.45

After the 2015 drilling program, a total of two certified standards and four of the high grade reference duplicate pulps were inserted into the assay sample stream. The variability between the certified standard assay results (assayed during the 2015 Nyngan program) and the certified value was -1.08% to 3.45%. The variability between the assay results for the high grade duplicate pulps (assayed during the 2015 Nyngan program) and the averaged historic assay results was 1.64% to 5.05% (see Table 11.2 for historic results and averages).

With the diamond drill samples, a total of four certified standards and four high grade reference duplicate pulps were inserted into the sample stream. The variability between the certified standard assay results and the certified value was -6.45% to -2.64%. The variability between the assay results from the high grade duplicate pulps (assayed during the 2015 Nyngan program) and the averaged historic assay results was -0.64% to 1.37% (see Table 11.2 for historic results and averages).

The performance of the high grade reference duplicate samples using the three analytical techniques is compared in Table 11.3 and lists all assay results obtained from these samples prior to the 2015 Nyngan drilling program. An average of the initial Sc-ICP06 Sc results and all subsequent historic Sc-ICP06 assay results for each of the high grade duplicate pulps (HGSR-1, HGSR-2 and HGSR-3) has been used to compare the performance of the use of these pulps with the 2015 program.

Table 11.3 2015 Standard (Reference) Samples

Sample No.	Initial Assay ME-ICP61	Reference Assays (ME-ICP61)	Average Assay (ME-ICP61)	Initial Assay (Sc-ICP06)	Reference Assays (Sc-ICP06)	Average Assay (Sc-ICP06)	Initial Assay (INAA)
HGSR-1	605	577, 653, 558.	598.25	622	619, 638, 633.	628	587
HGSR-2	531	467, 624, 477.	524.75	672	672, 679, 673.	674	637
HGSR-3	509	494, 441, 374.	454.5	600	606, 614, 622, 616.	611.6	583

11.7 Adequacy Opinion of Author

In the opinion of the QP, Stuart Hutchin, the quality of sample preparation, security and analytical proceedures is considered adequate. The Author also notes that ALS operates with a rigorous system of internal standards and duplicates, and participates in regular round-robin analyses of samples with other commercial laboratories worldwide.

Considerable development of analytical proceedures has been conducted by ALS in recent years for scandium contained in laterite deposits, including direct work in concert with Rangott Mineral Exploration Pty Ltd, on the Nyngan resource and other NSW lateritic scandium property targets under development by other mining companies.

12.0 DATA VERIFICATION

12.1 Data Verification Measures

The geological database has been provided to Mining One by Rangott Mineral Exploration Pty Ltd, (RME) and by SCY. RME has been involved with the project since the intitial drilling program was undertaken by Jervois in 2005, and SCY has been involved with the project since 2009. In addition to the drilling program data, Mining One has also been provided with ALS reports and assay logs on the drill hole data used in this Report.

During the period of ownership by EMC-A, a number of validation exercises have been completed on the database to provide a high level of confidence in the data used in the geological modeling and the associated Mineral Resource Estimate.

The following discussion provides a summary of the previous verification exercises completed by RME (as part of the previous NI 43-101 Technical Report) and by Mining One, as a part of the current Technical Report.

12.2 Data Verification on 2010 and 2014 Technical Reports

The following observations and independent checks by RME personnel were undertaken to support the accuracy and integrity of the assay and resource calculation work on the initial (2010) Nyngan Resource, on which Maxell Rangott was QP, and on the 2014 Technical Report (ammended in 2015), on which Maxell Rangott was also QP:

- RME personnel reviewed sampling techniques on the 2006 (and 2008) drill program holes, including the recording of sample recoveries captured on the drill log sheets.

- RME personnel verified the packaging and shipment of mineral samples to the ALS assay laboratory.

- Jervois employees who supervised the drill operators on the 2006 drill program were personally interviewed by Maxell Rangott, as to verification of process employed for field sample collection, preparation, and transport procedures.

- The analysis of the samples was conducted by ALS, an independent minerals assay laboratory, applying methods with wide industry acceptance, consistent with techniques others in this district had been using with confidence for some years, after various check analyses in other laboratories.

- ALS included standards, blanks and duplicates during the laboratory analysis and provided certificates to verify this practice. There were no anomalies reported from this control measure.

- The original ALS assay results documents are available, and in the posession of SCY and RME, and they were reviewed and checked for consistency by RME against assay results used in the previous NI 43-101 Technical Report, with an effective date of October 10, 2014.

- RME verified that proper care was taken to accurately locate the drill hole locations on the 2006 (and 2008) Nyngan drill programs. Drill collars were surveyed using a Garmin GPS12 XL instrument. A marker pin inscribed with the drill hole number was placed in each collar. At the end of the drilling program, Consulting Surveyors completed a controlled survey of the drill hole collars using (1.41) Differential GPS software.

RME has had the opportunity to participate in other project work in the district, where lateritic resources were being evaluated. This has generated data that has corroborating value for the Nyngan resource data accuracy, assay accuracy, and density calculation accuracy. Specifically:

- RME reviewed results of an assay check program done previously on laterite samples (predominantly from Jervois' nickel/cobalt laterite deposits at Young, NSW). This program compared ALS assay values to Becquerel Laboratories Neutron Activation assays on Young samples, both at laboratories at Lucas Heights, NSW, and in Canada, noting consistency in results, further supporting ALS work accuracy on Nyngan property laterite samples.

- RME reviewed results of a density check program on local laterites, again conducted by Jervois, comparing calculations on the four lithologies in the Nyngan resource, and compared them to those from another laterite project in NSW for consistency. RME also compared the density figures with those determined on core from a third prospect in NSW. Good agreement between the three sets of values for the hematitic and limonitic laterite were noted, with a somewhat lower value noted for the saprolitic laterite at Nyngan, when compared to the other two prospects.

The assay results of the 2014-15 SCY drilling program, while not a part of the drill hole data included in the 2014 Technical Report, were partially available in 2014, and were reviewed to validate the grades, lithologies and data consistency of the earlier drill results. The more recent drilling results that were available, were cross-checked by RME staff for that purpose, at the time the 2014 NI 43-101 PEA, ammended in 2015, was issued by SCY.

12.3 Mining One Data Verification on 2016 Technical Report

Mining One conducted independent verification on data used in this Technical Report, both in discussions with RME personnel, and through independent review and check of data resulting from the 2014 to 2015 drill program. Specific verification steps included:

- Review of ALS assay reports on the 2014 to 2015 drill program, confirming consistency with data files supplied by RME.

- Confirmation that ALS employed industry standard use of blanks, duplicates and standards in their assay results reporting.

- Detailed discussion with Maxell Rangott of RME, regarding work and steps taken to insure verification of data accuracy on the 2006 drill program, were Mr. Rangott had first-hand experience with the program and the results.

- Detailed discussion with RME personnel, who managed and field-supervised the drill program in 2014-15 for EMC-A, as to QA-QC steps taken at that time, and since, to secure data and samples.

- Independent verification with ALS regarding the validity of assay techniques used on Nyngan resource, specifically the validity, integrety and accuracy preference with respect to lithium borate fusion techniques over four acid digestion techniques for new assay results, where they are available with recent drilling assays.

12.4 Site Inspections

In accordance with NI 43-101 guidelines, Stuart Hutchin and Geoffrey Duckworth, both Qualified Persons with respect to this Report, have both visited the Nyngan project site within the six months prior to the effective date of this Report. The purpose of these visits was as follows:

- Understand and view the geological and geographical setting of the Project.

- Witness the extent and locations of development drilling conducted to date on the property, specifically the recent 2014 to 2015 drill program and recent geotechnical drilling supporting the site development plans in the feasibility study.

- Understand the ecological setting for the Project, including flora and fauna on site, water management, and potential impacts from mine development and mitigation strategies that should be a part of mine and property development.

- Understand logistical matters with respect to haul roads, topography, fencing needs, proximity to neighbors and to evaluate the resources and support capabilities in existance in the town of Nyngan.

12.5 Opinion on Data Adequacy

The 2006 to 2008 resource database and information was verified without discrepancy by Maxell Rangott for SCY, as a part of a 2014 NI 43-101 Technical Report Ammended in 2015), as the Qualified Person.

Mining One, with Stuart Hutchin as the Qualified Person, has accepted that appropriate scientific methods and best professional judgement were used in the collection and interpretation of the 2006 to 2008 resource drill program, and similarly that the database related to both the 2006 to 2008 and the 2014 to 2015 drilling programs, as supplied by

SCY and RME, is sufficiently reliable to support Mineral Resource Estimation and mine planning, as presented in this Technical Report.

13.0 MINERALS PROCESSING AND METALLURGICAL TESTING

13.1 Metallurgical Sampling and Test Programs

Jervois Mining Ltd started conducting preliminary metallurgical test work on Nyngan laterite material in 2008, and Scandium International (SCY) has continued and extended the testing activities of Nyngan ores from 2010 using several independent laboratories, covering a variety of flowsheet processes. All of the reports and results of this work was provided to the Author of this Chapter 13, (Dr. Nigel Ricketts) for review and synthesis, specifically to examine the relevance of the metallurgical test work conducted to date to the proposed flow sheet.

The various contributing program dates, purpose and results were as follows:

- 2008 – METCON Laboratories (NSW, Australia), Ore characterisation and scoping atmospheric leach tests (Jervois).
- 2009 – CSIRO (Vic, Australia), Mineralogical characterisation, bench scale leaching, bench and pilot scale acid bake, and solvent extraction (SX) for Jervois.
- 2010 – Hazen Research (Colorado, USA), Mineralogical characterisation, acid bake and solvent extraction (SX) both at bench scale and pilot scale (SCY).
- 2011 – Hazen Research, High pressure leaching (HPAL), and product precipitation.
- 2012 – SGS Lakefield (Toronto, Canada), Follow up HPAL test work investigating optimisation conditions.
- 2014 – SGS Lakefield, Further HPAL test work, materials handling/settling characteristics.
- 2015 – SGS Lakefield, HPAL test work covering initial test pit material and large scale batch autoclaving.
- 2015/16 – SGS Lakefield, Oxalate precipitation, calcination and product purity studies.
- 2015/16 – Nagrom (Australia), Detailed SX investigations, product precipitation calcination and detailed product purity studies.

13.2 Mineralised Resource Provided to Metallurgical Laboratories

The samples delivered to Hazen Research, SGS Lakefield and CSIRO facilities that were used in the test work programs were bulk samples taken from the original sample bags which contained drill cuttings for each metre of the Jervois drilling program. Some samples were entirely limonitic whilst others were entirely saprolitic and some were a combination of the two hosting clays. Prior to dispatch of the samples to test facilities, the bags were stored in a locked, secure building in Nyngan.

Hazen Research received two shipments of laterite material from EMC Metals in 2010 that was primarily used for an acid bake research program. The first was a set of five small samples, three limonite and two saprolite samples, weighing from 1.4 kg to 8.6 kg each, which were used in the laboratory scale program. The second shipment included 741 kg of limonite and 371 kg of saprolite for pilot scale test work. These samples were bulk samples of indeterminate origin from the Nyngan site recovered from the remnant samples of the 2008 Jervois Mining drilling program and were shipped directly from Australia to Hazen in Colorado (USA).

The limonite and saprolite samples were separately dried and homogenised. Prior to crushing, 51 kg of limonite and 29 kg of saprolite were extracted and saved as library samples. Each sample type was then crushed to 100% passing 50 mesh (297 µm) and re-blended. A 10 kg split of each crushed sample type was saved as a library sample for further analysis work as needed.

The five small samples were individually homogenised and representative splits of each of the samples removed for analysis and testing. Semi-quantitative XRF scans were performed at Hazen Research, followed by quantitative analysis of minor elements not considered reliable in the XRF scan, namely scandium, cerium, lanthanum and phosphorus. These were checked by an outside laboratory (Huffman Laboratories, Inc.) as a quality control measure.

The second shipment consisted of bagged and loose material in steel drums. Samples referenced in Metcon reports labelled as Batch 3 Gilgai limonite and Batch 2 Gilgai saprolite were used for laboratory studies. The results from these samples are shown in Table 13.1. A second batch of Batch 3 limonite was also used in some of the extraction work.

Table 13.1 Analysis of Crushed and Blended Head Samples

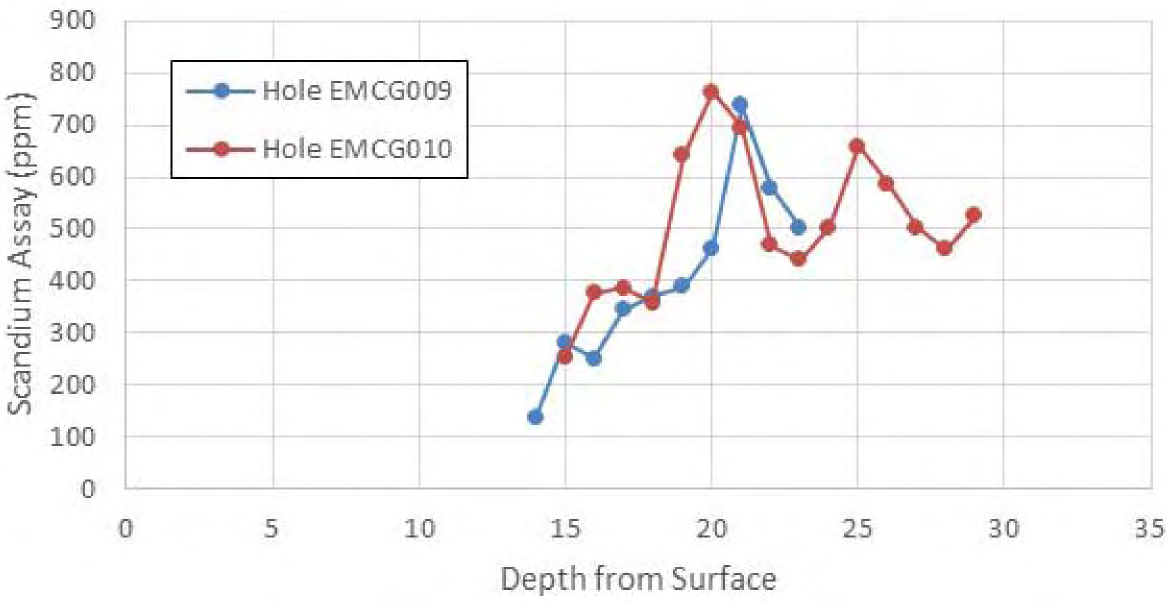
Element	Head Assays for Samples Tested					
	Hazen Research		SGS Lakefield			
	Limonite	Saprolite	Limonite	Raw Limonite	EMCG090	EMCG010
Sc (g/t)	347	258	321	349	406	516
Ni (%)	0.027	0.124	0.024	0.025	0.002	0.03
Co (%)	-	-	<0.01	0.01	<0.01	0.04
Cu (%)	0.004	0.004	0.005	0.007	-	-
Zn (%)	0.007	0.003	0.01	0.012	-	-
Fe (%)	27.7	16.8	25.8	27.8	22.6	29.2
Mg (%)	0.30	3.16	0.49	0.35	0.30	0.20
Al (%)	9.93	4.41	9.38	8.52	10.2	8.5
Cr (%)	0.10	0.15	0.18	0.22	0.24	0.28
Mn (%)	0.51	0.60	0.51	0.64	0.67	1.83
Ca (%)	0.12	1.75	0.077	0.14	-	-
Si (%)	-	-	12.8	12.8	16.9	12.2

For the SGS Lakefield HPAL work, two batches of material were received. For the work conducted in 2012, two bulk samples of Nyngan limonite were supplied by EMC Metals to SGS Lakefield. These were labelled as “Limonite” and “Raw Limonite” similar in origin to the Hazen samples. These samples were composited from limonite material recovered from drill core from Jervois Mining drill holes NA29 (18 to 23 m), NA54 (20 to 22 m), NA57 (52 to 53 m) and NA58 (38 to 43 m).

The second batch of samples used in the 2014 to 2015 test program were the metre by metre samples from drill holes EMCG009 (14 to 24 m) and EMCG010 (15 to 30 m). These were characterised in terms of chemical analysis, analysis for moisture and contained chloride, and chemistry by size fraction. The head assays for the composites made from the samples and used in the HPAL leaching work are shown in Table 13.1. These drill holes were specifically selected because they are located in the early years of the preliminary pit design. They are substantially higher in grade than the earlier samples used in the early leaching work.

It should be noted that the limonite at Nyngan varies in chemical analysis by depth within the limonite layer. Figure 13.1 shows the scandium composition by depth within the limonite layer for the two drill holes used in the latest SGS work. The scandium concentration is highest in the middle of the limonite layer.

Figure 13.1 Scandium Concentration Profile in Drill Holes EMCG009 and



EMCG010

13.3 Metallurgical Testing - Current Project Flowsheet

The proposed flow sheet for scandium oxide recovery from the Nyngan laterite deposit consists of:

- Open pit mining.
- Mill feed de-agglomeration in a scrubber and ball mill.
- High pressure acid leaching in a continuous autoclave.
- Solid-liquid separation in a CCD circuit.
- Solvent extraction of scandium using a primary amine.
- Stripping of the amine with hydrochloric acid solution.
- Precipitation of scandium oxalate by oxalic acid addition.
- Calcination of the scandium oxalate to produce scandium oxide.
- Neutralisation of the leach residue with lime and conventional tailings disposal.

13.3.1 High Pressure Acid Leach Test Work

Test work on High Pressure Acid Leaching has been conducted at both Hazen Research and SGS Lakefield. Most of the leaching has been conducted using two litre autoclaves, although some 20L autoclave tests were conducted at SGS. The traditional variables commonly used for HPAL leaching of nickel laterites were examined including:

- Acid:ore ratio.
- Residence time.
- Temperature.
- Pressure.
- Solids density.

The limonite used for the test work came from a number of drill holes from the Nyngan site, with the latter work at SGS using material from drill holes located in the proposed first five years of mining operation.

The early work at Hazen Research consisted of six HPAL tests at 2L scale in which recoveries of 73 to 81% were achieved at 10 and 20% solids and up to 60 minutes residence time. The tests appear to have used limited acid additions at 0.25 kg sulphuric acid per kg of limonite, which could explain the less than desirable scandium recoveries.

The work at SGS on HPAL leaching has been conducted in three campaigns:

- A series of 16 HPAL tests, ten on limonite and six on acid bake leach residue.
- A second series of six HPAL tests, three on limonite, two on saprolite and one on a limonite / saprolite blend.
- A third series of 20 HPAL tests on limonite only.
- A final fourth series of tests in conjunction with sample production for residue settling trials.

Most of the tests have been conducted in 2L autoclaves, although three were conducted at 20L scale to produce leach residue for subsequent tailings testing.

From the bench scale tests at SGS Lakefield, a set of optimum leach conditions based largely on the third SGS Lakefield series of HPAL tests have been selected for the DFS. These include:

- Acid:ore ratio of 0.325:1.0, resulting in a net sulphuric acid consumption (when some recirculation to pregnant leach solution (PLS) feed is taken into consideration) of 275 kg/t of limonite ore.

- Residence time of 90 minutes.
- Temperature of 265°C which is within the known technical capability of HPAL operations.
- An average scandium recovery to solution of 87%.

With no continuous autoclave pilot operation having been conducted, the CCD circuit after HPAL was been designed on a limited amount of static and dynamic settling testing. A conservative figure of 31% thickener underflow density has been assumed across the plant, resulting in the need for an eight stage CCD thickener wash circuit.

13.3.2 Solvent Extraction Test Work

Solvent extraction test work for recovery of scandium from the HPAL solutions has been conducted at CSIRO, Hazen Research and at the Nagrom laboratory in Brisbane.

Solvent extraction test work was initially conducted at CSIRO in 2010, for Jervois Mining, on solutions generated from acid bake processing of Nyngan limonite drill core. Bench scale work examined a number of potential solvent extraction organic reagents. Extraction efficiency and selectivity of scandium over a range of other elements was conducted across a range of pH values.

This work identified Primene JM-T primary amine as the preferred solvent extraction organic reagent. It was found to be quite selective for scandium over iron. A series of isotherms was conducted at various organic strengths. Examination of diluent to be mixed with the Primene JM-T showed little influence on extraction characteristics.

Stripping kinetic tests showed that stripping was very rapid with 96% of the scandium being stripped in 30 seconds.

Some limited phase disengagement work was conducted, showing that the Primene JM-T would have a reasonable probability of success.

Subsequent pilot plant operation at Hazen Research in 2011, also on acid bake solution, confirmed the operation of the Primene JM-T system on a semi-continuous basis. This pilot plant operated for ten days, on a 12 hours per day basis. Prior to the pilot plant operation, Hazen Research conducted some bench scale work on both extraction and stripping solutions to identify the number of stages required.

Operation of the pilot plant had the prime objective of scandium recovery. Using 5% Primene JM-T, extraction resulted in raffinate levels of 1 to 3ppm scandium from a 59ppm scandium feed. For the 5% Primene JM-T concentration, loaded strip liquor achieved 800 to 900ppm scandium and almost 3 g/l iron.

Bench scale work was conducted at Nagrom in Brisbane in 2015 to follow on from the Hazen work. Initially this was commenced to further examine the strip solution composition after precipitation test work identified contamination of the scandium oxalate precipitate during trials at SGS. This work led to a new confidential strip liquor composition.

Re-examination of the extraction and strip isotherms showed that two to three extraction stages would be required and only one to two strip stages.

The work at Nagrom then proceeded to a six day, 12 hours per day pilot plant campaign, using synthetic PLS solution as the feed, as dictated by a comprehensive METSIM model of the flowsheet. This model assumed that no pre-neutralisation of the PLS before extraction was required. This not only provided confirmation of the Primene JM-T organic with a feed composition close to that expected for HPAL solution, but also confirmed the new strip liquor composition as being very effective.

Extraction efficiency of > 99% was achieved, with raffinate regularly at 1ppm using a feed of 109ppm Sc. The loaded strip liquor assayed in the range 2,200 to 3,000ppm, depending on the process variants being examined. The first three days of operation were conducted with the solution composition from the original METSIM model, whereas the final three days used a slightly different composition. Also at the three day mark, the regeneration stage was removed from the circuit, seemingly without any detrimental effect. At the five day mark, the PLS composition was again changed to replicate a proposed process variant. This was very successful and became the process flowsheet carried into the DFS design.

Operation of the pilot plant was very stable and examination of the loading capacity of the organic used in the pilot plant campaign showed no significant deterioration over the six day period of the program. The loading capacity was also unaffected by the removal of the regeneration stage for the last three days of the trial.

13.3.3 Scandium Oxide Precipitation Test Work

Precipitation of scandium compounds has largely focussed on the precipitation of scandium oxalate and its subsequent calcination to produce scandium oxide.

Hazen Research examined precipitation of scandium using oxalic acid using the strip solution from the pilot plant SX trial. Oxalic acid solution was added and the solutions held for three hours at 65°C. A range of oxalic acid addition rates were examined, but were all high. The lowest oxalic acid addition rate was 2.88 molar ratio to scandium and this produced 97.3% scandium oxide. This was conducted on a feed solution of 1.65 g/l Sc and 14.5 g/l Fe, a much higher iron level compared to the DFS flowsheet.

SGS conducted a number of scandium precipitation and calcination trials in late 2015. A total of 23 precipitation trials were conducted from different feed solutions, at different temperatures, at various oxalic acid addition rates and using different neutralising agents or different acid levels. The starting point for the work was a synthetic loaded strip liquor, with various additions of neutralising agents to set a free acid level prior to precipitation.

The loaded strip liquor from the Nagrom pilot plant solvent extraction trials was used to conduct 12 precipitation trials. These trials focussed on scandium oxalate precipitation and examined process variables such as temperature and oxalic acid addition rates and were running in parallel to the SGS trials. The latter six oxalate samples were further calcined to scandium oxide and were then washed and assayed.

The scandium oxalate samples produced at Nagrom were much higher in grade than those produced at Hazen, SGS, and CSIRO. The scandium oxalate purity approached 99.9% at times and was always >99%. When calcined to scandium oxide, an increase in impurity levels was experienced as the scandium oxalate lost mass in calcining. Procedures were developed for production of 99.9% scandium oxide purity and product of this purity has been produced. At this level of purity, specialist analysis methods should be used for key elements, so the assaying of the small amount of sample was not considered to be absolute.

13.3.4 Filtration and Residue Settling Test Work

Dynamic and static settling tests have been conducted on the leach feed and leach residues in order to determine the likely thickener underflow tests. Limited filtration tests have also been conducted but were deemed to be unsuccessful.

Dynamic settling tests on the leach feed slurry showed that 40% underflow density was likely to be able to be achieved using Magnafloc 24 flocculant.

Filtration tests on feed slurry resulted in poor filtration characteristics with the lowest moisture able to be obtained being 44%.

Settling and filtration characteristics were conducted on HPAL discharge slurries. An underflow density of only 31% was able to be obtained from a 5% thickener feed using Magnafloc 338 as the flocculant.

13.3.5 Future Test Work

The current research program has led to a conservative process engineering design at DFS level. Further reductions in capital cost and operating cost could be possible if further development of the flowsheet was conducted. This could include:

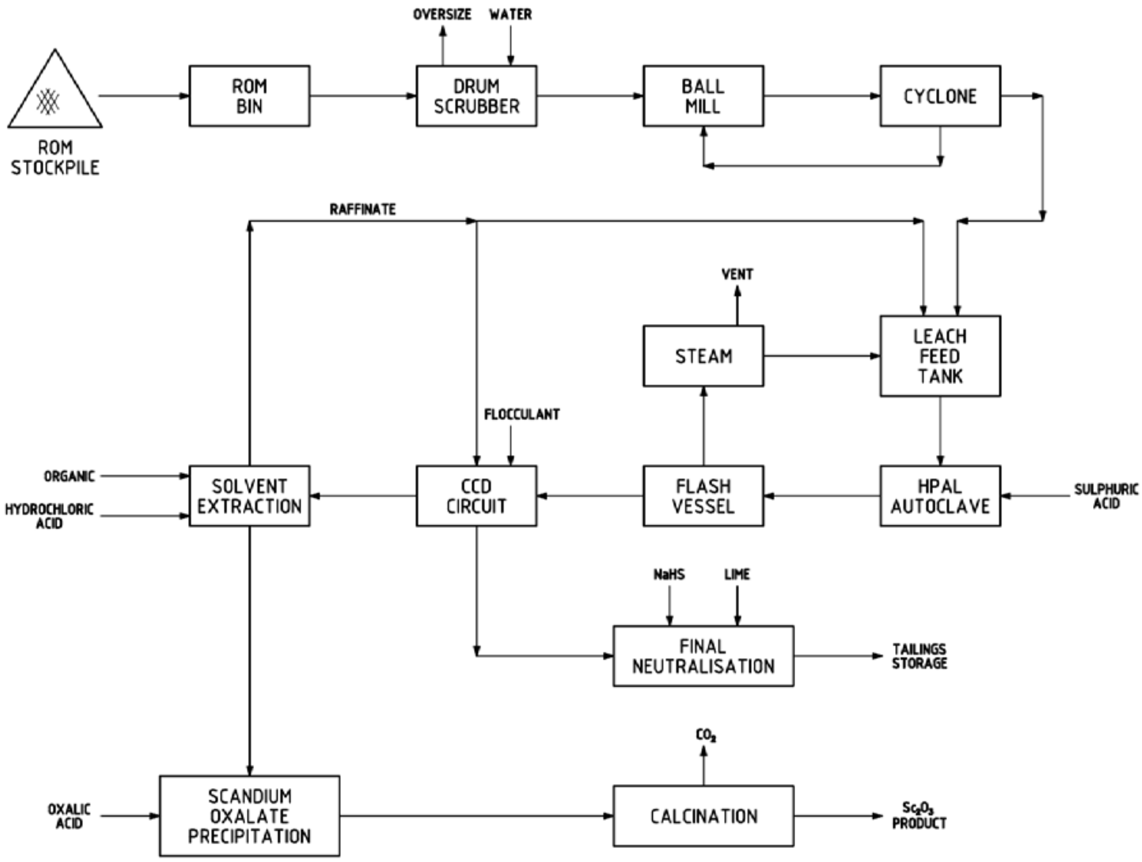
- Further investigation of optimum conditions in the high pressure acid leach of the limonite, including further work at lower leach temperatures and slightly higher slurry feed densities.
- Settling test work on hot HPAL slurries to improve the settled density in the CCD circuit, including a broader screening of flocculants and coagulants.
- Work to further justify the removal of the regeneration stage in solvent extraction which appears to be unnecessary.
- More work on the precipitation of scandium oxalate using real HPAL solution (not synthetic solutions) including further investigation into factors affecting product purity and recovery to solution.

- Further work on the calcination temperature for the oxalate and possible wash solutions to achieve even higher purity scandium oxide product.
- Further investigation of the final neutralisation process to gain better understanding of chromium, magnesium and manganese deportments in particular.

13.3.6 Flowsheet Implications

In general, the test work program has shown that 87% recovery of scandium to solution from a 400ppm scandium-bearing limonite can be recovered in a conventional HPAL circuit. Conventional CCD equipment can produce a solution in excess of 100ppm scandium as feed into solvent extraction. A well-known primary amine solvent extraction organic can concentrate the scandium approximately 20-fold in conventional equipment and using common reagents. The loaded strip liquor produced can produce high grade scandium oxalate which can be calcined and water washed to produce 99.8 to 99.9% scandium oxide utilising a single precipitation and single calcination stage. The simplified schematic flowsheet is shown in Figure 13.2.

Figure 13.2 Schematic Flowsheet for the Nyngan Scandium Project



The solvent extraction and precipitation programs conducted in 2015 have resulted in an evolution of the flowsheet compared to that developed by other researchers in the following areas:

- The extraction phase could be conducted successfully on HPAL discharge liquor.
- Stripping was easily conducted with a low acid strip solution.
- High purity scandium oxalate could be precipitated from the solvent extraction loaded strip liquor.
- Calcined scandium oxide, approaching 99.9% purity can be produced using the process flowsheet that has been developed with 83.7% scandium recovery of scandium in feed to final product.

14.0 MINERAL RESOURCE ESTIMATES

14.1 Previous Estimates

An initial polygonal resource estimate on the Nyngan property was disclosed in a technical report entitled "*Technical Report on the Nyngan Gilgai Scandium Project, Jervois Mining Limited, Nyngan, New South Wales, Australia*" and filed on SEDAR in March of 2010. The resource estimate, and the methodology behind the estimate, was most recently updated in the NI43-101 Technical Report (PEA) with an effective date of October 2014, subsequently re-filed as an Amended Technical Report in May 2015. The resources reported in these two Technical Reports are summarised in Table 14.1.

Table 14.1 Previous Nyngan Project Mineral Resource Estimate

Previous Resource Estimate - Effective Date - February 2010				
Nyngan Project NI 43-101 Resource Summary By Category	**Tonnes**	**Grade (ppm Sc)**	**Cut-Off Sc (ppm Sc)**	**Overburden Ratio (t/t)**
Measured Resource	2,718,000	274	100	0.81:1
Indicated Resource	9,294,000	258	100	1.40:1
Total Resource	12,012,000	261	100	1.10:1
NI 43-101 Technical Report on the Nyngan Gilgai Scandium Project, Jervois Mining Limited, Nyngan, New South Wales, Australia, dated March 2010, (Rangott Mineral Exploration Pty Ltd).				

Other than the February 2010 resource estimate described above, no other resource estimates have been reported for the project, prior to the release of this 2016 Technical Report.

14.2 Source Data

A source Microsoft Access database was supplied to Mining One by Rangott Mineral Exploration Pty Ltd (RME) that contained all previous drilling and assaying data for the Nyngan Project. This database was used to derive the estimation of resources. The source data files are summarised in Table 14.2.

Table 14.2 Source Data Access File

File Name	Microsoft Access Tables	Records
SIMC_NynganProject_RMECompiled_261115.aacb	ASSAY_Gilgai	2638
	COLLARS_Gilgai	141
	LITHOLOGY_Gilgai	464
	STANDARDS	4

14.3 Density Measurements

The 2010 polygonal resource estimate assigned density values that were derived from measurements taken at the nearby Young laterite (nickel) deposit. During 2015, density measurements were taken from core samples drilled into the Nyngan project area. The measurements were taken using the Archimedes method, which involves the measurement of loss of weight in water of the full core sample using an electronic balance. The core samples were dried prior to being covered in lacquer, and then weighed. These measurements are summarised in Table 14.3.

Table 14.3 2015 Gilgai Density Measurements

Lithology Domain	Number of Samples	Min (g/cm^3)	Max (g/cm^3)	Average
Alluvium	7	1.86	2.2	2.02
Hematite	4	2.12	2.38	2.24
Limonite	74	1.55	2.62	1.88
Saprolite	27	1.24	2.66	1.64

The average density values for each lithology domain type were used to assign the density values within the resource block model. Distributions of the density measurements within each of the lithological domains are shown in Figure 14.1, Figure 14.2, Figure 14.3, and Figure 14.4.

Figure 14.1 Alluvium – Density Measurements

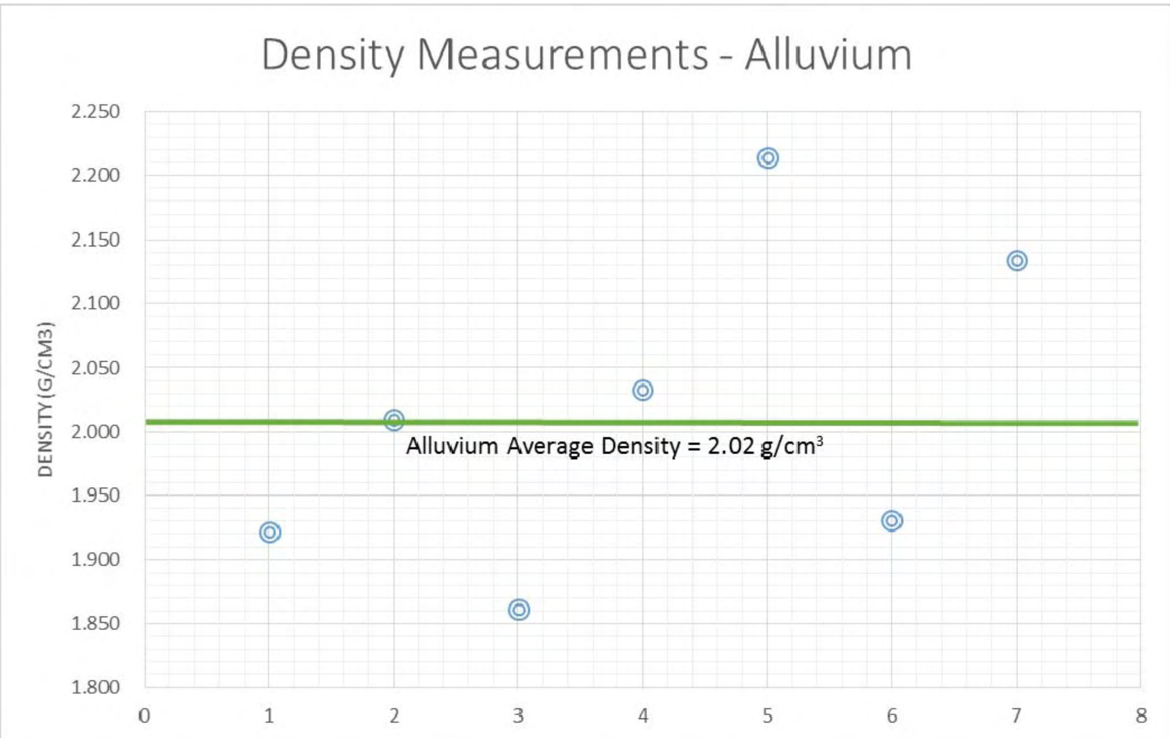


Figure 14.2 Hematite – Density Measurements

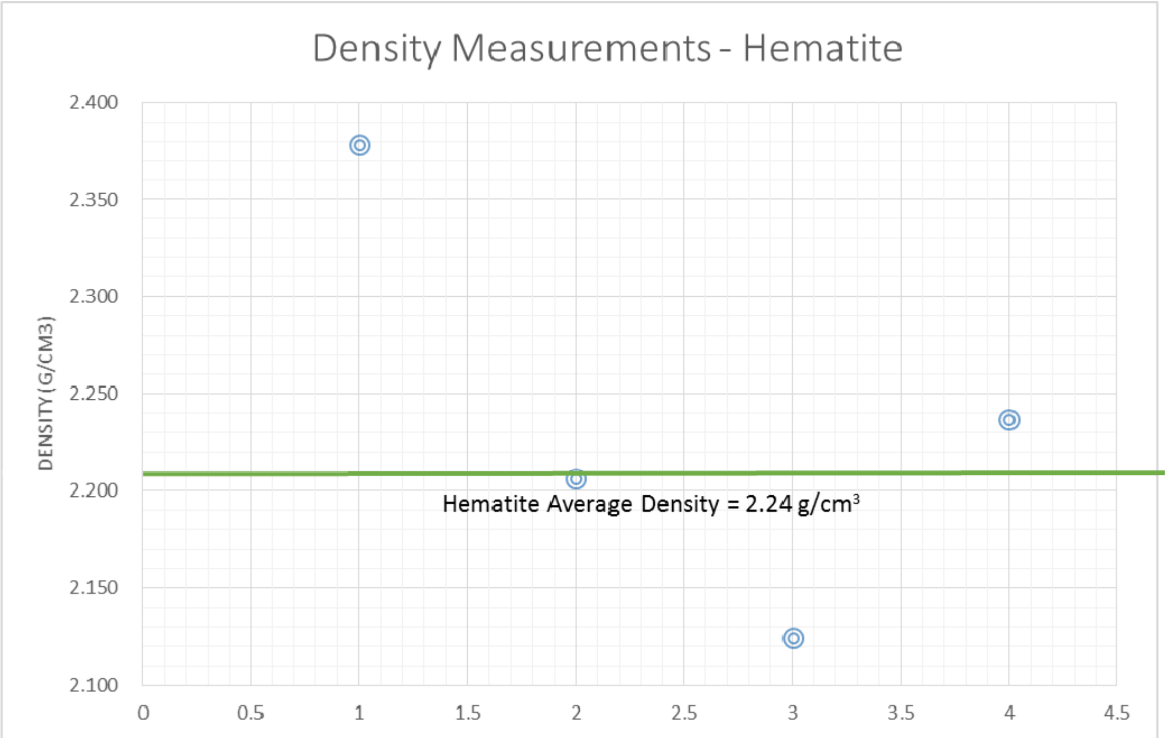


Figure 14.3 Limonite – Density Measurements

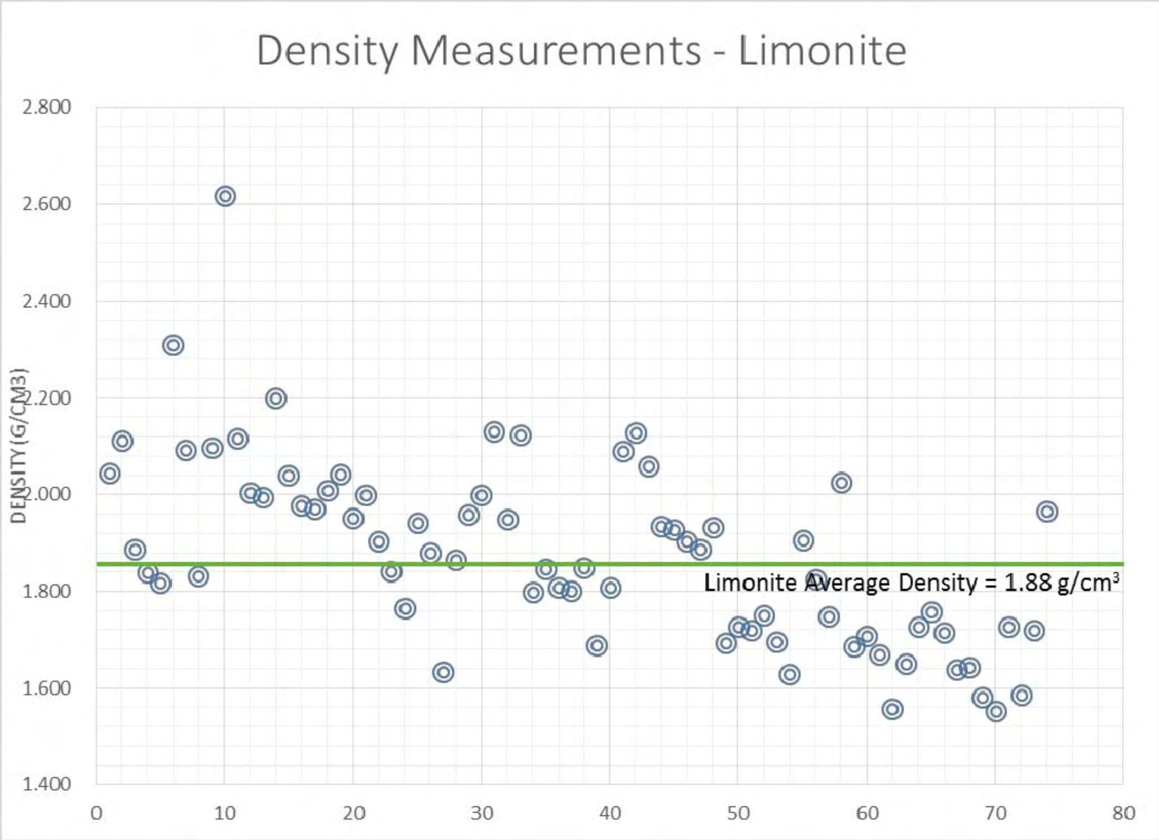
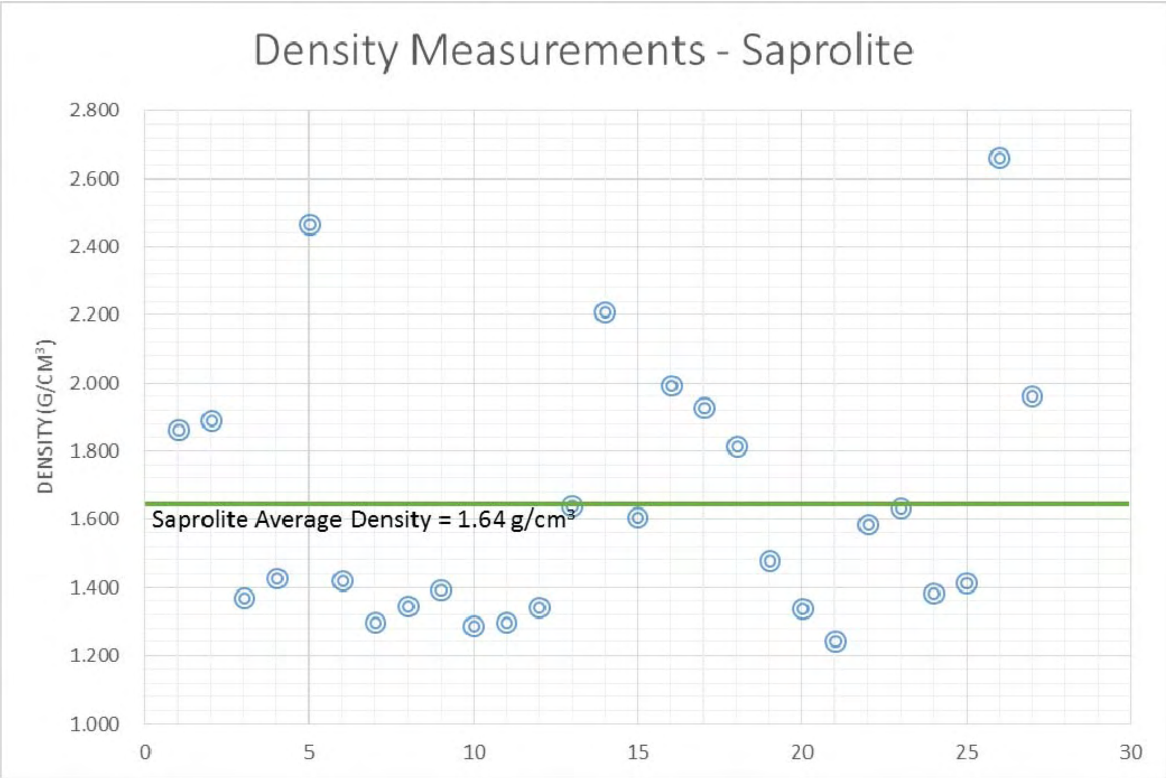


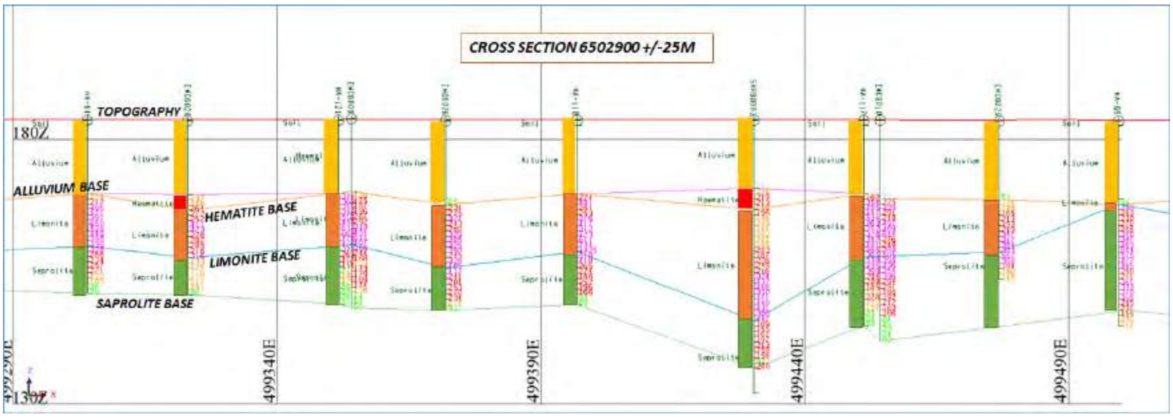
Figure 14.4 Saprolite – Density Measurements



14.4 Lithological Domains

Surfaces were constructed for each of the lithological domains, namely the base of alluvium, base of hematite, base of limonite and base of saprolite. These surfaces were constructed using the geological logging data contained within the drill hole database. Sections string interpretations were created on 50 m spaced sections through the deposit as shown in Figure 14.5.

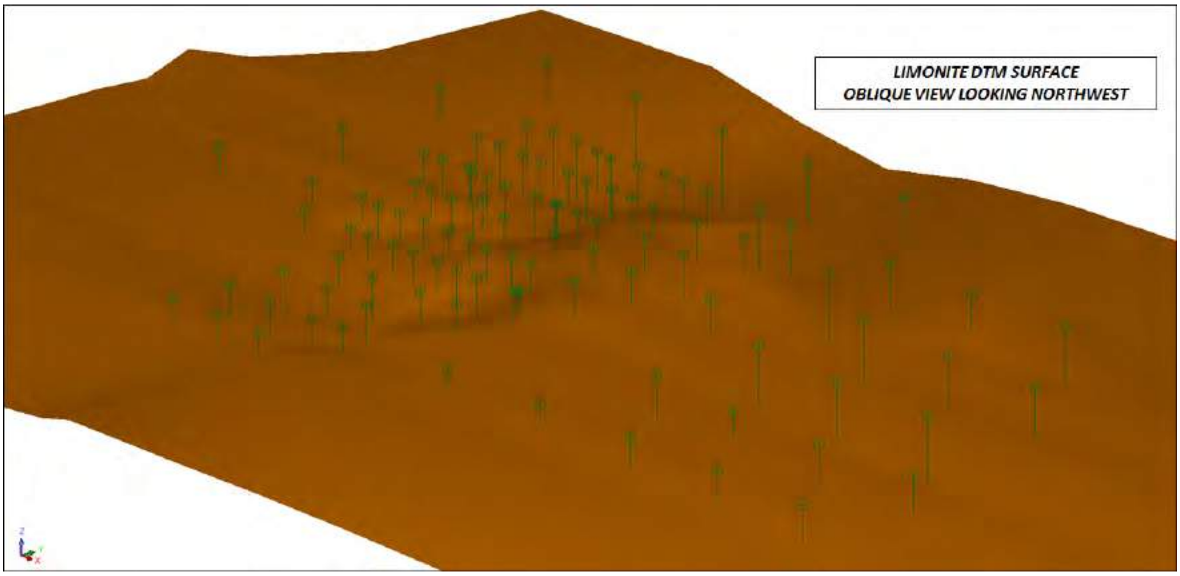
Figure 14.5 Lithological Domain Interpretation – Section 6502900 ± 25m



A digital terrain surface model (DTM) was then constructed from these strings to form the wireframe surface for each lithological type as shown in Figure 14.6.

The lithological and topographic surface DTM's were then used to constrain the resource estimate and also to code the model for lithology type.

Figure 14.6 Base of Limonite DTM Surface – Oblique View



A list of the DTM surfaces created to constrain the resource estimate is shown in Table 14.4.

Table 14.4 2015 Gilgai DTM Surfaces

Domain	DTM Name
Topography	topography.dtm
Alluvium	base_alluvium.dtm
Hematite	base_hematite.dtm
Limonite	base_limonite.dtm
Saprolite	base_saprolite.dtm

14.5 Drill Sample Compositing

The median sampling interval contained within the drill database is one metre. Given that one metre is the most common sampling interval and that the deposit is likely to be mined via open pit methods, a composite length was assessed as appropriate. A summary of the composite file statistics for each of the lithological domains is shown in Table 14.5.

The composite datasets for each lithological domain are also shown as histograms and cumulative frequency curves in Figure 14.7 and Figure 14.8.

Figure 14.7 Limonite Domain – Histogram (Sc_ppm on X Axis)

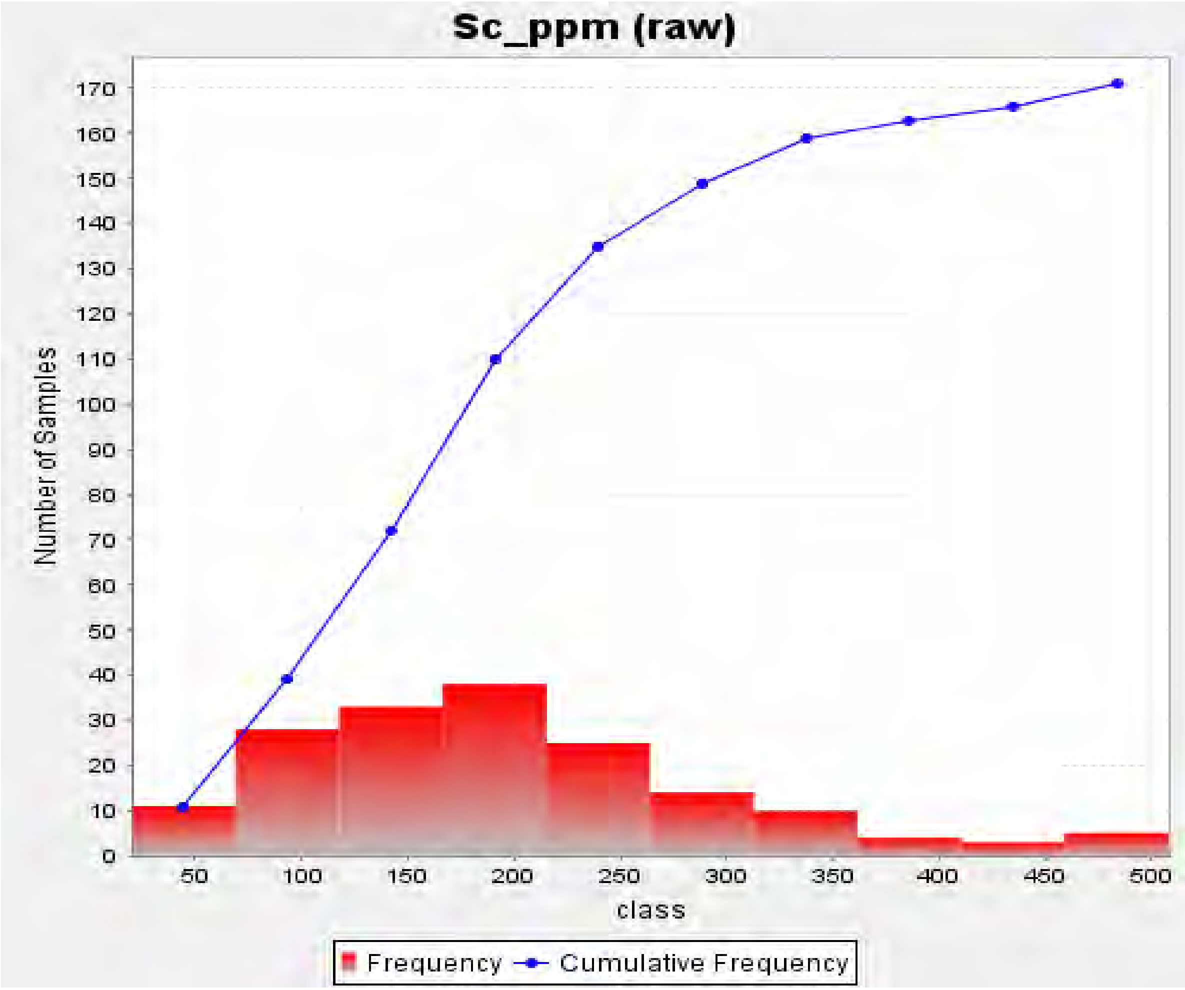


Table 14.5 Gilgai Composite File Attributes

D1	D2	D3	D4	D5	D6	D7
Sc_ICP06	Sc_ME_ICP61	Total_Sc_ppm	Al_pct	Ca_pct	Co_ppm	Cr_ppm
D8	D9	D10	D11	D12	D13	
Fe_pct	Mg_ppm	Mn_ppm	Ni_ppm	V_ppm	P_ppm	

Table 14.6 Gilgai Composite File Statistics

Domain	Composites	Min (Sc_ppm)	Max (Sc_ppm)	Mean (Sc_ppm)
Hematite	171	20	508	196
Limonite	1215	6	1260	290
Saprolite	1064	25	610	180

Figure 14.8 Hematite Domain – Histogram (Sc_ppm on X Axis)

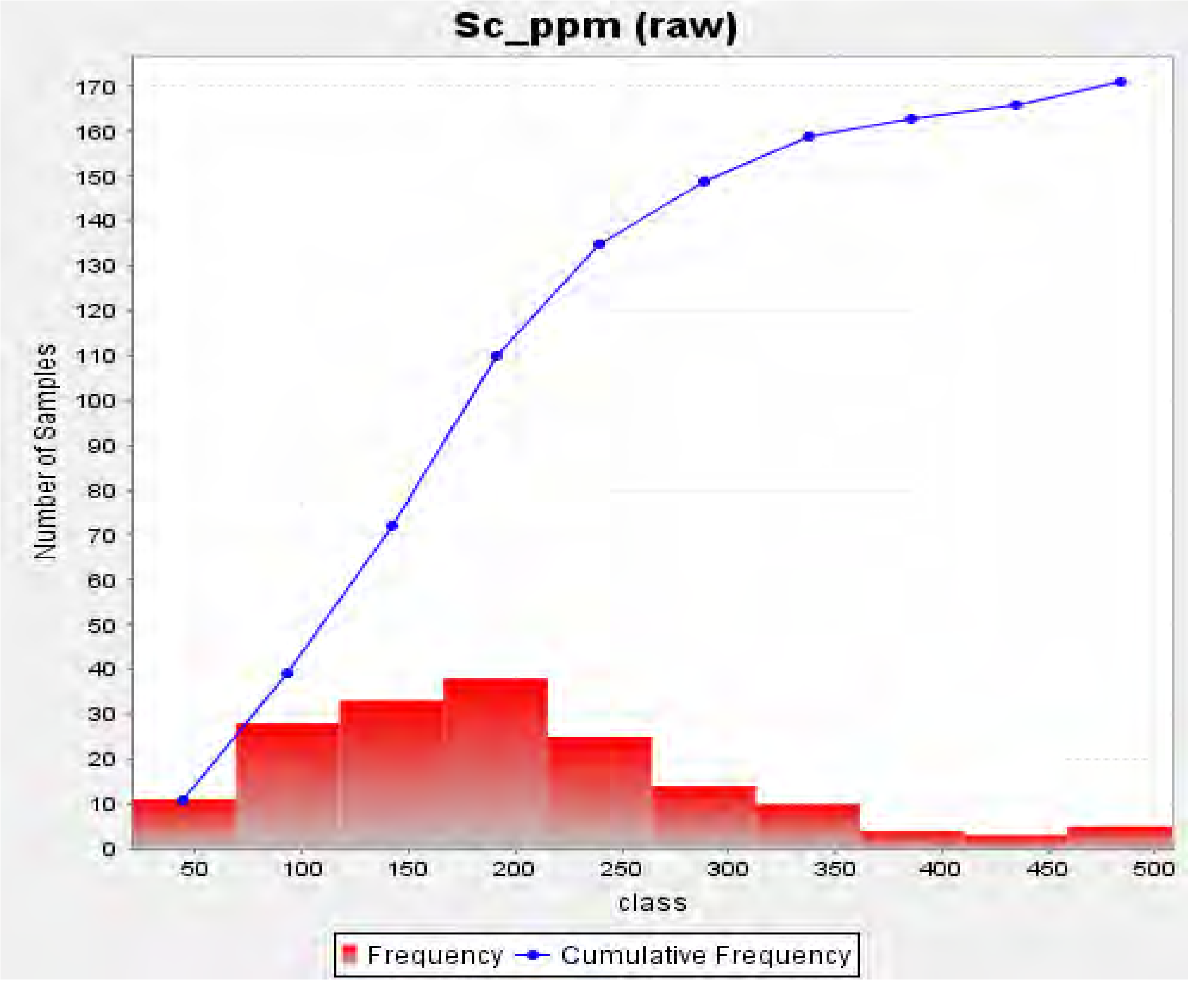


Figure 14.9 Limonite Domain – Histogram (Sc_ppm on X Axis)

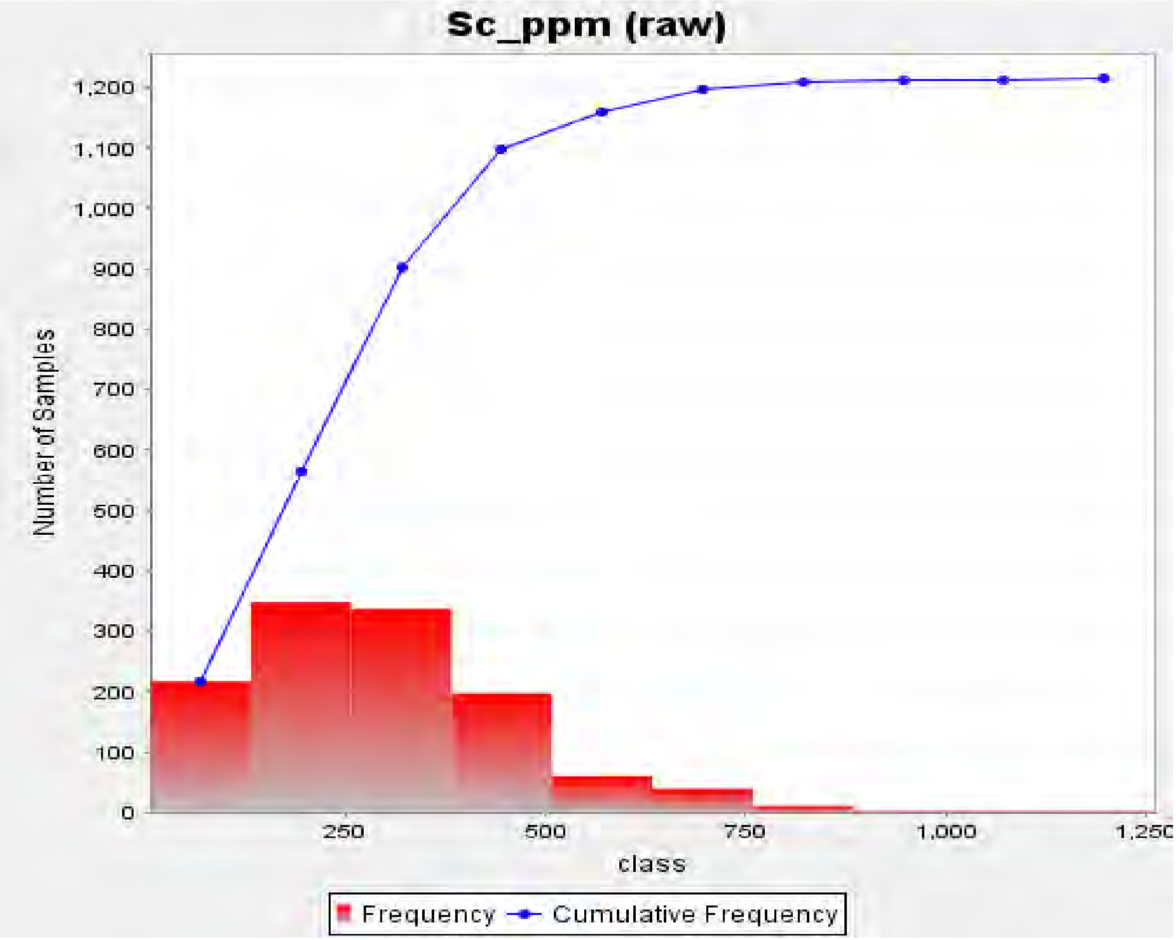
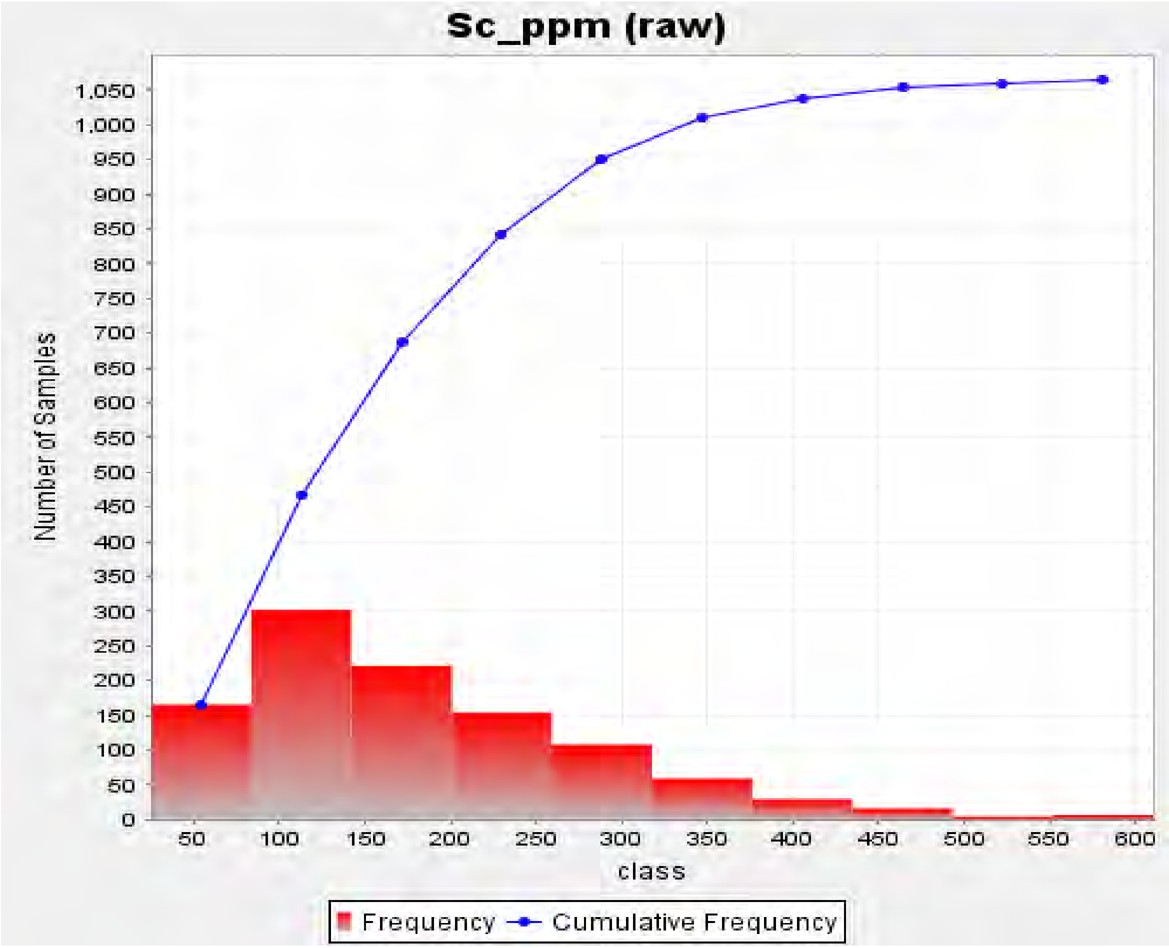


Figure 14.10 Saprolite Domain – Histogram (Sc_ppm on X Axis)



14.6 High Grade Outliers

High grade outliers within the resource assay dataset can potentially lead to an overestimation of the block grades if not appropriately accounted for within the resource modelling process.

Several methods are used to determine if high grade outliers require "capping", that is to decrease these grades back to the 95% confidence interval or by visually looking at the grade populations in probability and other plots.

The assay data contained within the limonite domain indicates that the 95% confidence interval is at 633ppm Sc. 56 scandium assays are above 633ppm, which represents less than 5% of the total assay dataset. Taking this into account and looking at the grade population distribution curves, it was not deemed appropriate to apply any grade capping to the dataset for the purposes of the resource estimation.

14.7 Variography & Estimation Search Parameters

Variogram analysis was completed for each of the lithological domains. The limonite and saprolite domains had sufficient sample pairs to allow for resolution of variograms. The variogram model used for the limonite domain is shown in Figure 14.11. The variogram parameters are also shown in Table 14.7.

Table 14.7 Variography Parameters – Gilgai Project

Domain	Nugget	Structure 1				Structure 2			
		Sill	Range	Major/Semi	Major/Minor	Sill	Range	Major/Semi	Major/Minor
Limonite	0.35	0.61	79.5	1	3	0.75	65.5	1	3

Figure 14.11 Limonite Domain – Variogram Model

14.8 Block Model Construction

The block model was constructed in Surpac software with the parent block chosen based on the average drill spacing and potential open pit mining methods. Sub blocking was also used to provide sufficient resolution along the contacts between the lithological domains. The parameters used to construct the base block model are summarised in Table 14.8.

Table 14.8 Block Model Construction Parameters

Model Co-ordinates			
	X(m)	Y(m)	Z(m)
Min	499,000	6,502,400	50
Max	500,200	6,503,200	200

Table 14.9 Block Model Attributes

Block Dimensions			
	X(m)	Y(m)	Z(m)
Parent Cell	25	25	5
Sub Block	5	5	1

Model Coordinates		
Field Name	Type	Description
al_pct	Float	Aluminium % block grade
ave_dist_samp_id2	Float	Inverse distance ave distance to samples
ave_dist_samp_ok	Float	Ordinary Kriging ave distance to samples
block _variance	Float	
ca_pct	Float	Calcium % block grade
co_ppm	Float	Cobalt ppm block grade
conditional_bias	Float	
cr_ppm	Float	Chromium ppm block grade
dist_to_near_samp_ok	Float	Distance to nearest composite – ok
dist_to_near_samp_id2	Float	Distance to nearest composite – id^2
fe_pct	Float	Iron % block grade
krig_efficiency	Float	
krig_variance	Float	
lagrange_muli	Float	
Lithology	Character	Alluvium, Hematite, Limonite, Saprolite
mg_ppm	Float	Magnesium ppm block grade
mineable_ore	Integer	1=yes, 0=no
mn_ppm	Float	Manganese ppm block grade
ni_ppm	Float	Nickel ppm block grade
num_neg_weights	Integer	

Model Coordinates		
Field Name	**Type**	**Description**
num_samp_id2	Integer	Number of composites used – id^2
num_samp_ok	Integer	Number of composites used – OK
p_ppm	Float	Phosphorous ppm block grade
res_cat	Integer	1=measured, 2=indicated, 3=inferred
sc_ok_ppm	Float	Scandium ppm block grade
sg	Float	Domain average density value
topo	Integer	0= above topo, 1=below topo
v_ppm	Float	Vanadium ppm block grade

14.9 Estimation Technique

Given the style of mineralisation and supporting drilling data, it was assessed that Ordinary Kriging would be a suitable estimation technique. An inverse distance estimate was also created to be used for model validation purposes.

The lithological surface wireframes were used as hard boundaries to constrain the grade interpolation and the estimation was also constrained by the topography.

14.10 Grade Interpolation Parameters

Grades were estimated into the model using the one metre composite files created for the hematite, limonite and saprolite domains. Three estimation passes were run for each of these lithological domains. Details of the parameters used for each estimation pass are summarised in Table 14.10.

Table 14.10 Grade Interpolation Parameters

Strike	Plunge	Dip	Pass#	Major / Semi	Major / Minor	Min Samp	Max Samp	Search Radius
020	0	0	1	1	3	3	40	40
			2	1	3	3	60	80
			3	1	3	3	100	200

14.11 Resource Classification

The resources were classified using a combination of the drill spacing and the confidence in the continuity of scandium grade and thickness of the modelled lithological domains. The variogram analysis shows ranges up to 80 m indicating sample correlation exists over that distance. Drill spacing in the centre area of the deposit ranges between 25 m x 50 m and 50 m x 50 m. This area is coded as measured and also exhibits strong continuity of mineralisation between drill holes.

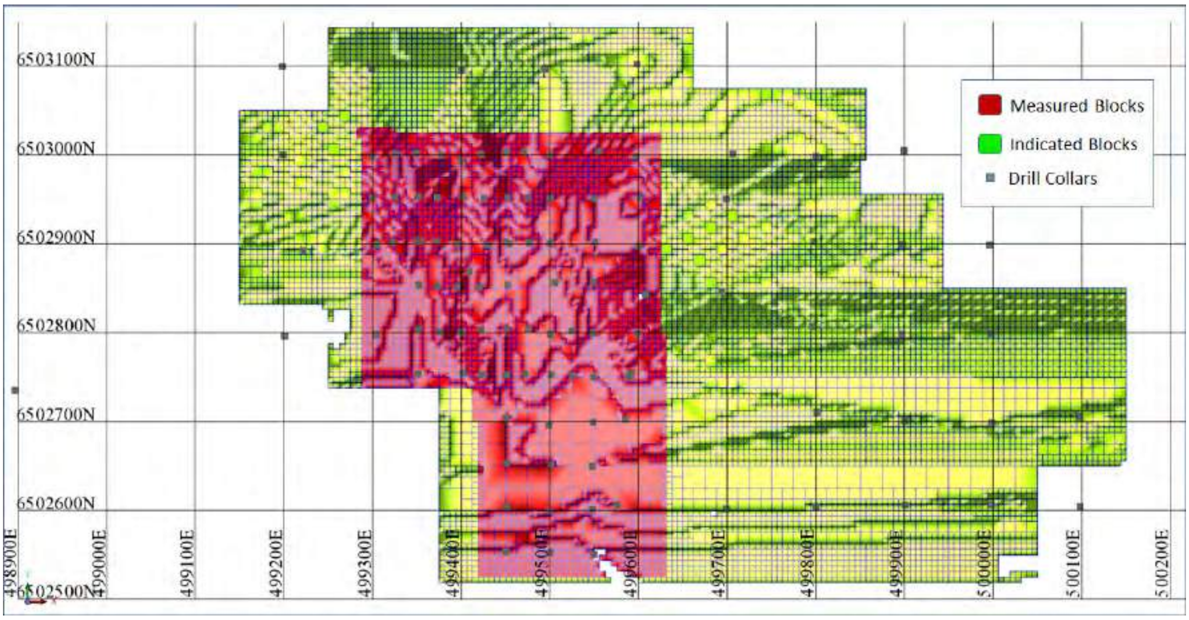
The blocks within the area of the resource where the drill spacing is 100 m x 100 m has been coded as indicated. Geological confidence is still high within these blocks, however the larger drill spacing is assessed as only supporting an indicated resource category.

No inferred blocks have been coded into the model given that the boundary of the mineralised area is covered by a minimum of 100 m x 100 m spaced drilling and that the lithological model has not been extended outside of the area drilled to this spacing.

The blocks were coded using three dimensional wireframes for the measured and indicated material as supported by the drill density and overall geological confidence in the mineralisation's continuity between drill holes.

The resource categories coded into block model are shown in Figure 14.12.

Figure 14.12 Resource Classification of Blocks – Plan View



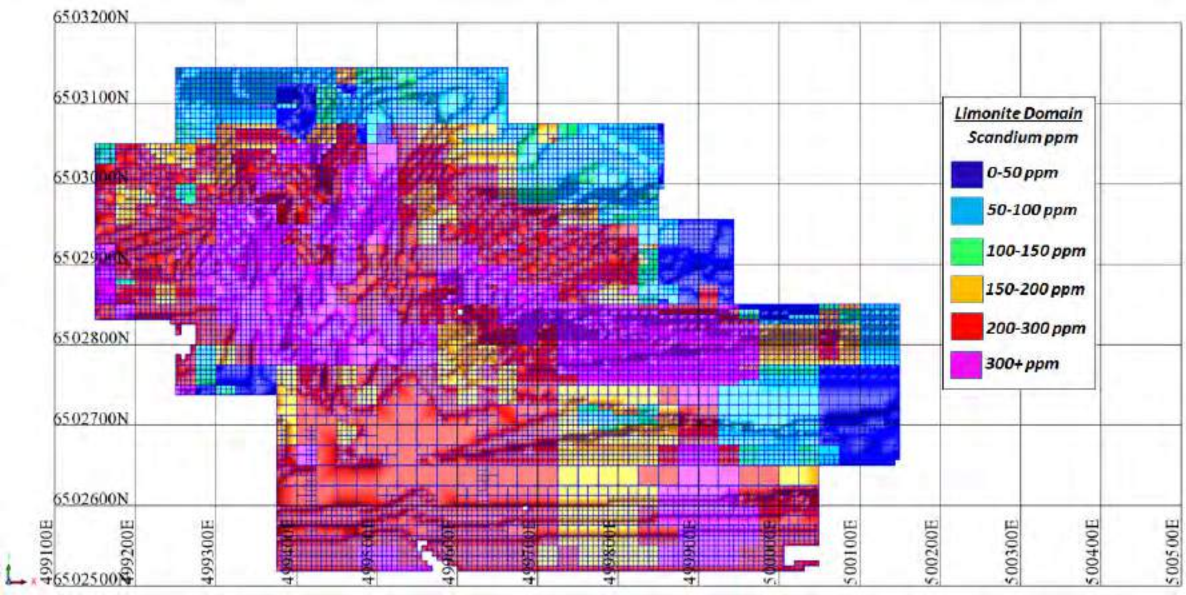
14.12 Estimation Results

The results of the estimation indicate that the limonite domain contains 52.8% of the total resource tonnage at the highest grade using a scandium grade cut-off above 100ppm. The limonite domain is the focus of the estimation of project reserves. Given the drill spacing and confidence in the continuity of the scandium mineralisation, it was deemed appropriate to state resources in the Measured and Indicated categories with no Inferred blocks. A boundary was applied to the estimation however, to ensure that blocks were not estimated within areas of low geological confidence.

Table 14.11 Nyngan Scandium Project Mineral Resource Estimate (>100ppm Sc)

Nyngan Scandium Resource Estimate				
(Resource Effective Date is April 15, 2016)				
Domain	**Resource Class**	**Volume (Mm^3)**	**Tonnes (M)**	**Scandium* (ppm)**
Hematite	**Measured**	**0.19**	**0.42**	**229**
	Indicated	**0.31**	**0.69**	**150**
	M&I Total	**0.50**	**1.11**	**180**
	Inferred	**-**	**-**	**-**
Limonite	**Measured**	**1.55**	**2.92**	**314**
	Indicated	**3.18**	**5.97**	**259**
	M&I Total	**4.73**	**8.89**	**277**
	Inferred	**-**	**-**	**-**
Saprolite	**Measured**	**1.43**	**2.35**	**188**
	Indicated	**2.72**	**4.46**	**191**
	M&I Total	**4.15**	**6.81**	**190**
	Inferred	**-**	**-**	**-**
All Domains	**Measured**	**3.17**	**5.69**	**256**
	Indicated	**6.21**	**11.12**	**225**
	M&I Total	**9.38**	**16.81**	**235**
	Inferred	**-**	**-**	**-**
***Cut-off value is 100ppm in all domains**				
Mineral Resources that are not Mineral Reserves do not have demonstrated viability.				
Mineral Resources are inclusive of Mineral Reserves.				

Figure 14.13 Limonite Domain – Block Model Plan View



14.13 Grade Tonnage Curves

Grade tonnage curves were created by reporting each lithological domain separately from the Resource block model. These are shown in Figure 14.14, Figure 14.15 and Figure 14.16.

Figure 14.14 Hematite Domain – Grade Tonnage Curve

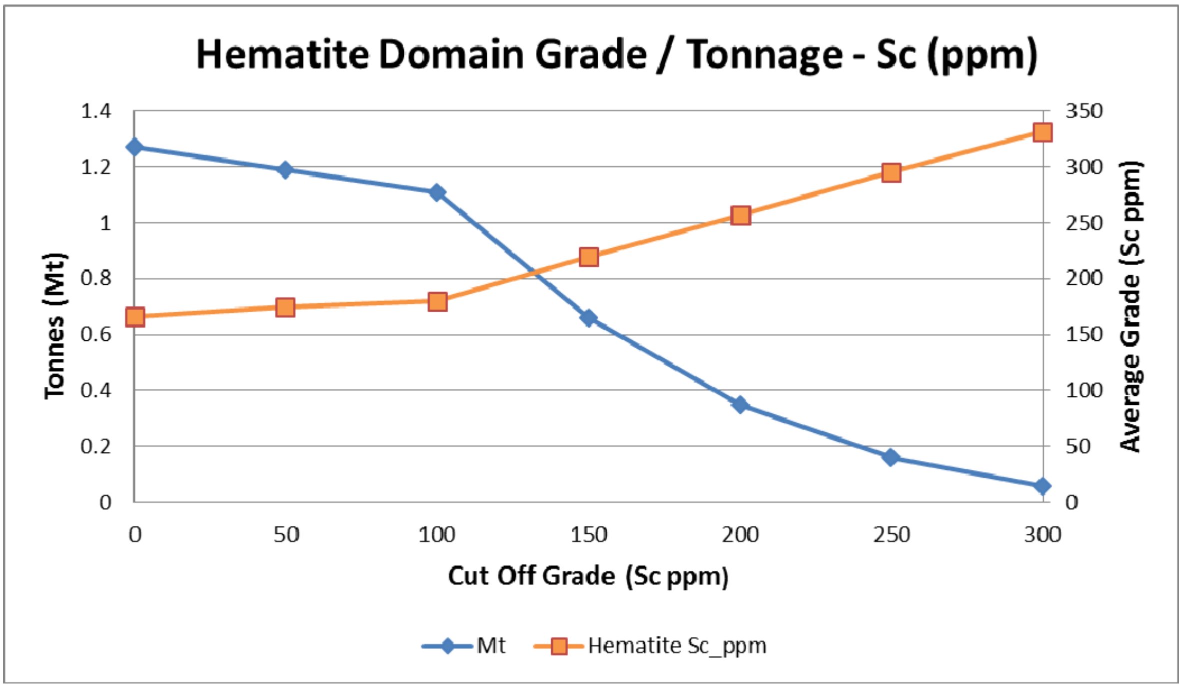


Figure 14.15 Limonite Domain – Grade Tonnage Curve

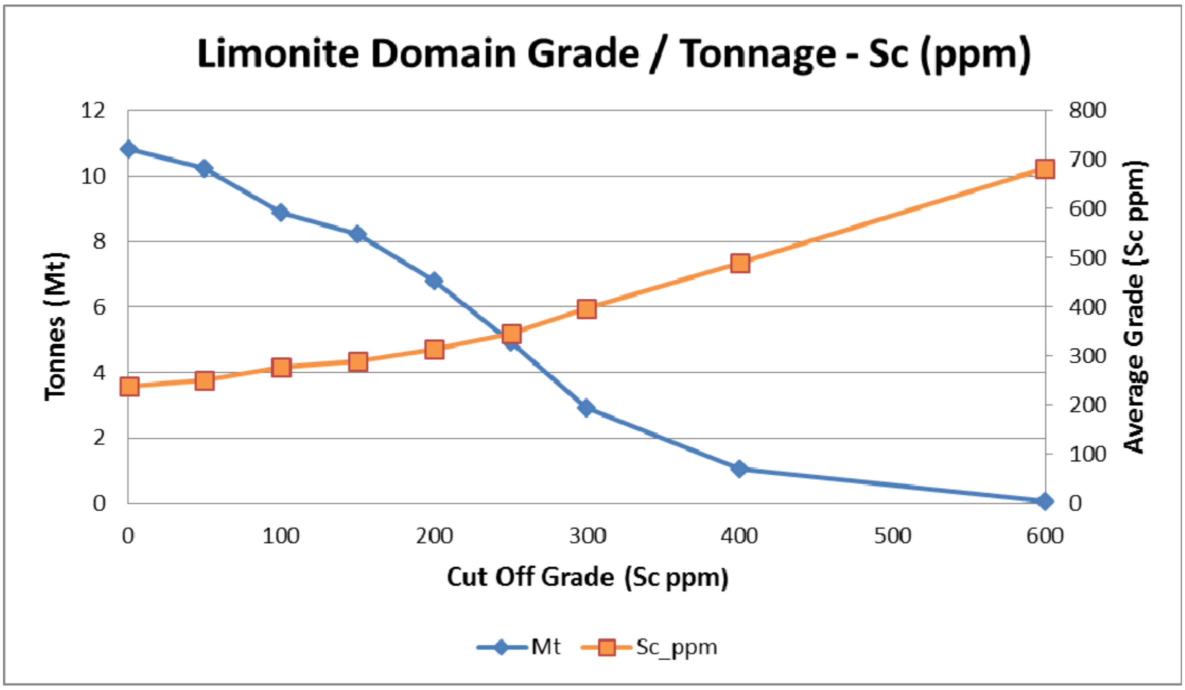
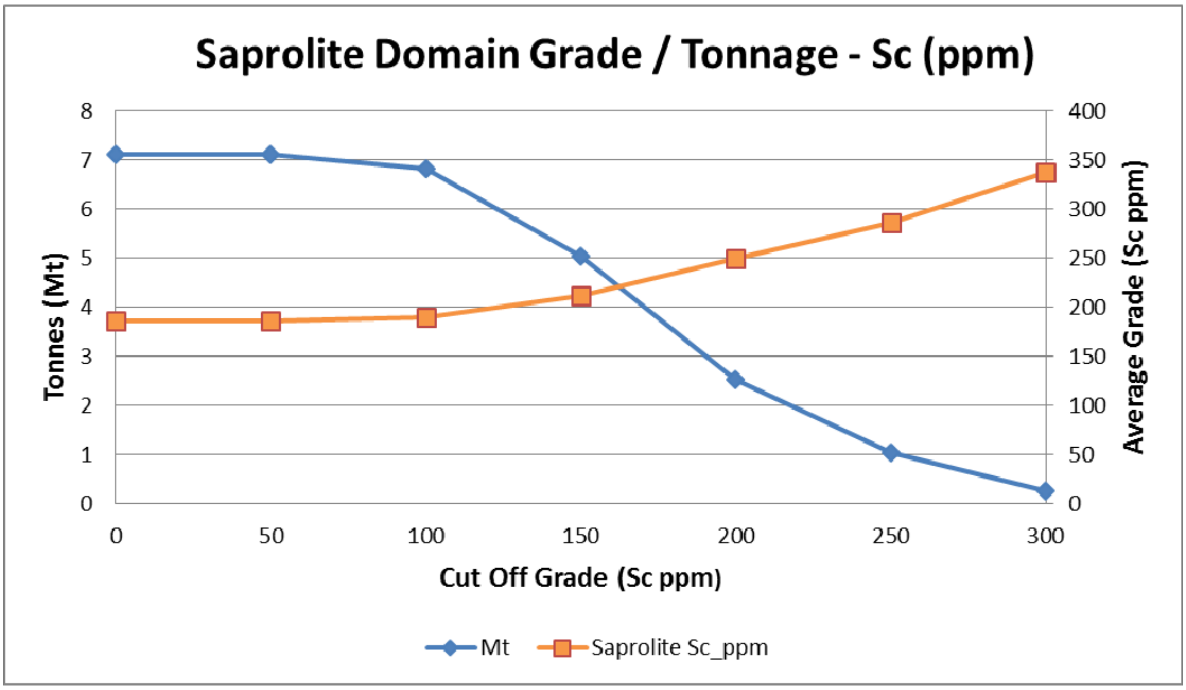


Figure 14.16 Saprolite Domain – Grade Tonnage Curve



14.14 Block Model Validation

The block model and estimation process was validated via a series of checks, as follows:

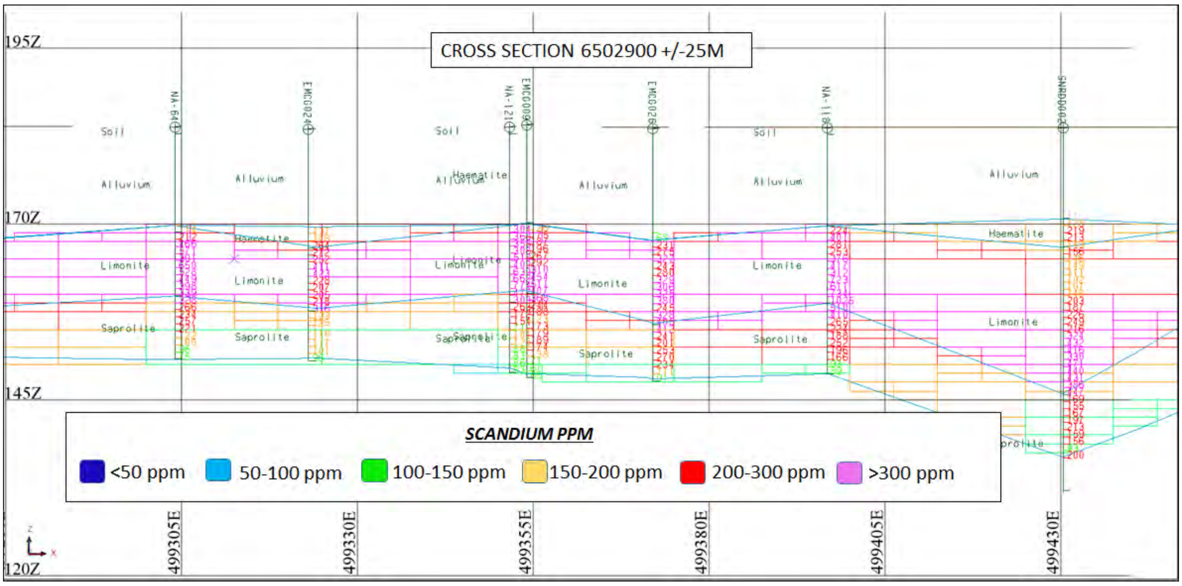
- A comparison of the block model volume within the modelled lithological domains and the volume contained within the 3D lithological models. The results of this validation check are shown in Table 14.12.

Table 14.12 Model Volume Validation

Lithology Domain	Wireframe Volume	Block Model Volume	Variance
Hematite	570,386	570,000	<1%
Limonite	5,769,853	5,750,000	<1.5%
Saprolite	4,348,082	4,330,000	<1%

- A visual validation, completed by comparing the block grades with the scandium assays within the surrounding drill holes. As shown in Figure 14.17, the comparison between the raw assay data and the individual block grades is good.

Figure 14.17 Block Model Validation Cross Section 6502900 ± 25m



15.0 MINERAL RESERVE ESTIMATES

15.1 Introduction

This Feasibility Study demonstrates that the Nyngan Scandium Project is economically viable, based on; mineral resources, production cost estimates, metallurgical recoveries, and market pricing estimates. Based on these results, Measured and Indicated Mineral Resources within the designed pits are considered Proven and Probable Reserves according to CIM Definition Standards. The final reserves are reported at an effective cutoff of 155ppm scandium, which is the same for both mining pits. This cut-off was chosen to maximise the Project NPV and IRR, and are not the same as the minimum economic cutoff applied to the resource estimates (100ppm Sc).

This Reserve estimate has been generated using conventional mine optimisation and evaluation techniques. Mining related cost data has been developed by Mining One, while all other economic inputs including processing costs, recoveries and sales data has been provided by Lycopodium and SCY. Where data has been provided by third parties, Mining One have substantiated these estimates to ensure they are reasonable and consistent with the assumptions and findings in other sections of this Technical Report.

15.2 Whittle Pit Optimisation

The optimisation methodology adopted for the Nyngan Scandium Project used the resource model generated by Mining One, which contained mineable resource codes to which Whittle-specific fields were allocated, in preparation for an optimisation calculation, done in Gemcom's Whittle-4X optimisation software.

Whittle-4X utilises a Lerchs-Grossman algorithm to calculate a suite of pit shells which enables the highest value shells to be identified for specified revenue factors, and ultimately enable the most economic pit to be identified. Application of the Lerchs-Grossman algorithm is an industry-standard approach for defining an optimum open pit shape and development of a mining sequence. The methodology relies on the preparation of a 3D block model to represent all parts of the mineralisation and host rock that can reasonably influence the pit shape.

Whittle-4X structure arcs are used to define the precedence of block removal, such that any block cannot be considered for mining unless certain overlying blocks are also mined. This effectively defines the slope geometry for an open pit operation. The optimisation then considers finding the combination of positive and negative cash flow blocks, consistent with the slope precedent rules, which are accumulated to find pit shell with the maximum positive cash flow.

Three key parameters were optimised along with the pit dimensions and outputs, specifically:

- A target scandium grade of 400ppm was set for each year's mining output, designed around a benchmark 75,000 tpy ore delivery requirement to the process facility.

- The mine production life was set at 20 years.

- Additional borrow pits have been designed outside the economic pit optimisation, to generate waste material for construction of the residue storage facility and site-required earthworks. These pits have been captured as a construction cost and are reflected in the economic justification for the mine.

15.3 Calculation Parameters

The resource is divided into three mineral lithologies; hematites, limonites, and saprolites, and while each lithology contains economic scandium content above the resource cutoff grade of 100ppm, the different resource types have not all been evaluated economic. Hematitic and saprolitic ore types have potential future value however have not been assigned economic value in the preparation of these reserves. These materials report to the mineralised waste dump which may have future economic value but the lack of processing data on these materials has resulted in this potential being excluded from the economic modelling. For this reason, realizing optimum recoveries will require that these different resource types not be mixed together, specifically at the front end of the processing facility (autoclave).

This Feasibility Study is based on processing limonite resource only for scandium, so the demonstration of economic viability with respect to establishing a Mineral Resource is only for that resource type. The Feasibility Study considers a 20 year project life. While the mineral resource totals suggest more capacity to produce product, and for longer periods, the planning, assumptions and economics have been constrained to 20 years of production, and on a relatively small scale of mining and processing.

This assumption also represents limiting parameters on establishing the Mineral Reserve estimate.

This assumption also represents limiting parameters on establishing the Mineral Reserve estimate.

The selected mining strategy includes the following general factors:

- Mining will be done on a campaign basis, over a 20 year assumed life.

- Mining will employ open pit mining methods, utilising a conventional truck – excavator technique.

- Plant ore feed will only be limonite resource, averaging 409ppm scandium over the planned mine life.

- Material characteristics and geotechnical considerations have been included into the design parameters.

- Consideration has been given to topographical characteristics and lease boundaries which may affect mining, surface infrastructure, waste dumps, and stockpile locations and dimensions.

- The mine pits have been designed with consideration to the impact on the environment, including minimising tree line disturbance.

- The construction of surface infrastructure supplement pit waste material from within the optimised pit footprint, with borrow-pit waste material, which will then serve as pre-strip activity for mining beyond the current mine life.

15.4 Cut-off Grade Equations

The mineral reserve estimate for the Nyngan Scandium Project is based on two open pit designs and predicated on a US$2,000 /kg scandium oxide price. The operating cost assumptions are in general alignment with feasibility study estimates for limonite resource.

The cut-off grade applied to the mineral reserve is effectively 155ppm. This 155ppm cut-off was applied as a constraint parameter to the Whittle pit optimisation work to ensure an annual head feed grade of 400ppm. It served to exclude the lowest grade levels of limonite resource from the 20 year production model and enabled realization of the 400ppm target grade production in certain years. Hematite and saproloite lithologies have been excluded from all cutoff grade assumptions. A total of 19,500 t of limonite ore representing 3% of the total mineralised waste stockpile failed to meet cutoff and blending parameters.

15.5 Mineral Reserve Estimate

Using the NI 43-101 updated Mineral Resource Estimate that is a part of this Technical Report, a new Proven and Probable Mineral Reserve of 1,436,000 t is established at a grade of 409ppm scandium, for the Nyngan scandium property. Estimated mineral reserves have been presented in Table 15.1.

Table 15.1 Mineral Reserve Statement – Nyngan Scandium Project

Pit Reserves-West Pit

Nyngan Scandium	Volume (BCM)	Tonnes	Scandium (ppm)
Proven Reserve	422,614	794,514	393.7
Probable Reserve	87,747	164,965	333.3
Total Ore	510,361	959,479	383.3
Waste	1,397,061	2,850,672	
StripRatio		2.97	

Pit Reserves-East Pit

Nyngan Scandium	Volume (BCM)	Tonnes	Scandium (ppm)
Proven Reserve			
Probable Reserve	253,697	476,951	460.0
Total Ore	253,697	476,951	460.0
Waste	1,025,100	2,066,514	
StripRatio		4.33	

Total Pit Reserves

Nyngan Scandium	Volume (BCM)	Tonnes	Scandium (ppm)
Proven Reserve	422,614	794,514	393.7
Probable Reserve	341,444	641,915	427.4
Total Ore	764,058	1,436,429	408.8
Waste	2,422,161	4,917,186	
StripRatio		3.42	

Notes:

1) The Mineral Reserve is as of April 15, 2016.

2) All Mineral Reserves have been estimated in accordance with CIM standards as prescribed by the National Instrument 43-101.

3) Mineral Reserves were estimated using the following mining and economic factors:

a. A 2% dilution factor and 97.5% recovery was applied to the mining method;

b. Wall angles of 37 degrees for the West pit and 33.5 degrees for the East Pit;

c. A Scandium Oxide (Sc2O3) price of US$2,000/kg

d. An overall processing recovery of 83.2% for scandium oxide from the process facility

4) The Mineral Reserve calculation effectively employed a cut-off grade of 155ppm elemental scandium, which is above the economic cut-off grade, and allows Whittle to achieve an average ROM grade of +400ppm for the life of mine.

5) Mineral Reserve Estimates were prepared under the guidance of Dean Basile who is a Principal Engineer at Mining One Pty Ltd and is classified as an independent author. He is a Member of the Australasian Institute of Mining and Metallurgy and has over 20 years of relevant engineering experience and is the Qualified Person for Mineral Reserves.

15.6 Reserve Classification and Future Exploration Infill Drilling

Exploration drilling may improve confidence of the Indicated portions presented in the open pit areas. The Reserve presented herein has been constrained to a 20 year mine life to conform with the available economic data available at the time of preparing this report. Based on the financial data used in the preparation of this report the potential exists to increase Mineral Reserves based on the existing Measured and Indicated Resource.

16.0 MINING METHODS

16.1 General Overview

The Nyngan scandium deposit is considered a surface-mineable deposit, with an overall strip ratio approximating 3.4:1, depending on specific areas mined, and which portions of the resource material is being mined for production. The mine design has been prepared by Mining One Consultants (Melbourne) and has been developed using industry recognised analysis techniques including pit optimisation using Whittle-4X and Surpac mine planning software. All earthworks will be carried out using a mining contractor on a campaign basis, and mining will be carried out using selective truck and excavator mining methods. Campaigns will typically be conducted three times each year for the 20 year mine life.

Four key parameters have been applied to the mine plan to maximise project value:

1. The mine plan is limited to a 20-year duration, recognising that this timeframe utilises less than 12% of the total measured and indicated resource contained in the resource model.

2. The mine plan targets delivery of only limonite resource to the processing facility, the processing route designed in this Feasibility Study is tailored for limonite-only production, at a 75,000 tonnes of ore per year (tpy) feed rate.

3. The pit optimisation achieved an optimised shell approximating 100 years at the scheduled ROM feed rates. For the purpose of this study and to align with the economic life of the processing assets the pit shell approximating 20 years of ore production at a feed rate of 75,000 tpy was selected as the basis for the pit design. An overall head grade of over 400ppm was achieved for this shell.

4. The optimisation identified two discrete mining areas to which a western and eastern pit design was developed. While these represented the optimum pit designs the pits will be over excavated to source material for the construction of the Residue Storage Facility. These cutbacks are referred to as borrow pits and the costs associated with these pits have been captured as sustaining capital in the economic analysis.

These four external variables to the mine planning / optimisation process created two associated mining activities, not specifically related to the primary task of delivering scandium resource material to the processing facility.

- The head grade target and limonite-only restriction applied to the reserves resulted in other grade-bearing material being deposited onto a mineralised waste dump. This includes low grade limonite ore, scandium bearing hematite, and saprolite ore. A total of 620,000 t of mineralised waste at a grade averaging 200ppm will remain at the end of the 20 year mine life. Further work is required to determine the economic viability of this material and therefore no economic value has been assigned to this potential asset.

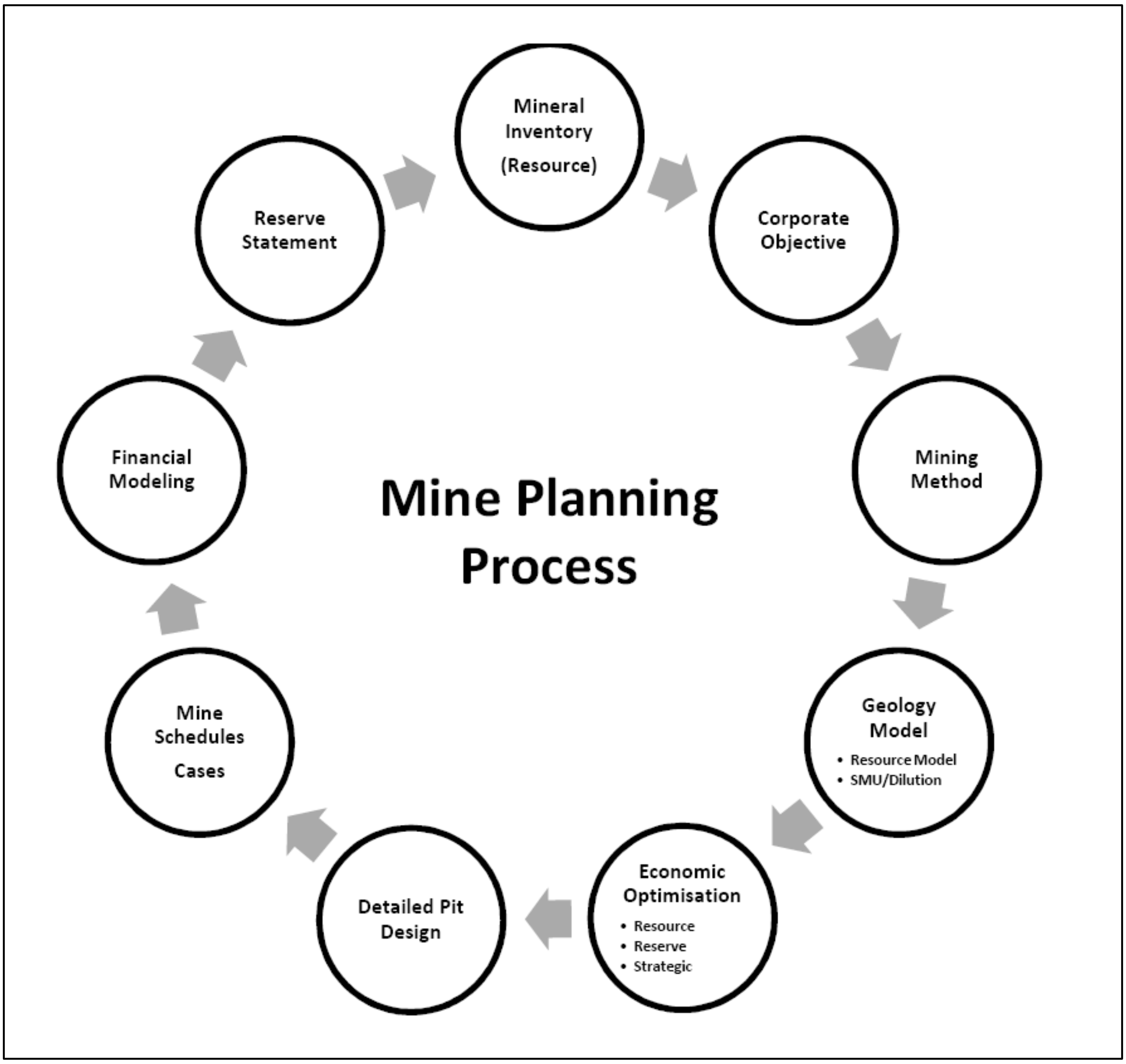
- The two pit mining strategy generates significant waste, but not enough to meet the 20 year infrastructure requirements for capacity expansions of the Residue Storage Facility. As a result, additional borrow pit material is excavated from around the pit area and used to meet the needs of the Residue Storage Facility construction and all waste material is consumed by site infrastructure. No waste dump will be required for the project.

- These two mining-related activities represent value to the Project beyond the 20 year term, in the form of a potential stockpiled resource for processing and pre-strip value for future mining areas. The borrow pits have been located based on the outlines of pit shells that were generated by the optimisation project which will reduce the pre-strip demands on any future cutbacks to the pit. The cost of these activities has been absorbed in the 20 year Feasibility Study economics and the potential future value has not been recognised.

16.2 Mine Development and Optimisation Process

A systematic approach was undertaken to deliver a balance between the three target parameters of head grade, annual production and waste movement. Mine design, planning and scheduling to an optimised development plan is an iterative process to ensure all options are reviewed and the selected scenario will provide the desired outputs for the project. The mine design and scheduling process followed for this Project is illustrated in Figure 16.1.

Figure 16.1 Mine Planning Process



16.3 Mine Pit Optimisation - Overview

Industry recognised pit optimisation practices were used to identify the optimum pit to mine, based on the mineral inventory provided from the Mineral Resource database. The digitised mineral resource block model database from Surpac software was imported into Gemcoms' Whittle-4X mine optimisation software, where a full evaluation of the resource was conducted to identify the pit shell design that balanced the highest NPV value against the required 20 year throughput target for the processing facility.

16.3.1 Pit Optimisation using Whittle-4X Software

The Project resource model was the source of mineable resource blocks to which Whittle - specific fields were allocated in preparation for the optimisation in Gemcom's Whittle-4X optimisation software. Whittle-4X calculates a suite of pit shells which enables the highest value shells to be identified for specified revenue factors, which ultimately enable the most economic pit to be located within the ore body. This is achieved based on a given set of mining, metallurgy and economic parameters.

Whittle-4X software drives its optimisation calculations by applying the Lerchs-Grossman algorithm; an industry-standard approach for defining an optimum open pit shape and development of a mining sequence. The methodology relies on the preparation of a 3D block model to represent all parts of the mineralisation and host rock that can reasonably influence the pit shape. The individual resource blocks are assigned a revenue value, which then initiates an optimised sequencing and selection of blocks based on various cost factors.

Whittle-4X structure arcs are used to define the precedence of block removal, such that, a block cannot be considered for mining unless certain overlying blocks are also mined. This effectively defines the slope geometry for an open pit operation. The optimisation then considers finding the combination of positive and negative cash flow blocks, consistent with the slope precedent rules, which are accumulated to find pit shell with the maximum positive cash flow.

Whittle-4X software has capabilities to vary mineral pricing and other cost parameters to create nested pit shells that inform mine planners how to revise mine plans as mineral prices change with time. In this case, prices were considered stable and the 20 year mine life assumption on a much larger potential resource limited the value of planning around more marginal resource blocks.

16.3.2 Block Model

The Mineral Resource Model (nyngan_scandium_dec2015.mdl) was constructed in Surpac software and was used as the basis for the Whittle block model. Section 15 of this report summarises the process to generate the resource model. The resource block model was imported into Whittle software package using the user / parent block size of 25m x 25m x 5m. This enabled a reasonable resolution to be achieved for the pit shells.

Several checks were undertaken to validate the block model to ensure all data was imported correctly:

- The block extents were checked to ensure the block model was adequate for the optimisation, this involved checking maximum and minimum values.
- The model was checked to ensure no null values existed in the model.
- Grade distributions were checked to ensure there were no abnormal values in the model.
- Ore totals were checked and validated against the resource statement.
- Field values were checked to ensure all required fields existed within the model.

Prior to the Whittle Pit Optimisation, the block model was modified to ensure there was sufficient data for the optimisation, this primarily involved the inclusion of fields to enable the economic evaluation to be undertaken. Several attributes / data fields were created in the block model as required for the Whittle process as follows:

Rock Type Code

The 'wtype' data field was added to the block model as a 'Whittle rock type' code to identify ore and waste blocks. An ore block, within this context, simply means that Whittle will treat the block as ore if revenue exceeds or equals the cost of mining the block and is based on economic data specific to the recover and sale of Scandium oxide.

The basic assumptions to differentiate rock types were as follows:

- 'AIR' was assigned to the blocks above the topographic surface (topo = 1). A block that was partly below the topographic surface was classified either as a Waste Block or a Potential Ore Block.
- 'WSTS' was assigned to the blocks with zero Scandium grades.
- All blocks with over 0% Scandium grade were classified as potential ore blocks.
- The rock type was also differentiated by Resources Classification so the optimisation outputs could be grouped based on the resource classification.

Other Modifying Factors

- 'gtzone' – a code for geotechnical zones, this enables different slope angles to be specified for various face orientations to ensure the geotechnical parameters are met.
- 'mcaf' – the Mining Cost Adjustment Factor, is the factor is to adjust the mining cost based on the depth of mining. MCAF is used in Whittle to represent the mining cost adjustment as mining progresses deeper. MCAF acts as a multiplier on a reference mining cost.
- 'mcaf' – the Mining Cost Adjustment Factor, is the factor is to adjust the mining cost based on the depth of mining. MCAF is used in Whittle to represent the mining cost adjustment as mining progresses deeper. MCAF acts as a multiplier on a reference mining cost.
- 'pcaf' – the Processing Cost Adjustment Factor is similar to MCAF, PCAF is assigned to differentiate processing cost based on the bench or pit location. PCAF acts as a multiplier on a reference processing cost. A default value of one was used in the block model.

16.3.3 Whittle Optimisation Parameters and Process

The processing assumptions, cost operating parameters, and commodity price were identified and validated for input into the Whittle program. These economic values were derived from detailed economic modelling of the proposed mining and processing methodologies.

A summary of the input parameters and assumptions used to develop the Whittle base case (mining, processing, and selling costs) are presented in Table 16.1.

Table 16.1 Whittle Input Parameters

Whittle Input	Unit	Value	Source
Whittle or Design		Whittle	Mining One
Model Name		nyngan_scandium_dec2015.mdl	Mining One
Run Date	dd/mm/yyyy	12/02/2016	Mining One
Sc_2O_3 Selling Price	US$/kg	2,000	EMC
Sc to Sc_2O_3 Conversion Ratio		1.534	EMC
Effective Sc Selling Price	US$/kg	3,060	EMC
Discount Rate	%	10%	Mining One
Processing Rate	t/year	75,000	EMC
Overall Slope Angle	Degrees	30	Knight Piésold
Reference Mining Cost	US$/t	4.59	Mining One
Mining Cost Adjustment Factor		“MCAF used”	Mining One
Stockpiles			Mining One
Re-handle Cost	US$/t	0	Mining One
Cut-off Grade	ppm	0	Mining One
Mining Limit		No Limit	EMC
Mining Dilution		2%	Mining One
Mining Recovery	%	97.5%	Mining One
Raised Cut-off Grade	ppm	0	Mining One
Processing Cost	US$/Ore t	256	Lycopodium
Mill Recovery	%	83.2	Lycopodium
Ore Processing Limit	t/year	75,000	EMC

With the Whittle inputs selected from the Surpac resource block model and the mining and costing parameters identified and established, the software was run in iterative form to establish both a life-of-mine pit outline and sequence and a 20 year mine life pit design to meet the criteria of the feasibility study.

Lithology codes were used to tag the ore and waste materials with only the limonite ore being assigned economic value. Hematite and saprolite ores were ignored by the Whittle software and assigned zero economic value (ie. treated as waste). To ensure the targeted head grade of 400ppm was achieved the cut-off grade was modified until this head grade was achieved. An artificial cut-off grade of 155ppm scandium was adopted as this was the lowest cut-off grade to deliver the desired head grade. This ensured the Whittle optimisation did not attempt to optimise near surface low grade ore.

The economic head grade for this project approximated 120ppm so the artificial cut-off was significantly higher than the natural cut-off grade.

Upon completion of the Whittle output, a validation process was carried out to confirm that the optimisation process used the correct data and parameters. In addition, the Whittle formula inputs were derived from the base formulas confirming that the Whittle output was valid and consistent.

The Whittle optimisation software run-process steps are outlined in Table 16.2.

Table 16.2 Whittle Optimisation Process

Received Data		Resource Block Model is provided in Datamine (.dm) format
Block Model	**Validation**	The imported Block Model is validated by undertaking several checks, which includes: • Randomly selected block comparison. • Visual check. • Resource tonnes and grade comparison.
	Preparation	The Block Model is prepared to have sufficient information for Whittle. Block Model is exported to *.mod and *.par format.
Whittle Model Preparation		*.mod and *.par files are imported into Whittle. Input parameters are developed in Whittle. A validation routine is undertaken, which includes: • Block value check. • Mining cost check. • Element processing cost check. • Undiscounted cash flow check.
Pit Optimisation		Whittle Pit Optimisation is run to determine the ultimate shell at Revenue Factor 1.
Pit Design		The pit design is developed based on the optimum pit shell.
Project Evaluation and Reserves Estimate		Project Financials are evaluated and reserves estimates concluded.

Furthermore, a validation process was carried out to check whether:

- The optimisation process used the correct data.
- The optimisation parameters were inputted correctly.
- The formula inputs to Whittle were derived from the base formulas correctly.
- The Whittle output was correct.

The following validation routine was undertaken:

- Rock tonnes comparison between Surpac and Whittle (see Table 16.3).
- Block value check in Whittle.
- Internal peer review.

Based on the results from the checks that were carried out to validate the Whittle model, it was concluded that there were no significant flaws in the Whittle model and the model was considered valid for further mine planning.

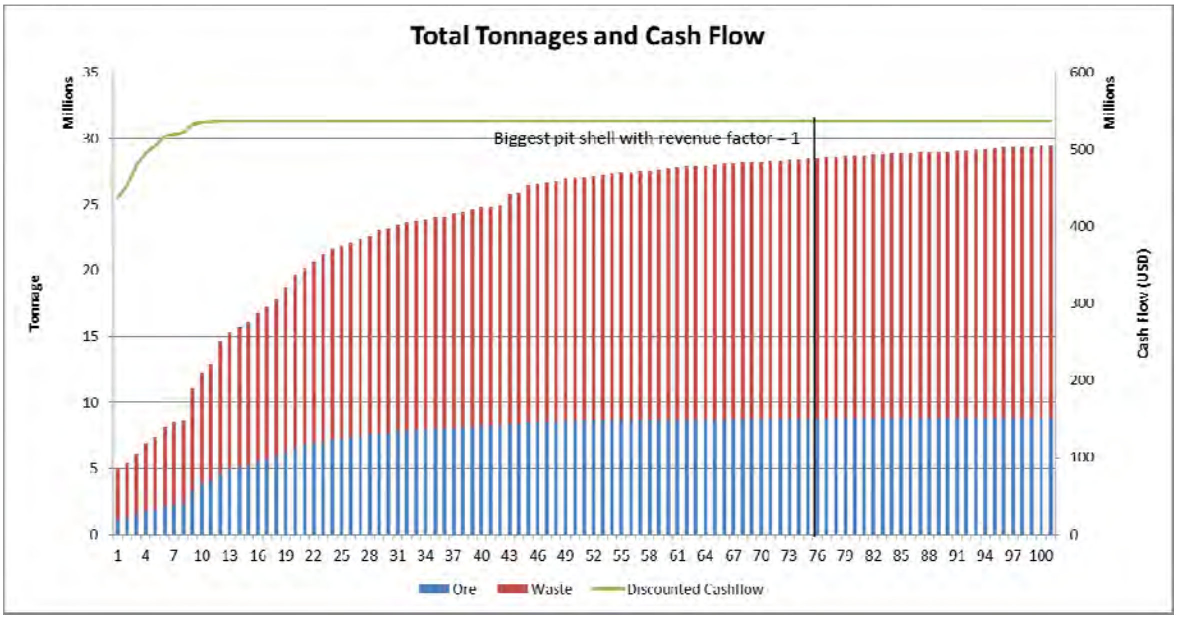
Table 16.3 Whittle Input Parameters

Wtype	Surpac	Whittle	Variance
	Tonnes	Tonnes	%
insa	4,714,039	4,714,032	0%
inli	7,877,182	7,877,192	0%
inal	11,200,150	11,200,172	0%
mesa	2,402,184	2,402,180	0%
meli	2,933,553	2,933,557	0%
meal	4,258,472	4,258,480	0%
mehe	425,250	425,250	0%
inhe	859,688	859,688	0%

16.3.4 Pit Optimisation Results

Based on the aforementioned parameters and assumptions, Whittle was run to define the pit shell at various revenue factors. Figure 16.2 illustrates the cash flow for each shell generated by the optimisation for the base case.

Figure 16.2 Whittle Optimisation Results – Optimum Shell 76



As indicated by the dark line in Figure 16.2, shell 76 represents the optimum shell at Revenue Factor 1. A summary of shell 76 optimisation results is provided in Table 16.4.

Table 16.4 Shell 76 – Optimisation Outputs

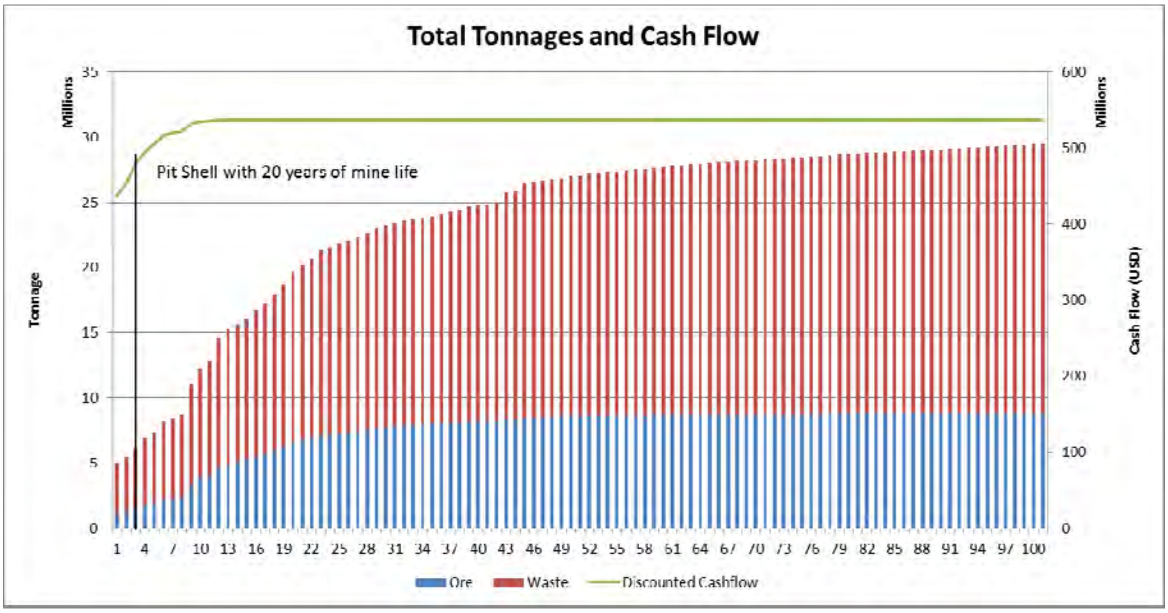
Description	Unit	Pit Shell
Total Tonnes	t	28,488,947
Waste	t	19,717,875
Ore	t	8,771,072
Sc Grade	ppm	272
Life of Mine	Year	116
Disounted Best Cash Flow*	Million US$	537
Discounted Worst Cash Flow*	Million US$	226

*** Based on operating costs only, exclusive of capital costs**

16.3.5 Pit Shell Selection

The business objective required a pit design that delivered 20 years of feed to the processing plant at a rate of 75,000 tpy. Based on this criterion, pit shell 3 was been selected as the basis of the pit design. As illustrated in Figure 16.3 it can be seen that the selected shell is significantly smaller than the optimum shell.

Figure 16.3 Whittle Optimisation Results – Shell 3



A summary of shell 3 optimisation results is provided in Table 16.5

Table 16.5 Shell 3 – Optimisation Outputs

Description	Unit	Pit Shell
Total Tonnes	t	6,161,302
Waste	t	4,647,808
Ore	t	1,513,494
Sc Grade	ppm	412
Life of Mine	Year	20
Discounted Bestt Cash Flow*	Million US$	480
Discounted Worst Cash Flow*	Million US$	460

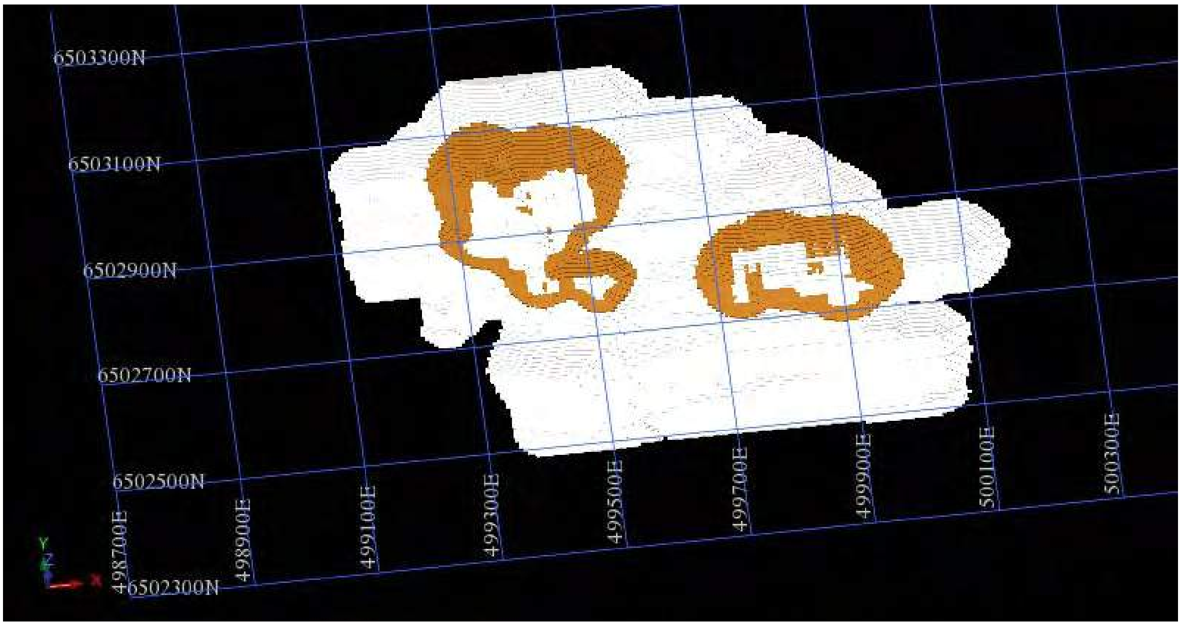
*** Based on operating costs only, exclusive of capital costs**

16.3.3 Whittle Pit Design Outputs

The Whittle software generated an optimum pit shell for the full limonite resource, covering the entire 8.9 Mt measured and indicated limonite resource. The shell that met the 20 year mining criterion (shell 3) was then selected as the template for the pit design.

Figure 16.4 illustrates the relationship between the optimum pit shell in white (shell 76) and the shell adopted for the evaluation of the scandium project (shell 3).

Figure 16.4 Pit Shell Outlines – Optimum Shell (76) vs. 20 Year Shell (3)



16.4 Mine Pit Final Design and Layout

16.4.1 Design Criteria

Following the pit optimisation process, pit designs were fitted to the shells based on the design criteria determined by the geotechnical assessment of the site. Two separate pits were designated as the western and eastern pits. The western pit is the larger of the two, and is sequenced such that mining commences in this pit first, as it is physically closer to the Residual Storage Facility and the processing plant. This location minimises early period costs associated with the initial Residue Storage Facility construction, the production haulage costs and it provides time to address environmental offsets for access into the eastern pit.

Pit design parameters were based on geotechnical recommendations from work completed by Knight Piésold Consulting (Feb 2016: BR801-00286 TDR M16001). The waste dump was designed based on estimated slope parameters provided by Mining One.

The overall pit design was aligned with the geotechnical design criteria with the benches being designed to meet the slope design specifications outlined in Table 16.6. The final 20 year outlines on the western and eastern pits are shown in Figures 16.5 and Figure 16.6, respectively.

Table 16.6 Pit Design Parameters

Slope Height	Bench Height (m)	Batter Angle	Berm Width (m)	IRSA
West Pit				
Surface to -10 m	10 m	34°	5 m	
-10 m to -20 m	10 m	39°	5 m	33.5°
-20 m to -45 m	10 m	50°	5 m	
East Pit				
Surface to -6.5 m	6.5 m	34.5°	5 m	
-6.5 m to -15 m	8.5 m	34.5°	5 m	37°
-15 m to -26.5 m	11.5 m	34.5°	5 m	
-26.5 m to 35 m	8.5 m	50°	5 m	
Waste Dump				
Waste dump	10	32	5	20° - 25°
Road Design				
Single lane ramp	11 m width and 10% gradient			

Figure 16.5 Western Mining Pit Final Design Outline

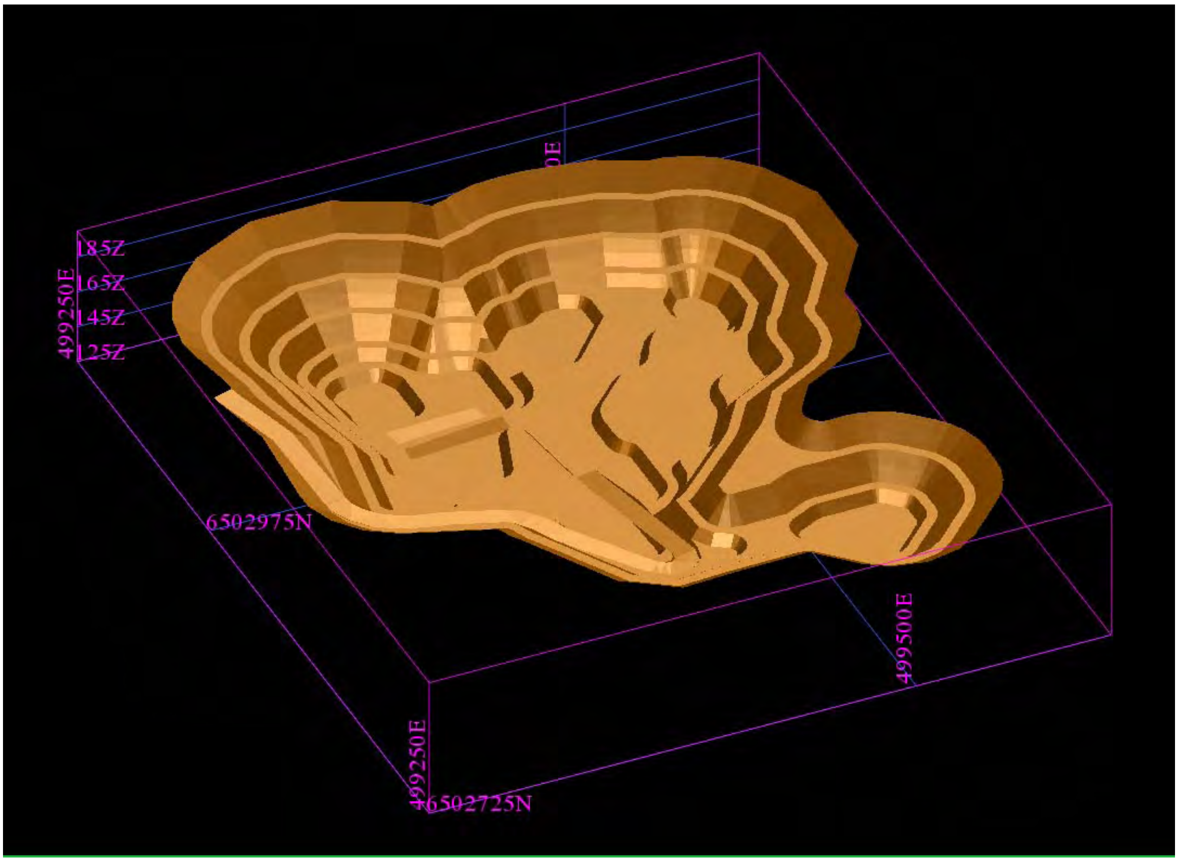
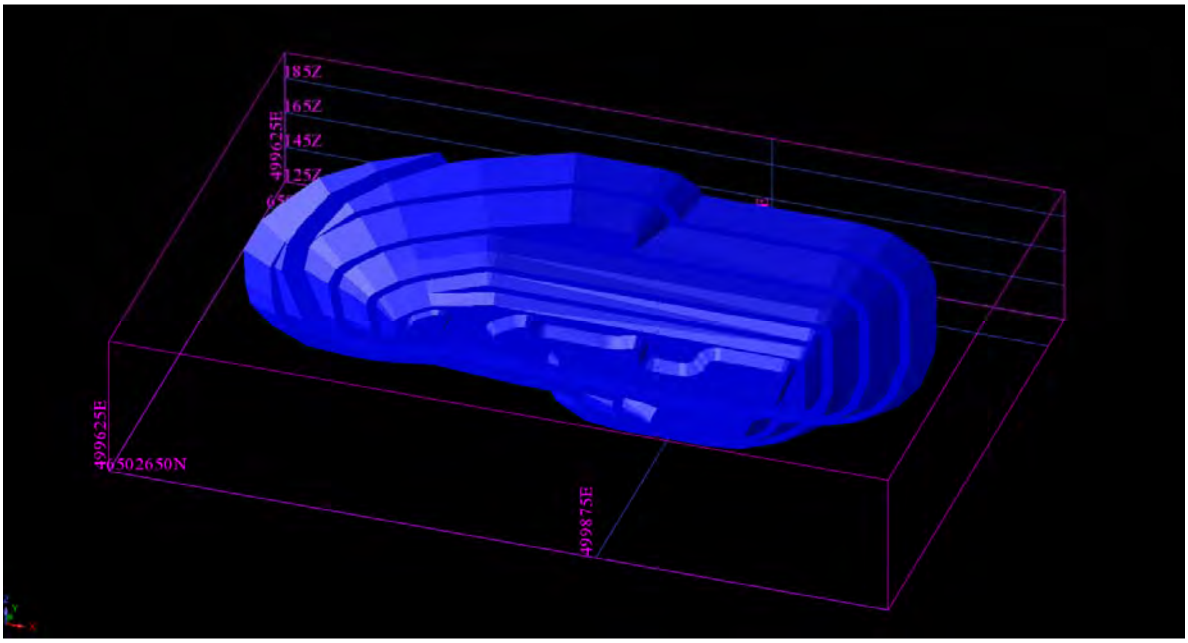


Figure 16.6 Eastern Mining Pit Final Design Outline



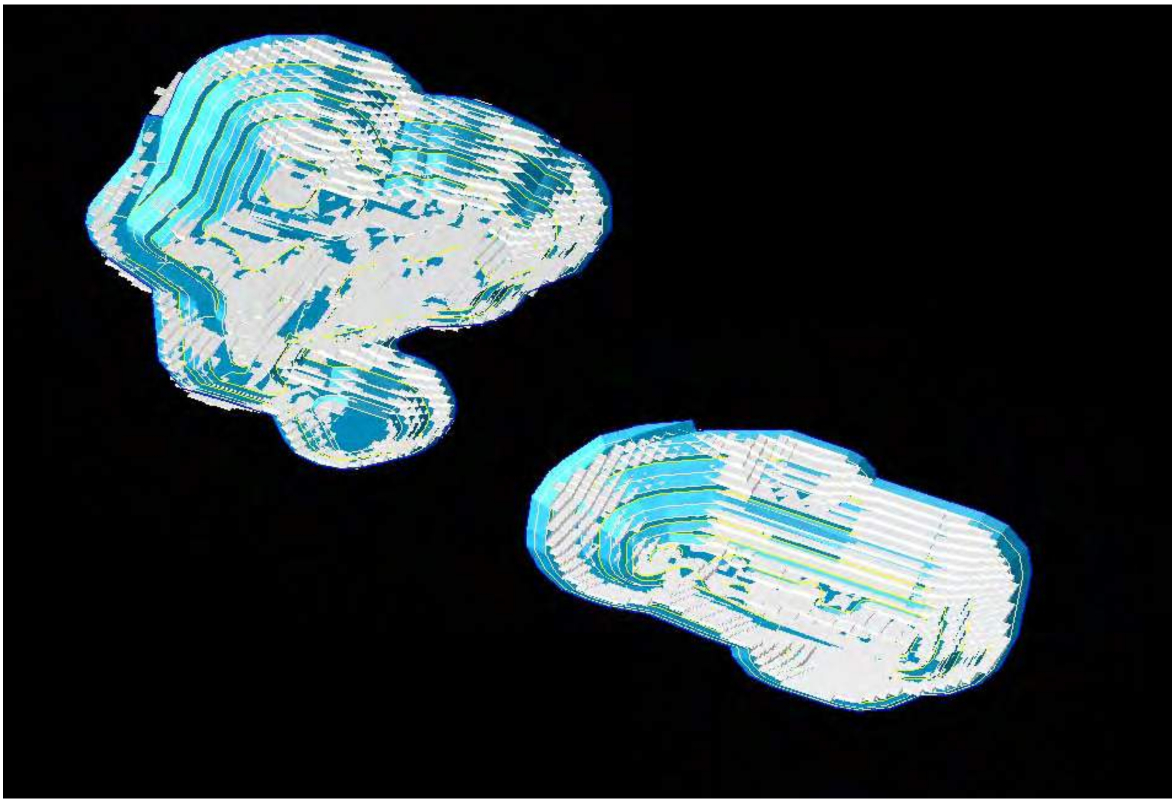
To ensure the pit designs were in line with the Whittle shells upon which they were based, a comparison of the relative quantities between the Whittle shell and the pit designs was prepared to ensure the design was within the accepted tolerances. Table 16.7 illustrates that the pit design carried approximately 3.7% more material than the Whittle shell. This is considered to be within acceptable limits as allowances for roads and berms must be factored into the discrepancy.

Table 16.7 Quantitative Comparison Between Whittle Shell and Pit Designs

Description	Unit	Whittle	Design	Variance
Total Tonnes	t	6,161,302	6,390,450	3.7%
Waste	t	4,647,808	4,907'047	1%
Ore	t	1,513,494	1,483,403	-1%
ScO Grade	%	412	418	-1%

Figure 16.7 provides a visual overlay of the Whittle shell in white against the pit design in blue.

Figure 16.7 Whittle Shell against the Pit Designs

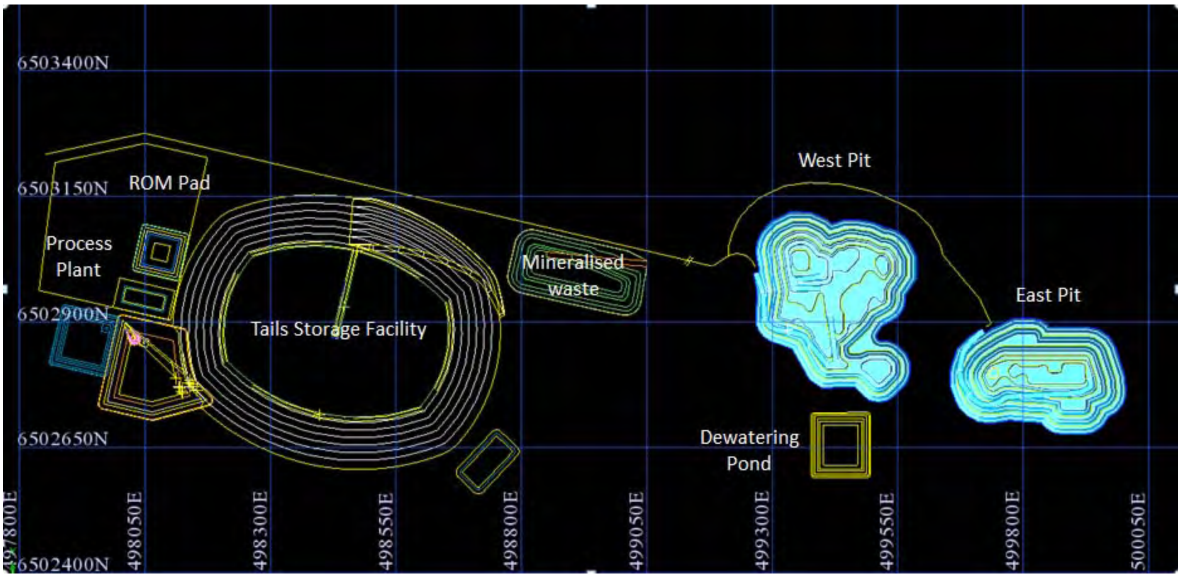


The approximate dimensions of the two pits are as follows:

- Western pit approximates 350m N-S and 350m E-W and;
- Eastern pit approximates 225m N-S and 350m E-W.

The two mining pits are relatively close to the planned processing facility location and are illustrated in the site plan in Figure 16.8.

Figure 16.8 Location Plot on Mining Pits and Processing Facilities



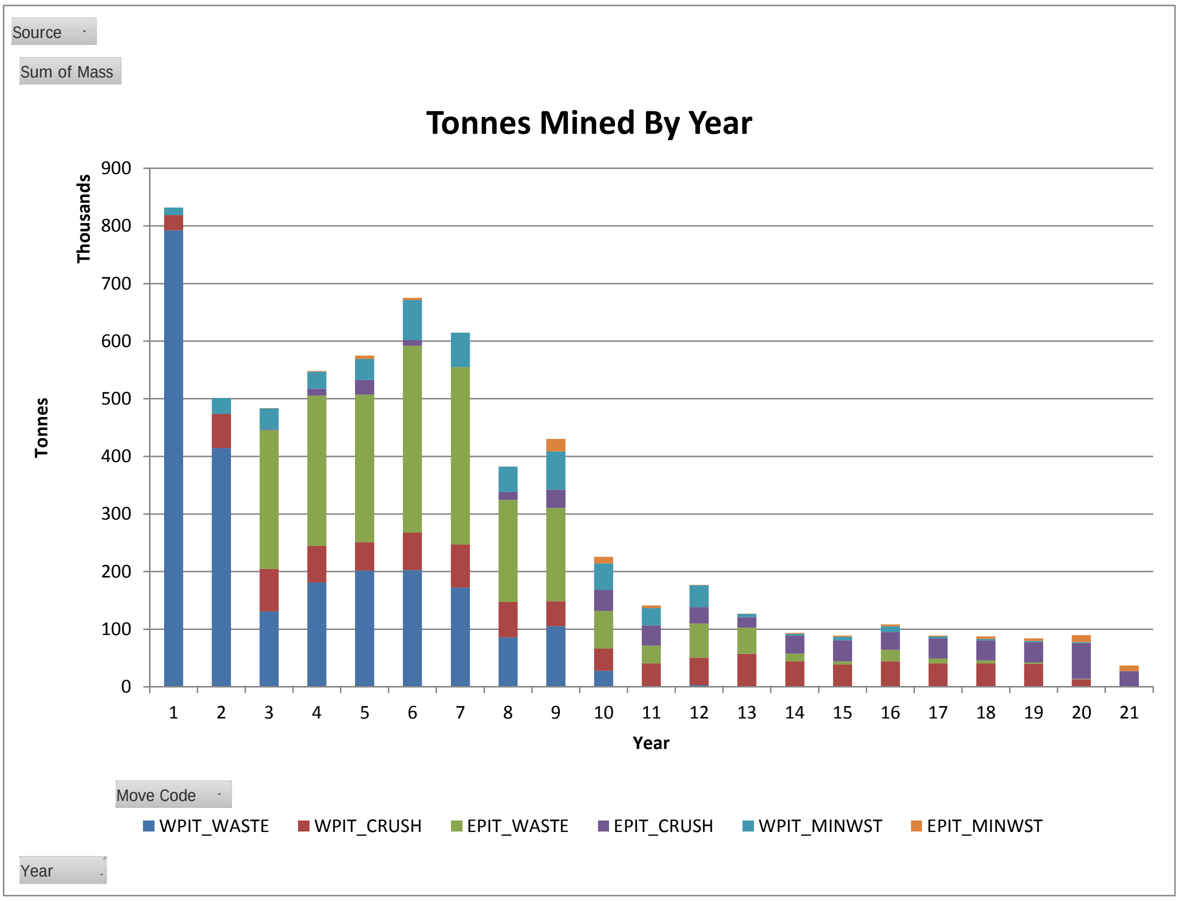
16.5 Mining Scheduling Overview

The scheduling process for each mining pit involved sequential bench design, calculation of ore and waste quantities by bench, and resource grades by bench, using Surpac software and the resource database. In-pit resource mining was then scheduled using Geovia's software. Head grades were then calculated for the resource delivered to the process facility ROM stockpile, based on a mine recovery parameter of 97.5%, and a dilution factor of 2%. Logical mine bench sequencing was then determined, based on delivery requirements for both ore and waste. The schedule was refined over a number of runs to deliver 75,000 t of ore at a grade approximating 400ppm for each year of operation.

Loss and dilution of 2.5% and 2.0% respectively was applied to the schedule, these dilution estimates were calculated using dilution modelling. Dilution modelling applied a 250 mm skin across the target resource and then calculated equivalent loss and dilution estimates based on this skin being mined as part of the target material. The low numbers achieved for this exercise are the result of mining within the larger life of mine ore boundary, such that most of the dilution material carried economic grade.

The mine is considered a relatively low volume operation, with annual total waste/ore production varying between 700,000 tpa the early years down to 100,000 t in later production periods, as depicted in Figure 16.9.

Figure 16.9 Total Mined Tonnages by Year



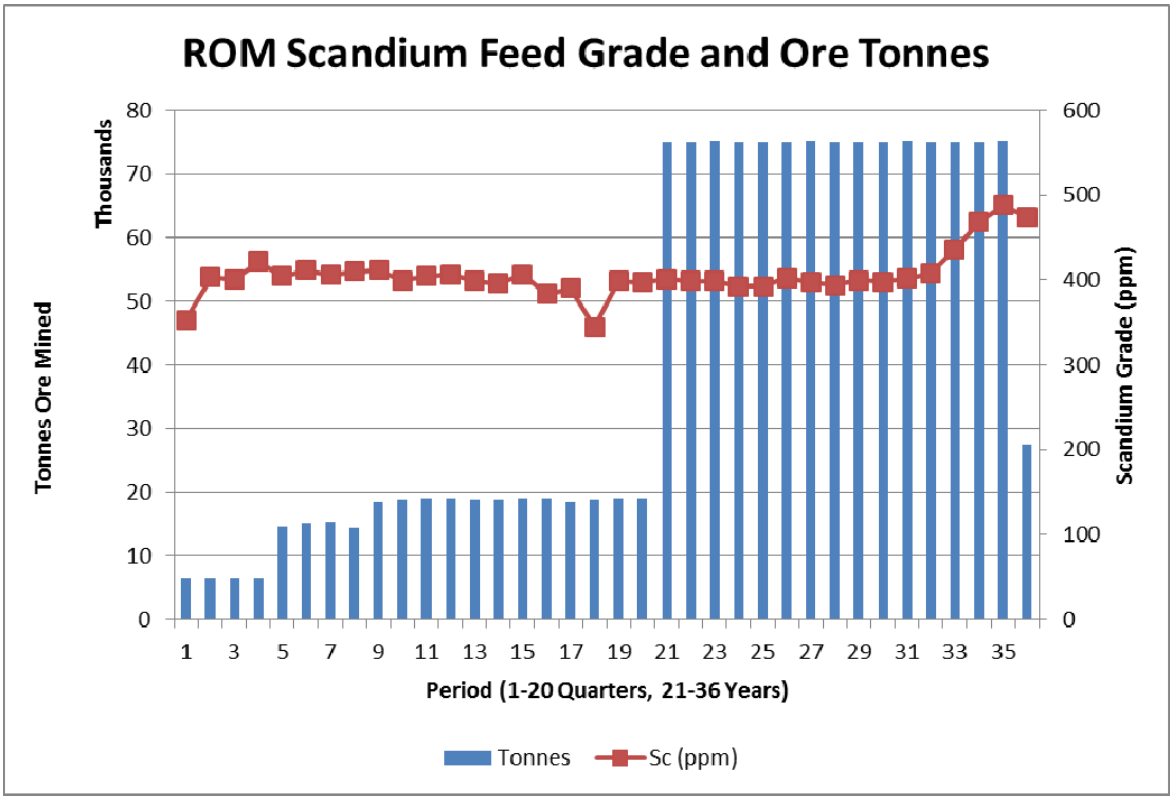
The 20 year mining schedule incorporated both the western and eastern pit designs, with the western pit developed first. No interim pits were designed, as the pit geometry provided little space for stage plans to be developed. The start-up profile for the operation was to ramp up scandium feed to the process plant over the initial two years of operation, reaching nameplate throughput in year three of 75,000 tpy, as shown in Table 16.8, at a 400ppm head grade.

Table 16.8 Production Ramp-up Targets

Period	Ore Production Tonnes
Year 1	26,500
Year 2	60,000
Year 3 - 21	75,000

Mining activity by year has been planned to closely match the nameplate process facility capacity beginning in year three. Figure 16.10 illustrates the volumes and grade production levels from the two pits over the 20 years of planned operation. Note this graph shows the first five years on a quarterly basis (20 periods), and then illustrates years 6 to 20 on an annual basis. It should also be noted that the 400ppm head grade is sustained over the 20 years of operation.

Figure 16.10 ROM Ore Tonnes and Scandium Grade (ppm)



The resource data and optimisation software generated pit shells in two areas where in-situ limonite grades generally averaged 400ppm. The limonite is shallow in these areas and shows good continuity at good mineable widths. Given a longer mine life assumption, the two separate pits would ultimately converge into one, as can be understood from Figure 16.4. The majority of the resource material is in the measured category in both of these two mine pits, further increasing confidence in the data supporting the selection points.

The schedule maintained an average scandium grade of approximately 409ppm for the life of the mine. Mining tonnages are shown by year over the 20 year production period in Table 16.9, and scandium grades (ppm) of resource mined and delivered to the processing plant facility or the low grade stockpile are shown by year in Table 16.10.

Table 16.9 Mining Quantities by Year (t)

Mine Material Movements (tonnes)	2017 Year 0	2018 Year 1	2019 Year 2	2020 Year 3	2021 Year 4	2022 Year 5	2023 Year 6	2024 Year 7	2025 Year 8	2026 Year 9	2027 Year 10
Waste Material	630,560	145,464	408,828	393,941	442,304	457,843	661,603	345,070	263,121	267,370	92,909
Ore to Process Plant	6,471	19,773	59,023	75,008	75,213	75,008	75,008	75,008	75,213	75,008	75,008
Low Grade Stockpile	3,139	10,023	27,990	36,800	30,531	41,928	73,560	59,722	43,741	87,863	57,737
Total Mine Material	640,169	175,260	495,841	505,748	548,048	574,778	810,170	479,800	382,075	430,241	225,654

Mine Material Movements (tonnes)	2028 Year 11	2029 Year 12	2030 Year 13	2031 Year 14	2032 Year 15	2033 Year 16	2034 Year 17	2035 Year 18	2036 Year 19	2037 Year 20	20 Year Total
Waste Material	31,690	63,044	45,849	13,834	5,695	19,924	8,618	5,360	2,412	843	4,306,281
Ore to Process Plant	75,008	75,213	75,008	75,008	75,008	75,213	75,008	75,008	75,008	75,213	1,436,429
Low Grade Stockpile	34,362	38,785	5,887	4,957	7,955	13,322	5,099	7,031	6,820	13,652	610,905
Total Mine Material	141,060	177,042	126,743	93,799	88,657	108,459	88,725	87,399	84,240	89,708	6,353,615

Table 16.10 Mined Scandium Grades by Year (ppm)

Mined Resource Grade (ppm)	2017 Year 0	2018 Year 1	2019 Year 2	2020 Year 3	2021 Year 4	2022 Year 5	2023 Year 6	2024 Year 7	2025 Year 8	2026 Year 9	2027 Year 10
Ore to Process Plant	353	409	408	405	396	383	401	399	399	392	392
Low Grade Stockpile	0	181	254	244	228	200	232	221	202	176	169

Mined Resource Grade (ppm)	2028 Year 11	2029 Year 12	2030 Year 13	2031 Year 14	2032 Year 15	2033 Year 16	2034 Year 17	2035 Year 18	2036 Year 19	2037 Year 20	20 Year Total
Ore to Process Plant	402	398	394	400	398	402	408	436	469	488	409
Low Grade Stockpile	195	203	233	192	194	199	197	208	146	135	203

16.6 Mine Pit Plan Progression

The following illustrations show the progression of pit development on a five year basis for both the western and eastern pits, through the 20 year planned mine life.

The pit shells are shown for years 1, 5, 10, 15, and year 20, in Figures 16.11 through to Figure 16.15. The red / blue colour represents mining faces at the end of the relevant period, and the western pit is shown on the left, while the eastern pit is shown to the right.

Figure 16.11 Mine Pit Configuration – Year 1

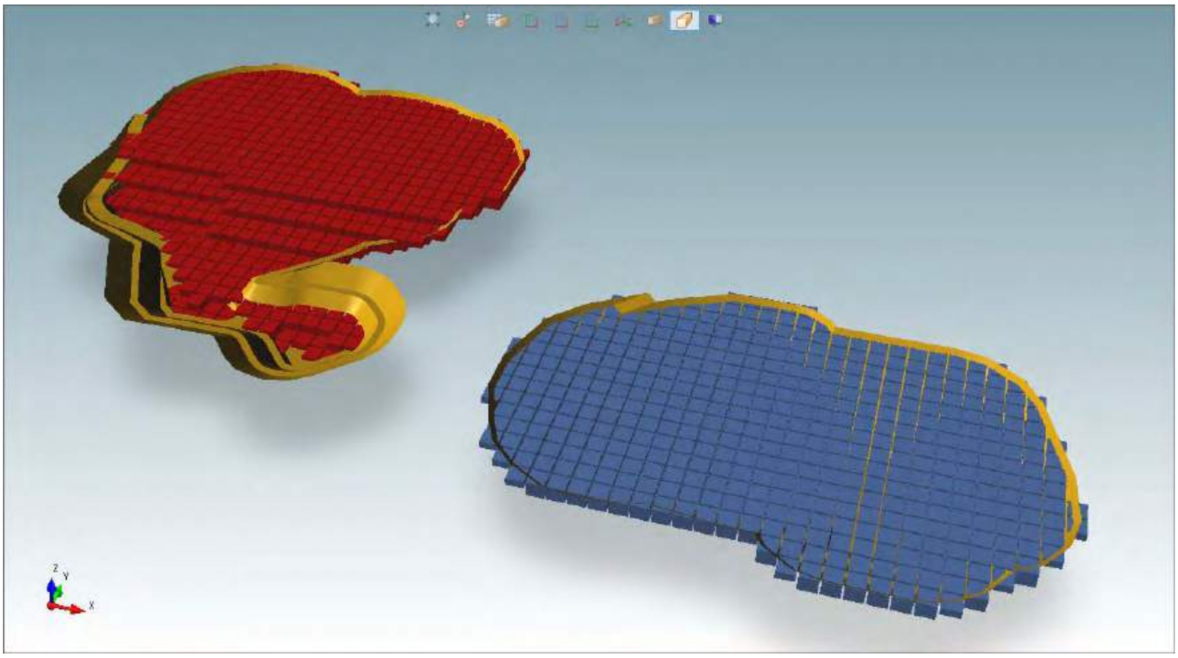


Figure 16.12 Mine Pit Configuration – Year 5

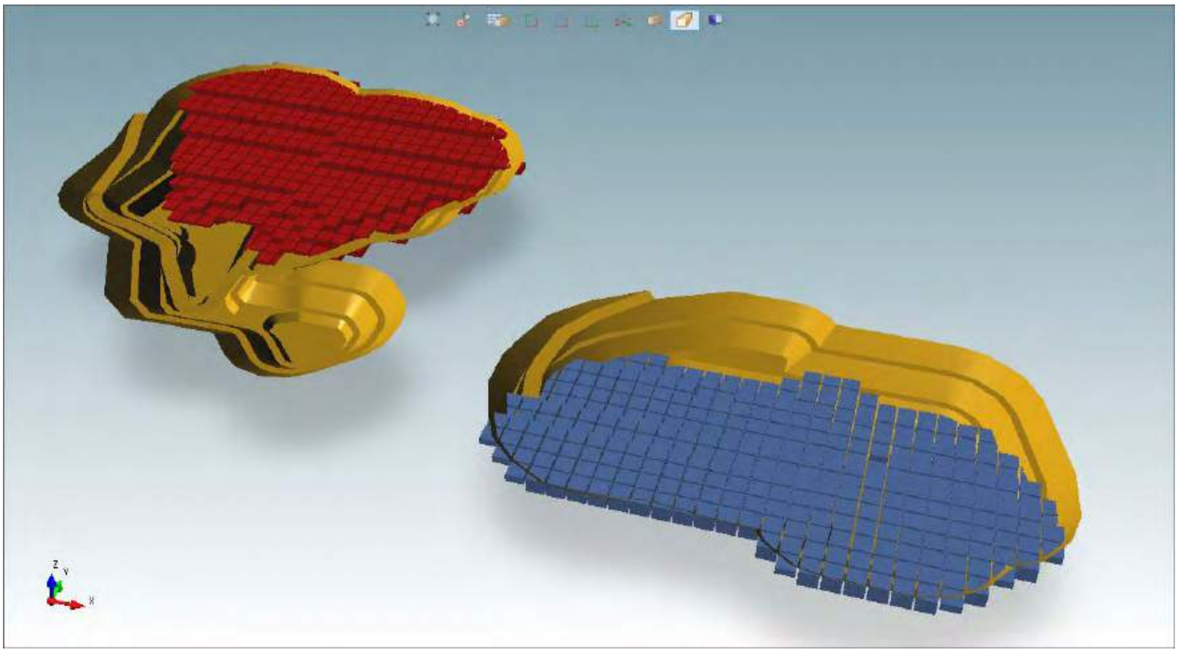


Figure 16.13 Mine Pit Configuration – Year 10

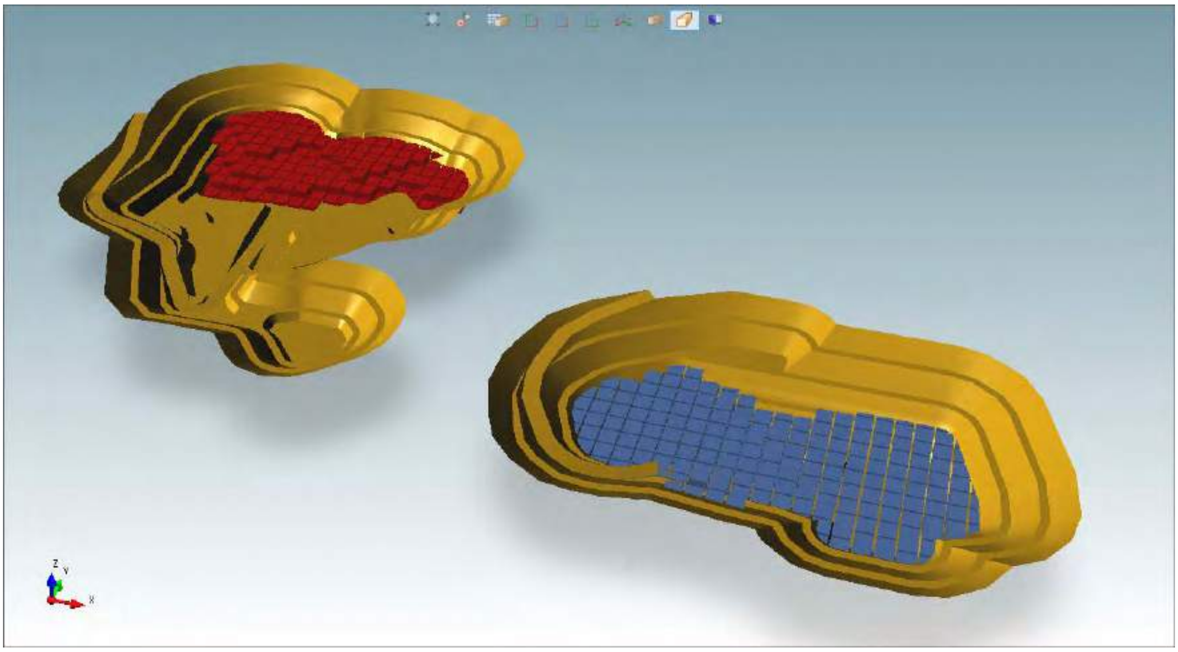


Figure 16.14 Mine Pit Configuration – Year 15

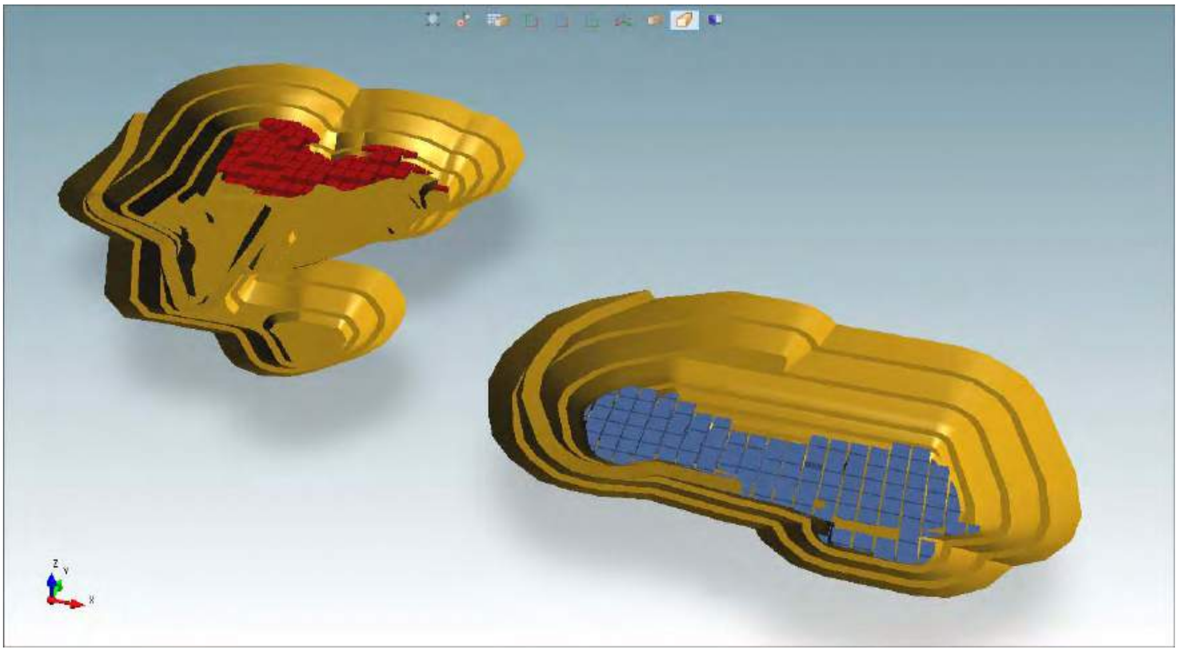
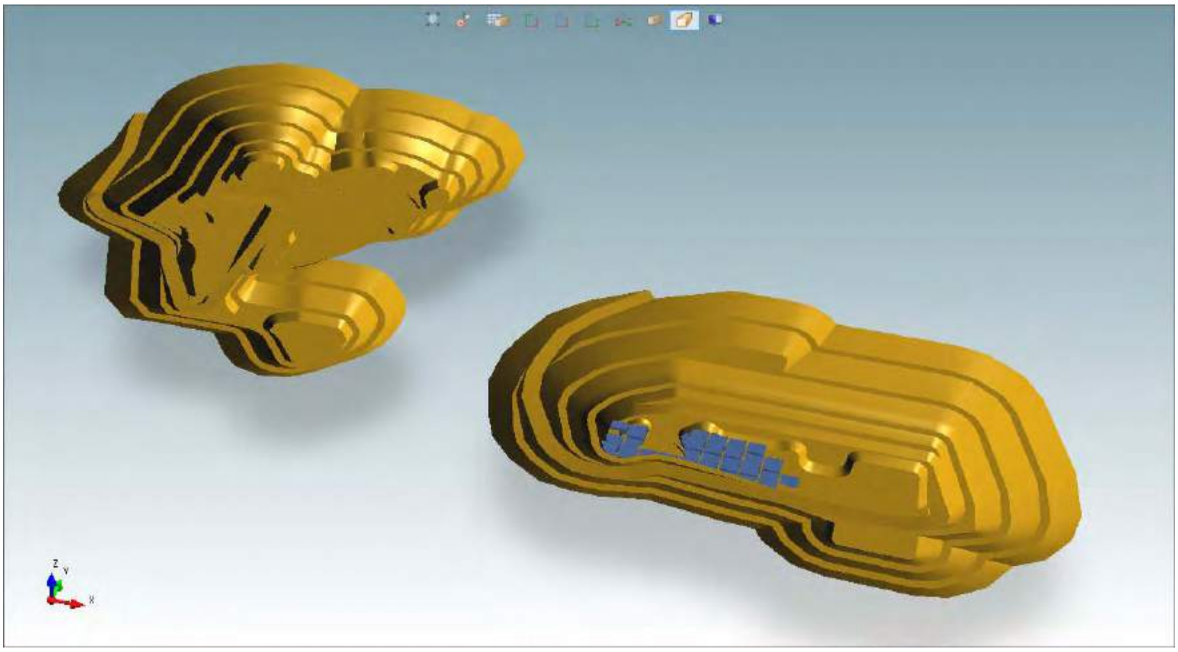


Figure 16.15 Mine Pit Configuration – Year 20



The western pit is the larger of the two pits, containing a volume of 1.9 Mbcm. The western pit will be mined from surface at approximately 185 m RL down to 135 m RL for a total depth of 50 m. The eastern pit is somewhat smaller, having a total volume of 1.3 Mbcm and a mining depth of 45 m.

Table 16.11 provides a summary of the bench volumes across both of the pits.

Table 16.11 Life of Mine Bench Volumes

	Material Types			
Bench RL	**Waste BCM**	**MinWST**	**Ore BCM**	**Total**
180	558,252	0	0	558,252
175	667,920	0	0	667,920
170	529,635	3,788	4,370	537,793
165	227,689	142,911	96,148	466,748
160	87,504	73,859	191,713	353,076
155	45,063	32,632	213,662	291,357
150	13,352	17,821	145,145	176,318
145	2,370	11,654	90,224	104,248
140	245	11,266	33,069	44,580
135	34	1,894	4,322	6,250
0	0	0	0	0
0	0	0	0	0
Grand Total	**2,132,066**	**295,825**	**778,653**	**3,206,544**

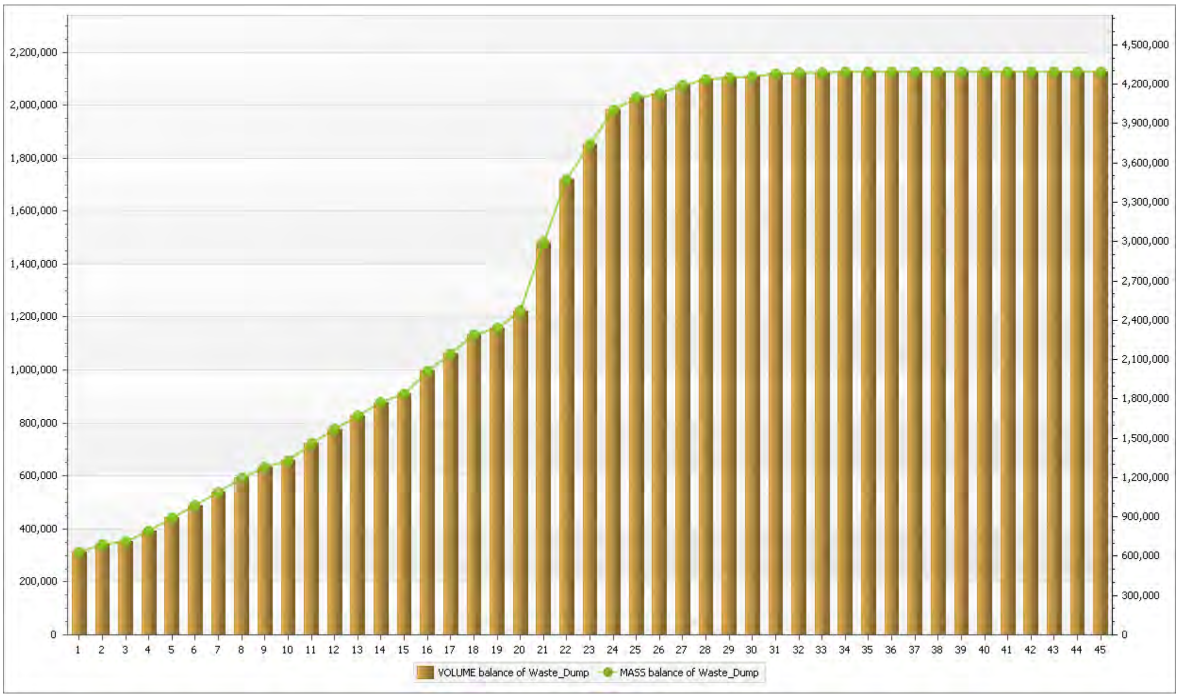
Limited ground water data was available at the time of preparing this report, however the December 2011 groundwater study prepared by Impax group (IMPAX; 2011) was considered in the preparation of this report. Minimum groundwater is anticipated on the basis of the Impax report for the proposed pit designs.

16.7 Mine Waste Handling and Management

The Nyngan resource sits close to the surface with a low overall strip ratio, and as a result the mining process does not generate adequate waste to meet the volume demands for required site infrastructure. All waste generated by mining activity will be consumed by the construction of various site facilities, the biggest of which is the Residue Storage Facility. It is unusual for a surface mine to not require a waste dump facility, but this mine as designed will not require one.

Figure 16.16 and Table 16.12 provide a summary of the waste balance between the scheduled waste movement and overall infrastructure demands.

Figure 16.16 Cumulative Mining Waste Generation – 20 Year Project

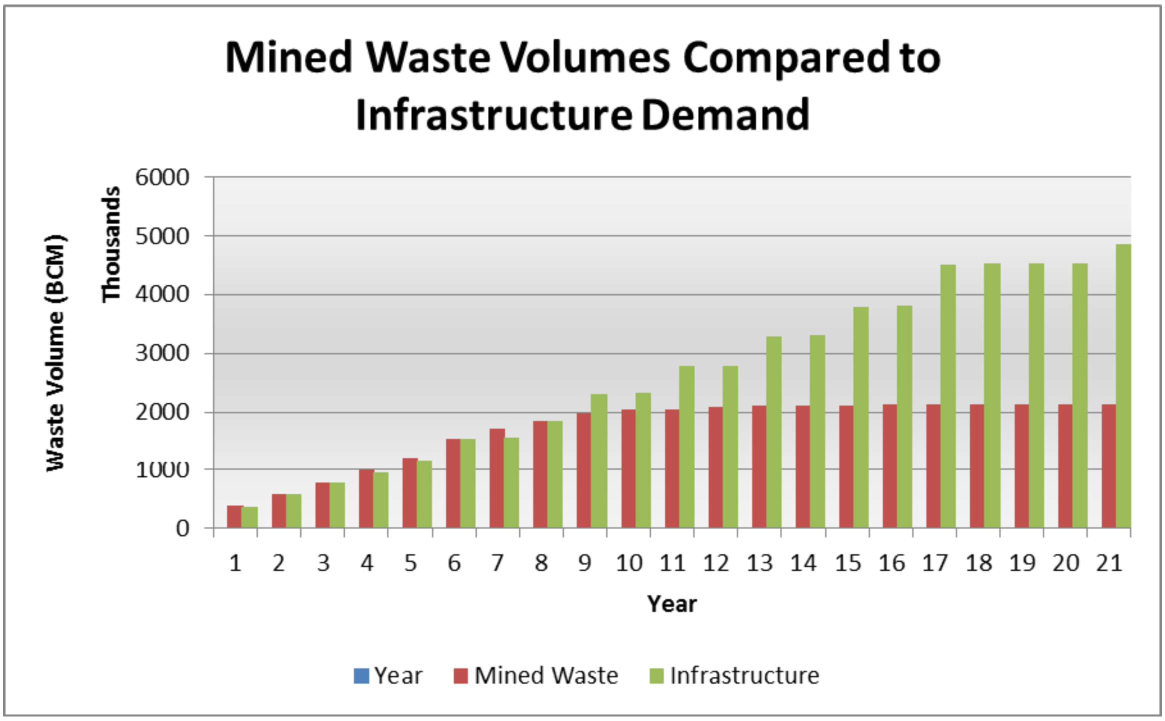


The alluvium waste will be removed by excavator and loaded into trucks, where it will then be transported directly to site infrastructure works, to minimise any double handling costs. The single largest demand for construction materials will be for the Residue Storage Facility, which requires significant material during mine development, but also requires significant material for capacity expansions throughout the 20 year life of the Project. Infrastructure material demands during initial site development also relate to construction of a number of water catchment ponds, mine roadways, and berms, which are required across the lease. Great care was taken to align waste removal schedules with the infrastructure requirements, to the extent that was possible and also meet production targets.

Table 16.12 Waste Balance – Pit Design Against Infrastructure

Year	Mined Waste		Infrastructure	Balance
1	384,116		377,701	6,415
2	586,595		583,110	3,485
3	781,615		771,058	10,557
4	1,000,638		945,358	55,280
5	1,227,299		1,167,787	59,512
6	1,554,826		1,553,472	1,354
7	1,725,652		1,573,753	151,899
8	1,855,910		1,849,559	6,351
9	1,988,294		2,306,097	-317,803
10	2,034,289		2,322,383	-288,094
11	2,049,995		2,782,203	-732,208
12	2,081,213		2,796,206	-714,993
13	2,103,937		3,287,168	-1,183,231
14	2,110,785		3,301,538	-1,190,753
15	2,113,605		3,790,638	-1,677,033
16	2,123,468		3,804,059	-1,680,591
17	2,127,759		4,509,767	-2,382,008
18	2,130,439		4,535,413	-2,404,974
19	2,131,649		4,535,413	-2,403,764
20	2,132,066		4,535,413	-2,403,347
21	2,132,066		4,862,131	-2,730,065

Figure 16.17 Mass Balance Between Mining and Infrastructure



The waste movement generated by mining activity can sustain infrastructure requirements until the start of year nine, after which time waste material will have to be sourced from borrow pits.

The borrow pits have been located within the footprint of future economic mining areas, in order to allow the waste material movement to contribute the future development of the resource. The borrow pit design consists of three phases, illustrated in Table 16.13, included is an overview of the development timeline.

Table 16.13 Borrow Pit Development Timeline

	Cumulative Volume (BCM)	Year
Phase 1	377,185	9 to 11
Phase 2	1,390,213	11 to 15
Phase 3	3,004,476	15 to 20

The three borrow pit phases have been designed primarily to meet the capacity expansion needs of the Residue Storage Facility in the later years of the mining operation. The final borrow pit volume also provides additional capacity to cater for variations in the material balance. This also provides a waste resource for capping at the end of mining if required. The batter angle on all borrow pits was flattened to 18° to minimise the need for landform contouring at the end of mining.

An overview of the borrow pit development is provided in Figures 16.18 to 16.20.

Figure 16.18 Borrow Pit – Year 9 to 11

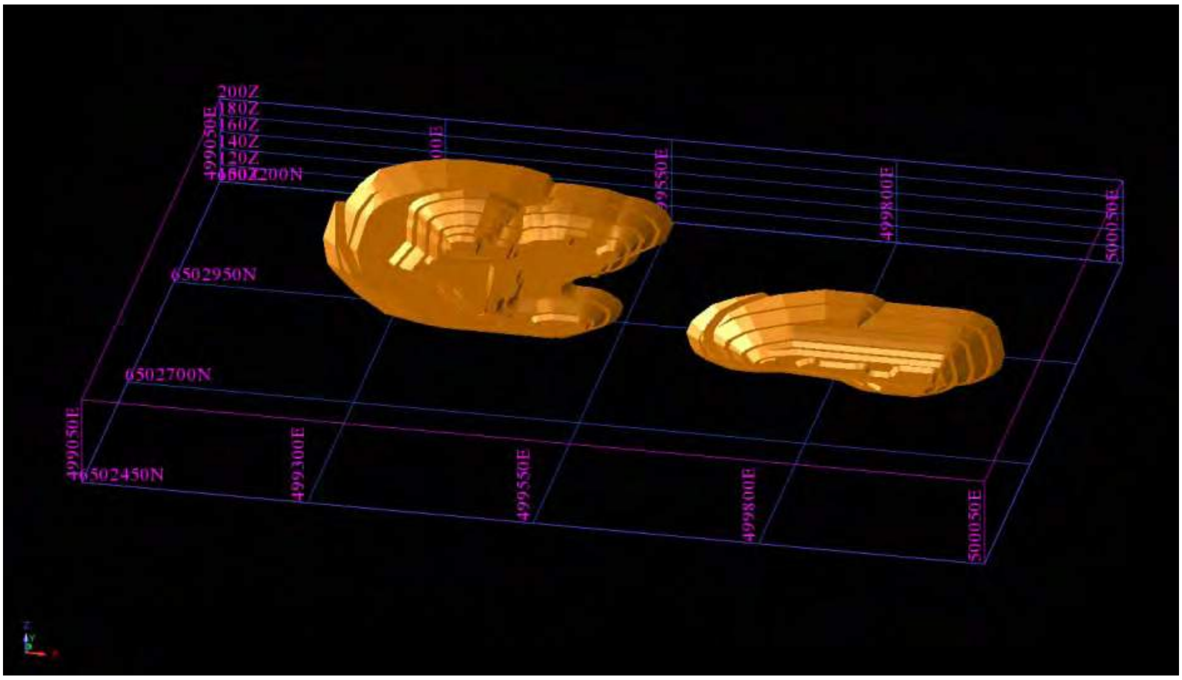


Figure 16.19 Borrow Pit – Year 12 to 15

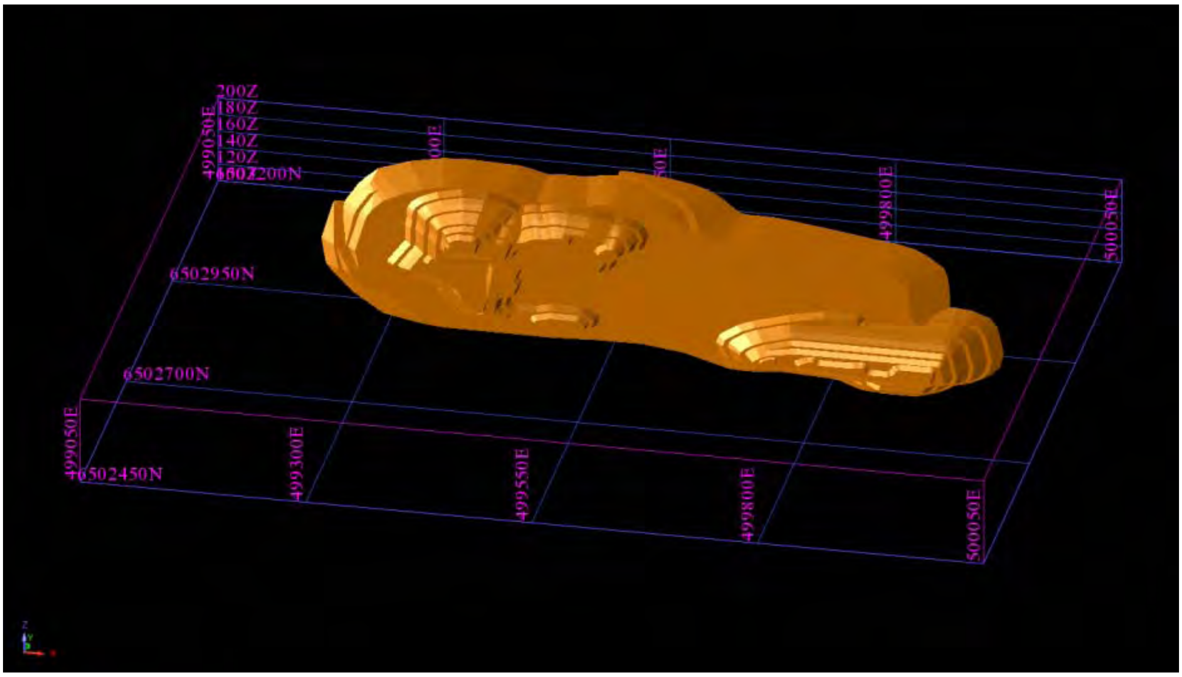
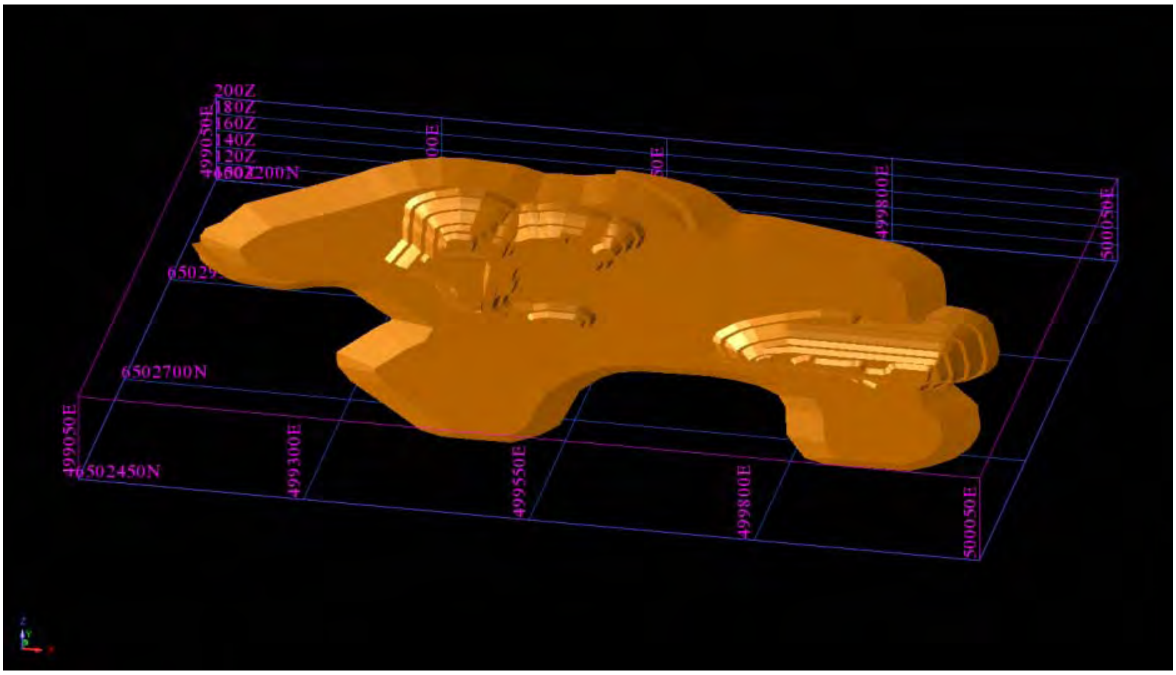


Figure 16.20 Borrow Pit – Year 16 to 20



16.7 Mineralised Waste Dump

There are several material types within the pit areas that contain scandium grade but are not suitable for processing simultaneously in the scandium recovery circuits. Most of the surface hematite and underlying saprolite resource fall in this category and if they need to be mined they will be stored on the mineralised waste dump. While this material typically carries economic scandium grades, these resources do not lend themselves to the current recovery method and therefore are currently considered uneconomic. This material may have future value if an economic method of recovering the scandium with a plant configuration that is optimised for this type of material is developed in the future.

The mineralised waste dump (low grade resource stockpile) has been configured to hold 300,000 bcm of mineralised waste material and designed to accommodate a 20% swell factor. This was considered sufficient to accommodate the mineralised waste from both mining pits for the 20 year planned life of the Project. The dump has been strategically located within the tailings dam catchment area so that any runoff from this dump is returned to the site water balance.

The total volume of low grade mineralised waste estimated to be placed in the low grade dump over the 20 year planned Project life is summarised in Table 16.14.

Table 16.14 Mineralised Waste Sources

Source	Volume (bcm)	Required Capacity (bcm)
West Pit	248,819	298,582
East Pit	47,006	56,407
Total	**295,825**	**354,989**

The proposed low grade stockpile design is illustrated in Figure 16.21 with Figure 16.22 showing the location with respect to the site infrastructure.

Figure 16.21 Low Grade Stockpile Design Profile

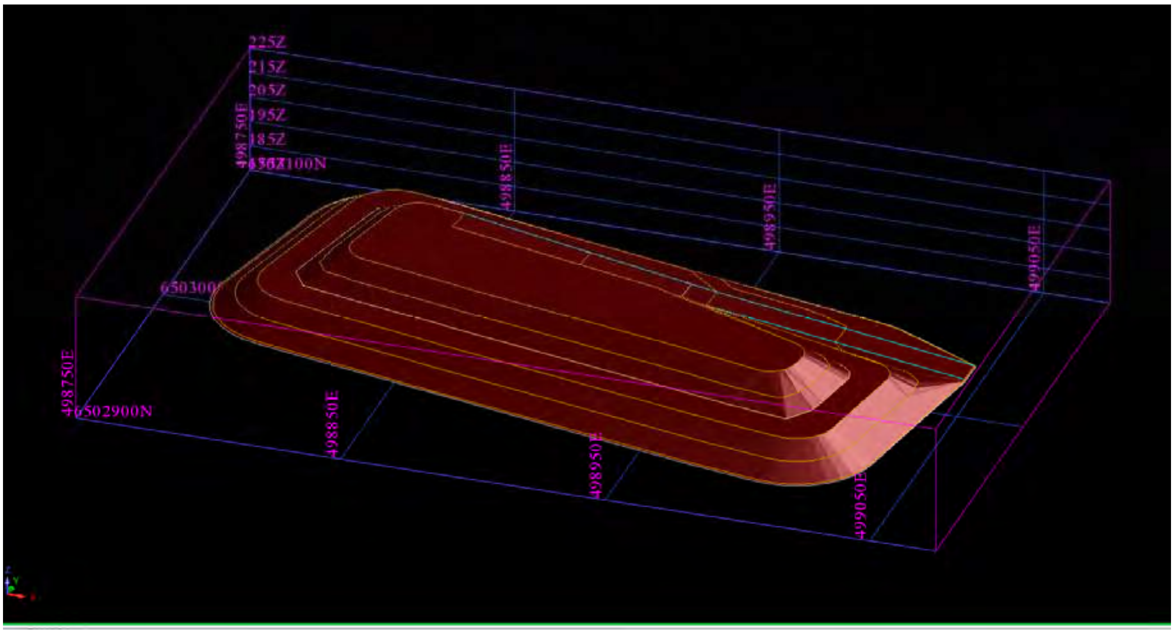
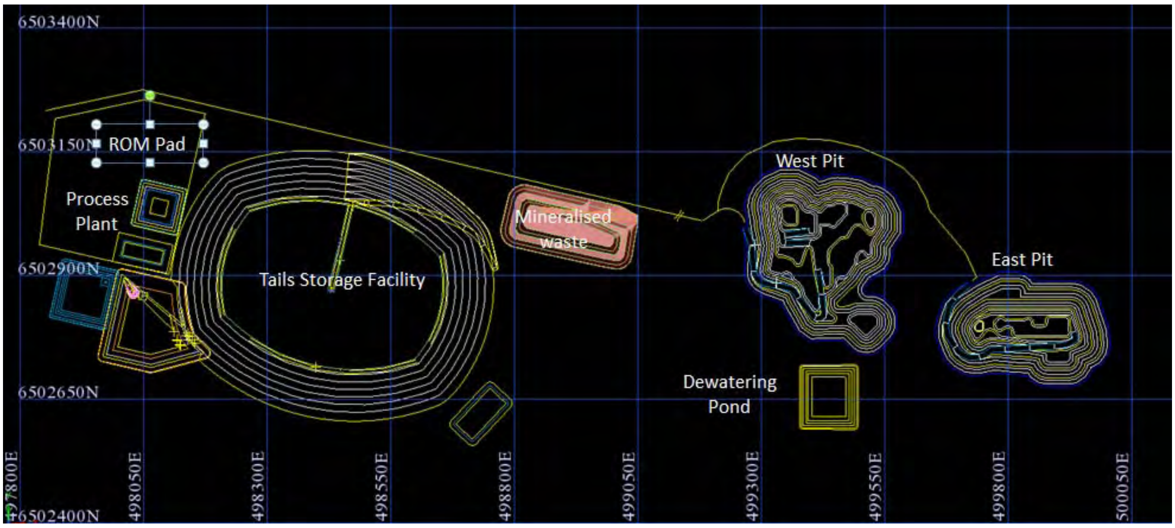


Figure 16.22 Site Location for Mineralised Waste Stockpile



16.8 Mining Activity Detail

Mining, haul road maintenance, and waste removal are planned to be carried out by a contractor, who will work three to four campaigns each year to maintain adequate inventory on the ROM. The contractor will likely operate on a dayshift-only basis, however this will be dictated by the contractor who will be paid on a schedule-of-rates basis. The primary earthmoving equipment will be a small excavator loading articulated dump trucks. While this equipment is not the most cost effective, the ease with which it can be mobilised and demobilised from site fits with the campaign strategy outlined for the project. Additionally, the all-wheel drive nature of articulated trucks will lend themselves to mining the clay materials encountered at site.

There are three basic materials being handled from the two mining areas - waste, ore and mineralised waste (low grade or off-spec resource). Each material has been scheduled to different locations for the determination of equipment and cost calculations:

- **High Grade Ore**: All limonite ore that is scheduled to be blended to meet the 400ppm scandium head grade target will be hauled from the respective pit to the processing plant run-of-mine (ROM) pad. Material will be stockpiled at the ROM pad and a processing plant loader will rehandle the material into the plant feed bin.

- **Mineralised Waste:** This consists of a number of materials but this material will be stockpiled on a single mineralised waste dump which is located between the western pit and the Residue Storage Facility. It is anticipated that during the 20 years of planned mining a total of 390,000 bcm (614,000 t) of this material will be stockpiled. Material scheduled to this dump includes:

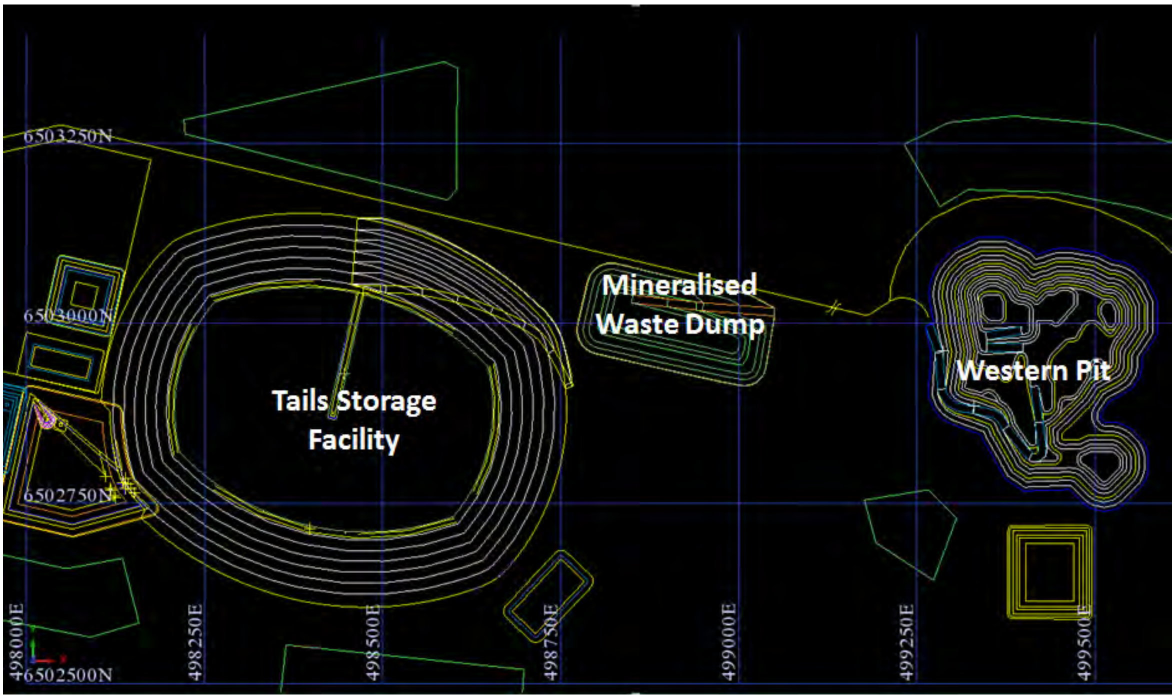
  - low grade (<155ppm Sc) limonite resource

  - all saprolite resource

  - all resource-bearing hematite material (not all hematite material contains scandium over 100ppm).

- **Waste:** All material classified as waste will be directly transported to the relevant infrastructure location for final placement. Excavation of the pit and construction of the infrastructure will occur concurrently, to eliminate double handling. For costing purposes, all material has been calculated to be hauled to the base of the residue storage facility where an overall cost has been applied and factored into the construction cost.

Figure 16.23 Location of Mineralised Waste Dump



16.8.1 Contractor Mine Responsibilities

The campaign mining program will utilise local contractors whenever possible. To ensure the economics of this approach, four local contract companies were approached to provide pricing on the site works. To provide context for proper and comparable bids, each contractor was provided with a contract framework and a responsibility matrix. The key areas outlined in that responsibility matrix included:

- **Staff:** All operational personnel including a Mine Manager, mining supervision and maintenance supervision are to be provided by the contractor. Survey, grade control, environmental and processing personnel are the responsibility of EMC-A.
- **Labour:** All equipment operators and mine maintenance personnel to be provided as a part of the schedule of rates. This included personnel to support pit de-water / pumping operations while on site.
- **Mine Planning**: Mine planning is to be prepared by EMC-A, with plans adhered to by the contractor. The contractor will be responsible for leaving the mining area in a safe state at all times. Bench clean-up and surface preparation, including drainage, is the responsibility of the contractor.
- **Geology:** All geological work will be conducted by EMC-A.

- **Survey:** To be provided by EMC-A, although control to be maintained by the contractor.

- **Geotechnical**: All technical advice and design criteria to be provided by EMC-A. The contractor will be responsible for excavating the pit in accordance with the design, and managing local geotechnical issues.

- **Administration**: The contractor will be required to provide monthly production reports and attend production meetings while they are operating on site.

- **Communications:** The contractor is to provide adequate communication infrastructure, including two-way radio coverage in the mining area.

- **Accommodation:** Contractor is to include accommodation overheads as a part of the contract rates.

- **Transport and Mobilisation**: All logistics are to be managed by the contractor, and a fixed mobilisation and demobilisation cost is to be identified as part of the bid.

- **Haul roads:** Major haul roads will be constructed by EMC-A, but will need to be maintained by the contractor whilst on site. The contractor will need to manage all in pit roads.

- **Dewatering:** Contractor to manage dewatering assets while on site. This includes excavation of sumps and relocation of dewatering pipe work. EMC-A will provide a pump, to be installed by the contractor at the end of each mining campaign.

- **Safety:** Contractor to comply with EMC-A standards in all respects. Contractor to provide operational procedures for the mining area which is to include drug and alcohol management, pre-employment checks and operational procedures. Contractor to provide safety statistics as required, and within EMC-A reporting timelines, as a part of mine management safety monitoring and reporting.

- **Equipment:** The contractor is to supply all mobile equipment for the excavation of the pits and transport of waste to the infrastructure sites. The number of fleet vehicles and capacities will be dictated by the schedule.

- **Infrastructure:** The contractor will provide all facilities to provide the earthwork services including any offices, workshops and warehousing facilities required by the contractor to complete their on-site tasks.

- **Maintenance:** All mobile maintenance is to be done by the contractor. Maintenance areas must comply with all environmental and legislative requirements, along with any standards set by EMC-A for the overall project. It is expected that any major equipment repairs will be done off site.

Contractors provided costs for the service and these were validated against each other to ensure the mining rates were competitive and within an acceptable range. From this exercise, Neill Earthmoving was selected as the basis for all economic assumptions for cost estimations. This contractor was considered as it is anticipated the campaign mining strategy will require a contractor that is close to the operation to ensure mobilisation and demobilisation penalties are kept at a minimum as well as to assist in developing a strong presence with the local community.

Neill Earthmoving provided a mobilisation and demobilisation cost as well as a schedule of rates based on commonly adopted rise and run estimates. Their rates were based on a base production rate of 350 bcm per hour which was based on their local knowledge as well as a number of test excavations that they had been involved in at the Nyngan site. An additional contingency was added with a dozer employed to support the excavator.

The mining fleet will typically be a small excavator, suitable for loading articulated dump trucks. This will be supported by a fleet of graders, water carts and dozers which will ensure roadways and material handling strategies are maintained.

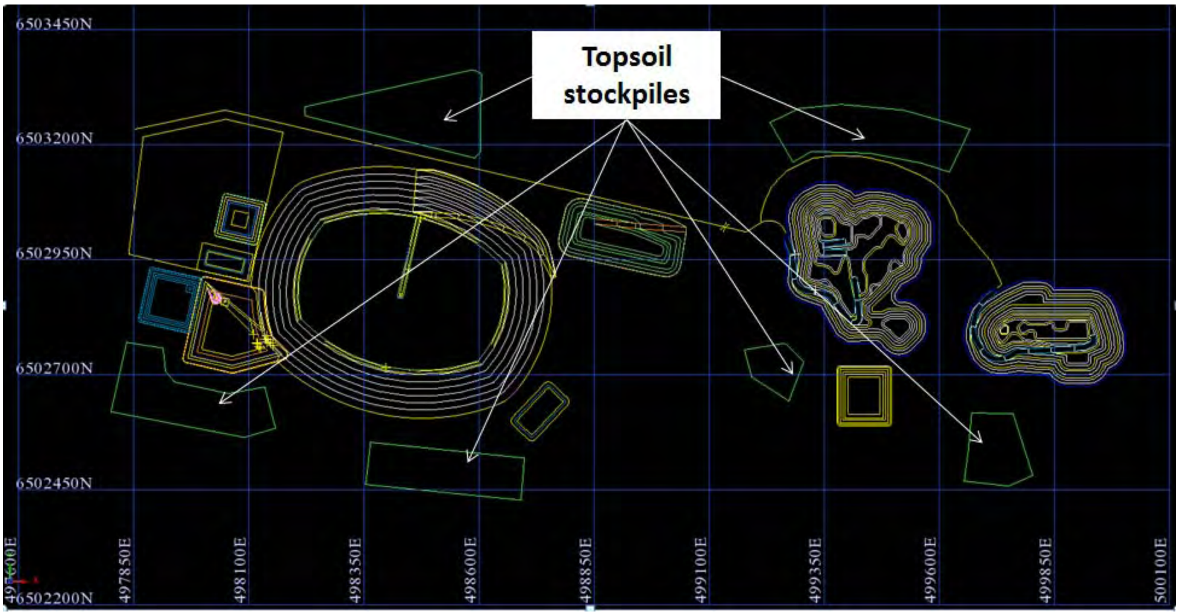
Drill hole data combined with consultation with personnel involved in the excavation of preliminary test areas indicates that the ground will predominantly be free dig and therefore no drilling or blasting will be required. The pits extend to a maximum depth of 50 m and will be excavated in a weathered clay horizon which should lend itself to a free-dig strategy.

To ensure minimal delays to the excavation process an allowance has been made for a dozer to provide ripping services for 35% of the operating time. This has been factored in at a rate reflecting Neil Earthmoving day rates.

16.8.2 Topsoil Management and Storage

The site will initially be cleared of topsoil which is 300 mm in depth. The topsoil will be pushed up and stored in stockpiles out of the way of the operation as illustrated in Figure 16.24. The western pit area will be cleared first as this provides the bulk of the waste for the construction of the initial infrastructure. Topsoil will be removed in stages and only as required for developing the respective area of the mine.

Figure 16.24 Topsoil Stockpile Locations



The western pit area will be cleared first as this provides the bulk of the waste for the construction of the initial infrastructure. Topsoil will be removed in stages and only as required for developing the respective area of the mine.

16.8.3 Geotechnical Parameters

The western pit will be mined by cutting down to ore in the southern end of the pit and then advancing to the north. This will require an in-pit face to be developed. This face will be maintained at a face angle that exceeds the recommended overall slope angle of 37 degrees to ensure the batter angles are maintained at a safe overall face angle.

Mining of the eastern pit will use a top down approach and therefore all faces will be dictated by the final pit angles as described in Section 15 of this report.

16.8.4 Pit Dewatering Considerations

A groundwater assessment prepared by Impax group (IMPAX; 2011) was used as the reference for determining the impact of ground water on the project. Based on this document and the relative depth of the pit designs, ground water is not anticipated to have a major impact on the project. According to the report the following observations were made:

- There was no groundwater activity recorded in any of the test holes for the alluvium overburden and therefore no groundwater is anticipated during the excavation of the waste overburden.

- If mining occurs at a depth of greater than 30 m below ground level then they are likely to encounter water-bearing strata. The potential rate of groundwater inflow to the open pits would depend of the area of aquifer exposed in the pit walls and/or pit base and the depth of excavation.

- Groundwater in the upper four meters of the subsurface at the Project site is of poor quality and relatively low yielding. Use of groundwater within a 10 km radius of the Project site is limited.

The depth of the two pits will be 50 m and 45 m for the western and eastern pit respectively and while inflows are anticipated for the later 20 m of excavation, the inflow rates will be low. Dewatering will be achieved by an in-pit dewatering pump with up to 40 L/s capability to manage minimal groundwater volumes as well as surface catchment. The dewatering strategy will entail establishing a mobile dewatering pump at the base of the pit, installed at the end of each mining campaign. The pumps will be started on a regular basis to draw down any accumulated water, between mining campaigns.

The water will be discharged into a surface holding pond specifically for mine water. This water will be cycled back to the plant for use in the recovery process. The water balance, as prepared by Knight Piésold for this report, indicates that the water balance across site is negative, indicating that most of the mine water that does accumulate in the mine pits during inactive periods will be needed for and consumed by the recovery process.

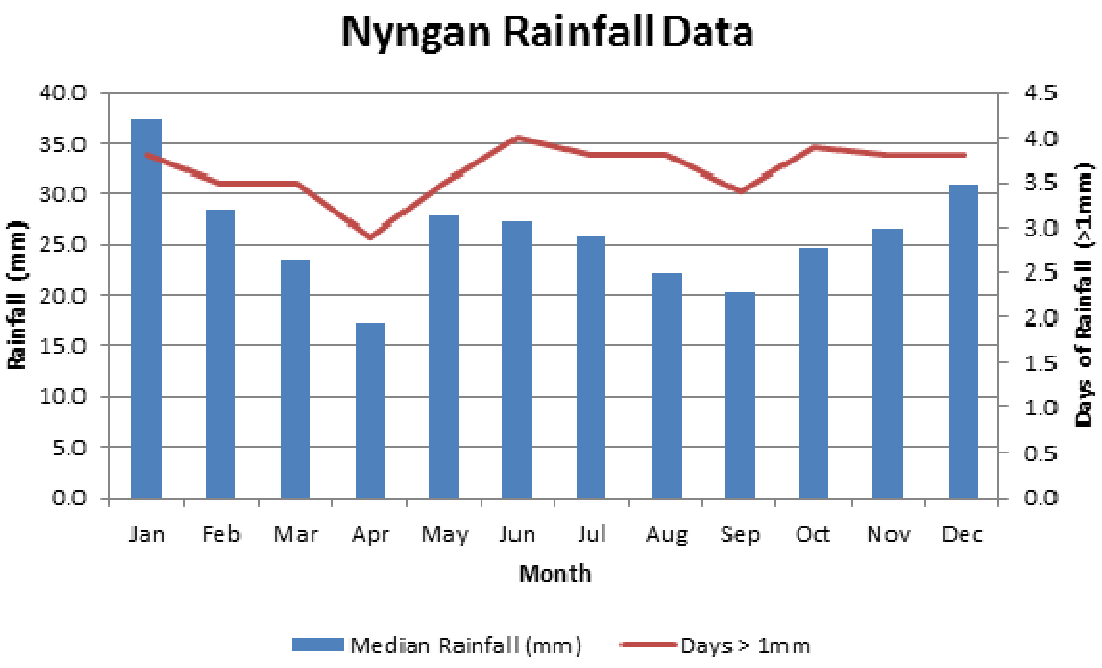
16.8.5 Regional Rainfall Details

Historic rainfall records for the Nyngan area have been recorded and tabulated by the Bureau of Meteorology. This data is available online, and was used to determine the rainfall trends in the region.

The original intention was to campaign mine during the dryer months, to minimise wet condition impacts on field operations. Upon closer review, the data shows less opportunity for this scheduling opportunity than first anticipated. Nyngan is subject to relatively consistent rainfall events throughout the year, as is depicted in Figure 16.25. While the monthly median rainfall does range from an average low of 16 mm in April, to an average high of 37 mm in January, each month tends to have a wet three to four days of rain at some point. Obviously, it is the heavy rain events that are best avoided in a production period.

Discussions with local contractors indicated that only a handful of these rainfall events would result in a full day of lost production and many rainfall events would occur at night time as well. The schedule will require some flexibility to weather that may not be planned out very far in advance.

Figure 16.25 Nyngan Annual Rainfall



16.8.6 Mining and In-Pit Grade Control

At a daily process plant feed rate of 240 tpd, it is desirable to campaign mine and stockpile the mined material several times during the year, rather than attempt to maintain and operate an even smaller mining fleet throughout the year. It is envisaged that 25,000 to 30,000 t of scandium-bearing material will be mined during each campaign. Because of the clay content of this material, the stockpile will be either contoured and compacted to minimise water ingress or covered by tarpaulins to prevent water absorption. The mining strategy will minimise stockpile quantities by only mining the required ore quantities during each mining campaign. On this basis, the required ROM capacity is relatively small, at 50,000 t maximum.

This stockpile strategy will be heavily dependent on the in-pit grade control methodology, including taking ore grade samples from each truck load that is delivered to the ROM. Better grade control in the pits will minimise the ROM stockpile quantities, along with any blending / re-handle needs from the ROM to the plant feed system.

Mining technique will be tailored to address the importance of grade control. Mining will be conducted on shallow mineralised lenses or flitches, typically of 2.5 m thickness. In-pit grade control will be carried out on each flitch to ensure overall grade control of the mineralised zone.

The in-pit sampling will occur at the end of each mining lense, and will involve a ditch witch cutting ditches at 5 to 10 m intervals through the exposed ore. These ditches will be sampled and sent away for assaying so that delineation of the orebody can be done prior to the next mining pass through the pit, or the next campaign. This will enable time to process samples as well as minimise grade control delays to the excavation process.

For stockpile grade control, each truck load will be assayed via a grab sample. It is envisioned samples representing 100 t of material will be consolidated and used to validate grade control conditions. This secondary grade control will be used to develop an understanding of the variance in the in pit grade control process and then be used to refine this process. If the in-pit process proves to be robust then over the longer term it is envisioned that the stockpile testing could be removed from the overhead.

There is opportunity to introduce in-pit assaying using hand held measuring tools, however this technology has not been proven and will be tested during the inception of the mine. This may represent a significant cost saving if proven reliable, however for the purpose of this study a more traditional approach has been adopted and therefore there is upside in all grade control estimates if such methods prove successful.

It is envisioned that in the longer term that assaying will be done on site, however for the purpose of generating an accurate economic estimate in this report all assaying has been evaluated using offsite commercial services.

Mill process test work done to date indicates that consistent grade control regarding mill feed is necessary to ensure that performance is maintained. While in-pit grade control is likely to be taken from 1 m trenches, the mining of ore would ideally be done on 2.5 m benches. While a majority of the ore is predicted to be mined by this bulk method it is believed that some portions of the ore body may require more accurate mining techniques than others, and therefore a 20% mining premium has been added to the cost of mining ore to allow for more selective techniques to be adopted. This also allows for dilution control.

16.8.7 Electrical Power to Site

Electrical power supply to the mining operations and associated infrastructure will be minimal as the contractor will be operating on a campaign basis. All contract pricing has been based on the premise that the contractor provides all site power using portable power generation. If power off-take is practical, then this will be factored into a detailed contract agreement as to leverage a better schedule of rates.

16.8.8 Contractor Workshop Facilities

Need for these facilities is expected to be minimal. All major scheduled maintenance to contractor equipment is to occur off site. While operating on site, the contractor will provide any relevant infrastructures to maintain equipment, and to warehouse any necessary parts / components to ensure mobile equipment productivity. Field servicing should be practiced, and minimised.

The mining contractor will be responsible for the provision of any office facilities required to deliver the mining service. Technical contractors such as the grade control and survey personnel will utilise temporary desk space at the processing facility while at site.

16.8.9 Camp Accommodation

The mine is located approximately 20 minutes from the town of Nyngan and therefore no accommodation facility is planned for the project. All contractors and consultants will be responsible for providing their own accommodation within the local township or within a distance deemed suitable for a safe commute to the mine site.

17.0 RECOVERY METHODS

17.1 Process Design

The process flowsheet selected as the study basis for the treatment of the Nyngan ore body has been chosen after evaluation of the available geology, mineralogy and metallurgical testwork results (see Section 13). The objective has been to select a robust treatment method that provides a sound basis for estimating capital and operating costs at a definitive feasibility study level of accuracy.

17.1.1 Selected Process Flowsheet

The process plant for the Nyngan Scandium Project will treat the scandium bearing limonite mineralisation from Nyngan to produce a scandium oxide product. The flowsheet consists of:

- Recovery of ore from mined stockpiles using a front end loader.
- Adding the mill feed to a hopper and then onto a conveyor.
- The lightly crushed mineralisation then is slurried with process water in the drum scrubber and then into a trommel screen.
- The slurry from the trommel screen underflow falls into a hopper and is pumped to the ball mill circuit, via the cyclone feed hopper, in order to further break up clay material. The trommel screen overflow is stockpiled as coarse rejects.
- The slurry from the ball mill discharges into the cyclone feed hopper and then pumped to a series of cyclones. Cyclone overflow passes to the leach feed thickener. Cyclone underflow (+75 µm) is returned to the feed chute of the ball mill.
- The leach feed thickener increases the solids density in the underflow to 38% solids. Leach feed thickener overflow is returned to the ore preparation circuit via the leach feed thickener overflow tank and associated pumps. The leach feed thickener underflow is pumped to the HPAL feed storage tanks.
- Leach feed thickener underflow is combined with a proportion of the returned solvent extraction raffinate (approximately 20% of the raffinate stream) in one of two HPAL feed slurry storage tanks to achieve the nominal feed solids density of 30% into the autoclave.
- Feed from the HPAL feed slurry storage tanks is passed through the HPAL feed slurry heater where it is heated in a heat exchanger with excess high pressure splash steam.
- Preheated HPAL feed slurry is further heated in three stages of splash vessels using flash vessel vent steam before being pumped with high pressure pumps

into the autoclave, where additional HP steam is added to raise the temperature to 265°C. Concentrated sulphuric acid is also added to the autoclave with a high pressure pump. Slurry density inside the autoclave is designed at 25% solids.

- The slurry is depressurised in three stages of flash vessels with letdown steam recirculated back to the corresponding splash vessels. Any excess steam is vented to atmosphere via the HPAL vent scrubber.

- The leach slurry, containing the dissolved scandium, is passed through an eight stage counter current decantation (CCD) circuit to wash the entrained scandium from the leach residue. The wash solution is a mixture of raw water, solvent extraction raffinate and dirty condensate streams from the flash vessels and pre-heaters.

- The pregnant solution from the CCD circuit containing the scandium is cooled, filtered in one of two sand filters and sent to solvent extraction for recovery of the scandium.

- Solvent extraction of scandium occurs by contacting the PLS with an organic phase containing a primary amine (Primene JM-T) dissolved in a kerosene (Shellsol D70) in three counter current extraction stages. A scandium sulphate complex ion leaves the aqueous phase and loads onto the amine. The organic phase is then washed with a dilute sulphuric acid scrub solution.

- Stripping the scandium from the Primene JM-T is conducted by contacting the loaded organic phase with a hydrochloric acid solution, boosted with extra chloride salt addition. The scandium enters the aqueous strip liquor as a scandium chloride complex ion.

- The stripped organic is regenerated with dilute sulphuric acid solution before being recirculated back to the extraction stages.

- The loaded strip liquor is filtered through a garnet anthracite filter and then a carbon column before being heated to 65°C in the LSL tank.

- Solution from the LSL tank is withdrawn in 6 m^3 batches on day shift operations and the scandium is precipitated by adding oxalic acid solution to the tank and stirring for 15 minutes.

- The scandium oxalate precipitate is filtered in a plate and frame filter press. The scandium oxalate is added to rotating kiln furnace and calcined to scandium oxide at 900°C, before being washed with deionised water and filtered. The scandium oxide is then dried and dispatched in small security drums.

- The residual slurry from the CCD circuit is partially neutralised with lime slurry to pH 2 and then sodium hydrosulphide (NaHS) is added to convert any Cr (IV) in solution to Cr (III). More lime slurry is added in two stages to raise the pH to 9 in order to precipitate any heavy metal ions from solution.

- The neutralised tailings slurry is thickened and sent to a conventional lined residue storage facility (RSF). Decant from the RSF is re-used as process water.

A schematic overall process flow diagram depicting the unit operations incorporated in the selected process flowsheet is presented in Figure 17.1.

The key issues considered in process and equipment selection are outlined in the next section.

The key process design criteria listed in Table 17.1 form the basis of the detailed process design criteria and mechanical equipment list.

Table 17.1 Summary of Key Process Design Criteria

	Units	Design
Annual Plant Throughput	tpa	75,000
Plant Operating Hours	h/y	7,500
Hourly Plant Throughput	t/h	10
Operating Days per annum	days	365
Head Grade	Sc ppm	400
Overall Recovery	Sc (%)	83.7
Sc2O3 Grade Produced	%	>99
Scandium Oxide Production	tpa	38.7
Autoclave Operation		continuous
Autoclave operating temperature	°C	265
Autoclave residence time	minutes	90
HPAL preheat / letdown stages	#	3
Solvent Extraction Configuration	type	3E-1W-2S-1R

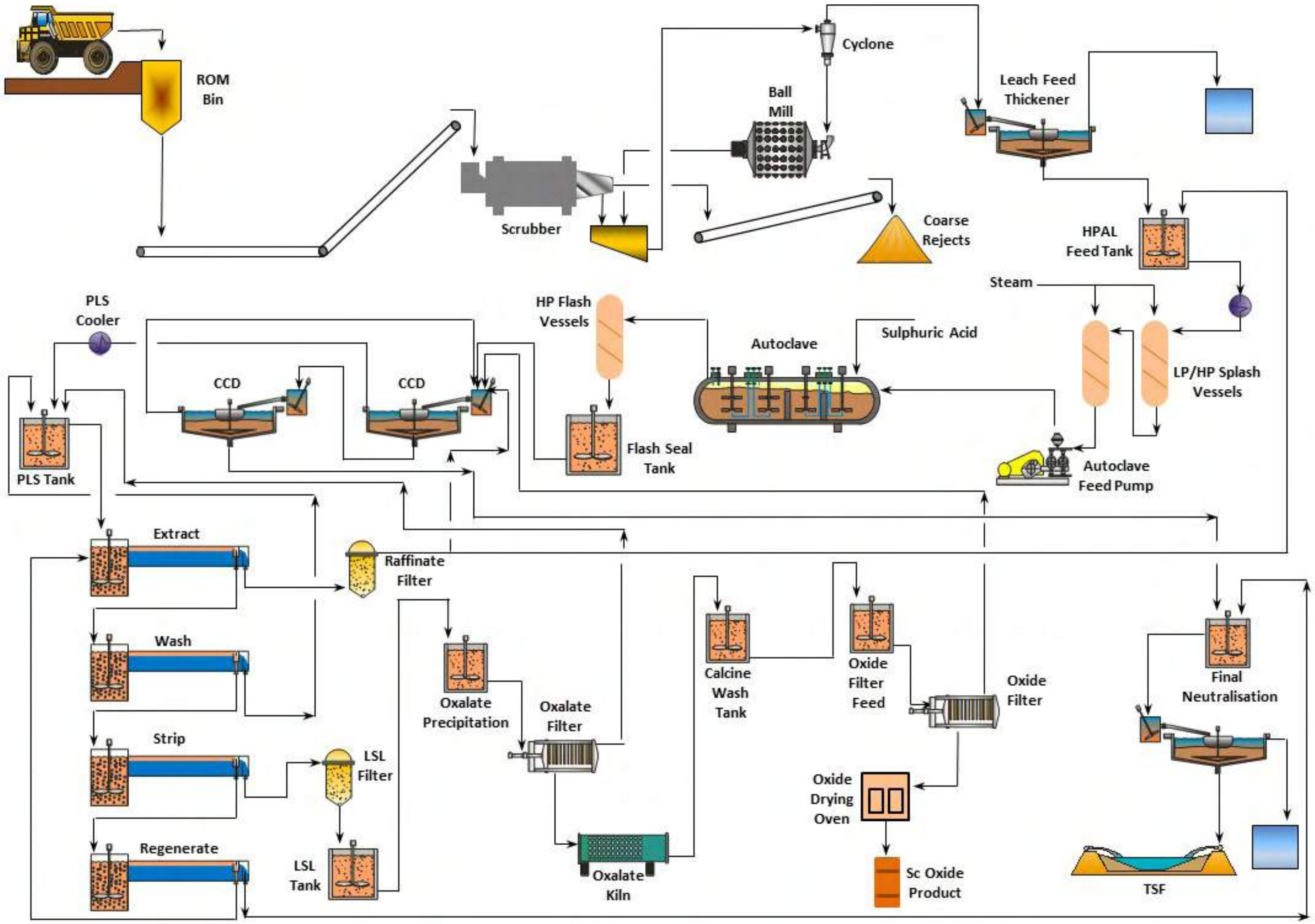
17.1.2 Mass Balance

A mass and water balance for the processing plant has been developed. Because of the complex hydrometallurgical process flow sheet, this was developed using METSIM software. Whilst as many inputs into the METSIM model were made on information from relevant metallurgical test work, at times some assumptions were made. These were largely process chemistry related or related to thickener underflow densities where test work did not exist or is not reliable.

Mass and water balances external to the process plant were not included in the METSIM model. The process mass and water balance have been reported for the 75,000 t/a nominal feed rate. The mass balance represents a nominal steady state design case and has been used to determine the plant design conditions in treatment of the Nyngan ore.

The mass and water balance is the basis for the design and specification of equipment that have been used to determine the plant layout and the capital cost estimate. In addition, they allow for the development of schedules for operating requirements, such as power, water, reagents and consumables used to calculate the plant operating cost estimate.

Figure 17.1 Schematic Overall Process Flow Diagram



17.2 Process and Plant Description

The major plant areas for the Nyngan Scandium process plant are as follows:

- Ore Preparation.
- Leach Feed Thickening and Storage.
- High Pressure Acid Leaching (HPAL).
- Counter Current Decantation (CCD).
- Solvent Extraction (SX).
- Scandium Oxalate Precipitation.
- Scandium Oxide Recovery.
- Final Neutralisation and Tailings.
- Reagents.
- Services.

17.2.1 Ore Preparation

PFDs 3185-000-PRPFD-0001 and 0002

Scandium bearing ore will be recovered from the Nyngan mine using open pit mining techniques and trucked to a run of mine (ROM) ore stockpile.

Material will be reclaimed from the ROM stockpile using a front end loader and added to a feed bin. A belt feeder then feeds ore from the bin onto a conveyor which delivers ore to a trommel scrubber to de-agglomerate the ore. The +10 mm oversize from the scrubber is rejected to a coarse rejects bin. The -10 mm material is directed to the ball mill discharge sump.

The ball mill will operate in closed circuit with cyclones being fed from the cyclone feed hopper via pumps. The +75 µm oversize from the cyclone underflow is directed back to the ball mill feed chute. The overflow from the cyclones is directed to the leach feed thickener.

17.2.2 Leach Feed thickening and Storage

PFDs 3185-000-PRPFD-0003 and 0004

The Leach Feed Thickener will thicken the slurry to 38% solids with the aid of flocculant addition. The underflow from the thickener will be pumped to the HPAL Feed Slurry Storage Tanks. Slurry from the tanks is then pumped to the LP Splash Heater. Excess

HP Splash steam from the HPAL circuit will be used to pre-heat this slurry to 80°C via the use of a spiral heat exchanger. Leach Feed Thickener overflow is re-used in the ore preparation circuit.

17.2.3 High Pressure Acid Leaching

PFDs 3185-000-PRPFD-0005 to 0008

The HPAL circuit consists of a continuous high pressure autoclave with three stages of preheat and letdown.

The preheated HPAL feed slurry is further heated in three stages of splash vessels using flash vessel vent steam before being pumped with high pressure pumps into the autoclave, where additional HP steam is added to raise the temperature to 265°C. Concentrated sulphuric acid is also added to the autoclave with a high pressure pump. Slurry density inside the autoclave is designed at 25% solids. Scandium and other metals are extracted from the solids under these leaching conditions.

The slurry from the autoclave is depressurised in three stages of flash vessels with letdown steam recirculated back to the corresponding splash vessels. Any excess steam is vented to atmosphere via the HPAL vent scrubber.

Any emergency pressure relief from the splash, autoclave and flash vessels is directed to the HPAL Vent Knockout Pot.

The slurry from the LP Flash Vessel gravitates to the Flash Seal Tank, prior to pumping to the CCD circuit.

The HPAL circuit also contains all necessary agitator seal and flush systems, along with pump HP gland water circuits.

17.2.4 CCD Circuit

PFDs 3185-000-PRPFD-0010 to 0013

The leached slurry from the HPAL circuit, containing the dissolved scandium, is passed through an eight stage counter current decantation (CCD) circuit to wash the entrained scandium from the leach residue. Each CCD thickener will thicken the slurry to 31% solids with the aid of flocculant addition, prior to being pumped to the next thickener in the circuit. The wash solution (added to CCD No.8) is a mixture of raw water, solvent extraction raffinate and dirty condensate streams from the flash vessels and pre-heaters.

CCD No.1 overflow reports to the solvent extraction (SX) circuit as pregnant liquor (PLS), whilst CCD No. 8 underflow is pumped to the final neutralisation circuit.

17.2.5 Solvent Extraction

PFDs 3185-000-PRPFD-0014 to 0018

CCD No. 1 overflow solution (PLS) forms the basis of the solution feed into solvent extraction. The PLS is filtered and then cooled and stored in the PLS Storage Tanks. The PLS is pumped from these tanks to the first of three counter-current Extraction Mixer-Settler Units. Scandium is extracted from the PLS by contact with an organic extractant dispersed in a solvent kerosene product. When contacted together, the scandium transfers from the aqueous phase to the organic phase. The solution that is stripped of scandium (raffinate) is passed through activated carbon columns to remove any entrained organic phase and then returned to various areas of the HPAL and CCD circuits.

The loaded organic is scrubbed with a dilute sulphuric acid solution in the Wash Mixer-Settler to wash the organic phase. The washed organic is then pumped to the first of two counter-current Strip Mixer-Settler Units. Scandium is stripped off the organic phase of scandium with a diluted hydrochloric acid solution boosted with chloride. The resulting loaded strip liquor (LSL) is then passed through a dual-media filter to remove any entrained organic phase before passing into the scandium recovery circuits. The stripped organic phase is regenerated with dilute sulphuric acid solution in the Regeneration Mixer-Settler and then returned to the extraction circuit.

In the unlikely event of a fire occurring, within the solvent extraction mixer-settlers and/or the solvent extraction tank farm and bunded area, fire fighting foam is provided from a Foam Fire Suppression system.

Crud will be removed from the Mixer Settlers units on an as-needs basis, by a mobile air-operated pump system. The crud will be pumped to a collection tank for processing through the crud treatment circuit. This circuit will also treat entrained organic from after-settlers, along with spillage into SX sumps.

17.2.6 Scandium Oxalate Precipitation

PFDs 3185-000-PRPFD-0019 and 0020

The loaded strip liquor (LSL) is the feed product for scandium oxalate precipitation. The LSL is filtered to remove entrained organic form the SX circuit prior to storage in the Loaded Strip Liquor Tank. Heated LSL is added in a batch process to the Oxalate Precipitation Tank, where oxalic acid solution is added to precipitate scandium as scandium oxalate. After completion of the batch process, the precipitate is pumped to the Scandium Oxalate Filter for filtration and collection of washed scandium oxalate solids.

At the end of the filtration cycle, the Scandium Oxalate Filter is opened and the filter cake discharged into the Oxalate Filter Discharge Cart. This cart is then manually delivered to the Scandium Oxalate Rotary kiln.

17.2.7 Scandium Oxide Recovery and Packaging

PFDs 3185-000-PRPFD-0020 and 0021

The scandium oxalate solids are added to the Scandium Oxalate Rotating Kiln and calcined to form scandium oxide at 900°C, before being washed with deionised water to remove impurities and then filtered. The scandium oxide is then dried at 120°C, cooled, then manually loaded into the Scandium Oxide Storage Hopper. The Scandium Oxide Screw Conveyor will fill the final product drums. These drums are located on a Weigh Scale for final product mass measurement. Samples of each batch of oxide are taken and the batch number is recorded on each of the product drums.

The areas located near dry scandium oxide operations are ducted into the Drying Oven Bag Filter for hygiene purposes and to recover any valuable scandium oxide dust. The contents of the Dust Collector Bin are periodically manually returned to the Oxalate Precipitation Tank.

17.2.8 Final Neutralisation and Tailings

PFDs 3185-000-PRPFD-0023 to 0025

The residual slurry from the CCD circuit (CCD No.8 underflow) is pumped to the final neutralisation circuit. The slurry is partially neutralised with hydrated lime slurry to pH 2 followed by addition of sodium hydrosulphide (NaHS) to convert any chromium in solution as Cr (IV) to Cr (III). Additional hydrated lime is added in two stages to raise the pH to 9 in order to precipitate any heavy metal ions from solution prior to tailings disposal.

The neutralised tailings slurry reports to the Final Neutralisation Thickener where it is thickened to 31% solids with the aid of flocculant addition. The thickener underflow is pumped to the Final Tails Surge Tank and then subsequently pumped to the Residue Storage Facility (RSF). The RSF is a conventional lined slurry storage pond. Thickener overflow is pumped to the process water tank for re-use in the plant.

Supernatant from the RSF is directed to the Decant Pond for storage prior to returning to the process plant for re-use as process water.

A lined evaporation pond is included in the plant infrastructure for evaporation of excess process water, and/or other saline waters from the process plant.

17.2.9 Reagents

PFDs 3185-000-PRPFD-0026 to 0029

The major reagents utilised within the process plant will include:

- Concentrated sulphuric acid for the high pressure acid leach circuit and solvent extraction circuit.
- Concentrated hydrochloric acid for the solvent extraction circuit.

- Oxalic acid for the precipitation of scandium from the loaded strip liquor.
- Sodium hydroxide for wet scrubbers and the R.O treatment plant.
- Flocculants for thickening and filtration.
- Sodium hydrosulphide for chromium reduction in the final neutralisation circuit.
- Hydrated lime for the final neutralisation circuit.
- Water treatment chemicals for boiler feed water and cooling water treatment.

Reagent Storage

Bulk reagent supplies will be delivered to site in a mixture of bulk tanker, drums, bulka bag and transport containers. Reagents will be separated according to storage requirements, chemical properties and potential hazards. All acidic reagents will be stored in bunded facilities with acid resistant concrete floors. Special consideration will be given to storing of the organic chemicals for solvent extraction in a dedicated facility with spark-proof motors for any pumping requirements.

Sulphuric Acid

Sulphuric acid is the most significant reagent in the flow sheet. It will be trucked to site from a coastal location in B-double trucks. It will be supplied as 98% strength and will be offloaded from the trucks into a dedicated storage vessel. It will be pumped to the HPAL and SX areas at the 98% level. The site plan allows for ten days of storage on site.

Hydrochloric Acid

Hydrochloric acid is used in the stripping circuit of the solvent extraction plant. It will be delivered to site in bulk transport at 33% concentration and be discharged to a storage tank of ten days capacity.

Lime

Hydrated lime will be delivered to site in bulk transport. The hydrated lime will be slurried to a 20% w/w milk of lime slurry will be continuously circulated via a ring main to the Final Neutralisation circuit.

Flocculant

Allowance for three different flocculant makeup and storage circuits has been allowed for in the plant design. A number of thickeners and CCD thickeners are present in the design. Each flocculant will be supplied in 25 kg bags and be made into working solutions using vendor package jet-wet dosing systems.

Extractant

A primary amine extractant will be used for extracting scandium from solution. It will be supplied in 1 m^3 IBC containers and will be used at 100% strength.

Diluent

The primary amine extractant will be diluted into Shellsol D70 diluent. The diluent will be delivered in 1 m^3 IBC containers and will be delivered at 100% strength to the organic make-up circuit.

Oxalic Acid

Oxalic acid ($C_2O_4H_2$) will be used to precipitate scandium from solution. Oxalic acid is a white powder and will be delivered in bulka bags. The bulka bags will be emptied into a mixing tank and demineralised water will be used for make up the solution to the desired concentration. The arrangement will consist of a mixing and storage tank.

Sodium Hydroxide

Sodium hydroxide (NaOH) will be supplied as a 50% w/w solution in 1 m^3 IBC containers. It will be transferred into a storage tank and then pumped to the various wet scrubbing duties and the RO water treatment plant.

Sodium Hydrosulphide

Sodium hydrosulphide (NaHS) will be supplied in one tonne bulka bags. It will be mixed then stored as a 20% w/w solution. The solution will be pumped to the final neutralisation circuit for chromium reduction.

Water Treatment Chemicals

Miscellaneous chemicals will be required for water treatment for potable water, boiler feed water, and cooling water including the following:

- Chlorine.
- Corrosion inhibitors.
- Algaecide & Biocide.
- Dispersants.

17.2.10 Water Services

PFDs 3185-000-PRPFD-0030 to 0032

The process plant will utilise raw water, process water, demineralised water, filtered water, gland water, and potable water.

Raw Water, Filtered Water and Fire Water

Raw water requirements for the process plant will be made-up from both reclaimed water from the mine pit and sediment pond, along with from the pipeline that services both the Nyngan and Cobar townships. A Raw Water Pond with 30 days of storage will be constructed. The majority of the raw water will be filtered for various uses. Raw water will also be used to supplement the process water requirements, along with hydrated lime slurrying.

Raw water will undergo filtration and then be stored in the Filtered Water Tank. Filtered water will be distributed to all non acidic process water uses, including reagent make-up, gland water, cooling water make-up, potable water make-up and feed to the RO treatment plant.

Firewater will be supplied from the raw water storage pond, via a dedicated suction manifold. The firewater system will comprise:

- An electrical jockey pump.
- An electrical firewater pump.
- A diesel standby firewater pump.

The firewater system pressure will be maintained by the jockey water pump. An electric fire water pump will automatically start on a drop in line pressure. The diesel fire water pump will automatically start if the line pressure continues to drop below the target supply pressure, which will occur when there is significant fire water demand or during a power failure.

Process Water

Final Neutralisation thickener overflow and RSF decant return provide the source of process water. Any make-up requirements to the process water circuit will be from the Raw Water Pond.

Process water is used for a number of services including:

- Ore preparation dilution water.
- Vent Scrubber solution make-up.
- Mine water requirements.
- Flocculant dilution water.
- Dust suppression.
- Service points around the plant.

Demineralised Water

Demineralised water will be produced from the Reverse Osmosis (RO) treatment facility. It will primarily be used as boiler feed supply for HP steam production. Other uses include mixing and/or dilution of reagents used within the SX and scandium precipitation circuits to achieve high product purity, along with make-up to the HPAL agitator seal water circuit.

Gland Water

Gland water will be filtered water. Dedicated gland water pumps will supply gland seal water from the Filtered Water Tank to the required pumps across the process plant.

Potable Water

Filtered water will be pumped to the Potable Water Treatment Plant for production of potable water for the process plant site. From the treatment plant it will be stored in the Potable Water Tank. Potable water will be distributed for human consumption across the site, and to the safety showers and eye wash stations throughout the process plant.

17.2.11 Air and Steam Services

PFDs 3185-000-PRPFD-0033 to 0034

Plant Air and Instrument Air

Plant and instrument air at 700 kPag will be provided by two high pressure air compressors, operating in a lead-lag configuration. Instrument air will be fed from the HP Air Receiver and dried for subsequent instrument air demand.

LPG Storage and Distribution

Liquefied petroleum gas (LPG) will be delivered to site in bulk and transferred to a storage bullet on site. LPG will be used as the fuel source to operate the steam boiler.

Steam Generation

HP Steam will be generated from the Boiler Package. Saturated steam at 280°C and 6,300 kPa will be produced and used for slurry heating in the HPAL circuit.

17.3 Process Plant Layout

The layout for the Nyngan Scandium process plant is shown in Figure 17.2. Equipment has been sized according to scale as per the detailed mechanical equipment list developed for the feasibility study.

More detailed layouts of various areas of the process plant were developed for estimating of structural steelwork and concrete quantities. The High Pressure Acid Leaching area is shown in Figure 17.3 and the Solvent Extraction area is shown in Figure 17.4.

Figure 17.2 Process Plant Layout

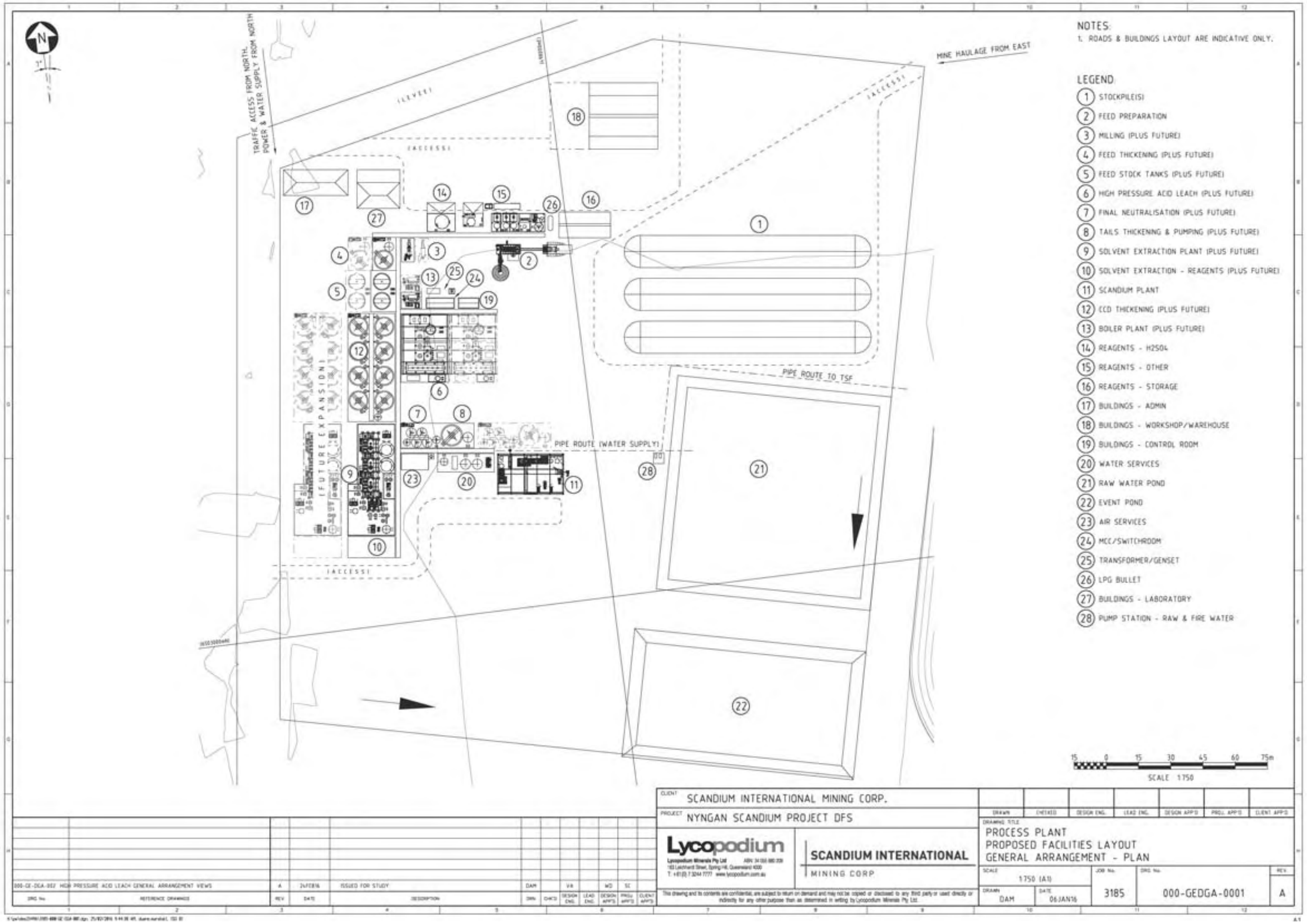


Figure 17.3 High Pressure Acid Leach Area Layout

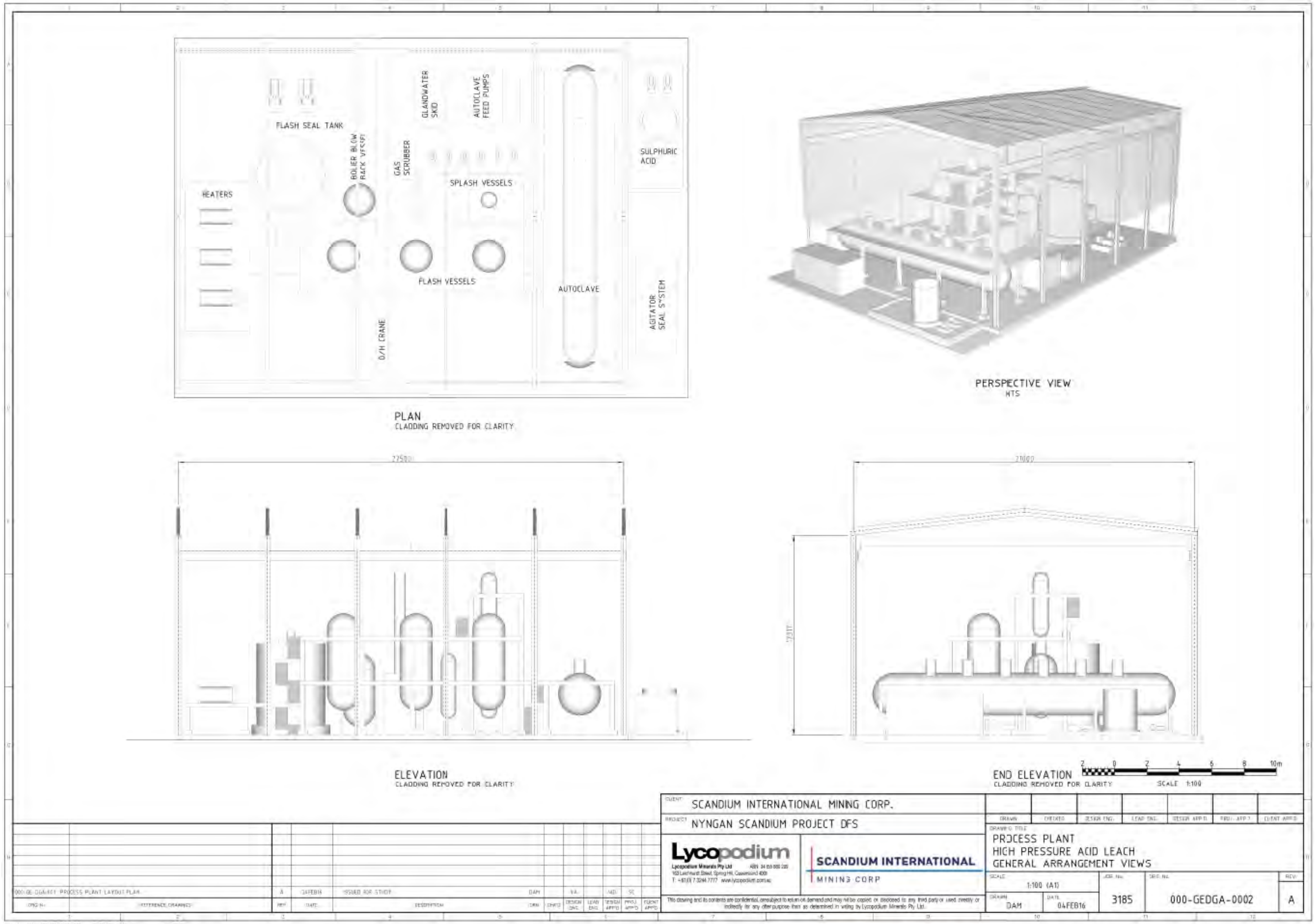
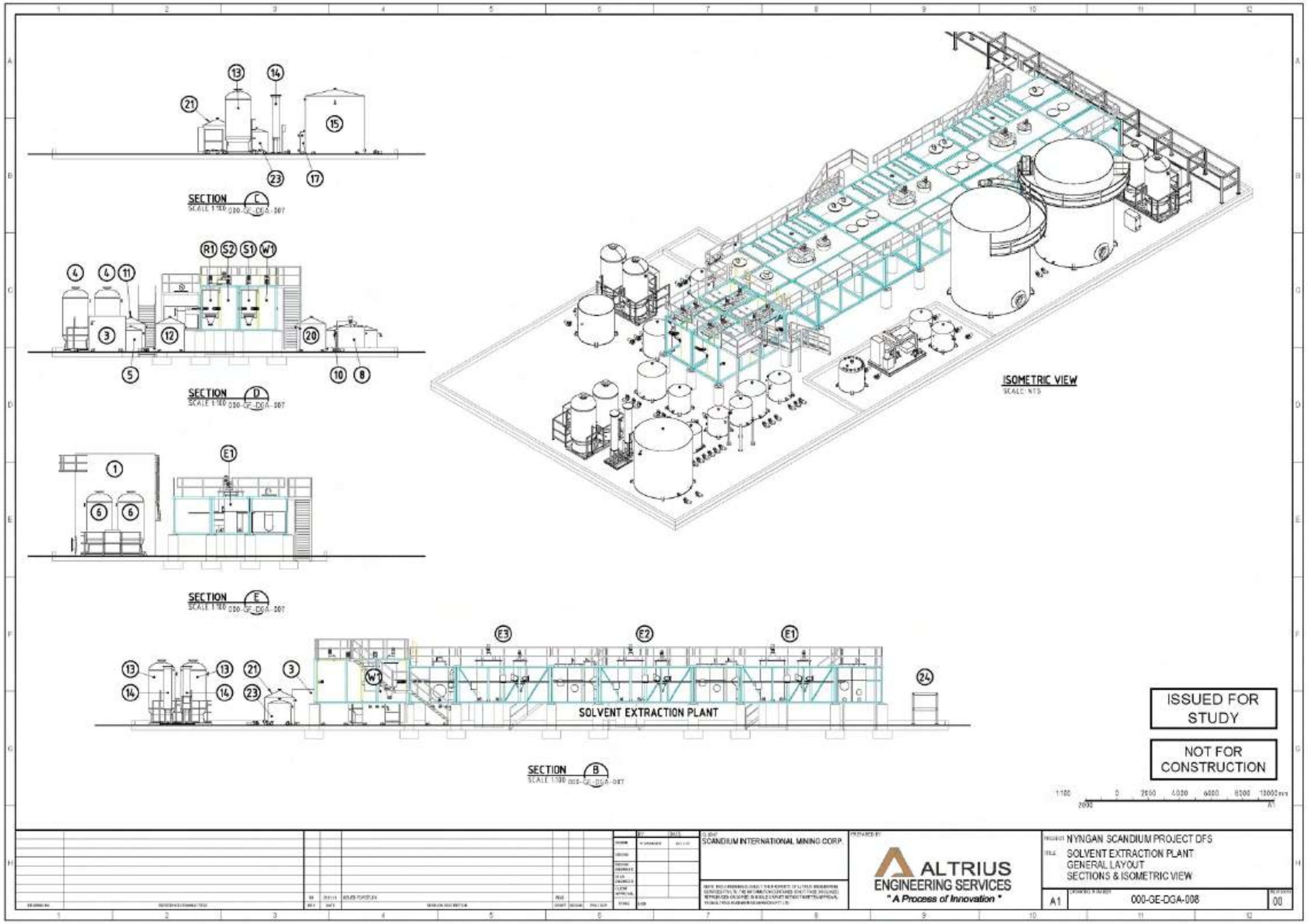


Figure 17.4 Solvent Extraction Plant



18.0 PROJECT INFRASTRUCTURE

18.1 Access and Haul Roads

The Site Access Road from the Barrier Highway to the plant side is planned as an all-weather, unsealed two lane road suitable for use by light and heavy vehicles. The road has been designed to a width of 10.5 m that would provide dimensional adequacy for two loaded semi-trailer trucks to pass safely. The planned road elevation is slightly above the natural ground surface and appropriate road-side drainage would be constructed due to the propensity of flooding during periods of heavy rain. It is likely that a “Crown Road” easement will be acquired for the road. The road will be used for accessing the plant by operating and maintenance personnel, supply of reagents and consumables and transport of product. A mine haul road will be constructed for the short distance from the mine to the process plant site. This road would have a width of 10.5 m to allow safe haulage 34 tonne road haul trucks and bunding to 50% of the tyre height. Plant roads are to be built within the plant boundary and will be all weather gravel roads.

It is planned that the plant personnel will be housed in existing accommodation in Nyngan and will drive the approximately 20 km to and from site every day.

18.2 Power Supply

18.2.1 Installed Load and Maximum Demand

The installed load and maximum demand for the site is shown in Table 18.1. The maximum demand is calculated for a half hour window and represents the minimum supply capacity required for the site.

Table 18.1 Plant Power Demand

Area	Plant Installed Load	Plant Maximum Demand	Plant Average Continuous Load
Process Plant	3,057 kW	1,412 kW	1,234 kW
TSF / Infrastructure	190 kW	67 kW	60 kW
Totals	**3,247 kW**	**1,479 kW**	**1,294 kW**

18.2.2 Power Supply

The site will be supplied at 33 kV via a connection to an existing overhead powerline, running adjacent to the Barrier Highway through existing farm land, located 2.5 km north of the site. The overhead powerline is owned by Essential Energy and a preliminary connection request was lodged as part of the feasibility study. A subsequent response from Essential Energy has been received confirming the viability of a 1.6 MW supply capacity, subject to the following line upgrade / modification works being undertaken by the Proponent as part of the project.

- Conductor replacement (re-stringing) of 19 km of the existing overhead line between the Nyngan townsite 22/33 kV step-up transformer yard (NYGS) and the mine take-off.
- Installation of isolation transformers to three existing spur SWER (single wire earth return) overhead lines along the upgraded line section.
- Provision of temporary generation to consumers during line outages.

From the mine take-off point, a 2.5 km 33 kV overhead spur line will be constructed down to the plant site, running adjacent to the site access road easement. This will then terminate at the site HV switchboard providing the Essential Energy battery limit and utility metering.

Of note from the preliminary discussions with Essential Energy is that the present proposed site electrical loads are close to the maximum capacity that their network can support on this existing 33 kV overhead line. Should the load increase significantly in the future due to process expansion then it is highly likely that further upgrades to the town substation would be required or preferably a new connection to the nearby 66 kV overhead line would be established. Neither option has been explored in depth in this study due to the significant capital outlay they present for no present operating benefit. Implementation timing for both options would likely be in excess of 24 months given the challenges in dealing with the Essential Energy and coordination of significant grid outages.

18.3 Electrical Distribution

The electrical system for the Project is based on 33 kV high voltage distribution and 415 V drive voltages. System frequency is designed at 50 Hz.

The site High Voltage (HV) switchboard will be located on the north edge of the administration area with all connecting supply cabling installed underground in conduits.

The HV switchboard primarily supplies the process plant distribution transformer, a 2,500 kVA 33 kV / 415 V step down transformer to supply all process and local infrastructure requirements. A second feeder also supplies an overhead powerline system on the site which reticulates power to the decant pond, tailings storage facility and mine services contractors yard via a combination of pole top and skid mounted step down transformers. The overhead line length is approximately 2.3 km and will be strung with Optical Ground Wire (OPGW) to facilitate connection of remote facilities via fibre optic.

To prevent equipment damage and extended downtime following power outages, the site process plant drives have been split into non-essential and essential services. All essential services are capable of being powered by a standby generator which will start in the event of a power failure. The generator is nominally rated at 1000 kVA and self bunded with fuel capacity for 24 hours run time.

18.3.1 Electrical Switchroom / Control Room

The process plant is based around a single electrical switchroom which houses two LV Motor Control Centres (MCC), Process Control System (PCS), Variable Speed Drives (VSD) and operator control room. Based on the equipment requirements, approximate dimensions for the switchroom have been calculated at 45 m long x 4.5 m wide. The room would be transported in two sections and joined onsite via an open walkway.

The switchroom is sealed for dust ingress and will be supplied complete with air conditioning, Uninterruptible Power Supplies (UPS) and fire detection system.

The switchroom will be mounted on 2 m high steel pedestals to facilitate cable installation below the switchroom and bottom entry connection to the internal equipment through gland plates. Entry to the rooms will be via stairs and access platforms constructed at each end and in the middle.

18.3.2 Transformers and Compounds

All 33 kV / 415 V distribution transformers will be of ONAN (non-fan forced) cooling configuration and vector group Dyn11.

The process plant transformer will be installed into a bunded compound, sufficiently spaced from the switchroom, standby generator and other structures so as to avoid requirements for fire rated blast wall.

Field distribution transformers for the stormwater pond and mine services contractors' yard are 100 kVA 33 kV / 415 V and will be pole mounted on the overhead powerline.

Due to the incremental construction and stage lift methodology for the residue storage facility, the transformer and decant pump MCC will be skid mounted and connected to the overhead powerline via a trailing cable. Subsequent lifts to the decant causeway, will only require disconnection / removal of the skid and coiling up of the trailing cable whilst the works are undertaken. Following completion of the earth works, the cable shall be uncoiled and the skid reinstalled at the new lifted height.

18.3.3 HV Switchboards

The site HV switchboard is a SF6 gas insulated fixed switchgear type installed into a raised outer enclosure. The board is provided with an incoming circuit breaker and metering cubical for utility tariff metering. The board is non-extendable and provided with a single future feeder for future potential process plant additions.

The design fault level and circuit breaker ratings adopted are:

- 33 kV switchboard busbar 630 A, 20 kA at 1 seconds.
- 33 kV circuit breakers 630 A.

Protection will be provided by microprocessor based protection relays.

18.3.4 Electronic Variable Speed Drives

LV variable speed drive (VSD) units range up to 75 kW and will be powered from the LV MCCs. These units will be installed along the internal wall of the electrical switchroom or internally to the field MCCs at the stormwater pond and tailings dam.

18.3.5 415 V Motor Control Centres

The LV MCCs will be double-sided and housed in the electrical switchroom. Construction of all MCCs is based on Form 4 segregation, Type 2 co-ordination. Starters in MCCs will be of demountable design and main incoming circuit breakers will be of withdrawable design complete with protection. Motor starters up to 90 kW will be equipped with thermal overload protection and electronic protection will be used for all larger drives. The LV MCCs will supply power to the low voltage motors, low voltage variable speed drives and low voltage distribution boards.

18.3.6 Fire Protection

The electrical switchroom will be provided with local fire detection systems consisting of Very Early Smoke Detection Apparatus (VESDA) sampling for the LV MCCs. Signals from the fire detection system will be wired to the respective Fire Indication Panel (FIP) in the switchroom and all signals will be monitored by a master fire detection panel (MFIP) in the Administration Building. Each FIP will also be wired to a local siren with beacon to warn staff of the fire detection.

18.3.7 Earthing System and Lightning Protection

The earthing system within the plant will be designed in accordance with relevant Australian Standards. The following method of system earthing will be implemented at various voltage levels:

- 33 kV Resistance earthed via Essential Energy.
- 415 V Solidly earthed system / Multiple Earthed Neutral (MEN) / T-N-C-S.

Lightning protection will be provided for buildings and structural steel as appropriate. Structural high points will be fitted with lightning masts of sufficient height and quantity to ensure that all exposed points will be covered as per ‘Rolling Sphere Method’ of AS 1768. Lightning protection systems will have their own independent earthing electrodes and will be interconnected with the power earthing system.

18.3.8 Electrical Field Installation

Cable ladder will generally be laid horizontally, with vertical ladders used in areas where spillage may occur. The central plant pipe rack will accommodate the primary cable runs, with multiple cable ladders used to segregate between power, control and instrumentation cabling. Sun cover will be provided over the top level of all cable ladder to provide protection against UV damage to cables and plant spillage. All cabling will be affixed with stainless steel cable ties on vertical runs and nylon on horizontal.

Plant lighting will be designed in a fit for purpose manner to suit the operational requirements of the plant. Ten metre high area flood lighting towers will provide general access lighting around the feed preparation and infrastructure areas. Process areas and staircases will be fitted with traditional break-back lighting poles and fixtures.

Cables of different voltage groups will be installed on separate ladders. If they need to be installed on the same ladder, then complete segregation of the ladders will be provided. Ladder routes will follow the mechanical pipe racks.

The scandium precipitation plant and solvent extraction modules have both been identified as areas with electrical hazardous areas. The field installation in both areas will utilise intrinsically safe instrumentation and hazardous area ‘Ex d’ rated flame proof enclosures for all terminal boxes and control stations.

18.4 Control System

18.4.1 General Overview

The general control philosophy for the plant will be one with a high level of automation and remote control facilities. Instrumentation will be provided within the plant to measure and control key process parameters.

The main control room, which will be located within the electrical switchroom, will house two PC based operator interface terminals (OIT). Two additional servers will also be located here to act as the control system supervisory control and data acquisition (SCADA) servers in a redundant configuration. The control room is intended to provide a central area from where the plant is operated and monitored and from which the regulatory control loops can be monitored and adjusted. All key process and maintenance parameters will be available for trending and alarming on the process control system (PCS).

The process control system that will be used for the plant will be a programmable logic controller (PLC) and Citect SCADA based system. The PCS will control the process interlocks and PID control loops for non-packaged equipment. Control loop set-point changes for non-packaged equipment will be made at the OIT.

18.4.2 Field I/O

All instrumentation and field controls will be captured by the PCS via remote I/O modules, generally located at each process module of the plant, primarily to minimise the extended cable run lengths back to switchroom. These remote I/O modules are electrical field enclosures housing power supplies, network equipment, marshalling terminals and PLC remote I/O nodes. All remote I/O nodes will be linked to the PLC via a PCS Ethernet network, supported over the site fibre optic cabling between switchroom, remote I/O modules and key infrastructure buildings.

18.4.3 Drive Control

In general, the plant process drives will report their ready, run and start pushbutton status to the PCS and will be displayed on the OIT. Local control stations will be located in the field in proximity to the relevant drives. These will, as a minimum, contain start and latch-off-stop (LOS) pushbuttons which will be hard-wired to the drive starter. Plant drives will predominantly be started by the control system in automatic operation.

The OITs will allow drives to be selected to Auto, Local, Remote or Out-of-Service modes via the drive control popup. Statutory interlocks such as emergency stops and thermal protection will be hardwired and will apply in all modes of operation. All PLC generated process interlocks will apply in Auto and Remote modes. Process interlocks will be disabled or bypassed in Local mode with the exception of critical interlocks such as lubrication systems on the mill.

Local selection will allow each drive to be operated by the operator in the field via the local start pushbutton. Remote selection will allow the equipment to be started from the control room via the drive control pop-up. Status indication of process interlocks as well as the selected mode of operation will be displayed on the OIT.

18.4.4 Control Loops

Regulatory control loops will be provided for all key process circuits to provide optimal functionality without regular operator intervention.

There will be two modes for loop controlled set points available in the OIT. These are 'Loop Auto Mode' and 'Loop Manual Mode'. In Loop Auto Mode (analogous to cascade control), the set point will be predominantly controlled by the applicable 'master' PID loop (e.g. for thickener underflow pumping control, the bed pressure PID controller output will supply a set point for the thickener underflow flow control loop which ultimately controls the speed of the thickener underflow pump). In Loop Manual Mode, set point may be entered manually from the loop set point pop-up in the OIT.

Where required, analogue set points from the PCS to vendor supplied control panels can be done either via the OIT or via vendor control panels.

18.5 Communications

18.5.1 Network Topology

The onsite communications network is designed around a site wide fibre optic backbone which will be shared by all services. This will minimise cabling and related communications equipment and be installed in underground conduits, cable tray and via the overhead powerline OPGW. The services that will use the common fibre optic backbone include:

- Corporate LAN including telephony (Voice over Internet Protocol – VoIP).
- Plant Control System.

18.5.2 External Connectivity

To provide external connectivity to the site, a high speed wireless link will be installed to communicate to the National Broadband Network (NBN). This is presently being rolled out through regional NSW and is expected to be provisioned to Nyngan town site in 2016 by way of new hardware installed on the existing mobile phone tower. This solution offers the lowest capital and operating expenditure compared to traditional high cost dedicated fibre optic links with Telstra and is ideally suited to the minimal site numbers.

18.5.3 Server / Computer Infrastructure

Corporate servers, network switches and a firewall will be installed onsite to support the users locally, with the expectation the Proponent will implement a VPN link to any remote central office as required. An allowance of 20 computers, a mixture of workstations and laptops, has been made along with required software and office equipment such as docking stations, monitors, photocopiers and cabling.

18.5.4 Voice Services

The site voice service is based on the implementation of a Voice over IP (VoIP) system. An allowance has been provided for provision of 20 desk phones, plus reception and meeting room conference phone. Supporting server infrastructure and software will be installed on the site servers. The system will function over the high bandwidth site link to the NBN. The site also receives mobile phone coverage and an indoor booster for the main office has been included.

18.6 Water Supply and Onsite Water Management

18.6.1 Water Supply Source

Water will be provided to the site by connecting to one of the two parallel pipelines which runs adjacent to the Barrier Highway, some 5 km from the raw water storage pond at the processing facility. The pipelines are owned and operated by the Cobar Water Board, which was established to supply bulk water to the Cobar Shire Council and local mining companies.

The Board's principal source of water is the Bogan River at Nyngan, where water is stored in a series of pools known as the Bogan Storages. The storages are formed by a weir (the Overshot Weir) and several earthen embankments. The Bogan River is an ephemeral stream, and is generally inadequate to meet the needs of the Board, Nyngan town and approved irrigators.

Security is better assured by a connection to the Macquarie River at Warren through the Albert Priest Channel. This channel is an approximately 70 km long earth channel and was constructed in 1942. The channel discharges flows into the upper reaches of the Bogan Storages.

From Nyngan, the Board pumps water through parallel pipelines some 130 km to a 1.14 ML reservoir at Fort Bourke Hill, Cobar. Hermidale booster pumping station, located mid-way along the pipelines, is in operation to increase the rate of flow to assist in the transfer of water.

In 2014 and 2015, approximately 4,600 ML of water was pumped through these pipelines.

A new 160 mm diameter HDPE pipe is planned to tie into the existing pipeline, be fitted with an isolation valve and be buried alongside the new access road to fill a site based raw water storage dam of 15 ML capacity. The 160 mm line will be of sufficient size to cater for a potential fourfold expansion of the processing plant without the need for further upgrade (subject to available spare capacity in the supply pipeline).

The raw water dam will be an earthen dam with a balance cut-to-fill “turkey’s nest” construction.

The average daily demand for raw water for the plant will be approximately 0.8 ML, and the raw water dam will hold approximately 18 days of storage. An on-site storage buffer is recommended as a protection against potential supply outages in the Cobar Water Board infrastructure.

The annual demand for raw water will be approximately 260 ML. In order to ensure the project has access to sufficient water in times of supply cutbacks, EMC intend to purchase high security water licences for twice the anticipated annual requirement. This will also cover supply system losses of the Albert Priest Channel and the Bogan Storages.

EMC-A have confirmation from the Cobar Water Board that an application for a Major Consumer connection for this project would be considered favourably.

18.6.2 Water Balance Modelling

A detailed water balance model was developed for the site with a daily time step. The water balance model was run under average, 1 in 100 ARI dry and 1 in 100 ARI wet climatic conditions. The average results indicate that between 19% and 42% of the process demand is provided by water recovered from the RSF, with annual water demand from Cobar water service pipeline of up to 19% of the total process water demand.

Under 1 in 100 ARI dry conditions, the predicted water shortfall increases significantly (by three to six times) compared to the average conditions. The highest shortfall would be in year 20, with approximately 163,700 m^3 of water needing to be obtained from the Cobar water service pipeline.

Under 1 in 100 ARI wet conditions, no plant shortfalls are anticipated other than during year one when a shortfall of 6,300 m^3 would be required from the Cobar water service pipeline. However, the water volumes within the RSF pond, event pond, external decant pond and evaporation pond do not exceed their defined capacities under wet conditions. As such, no uncontrolled water releases should occur.

18.6.3 On-site Water Storages

Several on site water storages have been designed to manage the different classes of water onsite including raw water feed, sediment laden water and process or contaminated water. These storages have been designed by Knight Piésold with details of the designs provided in the Residue Storage and Water Management Report prepared by Knight Piésold (Knight Piésold, 2016).

External Decant Pond

Supernatant water removed from the surface of the RSF will be pumped to a decant pond. The decant pond is a paddock style facility which abuts the southwest embankment of the RSF. The design storage capacity of the external decant pond is 85 ML with an additional 0.6 m freeboard. This design capacity provides sufficient volume on top of the maximum normal operating pond to allow the runoff generated by a 1 in 1,000 year ARI 72 hour rainfall event on the RSF to be stored, whilst retaining sufficient freeboard to store a 24 hour PMP event. No spillway has been provided for this facility as it has no external catchment and the freeboard is sufficient to store the 24 hour PMP event. Based on the geochemistry of the supernatant, the decant pond includes a robust liner system, comprising 1 mm HDPE, underlain by a flownet drainage layer and secondary 1.5 mm HDPE liner. The secondary HDPE liner is then underlain by a 300 mm compacted clay liner consisting of conditioned in-situ material or imported clay from other development areas.

Evaporation Pond

The evaporation pond is required to store spent process solutions which are not appropriate to recycle. The evaporation pond is a paddock style facility which abuts the west embankment of the decant pond. The design storage capacity is 25 ML with an additional 0.9 m freeboard which is sufficient capacity to store rainfall from the 72 hour PMP event. This is a conservative flood storage allowance to account for uncertainty relating to the volume of salt which will accumulate in the facility and the likely high concentration of metals. Based on the geochemistry of the process solutions, the evaporation pond includes a robust liner system, comprising 1 mm HDPE, underlain by a flownet drainage layer and secondary 1.5 mm HDPE liner. The secondary HDPE liner is then underlain by a 300 mm compacted clay liner consisting of conditioned in-situ material or imported clay from other development areas.

Raw Water Pond

Raw water for the project will be supplied via the Cobar water service pipeline. However, at certain times this water source may be unavailable for several days at a time. Therefore, a small raw water pond will be maintained on site at full capacity in case of pipeline outages. The design storage capacity is 15 ML with an additional 0.5 m freeboard. There is no requirement to line this facility as the water contained will be of a high quality, however the base will be scarified, moisture conditioned and compacted to minimise seepage losses.

Event Pond

The event pond is a below ground facility designed to contain all plant site runoff associated with a 1 in 100 year ARI 72 hour event, equivalent to a volume of 22 ML. However, sediment will need to be removed from the facility following rainfall events to maintain capacity. Base preparation will consist of scarifying, moisture conditioning and compacting the base and sides of the facility and overlaying with a 1.5 mm HDPE liner.

Sediment Ponds

Excess water from the pit dewatering will be temporarily stored in Sediment Pond 1 and pumped back to the plant circuit as required. The rainfall runoff from the RSF downstream batters and areas contained within the process area levee bund will drain to the process area sediment pond (Sediment Pond 2). The water stored within the process area sediment pond will be pumped to the external decant pond for reuse. Water collected in these sediment ponds should be appropriate for pasture irrigation. Base preparation of the sediment ponds will consist of scarifying, moisture conditioning and compacting.

18.7 Residue Storage Facility

Knight Piésold has designed the Residue Storage Facility (RSF) for the Project in accordance with the ANCOLD Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure and the New South Wales Dams Safety Committee (DSC) Guidance Sheets. Details of the design are provided in the Residue Storage and Water Management Report prepared by Knight Piésold (Knight Piésold, 2016).

18.7.1 Geotechnical Investigation

Knight Piésold conducted a geotechnical investigation of the proposed RSF to determine the foundation conditions. Knight Piésold also conducted geotechnical investigations of the open pit to determine the material types available for construction of the RSF. The geotechnical investigations found that the RSF is underlain by a clayey topsoil layer averaging 300 mm thickness, underlain by indurated alluvial clays of between 2 m and 6 m thickness. These clays are moderate to high plasticity and in places are cemented by iron oxides. Underlying the clay is a variable sequence of alluvial sands, gravel, silts and clays. Drilling in the RSF area did not encounter bedrock with the bore holes advanced to a maximum depth of 62 m.

The open pit area exhibited a similar strata profile to the RSF area with the exception that the base of the alluvial material was encountered from depths of approximately 17 m. The alluvial deposits were underlain by a laterite / saprolite / saprock sequence prior to medium strength pyroxenite bedrock being encountered.

Groundwater was not monitored during the geotechnical investigation, however, previous studies indicate that the standing water level in the vicinity of the pit to be between 22 m and 25 m below ground surface.

18.7.2 Residue Physical Characteristics

Residue will be pumped to the RSF as a slurry at 31% solids and will be deposited sub-aerially to facilitate drying and consolidation of the residue mass. A residue sample was produced by SGS Minerals Services (Lakefield) from a 20 litre autoclave bench scale test and supplied to Knight Piésold for testing. The sample consists of 12% sand, 86% silt and 2% clay. The testing indicates that the material is silt, with sand.

The residue tests indicated that the residue is expected to settle moderately fast but achieve low densities. The densities achieved in the testing were 0.50 t/m^3 and 0.59 t/m^3 in the undrained and drained tests respectively.

Air drying of the samples indicates that they will reach a maximum air dried density of approximately 0.92 t/m^3 after approximately 80 mm of evaporation, when the moisture content of the sample is reduced to approximately 30%.

Both high strain and low strain consolidation testing was conducted indicating that consolidation due to self-weight loading from additional residue will not lead to significant increases in density above that achieved in the air drying test.

The residue is estimated to release 20 to 25% of the slurry water volume during the settling process, with the remainder of the water either lost to evaporation or retained in the deposited residue.

18.7.3 Residue Geochemical Characteristics

The residue solids were found to be ‘Potentially Acid Forming – Low Capacity’. However, this classification was due to the presence of alunite rather than sulphide minerals which are typically associated with acid generation. In theory, where hydrolysis of aluminium (released during alunite dissolution) proceeds to completion (with the generation of aluminium oxyhydroxides), the pH of the solution is near pH 4.

The residue solids were found to have a low number of element enrichments. However, the elements which were significantly enriched, namely arsenic, antimony and selenium, are metalloids which have a high degree of environmental toxicity and display solubility over a range of pH conditions. That said, these metalloids do exhibit strong adsorption onto iron oxides and, therefore, are likely to be tightly bound to the hematite in the residue solids. When the residue multi-element results are compared to guidelines for site contamination, they are found to exceed the human health and ecological criteria.

The residue supernatant was found to be of a poor water quality when compared to appropriate reference guidelines, primarily due to chromium (VI) present in solution at 7.52 mg/L. Later testing by EMC however has shown that the chromium (VI) concentration in solution can be reduced to 0.04 mg/L which will significantly reduce the risk profile of the supernatant.

18.7.4 Consequence Category

A consequence category assessment of the RSF has been conducted by Knight Piésold in accordance with the ANCOLD Guidelines on the Consequence Categories for Dams, and the New South Wales Dam Safety Committee Guidance Sheet for Consequence Categories for Dams. The RSF has been assigned a dam failure consequence category of "HIGH B" and an Environmental Spill consequence category of "SIGNIFICANT".

18.7.5 RSF Design

The RSF has been designed as a paddock style facility with a perimeter embankment around all sides of the facility constructed in stages over the life of the project. The facility will have a maximum height of 32 m at the end of the life of mine (LOM) and has been designed to store all residue produced by the process plant over a 20 year operating life. The total crest length at the end of the LOM will be 1,300 m, with a basin area of 12.7 ha and a total footprint area (to the downstream embankment toe) of 28 ha.

The facility has been designed to promote air drying to maximise the density of the residue stored within the facility. This has been achieved by staging the construction of the facility so that the drying area expands as the process plant throughput increases over the first four years of operation. In addition, a specialised decant tower system has been designed which will allow the pond on the facility to be reduced in size below that which would normally be achievable with conventional decant systems. Supernatant water and rainfall runoff will be pumped from the facility and stored in an external decant pond from where it will be recycled to the plant to meet process demands.

The RSF is equipped with an underdrainage system on top of the liner, comprising basin underdrainage drains and embankment toe drains to reduce the phreatic surface within the facility and to allow dewatering of the residue during operations and post closure. These drains report to the underdrainage sump from where the water will be recovered and pumped to the supernatant pond.

The RSF design includes a robust liner system on the basin and upstream embankment batters of the facility to reduce the potential for seepage from the facility. The basin liner system comprises a 1.5 mm HDPE liner overlying a 300 mm clay liner, which will be compacted to achieve a maximum permeability of 1.0×10^{-9} m/sec. Below the upper clay liner, a flownet (synthetic drainage layer) will be installed to capture and recover seepage (if any) which passes through the upper liner system. This sub-liner drainage will report to a drainage sump from where the water will be recovered and pumped to the supernatant pond. A secondary liner of compacted clay with a maximum permeability of 1.0×10^{-9} m/sec will be constructed below the flownet drainage layer.

The embankment will be constructed with an upstream 6 m wide compacted clay zone (with a maximum permeability of 1.0×10^{-9} m/sec) overlain by a 1.5 mm HDPE liner. The structural embankment zone will be constructed of overburden from the pit which will comprise moisture conditioned and compacted alluvial soil (clayey sands and gravels). The upstream batter of the facility will have an effective slope of 18.4° (1V:3H) to allow deployment of the HDPE liner and the downstream life of mine batter slope will also be

18.4° (1V:3H) to provide a stable facility that can be easily rehabilitated with minimal reshaping.

Seepage analysis of the facility design indicates that the phreatic surface within the residue mass close to the embankment drops considerably, indicating the effectiveness of the proposed toe drain system. The results further indicate very little infiltration through the liner system, with the embankment body remaining unsaturated. Additional seepage modelling indicates that the liner system proposed for the Nyngan RSF exceeds the liner criteria recommended by the NSW EPA for solid waste landfills.

The embankments have been designed to be geotechnically stable under design loading conditions, with stability analysis conducted in accordance with ANCOLD guidelines, taking into consideration drained, undrained and seismic design loads.

Simplified deformation analysis was undertaken for the LOM embankment to determine the post-earthquake induced vertical settlements which may lead to a potential loss of freeboard. The predicted maximum embankment crest settlements under the MDE are less than the design freeboard of 0.5 m. Therefore, the MDE event is considered unlikely to cause severe damage or instantaneous failure of the RSF embankments.

The liquefaction potential of the residue was evaluated using the PSD method based on gradation curves obtained from residue testing. Results indicate that the residue is likely to be liquefiable, as the grading curve for the residue falls within the boundaries of materials which are susceptible to liquefaction. The liquefaction potential of the foundation material which will also be utilised for embankment construction (Zone A) was evaluated based on the plasticity characteristics. The results indicate that the foundation / embankment construction material is unlikely to be liquefiable as the Atterberg limits fall outside the liquefiable zones.

The facility has been designed in accordance with the freeboard requirements of the NSW dams safety committee, with the facility provided with an operational freeboard of 500 mm and an environmental containment freeboard sufficient to contain the runoff generated by a 1 in 1,000 year ARI 72 hour rainfall event. A spillway has been designed and will be constructed at each stage of construction, with sufficient capacity to pass the peak flow generated by the probable maximum precipitation event (PMP).

18.7.6 Construction of the RSF

The facility will be constructed in stages over the life of the project. To reduce capital expenditure and to provide an appropriately sized facility for the initial residue throughput rates, the Stage 1 facility will be constructed as a single cell. The first cell will be located in the western half of the RSF footprint area and will be constructed during the pre-commissioning phase. This cell will be raised once after the first year of production. After the second year of production, the second cell will be constructed to the east of the first cell. The two cells will be combined into a single cell during the third year of production, after which the facility will continue to be constructed and operated as a single cell.

The facility will be constructed by downstream construction methods utilising material excavated from the open pit. The material will be hauled to the RSF from the open pit using mining trucks and will be placed in the embankment and liner zones. The material will then be moisture conditioned by water trucks prior to compaction of the fill using a combination of traffic compaction of vibratory rollers. Compaction, moisture content, particle size, plasticity and in-situ permeability of the fill will be measured during construction to ensure the material meets the geotechnical technical specification.

The geomembrane liners and flownet drains will be installed by a specialist geomembrane installation company. Quality control and quality assurance testing of the geomembranes and the installation welds will be conducted during the production of the liner material and during the installation process.

The construction of the initial and all subsequent stages of the construction will be overseen and signed off by a qualified engineer in accordance with the NSW Dams Safety Committee requirements. A construction report will be prepared which will contain a record of the all the quality control and quality assurance testing conducted during the construction with the report submitted to the NSW Dam Safety Committee.

18.7.7 Operation of the RSF

The residue will be transported from the processing plant to the RSF via a HDPE pipeline. When outside of the RSF footprint, the pipeline will be contained within a bunded corridor which will prevent release of residue in the event of pipeline failure.

The facility will be operated as a subaerial facility, with the residue deposited from the external embankments. During the deposition process, the solids will settle out to form sloping beaches and the liquid fraction (supernatant) will drain to the supernatant pond.

The deposition location will be moved on a regular basis using a system of spigots which will be opened or closed to move the deposition around the facility and maintain the supernatant pond at the decant tower location.

Supernatant liquor and minor rainfall runoff will be removed from the RSF by pumping from the decant tower to the external decant pond via a HDPE pipeline. A submersible decant return pump will be used for this application. After a large rainfall event a supplementary (stormwater) pump will be used to remove excess water from the facility. This water will also be pumped to the external decant pond via a HDPE pipeline. The stormwater pump has been sized to allow the runoff generated by a 1 in 1000 year ARI 72 hour rainfall event to be removed from the facility within seven days. The pond on the RSF will be kept as small as practical at all times to maximise the beach area and drying potential.

Submersible pumps will be installed in the two underdrainage sumps and two sub-liner drainage sumps to recover water. These pumps will have float switches so that when water is present within the sumps the pumps will operate automatically and pump the water to the supernatant pond.

18.7.8 Residue Storage Facility Closure Design

The geochemistry of the residues which will be deposited in the facility require a robust closure cover to minimise rainfall infiltration into the facility and reduce the potential for seepage from the facility post closure. To achieve this objective, the closure strategy for the facility will be to isolate and cover the contained residues by the construction of domed fill platforms, over which a HDPE liner will be installed. A sub-soil layer will be placed over the liner and the entire surface topsoiled and revegetated with shallow rooted pasture species. This will reduce the potential for rainfall infiltration into the facility and, therefore, reduce the potential for seepage.

18.7.9 Monitoring and Instrumentation

A comprehensive monitoring program has been proposed for the RSF to detect a number of potential problems which may arise during operation. The monitoring will include eight survey pins to check embankment movements in each stage and six deep and shallow monitoring bores to monitor groundwater levels and water quality downstream of the RSF.

The RSF is considered to have a “HIGH B” hazard rating. Thus, in accordance with the requirements of ANCOLD and DSC guidelines, annual audits will be required by a suitably qualified engineer to ensure that the facility is operating in a safe and efficient manner.

18.8 Surface Water Management

A detailed hydrological and flood modelling study was undertaken to estimate the peak runoff flow rates which occur in Whitbarrow Creek directly to the south of the Nyngan project site.

18.8.1 Flood Protection Bund

Assuming a freeboard of 1,000 mm above the 0.1% AEP flood extent, the flood protection bund around the pit will require a crest elevation of 185.6 m RL. Assuming a freeboard of 1,000 mm above the 0.1% AEP flood extent, the flood protection bund around the process area will require a crest elevation of 186.6 m RL.

18.8.2 Floodway

A floodway will be required between the Nyngan pit levee area and the process plant levee area to allow flows from the catchment to the north to be passed between these areas. The peak flow has been calculated at 2.6 m^3/s and the design of the road between these two areas shall include sufficient culvert opening and erosion protected overflow floodway width to convey this flow.

18.8.3 Bogan Creek Flooding

In additional to modelling of the peak storm runoff from Whitbarrow Creek, the potential impact (if any) to the Nyngan project from flooding of the Bogan River was assessed. The PMF has previously been estimated for Bogan River at the town of Nyngan as 15,162 m^3/s. Estimations of normal depth at a cross section adjacent the Nyngan project showed that the floodwaters would not impact on the project and, therefore, no detailed modelling of the Bogan River was conducted.

18.9 Mine Support Infrastructure

Mining will be undertaken by a small fleet of contract mining trucks and support equipment that will require periodic upkeep and maintenance. All pricing for the earthwork service was inclusive of contract facilities and therefore the only infrastructure required to be provided from EMC is a power supply for the mining contractor's offices and facilities.

As part of the earthworks contract, the contractor will provide the following facilities:

- A hardstand or compacted earth area for equipment park up.
- Upkeep and maintenance of temporary safety bunds and drains to enable mining to occur.
- Installation of a hardstand or compacted earth area for undertaking minor equipment repairs. All major repairs will be done offsite.
- Portable buildings as required to provide the excavation service.
- Standpipes for transferring water into site water carts.
- Mobile refuel and lube facilities that meet relevant Australian standards

The contractor will maintain all haulage routes and in pit roads as part of the haulage overhead. All contract personnel will reside locally and therefore no onsite camp facility will be required.

18.10 Process Plant Infrastructure

A security fence will be built around the process plant. The process plant utilises a number of high pressure vessels and corrosive liquids and access to site will need to be strictly monitored and stringent induction of site visitors will need to be conducted. The security fence will also need to be high enough to keep out grazing stock and kangaroos from entering the plant site.

The scandium oxide product is a high unit value product valued at around US$2,000 /kg. A one tonne shipment of product is therefore worth US$2M. However, no special security requirements are planned for shipping as the product would be very difficult to sell on the black market and the material from Nyngan is likely to have a chemical signature that will be specific to the Nyngan operation and would be easy to trace. Road transport of product in sealed steel drums to shipping facilities in a coastal location like Newcastle or Brisbane is envisaged. Air freight of the product from Dubbo is also a possibility.

Other process plant infrastructure will include:

- An administration building. This will be a prefabricated building approximately 30 m x 12 m comprising reception, offices, open plan office area, meeting room, crib room and ablutions.

- A laboratory. This will be a prefabricated building approximately 20 m x 12 m comprising an office, sample storage area, wet lab area, an XRF room, an ICP and AAS room, a LECO room and a clean room. A separate 20 m x 6 m undercover concrete slab area adjacent to the laboratory will be used for sample delivery and preparation.

  The laboratory will be equipped with some reasonably complex and expensive analytical instruments including:

  - an XRF (X-ray fluorescence) spectrometer
  - an Atomic Absorption Spectrometer (AAS)
  - an Inductively Coupled Plasma Optical Emission Spectrometer (ISP-OES)
  - two fume cabinets
  - small jaw crusher
  - ring mill
  - dust extraction system
  - drying oven
  - analytical balance.

- A combined workshop / warehouse building. Overall building size will be approximately 30 m x 30 m, and this will be a prefabricated shed without an overhead crane and will include a couple of offices.

- A combined MCC / central control room building complete with single office and ablution facility.

- A reagent storage building. This will be a prefabricated shed approximately 24 m x 12 m.

Roads within the process plant will be formed and sheeted with imported fill material, but will not be sealed.

An unsealed carpark for ten vehicles will be provided adjacent to the administration building.

The warehouse and reagent storage and delivery areas are kept separate from the main process plant to minimise heavy traffic interactions. As sulphuric acid may be delivered in B-double tankers, main delivery roads will be designed to accommodate these vehicles.

Any runoff from the unbunded areas of the process plant will drain via unsealed ground to the event pond. Subject to analysis of stormwater captured in the event pond, this will either be directed to the decant pond, evaporation pond or elsewhere via mobile diesel powered pump.

18.11 Accommodation

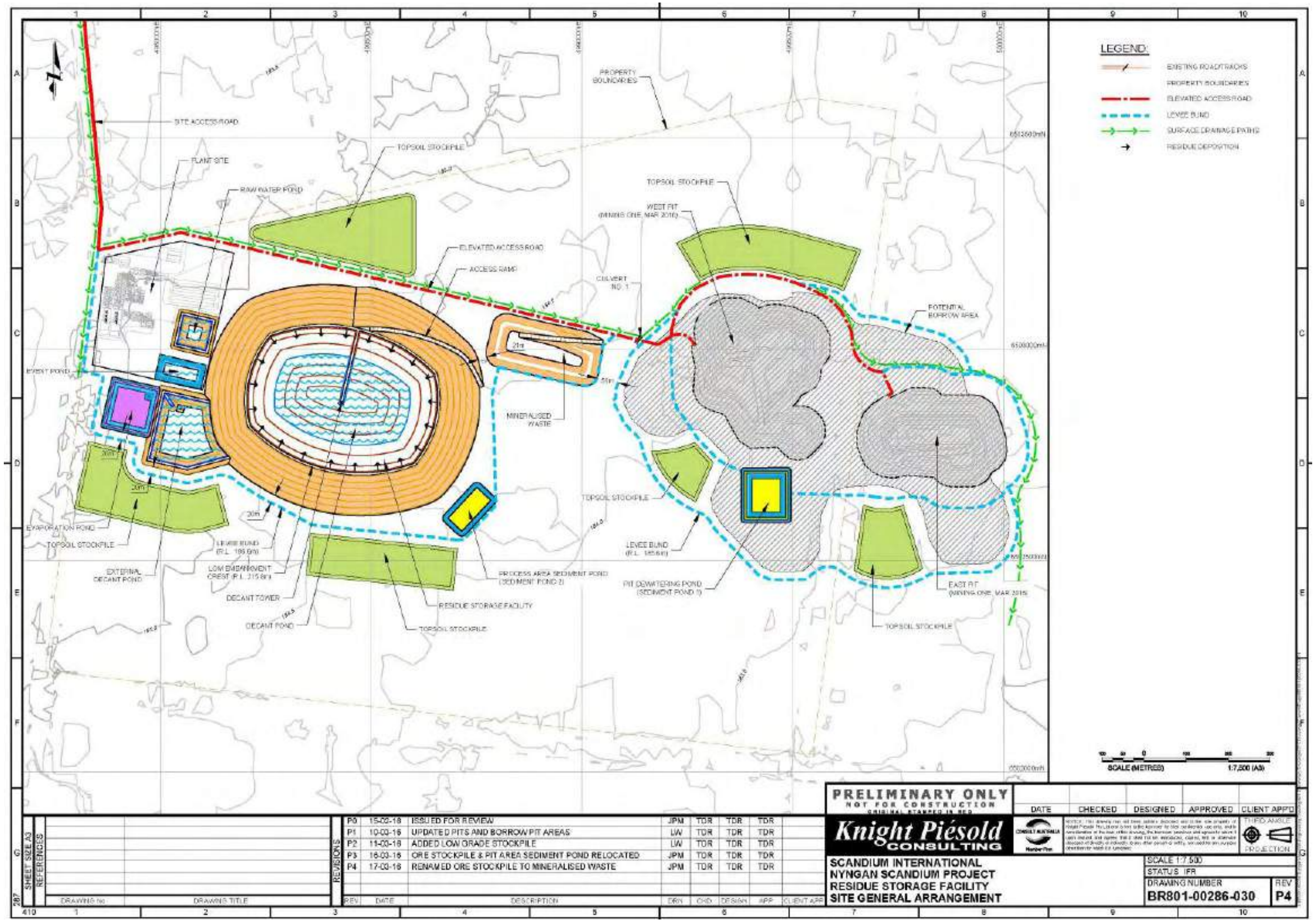
No dedicated construction camp will be provided for the project. Construction workers will be accommodated in Nyngan or use will be made of a currently unused construction camp (built for the recently constructed AGL Nyngan Solar Plant).

No dedicated operations camp will be provided for the project. Operating personnel will be accommodated in the Nyngan township.

18.12 Site Layout

An overall site layout is shown in Figure 18.1.

Figure 18.1 Site Layout



19.0 MARKET STUDIES AND CONTRACTS

19.1 Introduction – What is Scandium?

Scandium is an element, categorised as a light transition metal, atomic number 21. It is not technically a rare earth element (REE), although marketing convention has at times lumped scandium in with REE's. Nor is scandium geologically rare: with a crustal (Clarke) value of 22ppm, it is about as common as cobalt or yttrium, and is more common than lithium or lead. What is rare about scandium is for it to occur naturally in any significant concentration, which can be defined as over 100ppm. The fact that scandium widely distributes itself in low concentrations has made the element commonly geologically observed but consistently expensive to gather, concentrate and purify, and explains its scarcity as a commercially available commodity.

Scandium's uniqueness is such that minute additions of the element to aluminium alloys results in a step improvement in overall performance properties, including strength. No other alloying element gives the same level of multiple property improvements in such a diverse range of aluminium alloy systems as scandium.

19.2 Current Global Market Size

There is no transparent marketplace clearinghouse for scandium today. Buyers and sellers of any size advertise their respective interests and negotiate private commercial transactions. To the extent these scandium transactions trigger import/export reporting, or duty, they will be captured in governmental statistics, but the data is very incomplete, and can also be influenced by material upgrading into semi-finished parts. The most-quoted source of global scandium trade comes from the US Geological Survey (USGS) Mineral Commodity Summaries, published annually for approximately 90 minerals and specialty metals. The 2016 USGS summary for scandium (page 146) estimates the annual sales figure at "10 to 15 tonnes" for the twelve months ended December 2015, and has previously pegged the volume at "less than 10 tonnes" for many years. SCY believes the current scandium market in all forms to be between 15 and 20 tpy, based on apparent consumption of oxide in both alloys and solid oxide fuel cell (SOFC) applications. Product sources in Russia and China are difficult to track into global use statistics, and can take the form of aluminium-scandium (Al-Sc) 2% master alloy, in addition to scandium oxide. SCY believes the largest single user of scandium oxide today is Bloom Energy (Sunnyvale, California), which makes SOFC's. While their consumption is not publically disclosed, their supply sources (China / Russia) and imports of scandium-content semi-finished parts would likely fall outside the USGS data capture systems.

Aside from Bloom Energy, which has been able to meet its critical scandium need from current supply sources, the rest of the potential global market for scandium is constrained by limited product supply. The market is unable to answer greater demand, even at higher prices, and the product that is offered for sale is invariably absorbed by buyers willing to pay high prices for small amounts, in order to make small product runs or explore scandium's impacts in various applications.

19.3 Scandium Products Defined

Scandium is almost always found in nature in the form of a complex oxide, expressed by the chemical formula Sc_2O_3, also commonly referred to as scandia. Scandia is the form of the element that is most typically demanded by initial-use consumers, either for use directly or as an ingredient in downstream products.

Scandium can be purified into pure elemental form as a metal, although it is technically difficult and expensive to do so. In this elemental form, scandium metal is principally purchased and used for scientific and laboratory work. The element is not found in nature in this form, and will return to oxide unless carefully isolated from the atmosphere.

Scandia is most typically modified into a master alloy (or hardener) for use in alloying aluminium. An Al-Sc 2% master alloy typically has a 98% aluminium content and a 2% scandium content, and is designed to facilitate dosing precise quantities of scandium into larger volumes of molten aluminium, and can be done with or without other master alloys containing other metals to achieve desired multi-metal alloy recipes.

The purity standards for scandia in these different applications vary with the end-use application. Electrical applications and lighting usually require and specify 99.9% purity, while alloying and heat stabilising applications can generally be satisfied by 95 to 98% grades. Scandium metal and oxide grades above 99.9% purity are reserved for science and technical exploration of new applications.

19.4 Market Supply – Scandium Sources

There are no known primary scandium mining producers today. Most scandium production comes from by-product recovery from current refining activities for other metals, minerals, or rare earths. Scandium can also be found and separated from tailings, where it has been enriched by historic mineral processing, or from waste streams of operating chemical processing facilities, most notably titanium dioxide facilities (sulfate TiO_2 pigment plants) and uranium leach solutions.

Current significant scandium producers are located in China and Russia. Those and other potential sources can be summarised as follows:

- Chinese sources are spread over numerous producing assets. The Bayan Obo REE (Nb-Fe deposit) mine, host to the world's largest known rare earth element resource and located in inner Mongolia, produces some scandium. Other scandium sources are located in southern and central China, typically based off leach solution waste streams. China has additional potential scandium by-product sources from iron, tin, aluminium, and tungsten mining assets, located in a number of provinces.

- Russian production has traditionally come from scandium content in tailings from the Zheltye Zvoti mine in the Ukraine, formerly an iron and uranium underground mine, closed in the 1980s. Stockpiles of scandium oxide and Al-Sc 2% master alloy, from Russian strategic stockpiles built in the 1970s, continue to find their way onto commercial markets. UC RUSAL has recently announced their intent to construct a processing circuit at their Ural aluminium smelter facility to produce up to 2.5 tpy of scandium oxide from 'Red Mud' waste material, for use in alloys at that and other RUSAL aluminium facilities.

- Historic US and Canadian sources are very limited, and relate to historic fluorite and tantalum mining and processing facilities. Some (but not all) former tungsten mine tailings are known to contain potentially commercial amounts of scandium. Canadian REE projects are generally good candidates for scandium by-product recovery at the refining stage, and an early stage titanium / niobium project in Nebraska has additional scandium potential if developed.

- Australia has significant, large scale scandium resource potential in lateritic nickel and cobalt resources in the States of New South Wales and Queensland. Several potential scandium mining projects have been proposed, however there are currently no producing mines and no mines under construction. Certain other Asian lateritic nickel projects, specifically in Indonesia, the Philippines and New Caledonia, share this scandium by-product potential, but at lower scandium grades than the Australian targets.

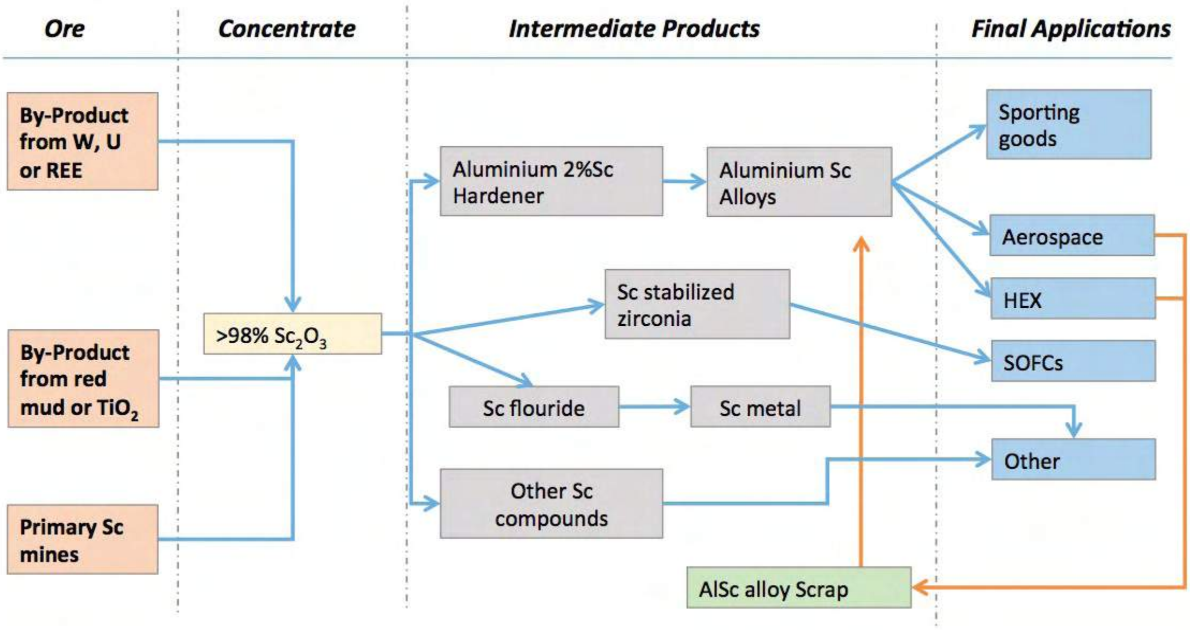
- Madagascar and Norway have potential scandium resources, uniquely occurring in pegmatite formations containing the mineral thortveitite. There are currently no operating or proposed scandium mines in Madagascar or Norway.

The challenges of multi-metal sources with respect to scandium bears some further discussion.

The Russian UC RUSAL Red Mud project (if built) will be the first to attempt to commercially extract scandium from Bayer Process waste streams formed in the bauxite refining process into alumina. This process is the most common one for refining bauxite globally, and it generates large volumes of waste material with low levels of numerous residual metals. Red mud tailings typically contain 50 to 110ppm scandium, but certain tailings locations show concentrations of 150ppm, depending on the mineralisation type and precise process route. The processes that essentially double the original concentration of scandium (typically 30 to 50ppm) also concentrate numerous other metals, specifically iron, aluminium and titanium, which are energy and process intensive to separate from scandium. Red muds also typically contain between 50 and 100ppm of uranium and thorium. Consequently, scandium recovery from these environmental legacy residues can be problematic, both as to technical and environmental challenges, as well as cost.

The multi-metal complexity issue tends to follow nickel / cobalt and niobium / titanium mineral deposits as well, where scandium is similarly in the 50 to 75ppm grade range. The process steps and refining parameters required to optimise recovery for the primary metals are not often the same as for scandium, forcing compromises on recoveries. Additionally, the size and scale of nickel / niobium / titanium projects is almost always large, and that can often create a mismatch for a scandium by-product circuit, either too small or too large to manage easily in the context of the principal target metal(s).

Figure 19.1 Simplified Scandium Value Chain Showing Actual and Potential Supply Routes



Source: CM Group, Adelaide, Australia

19.5 Scandium Market Pricing

There is no central quoted market price or clearing house for scandium today. Scandium oxide (and metal) sales take place between private parties at undisclosed prices. Quotes for oxide product are influenced by quality specification (grade), volumes required, availability through thin supply channels, and of course demand at any point in time.

Grade parameters are the single most important variant in oxide prices, for two reasons:

1. Quality upgrades are expensive and can negatively impact overall recoveries.

2. It is technically challenging to make higher purity product, and the capability to upgrade to very pure grades is not widely possessed.

High quality oxide is considered to be 99.9% grade or higher, as required for electrical applications. Aluminium alloy applications do not require this grade of oxide, and can be successfully manufactured from master alloy formed with scandia product grading 95 to 98%.

The nature of the trace contaminants also matters, with some being more problematic than others in specific applications. Radioactive elements, or metals that interfere with electrical applications in the case of SOFC's, are particular problems. Certain elements in very minute quantities can disrupt the surface quality of very thin rolled aluminium alloys.

These scandium oxide quality issues aside, discounts for lower grade product have greatly diminished in recent years, due to the tight supply for any grade of oxide product.

The published USGS Mineral Commodities data sheet has provided an influential reference in defining the apparent price for scandium oxide and scandium metal. The USGS posted prices were notoriously low in the 2008 to 2011 timeframe, as real market pricing during this period was demonstrated to be considerably higher. More recent USGS price estimates are consistent with current market experience. These estimates, as referenced below, are understood to be established by canvassing traders and specialty metals sellers annually for offered prices, and they represent small quantity sales only. They also tend to focus on highest quality product, rather than on commercially viable grades and forms.

Certainly, the Al-Sc 2% master alloy pricing is very relevant, as that is a 'manufacturing-ready', end-user form of scandium. In general terms, 1 kg of scandia can be converted into approximately 30 kg of 2% master alloy, so ignoring manufacturing costs, margins, material losses and technical capability, the 2% master alloy and scandia prices (99.99%) shown below are in rough balance for most years.

Table 19.1 USGS Historic Published Pricing for Various Scandium Products

USGS Pricing Statistics Scandium Products (US$)	Annual Estimated Pricing for Scandium Products				
	2011	**2012**	**2013**	**2014**	**2015**
Sc Oxide					
99.9% purity ($/kg)	**$3,700**	**$3,700**	**n/a**	**n/a**	**n/a**
99.99% purity ($/ kg)	**$4,700**	**$4,700**	**$5,000**	**$5,400**	**$5,100**
Sc Metal ($/gram)	**$100**	**$206**	**$213**	**$221**	**$221**
AL-Sc 2% Master Alloy ($/kg)	**$220**	**$220**	**$155**	**$386**	**$220**

Source: USGS Mineral Commodity Summaries, 2016, revised annually for scandium.

A call to Stanford Materials Corp., the US supplier referenced in the footnotes of the USGS Commodity Summary data sheet as a source of scandium quotations, confirmed (31 March 2016) the current oxide price for 1 kg of 99.5% grade product to be US$5,290 /kg, reasonably consistent with the price in the table above. A 10 kg order would reduce that price to US$4,920 /kg.

Current prices quoted on the Alibaba Group Holding Limited (HK) website (28 March 2016) for 99.9% to 99.99% grade oxide range from US$1,600 to US$3,500 (no duty paid), ex China chemical manufacturers, typically for 1 kg minimums. SCY initiated a purchase of a small quantity of <US$2,000 /kg oxide from a Chinese supplier working off this website in January, which has not been delivered as of the writing of this Report (four months).

This data supports a true oxide spot price, grading 99% to 99.9% ('two nines to three nines'), of around US$2,500 /kg today, recognising supplies are only available in limited quantities. Large quantity (tonnes) oxide pricing is not available, and only one long term sales contract is known to exist. That contract is between SCY and Alcereco, with a three-year term, 98.5% minimum grade scandium oxide, annual quantity of 7.5 t (7,500 kg), at an undisclosed price.

19.6 Scandium Applications

Two principal and potential high volume markets await a reliable and expanded supply of scandium. These two markets are:

1. SOFCs, which are very efficient electrical generation devices powered by a pure hydrogen source, or by re-formed natural gas / methane or more complex hydrogen sources.

2. Aluminium-Scandium alloys (Al-Sc alloys), superior performing variants of existing aluminium alloy types.

The principle advantages scandium delivers in these two market applications are:

- **SOFCs** – Scandium promotes critical and desired electro-chemical reactions at lower temperatures, which substantially extends the commercial life of the unit, avoids higher cost materials for containment, and increases electrical power output over competing materials.

- **Aluminium Alloys** – Scandium adds strength while preserving desirable properties in aluminium alloys. Scandium additions promote grain refinement, while retaining desirable superplasticity (ductility), and make alloys more responsive to precipitation hardening techniques. These effects increase the strength of almost all aluminium alloys, and substantially increase the strength of certain alloys. Scandium delivers this strength improvement while preserving/improving both corrosion resistance and weldability in specific aluminium alloys where it already exists.

Other commercial applications for scandium include doping of ceramics for increased hardness, applications in electrical devices that include laser parts and computer switches, mercury vapour high intensity lighting, and TV / digital displays.

19.7 Scandium Markets

The SOFC market is an emerging market with a revolutionary technology for efficient, clean, distributed electrical power. While the global power market is enormous, the application for this form of generation is particularly suited to certain power needs, such as ultra-high reliability requirement users, Direct Current (DC) demand, and off-grid users. Stationary power applications are commercial now, and the industry leader (Bloom Energy) is poised to meet rapid adoption. This market represents an immediate customer for reliable scandium supply in the short term, with very good growth potential over time, across global markets.

The global aluminium industry produced 58 Mt of primary metal in 2015, making it a US$100bn a year marketplace, not counting remelt and recycle sources -which are significant. Most aluminium sold today is alloyed with other metals in some form or another to promote improved material characteristics, particularly strength, and those alloys sell for two to four times the price of primary metal, making the market even larger. Aluminium alloys rival iron ore as the largest globally traded metal-containing commodity, and is ubiquitous in the manufacturing marketplace. Scandium represents a well-known additive in this alloy mix, and has application in all manner of construction, transport, aerospace, marine, and tubing markets. Scandium additions also show promise across all forms of aluminium products: wrought (sheet / plate), extruded forms, and cast systems. These alloy markets are already highly developed, as aluminium is widely accepted and integrated into products used today. Scandium's benefits will enable engineers to employ better alloy properties to existing applications and build higher performance products, within existing design and tooling parameters.

19.8 Scandium Market Forecast – Demand and Price

The demand for scandium will not be empirically evidenced until there is an adequate supply of scandium available for trade on world markets. Pricing will matter as well. Products will absorb the cost of scandium in aluminium alloys in different ways and to a different cost tolerance. The aircraft industry will likely be the most price insensitive application, even at low oil prices, but more so at high fuel cost levels. Other aluminium alloy applications will not see enough benefits from improved properties to justify added cost, and will see little scandium alloy take-up.

SCY commissioned an independent metals marketing group, CM Group of Adelaide, Australia, to provide a ten year scandia demand estimate and associated price forecast. The study, entitled *"The 10 Year Outlook for the Global Scandium Market to 2026*", was received by SCY in March 2016. The CM Group has experience in commodities research and market development studies, having previously done independent long-term market studies for magnesium, aluminium and tungsten, among other market analyses. The CM Group has historical ties to the aluminium industry worldwide. The detailed CM Group document is considered confidential, as it contains specific market strategy information, and will not be made publicly available. That noted, the outlook was commissioned in part to independently inform this feasibility study on future scandium price assumptions. Key findings in the CM Group research as they relate to scandium demand estimates and price forecasts, are as follows:

- The aluminium industry is generally aware of scandium and its significant positive influence on the properties of most aluminium alloys.

- The transportation sector, specifically aerospace, is likely to be a key demand source for scandium, although the SOFC market will also be important, as will other alloy applications.

- The global scandium market is expected to exceed 100 tpy by 2021 and to approach 180 tpy in the 10 year timeframe from 2016 to 2026. This growth forecast represents a 27% compound annual growth rate (CAGR) for the scandium market over the next ten years.

- Scandium pricing will depend somewhat on the realisation of supply growth, the timing of that growth, and the adoption rate of customers and industry segments to scandium alloys.

- The most likely case pricing scenario supports a current US$2,500 /kg scandia price today, with a downwards drift to US$2,000 /kg by 2020, followed by a drift back up to US$2,500 /kg by 2026.

- High and low pricing scenarios were also outlined. Their pricing estimates average approximately US$3,000 /kg and US$1,500 /kg over the ten year time frame.

- Both alternate scenarios assume a number of potential primary and secondary co-product supply sources come on line in the next three to four years, but the demand trends either ramp up faster than forecast or are delayed and develop more slowly. The low price / low demand scenario settles above US$1,500 /kg by 2022, based on product prices set by the highest cost, co-product supply sources.

19.9 Scandium Price Assumptions

This economic analysis for the Nyngan Project development contains an average US$2,000 /kg scandia price assumption, over all 20 years, covering various grades of product offered from 97% to 99.9%. This price assumption is supported by the pricing outlook supplied by CM Group, by a wide ranging set of discussions that SCY has had with interested customers over several years, and by evidence of a three year sales contract with an independent third party for 7.5 tpy of scandia, starting with project start-up in 2018. The existing off-take is with Alcereco (Kingston, Ontario), who is a knowledgeable alloy and master alloy manufacturer. SCY also has a formal strategic alliance with Alcereco, supported by a Memo of Understanding (MOU) and an addendum to that initial agreement specifically indicating the parties are actively building scandium markets for future sales agreements. The price on the off-take agreement has not been disclosed and is considered confidential by the parties.

The assumed scandia pricing level of US$2,000 /kg, applied to the economics of this feasibility study, is understood to enable scandium to bring value to both the SOFC and Al-Sc markets for customers.

The QP for Lycopodium has read both the CM Group *10 Year Scandium Global Outlook* document and the SCY / Alcereco 2015 off-take agreement, and notes that the statements made in this marketing summary are fully consistent with those documents, and is supportive of the scandium oxide price assumption in this feasibility study.

20.0 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

20.1 Summary of Result of Environmental Studies

20.1.1 Introduction

R.W. Corkery & Co Pty Limited (RWC) completed an Environmental Impact Statement (EIS) in April 2016, on behalf of EMC-A (the Applicant). This EIS supports an application for Development Consent for the Nyngan Scandium Project, and was submitted to the Department of Planning and Environment on 29 April 2016. The EIS, accompanied by a Specialist Consultants Study Compendium, will receive a compulsory adequacy review by Department staff and other relevant government agencies, as a condition to formal acceptance and public availability.

The EIS, and ultimately the granting of a Development Consent, forms a key part of a successful mining license application (MLA) to the NSW Division of Resources and Energy (Department of Industry), requesting permission to develop the Nyngan Scandium Project (the Proposal).

The EIS document was prepared with the assistance of the following specialist environmental and engineering consultants:

- Air Quality and Greenhouse Gas – Ramboll Environ Australia.
- Biodiversity – EnviroKey.
- Water, Rock and Surface Water – Knight Piésold.
- Groundwater – Ground Doctor.
- Noise – Spectrum Acoustics.
- Traffic – Constructive Solutions.
- Heritage – Artefact Heritage Services.
- Soils – Strategic Environmental and Engineering Consultants.

The following presents a brief overview of the results of those studies.

20.1.2 Air Quality

Ramboll Environ (2016) determined that no predicted particulate matter concentration or deposition result would exceed criteria at any residences as a result of the Proposal, and that that the Proposal would not result in significant greenhouse gas impacts. Furthermore, taking into consideration the Applicant's commitment to install a range of emission control devices to ensure compliance with the NSW Clean Air Regulations, Ramboll Environ (2016) determined that the Proposal would not result in adverse air quality impacts associated with the proposed processing operations.

20.1.3 Biodiversity

The Proposal would result in the disturbance of approximately:

- 9.3 ha of Poplar Box – Gum-barked Coolibah – White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion vegetation community.
- 135.7 ha of disturbed land used for cropping activities.

EnviroKey (2016) undertook an assessment of the impacts associated with the disturbance of this vegetation, and determined that the Proposal would not have a significant impact upon this community, as it is well represented in the immediate area.

EnviroKey (2016) further identified that:

- Five species listed under the TSC Act have the potential to occur within the Project Site.
- One protected species listed under the EPBC Act has the potential to occur within the Project Site.

EnviroKey (2016) undertook significance assessments for each of these species and determined that, with the implementation of management and mitigation measures, the Proposal would be unlikely to have a significant impact on any identified species.

The Applicant would implement a Biodiversity Offset Strategy to offset vegetation clearing impacts, including a proposed 64 ha Biodiversity Offset Area. EnviroKey (2016) concluded that the proposed Biodiversity Offset Strategy would be consistent with the Office of Environment and Heritage’s offsetting principles.

20.1.4 Surface Water

Knight Piésold (2016c) undertook an assessment of the hydrology of the Project Site and surrounds. In particular, the assessment focused on the potential for flooding associated with Whitbarrow Creek, located to the south of the Project Site. The assessment considered both a 1% (1 in 100 year) and 0.1% (1 in 1000 year) Annual Exceedance Probability (AEP) Storm.

Knight Piésold (2016c) determined that the maximum flood height under a 0.1% AEP event in the vicinity of the Processing Plant / Residue Storage Facility Area and the open cuts would be approximately 185.2 m AHD and 184.5 m AHD respectively. As a result; the Applicant proposes to construct levee bunds around the Processing Plant / Residue Storage Facility Area and open cuts of 186.6 m AHD and 185.6 m AHD respectively, or more than 1 m higher than the anticipated 0.1% AEP flood level.

In addition, all water with the potential to contain processing chemicals or salt would be retained within the Project Site under all circumstances. Water with the potential to contain suspended sediment only would, if required to be discharged, be tested prior to being irrigated to the surrounding land.

As a result, no adverse surface water impacts are anticipated.

20.1.5 Groundwater

Impax (2016) determined that the groundwater within the Project Site would not be suitable for any common beneficial use without prior treatment due to high salinity. Impax (2016) also determined that the Proposal is not anticipated to result in groundwater drawdown at any surrounding groundwater bores or drainage lines.

20.1.6 Noise

Operational and transport noise generated by the Proposal would, assuming the implementation of the nominated safeguards and controls, not exceed the relevant criteria at any privately-owned residence.

20.1.7 Traffic and Transportation

The Site Access Road and the intersection with Gilgai Road would be constructed to a standard suitable for all vehicles expected to access the Project Site (indicatively up to B-double size). Constructive Solutions (2016) state that the level crossing over the Nyngan to Cobar Railway and the intersection with the Barrier Highway are adequate for the proposed traffic movements. Finally, the proposed additional traffic movements would not result in the surrounding roads reaching or approaching their capacity/

As a result, the Proposal would not result in additional adverse traffic-related impacts.

20.1.8 Aboriginal and Historic Heritage

No sites of Aboriginal or historic heritage significance were identified within the Project Site.

20.1.9 Visual Amenity

Based on relative isolation of the Project Site and the proposed landscape and visual amenity related controls, the Proposal would not impact significantly on local visual amenity.

20.1.10 Soils and Capability

Given the establishment of soil management procedures and safeguards, the Proposal would result in significant soil and land capability impacts.

20.1.11 Other Impacts

Bushfire and agricultural impacts associated with the Proposal would be negligible.

20.2 Environmental Management Plans

The following Environmental Management Plans will be required to be prepared prior to the commencement of operations:

- Mining Operations Plan / Rehabilitation Management Plan.
- Environmental Management Strategy.
- Water and Flooding Management Plan.
- Noise Management Plan.
- Air Quality and Emissions Management Plan.
- Biodiversity Offset Strategy.
- Biodiversity Management Plan.
- Transport Management Plan.
- Pollution Incident and Response Management Plan.

20.3 Project Permitting Requirements

The Proposal would require Development Consent from the Minister for Planning and Environment and under Division 4.1 of the *Environmental Planning and Assessment Act 1979*. In addition, the following licences, leases, permits, agreements and approvals would be required to allow commencement of the Proposal:

- An Environment Protection Licence issued by the Environment Protection Authority (EPA) under Section 47 of the *Protection of the Environment Operations Act 1997*.
- A Mining Lease issued by the Department of Trade and Investment – Division of Resources and Energy (DRE) under the *Mining Act 1992*. The Applicant currently holds EL8316, ELA5232 and EL6096 over the Project Site and will submit a Mining Lease Application (MLA).
- Water Supply Works and Use Approval and Water Access Licence issued by the DPI – Water under the *Water Management Act 2000* for incidental water intersected by the proposed open cuts. The Water Access Licence must be consistent with the Water Sharing Plan for the Macquarie Bogan Unregulated and Alluvial Water Sources.

- A Section 138 Permit issued by the Bogan Shire Council under the *Roads Act 1993*, for construction of the intersection of the Site Access Road and Gilgai Road.

- An approval from the NSW Dams Safety Committee for the design and construction of the Residue Storage Facility, Evaporation Pond and External Decant Pond.

- A high voltage connection agreement with Essential Energy which holds an electricity distributor's licence under the *Electricity Supply Act 1995*.

Following receipt of development consent, the Applicant would also seek the necessary approvals / construction certificates from Bogan Shire Council for the construction of buildings, structures, and appropriate waste water treatment systems for the Proposal.

20.4 Social and Community Relationships

20.4.1 Community Consultation

The following information describes the consultation undertaken by the Applicant with the local and surrounding landholders.

20.4.2 Consultation with Neighbouring Landholders

The Applicant has undertaken a long-term program of consultation with surrounding landholders since the Applicant first became associated with the project in early 2010, including one-on-one meetings and informal conversations on site and via telephone. In addition, all neighbouring landholders were provided with a private briefing during the final stages of preparation of the EIS, with all comments incorporated into the final version of that document

20.4.3 Consultation with the Wider Community

The Applicant held a community meeting at the Nyngan RSL on 7 December 2015. The meeting was attended by approximately 15 residents of Nyngan. Mr George Putnam, President, CEO and Director of the Applicant, provided an overview of the Proposal and opened the floor for general questions and discussion. The attendees asked a number of questions in relation to the processing methodology and likely employment and business opportunities associated with the Proposal. The general consensus of the attendees was that the Proposal would provide much needed employment and economic activity. One attendee made the comment that the residents of Nyngan and surrounding areas are familiar with mining operations as many rely on the existing Tritton Copper Mine for part time employment and off-farm income.

20.5 Government Agency Consultation

20.5.1 Introduction

Both formal and informal consultation was undertaken with a range of government agencies at State and local levels throughout the preparation of this document. The following subsections provide an overview of government agency consultation in formalised meetings and throughout the ongoing development of the Proposal.

20.5.2 Conceptual Project Development Plan Meeting

A Conceptual Project Development Plan Meeting was held with the Department of Trade and Investment Division of Resources and Energy (DRE), on 31 January 2012. At that meeting, the viability of a scandium mine, potential markets, the identified resources and the Proposal, as it was then understood, were presented. As a result of that meeting, DRE agreed to support the Proposal moving to the development application phase and advised the Department of Planning and Environment that formal government agency consultation could commence.

20.5.3 Planning Focus Meeting

A Planning focus meeting was held for the Proposal on 21 February 2012 with the following government agencies in attendance:

- NSW Trade and Investment (now Division of Resources and Energy).
- Bogan Shire Council.
- DPI Crown Lands.
- NSW Office of Water (now DPI Water).
- Environment Protection Authority.

During the meeting, an overview of the Proposal, as it was then understood, was presented and attendees inspected the Project Site. Following the site inspection, the attending government agencies present verbally outlined the issues from their perspectives that the Environmental Impact Statement should address. A number of these issues and others (including submissions by the government agencies who couldn't attend the Planning Focus Meeting) were subsequently provided to the then Department of Planning and Infrastructure in writing to assist in the formulation of the Director-General's Requirements which were provided on 19 March 2012.

20.5.4 Revised Secretary's Environmental Assessment Requirements

The 2012 Director-General's Requirements identified that should an application for Development Consent not be submitted with two years of the date of the requirements, namely by 19 March 2014, that further consultation should be undertaken. As a result, the following agencies were provided with a description of the Proposal and were requested to provide agency requirements to be included in the Secretary's Environmental Assessment Requirements (SEARs). The date of the relevant correspondence is presented in brackets:

- Department of Planning and Environment (31 October 2014).
- Roads and Maritime Services (20 November 2014).
- Bogan Shire Council (20 November 2014).
- DPI-Water (then NSW Office of Water) (4 November 2014).
- Environmental Protection Authority (4 November 2014).
- DRE (4 November 2014).
- Crown Lands (4 November 2014).
- Office of Environment and Heritage (28 November 2014).

The SEARs were provided by DP&E on 17 September 2015. A full copy of the SEARs is presented in Appendix 2 of the EIS.

20.6 Mine Closure Requirements

20.6.1 Introduction

The Applicant notes that based on the identified resource and the proposed production rate, sufficient resources exist for 180 years of mining operations. Notwithstanding this, however, rehabilitation of all areas to be disturbed would be an integral part of the Proposal. Emphasis would be placed upon progressively creating the final landform, re-establishing soil profiles and vegetation essential to achieving the preferred land uses.

Rehabilitation activities would be planned and undertaken in accordance with a Mining Operations Plan (MOP) to be submitted to the DRE and approved following the issue of development consent and prior to the commencement of on-site activities. The MOP would also address any rehabilitation-related requirements nominated in the Development Consent for the Proposal.

In addition to the rehabilitation commitments in the EIS, rehabilitation would be planned and undertaken with reference to the following documentation:

- Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth Government, 2006).
- Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth Government, 2006).

- Strategic Framework for Mine Closure (ANZMEC, 2000).

20.6.2 Rehabilitation Objectives

In the short term, the Applicant's objectives would be to stabilise all earthworks and disturbed areas no longer required for Proposal-related activities. In particular, emphasis would be placed on shaping and stabilising the outer face of the levee bund and elevated haul road to minimise the potential for erosion of these structures and associated sedimentation.

The Applicant's longer term rehabilitation objectives are to ensure that:

- The rehabilitated landform is safe, stable, non-polluting and suitable for the identified long-term final land uses
- Suitable vegetation is established on the final landform, taking into account the proposed final land use
- The rehabilitated landform requires levels of maintenance commensurate with surrounding land
- Rehabilitation is undertaken in an efficient and economically sustainable manner
- The mining lease(s) over the rehabilitated landform can be relinquished and the security returned within a reasonable time after the completion of all mining and rehabilitation activities.

Final Landform

The final landform would comprise the following:

- Two bunded and fenced open cuts within a larger borrow pit.
- A free draining, covered Residue Storage Facility.
- A generally flat Processing Plant Area with all infrastructure not required for the final land use, including the levee bunds, removed.
- Two water storage dams, namely the Event Pond and Sediment Pond 1, with all other water storages removed.
- A site access road.

20.6.3 Final Land Use

The Applicant proposes the following final land uses for the Project Site. These land uses are permissible without further consent under the *Bogan Local Environment Plan 2011.*

- Residue Storage Facility – nature conservation (grassland)

  As the establishment of deep rooted vegetation on the facility could potentially adversely impact on the impermeable cap for the facility, the Applicant would establish a native grassland community on the final landform.

- Open cuts – water storage / final void and nature conservation (woodland)

  As backfilling of the final voids would sterilise surrounding resource, the Applicant proposes to use the final open cut voids for water storage or simply retain the open cuts as bunded voids to facilitate future mining operations.

- Borrow Pit – nature conservation (woodland)

  The generally flat floor and side slopes of the Borrow Pit would be rehabilitated to achieve a native woodland consistent with the existing native vegetation within the Project Site, namely Benson ID 103 – Poplar Box – Gum Coolabah and White Cypress Pine Shrubby Woodland mainly in the Cobar Peneplain Bioregion. The walls of the Borrow Pit would be shaped to be stable in the long term. The Final Levee Bunds would remain in place.

- Event Pond and Sediment Pond – Water storage

  The Event and Sediment Ponds would be retained as agricultural dams.

- Processing Plant Area – Agriculture

  The Processing Plant Area would be returned to the existing land use, namely agriculture.

Finally, a range of alternative post-mining land uses for the Project Site have been considered. Each of these require further development consent or approval under the *Bogan Local Environment Plan 2011* following the completion of mining and processing operations.

- Solar farm

  The Applicant notes that the Nyngan Solar Plant received development consent on 15 July 2013, with construction completed in mid-2015. As the Project Site would include large flat disturbed areas and power transmission infrastructure, potential exists for a similar facility to be constructed within the Project Site.

- Manufacturing facility

  Potential exists for an industrial manufacturing facility that would require separation from surrounding residential receivers while having good access to power, water and transportation. Examples may include chemical manufacturing plants or explosive manufacturing or storage plants.

- Intensive agriculture

  Potential exists for an intensive agricultural operation that would require warm to hot conditions, access to water and relatively easy access to markets to be established.

21.0 CAPITAL AND OPERATING COSTS

21.1 Capital and Operating Costs - Overview

Total initial capital cost for the project is estimated at US$87.1M. This spend level is envisioned to be completed on a 12 month schedule, commencing and completing in 2017. Minor amounts of engineering capital included in this estimate will need to be spent by the project owner in late 2016, in order to meet this timetable with regard to longer lead-time items. The capital cost estimate is summarised in Table 21.1.

Table 21.1 Total Project Initial Capital Cost

Nyngan Project Capital Cost Summary (millions)	Initial Project Capital Cost (US$M)
Mining Capital	
Pre-Stripping Cost	$1.72
Vehicles/Site Equipment	$1.26
Mining Subtotal	$2.98
Processing Plant Capital	
Process Plant Mechanicals	$40.96
Site Infrastructure	$25.95
Construction Costs	$3.91
EPCM Costs	$10.41
Owners Costs	$2.93
Process Plant Subtotal	$84.16
Total Project Capital Cost	$87.14

Project economics were modelled over 21 periods, with construction in period one, and operations planned over the next 20 years.

Mining activity was scheduled quarterly for five years, annually thereafter. The overall project throughput followed the mine plan, which generated yearly individual estimates of waste removal tonnes, annual mined tonnes delivered to the plant, and individual resource scandium grades based on resource modelling, by year.

Plant operating costs followed the individual mining tonnage throughput schedule, and estimated cost based on fixed and variable components. The fixed cost component represented an annual cost, regardless of plant throughput, while the variable component flexed the annual spend to reflect variable plant throughput levels.

These annual variables generate unique cost figures for each year of the 20 year project life, meaning no two years are alike. As a result, the presentation of annual spend and unit cost figures have been 'annualised' over the 20 year operating timeframe, in order to show a life-of-mine representative annual cost perspective.

The average annual operating cost estimate is summarised in Table 21.2.

Table 21.2 Total Project Average Annual Operating Cost

Nyngan Project Operating Cost Summary (millions)	Average Annual OpEx (US$M)	Average Unit Cost (US$/tonne)
Mining Expense		
Waste Removal Cost	$0.54	$7.49
Mining Cost	$0.79	$10.96
Mining Subtotal	$1.33	$18.45
Processing Expense		
Plant Fixed Cost	$8.05	$112.07
Plant Variable Cost	$10.29	$143.27
Tailings Pond Cost	$1.12	$15.60
Other General Costs	$0.19	$2.71
Process Plant Subtotal	$19.65	$273.65
Total Project Operating Cost	$20.98	$292.10
NOTE: Unit volumes based on mill feed quantities of resource. Does not include capitalized pre-strip waste.		

21.2 Mining - Capital Cost Detail

Overburden removal and resource mining for mill feed will be undertaken by a contract miner, who will supply all necessary operators and mining equipment to safely excavate the two pits. Pit dewatering will be maintained by pumping from the pit void, requiring a pump, a lighting plant, and pipework as capital items. Table 21.3 provides an overview of the mining capital:

Table 21.3 Life of Mine Mining Capital

Nyngan Project Mining Capital Cost Detail (US$)	2017 Year 0	2020 Year 3	2023 year 6	2028 Year 11	2033 Year 16
Pre-Strip Waste	$1,714,626				
Pump Equipment (dewater)	$42,000			$42,000	
Piping - West Pit	$28,000		$7,000	$7,000	$7,000
Piping - East Pit		$14,000	$7,000	$7,000	$7,000
Total Mining Capital	$1,784,626	$14,000	$14,000	$56,000	$14,000

21.3 Mining - Operating Cost Detail

The mining operation is very small, as the plant feed requirement is only 75,000 t of resource per year. Strip ratios are also modest (3.5 average), resulting in relatively low overburden removal requirements. Both overburden and resource mining will be free-dig, and will not require blasting. Annual overall mining costs do vary however, as the stripping ratio on a year to year basis fluctuates.

This mining will be conducted on a campaign basis, expected to be two or three times per year, with the mining contractor on site on an as-required basis. The length of each campaign will be dictated by the scheduled material quantities, but will typically be of a one month duration.

A preliminary tender was conducted to establish the cost of a full service bid from a local contractor. This established a rise and run matrix for the operation. Overall mining costs varied with both overburden requirements and also with depth from surface.

Table 21.4 Mining Unit Cost Detail

Nyngan Project Mining Unit Cost Detail (US$/tonne)	Average Unit Cost For All Mined Tonnes	Average Unit Cost Per Mill Feed Tonne
Waste Removal Cost	$5.25	$7.49
Mine & Haul Cost	$3.59	$5.12
Ancilliary Costs	$1.08	$1.53
Fixed Costs	$3.04	$4.31
Total Unit Mining Cost	$12.96	$18.45
NOTE: Mined tonnes includes stockpiled low grade resource, mill feed tonnes are processed tonnes. Does not include pre-strip waste.		

In addition to mining resource for mill feed, there is a significant requirement for infrastructure construction material. This need, combined with the initial stripping required to access resource mill feed, results in significant stripping during the early years of the project, significantly increasing overall mining costs during these years.

21.4 Process Plant & Infrastructure Capital Cost Detail

21.4.1 Introduction

The Nyngan Scandium Project is a relatively small development project by mining standards. Whilst the processing facility will typically process only 75,000 tpa of ore, it is relatively technically sophisticated. The plant contains a large number of process stages and reagent inputs, processes hot and acidic liquid / solid solutions, has notable high pressure circuits, and consequently will require a number of high grade materials of construction. Accordingly, the capital cost intensity ($/tpa throughput) can be expected to be significantly higher for this plant than other larger, less complex mineral processing operations.

21.4.2 Initial Plant Capital Cost

The initial capital cost for the process plant and infrastructure components of the project (including owner's costs) has been estimated at US$84.16M. This figure is summarised by area and by discipline in Tables 21.5 and 21.6.

Table 21.5 Process Plant and Infrastructure Initial Capital Cost (by Area)

Nyngan Project Process Plant Capital Detail (US$M))	Direct Capital Cost (US$M)	Contingency (US$M)	Total Initial Capital Cost (US$M)
Construction indirects	$3.50	$0.40	$3.90
Treatment Circuit/Plant	$36.48	$4.12	$40.60
Reagents & Plant Services	$12.37	$1.22	$13.59
Infrastructure	$11.42	$1.30	$12.72
EPCM Cost	$9.46	$0.95	$10.41
Owner's Cost	$2.79	$0.14	$2.93
Total Plant Capital Cost	$76.03	$8.13	$84.16

Table 21.6 Process Plant and Infrastructure Initial Capital Cost (by Discipline)

Nyngan Project Process Plant Capital Detail (US$M))	Direct Capital Cost (US$M)	Contingency (US$M)	Total Initial Capital Cost (US$M)
General	$2.31	$0.13	$2.44
Earthworks	$4.46	$0.67	$5.13
Concrete	$4.37	$0.52	$4.90
Steel & Plateworks	$5.17	$0.59	$5.75
Mechanical	$27.35	$2.88	$30.23
Piping	$8.41	$1.24	$9.64
Electrical & instrumentation	$8.66	$0.72	$9.38
Buildings	$3.23	$0.32	$3.55
Indirects	$9.28	$0.93	$10.21
Owners Costs	$2.79	$0.14	$2.93
Plant Capital Total	$76.03	$8.13	$84.16

21.4.3 Future Plant Costs – Capital and Expense

Sustaining process plant and infrastructure costs on the project (including owner's costs) are primarily related to recurring expenditure on the residue storage facility (tailings pond). These costs, over 20 years, total US$22.4M. This work is predominantly associated with the ongoing expansion of the residue storage facility, which requires capacity increases in 18 future stages (Stages 2 to 19), over planned the 20 year life of the project.

These ongoing operational costs are treated in the financial model as annual expenses. As the residue storage facility never exceeds a three year capacity relative to the project plan, the costs can be expensed annually as incurred, and are shown as part of annual costs. The initial cost of building the residue storage facility is capitalised and shown as capital in the initial capital estimate.

Apart from the earthworks cost associated with the periodic expansion of the residue storage facility, expenditure is included for decant pumps and associated pipes, power etc. for the second cell of the residue storage facility in 2020, also expensed, and a deferred purchase of an additional water licence (capital item), also planned for 2020.

Future capital costs are summarised by stage in Table 21.7.

Table 21.7 Residual Storage Facility Expansion Expense (by Year / Stage)

Residual Storage Facility Spend	2017 Year 0	2018 Year 1	2019 Year 2	2020 Year 3	2021 Year 4	2022 Year 5	2023 Year 6	2024 Year 7	2025 Year 8	2026 Year 9	2027 Year 10
(US$ M)	CapEx		Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8	Stage 9	Stage 10
Pond Spend	$2.00		$0.61	$1.66	$0.55	$0.49	$0.54	$0.78	$0.27	$0.61	$1.46
Surface Water Mgm't											$0.38
2nd Water License				$0.43							
Subtotal	$2.00	$0.00	$0.61	$2.09	$0.55	$0.49	$0.54	$0.78	$0.27	$0.61	$1.84
Contingency	$0.40		$0.08	$0.25	$0.08	$0.07	$0.08	$0.11	$0.03	$0.08	$0.27
Total Annual Spend	$2.40	$0.00	$0.69	$2.34	$0.62	$0.56	$0.61	$0.89	$0.31	$0.69	$2.10

Residual Storage Facility spend	2028 Year 11	2029 Year 12	2030 Year 13	2031 Year 14	2032 Year 15	2033 Year 16	2034 Year 17	2035 Year 18	2036 Year 19	2037 Year 20	20 Year Total
(US$ M)	Stage 11	Stage 12	Stage 13	Stage 14	Stage 15	Stage 16	Stage 17	Stage 18	Stage 19		
Pond Spend	$0.31	$2.34	$0.29	$2.47	$0.30	$2.46	$0.29	$3.44	$0.36		$19.23
Surface Water Mgm't											$0.38
2nd Water License											$0.43
Subtotal	$0.31	$2.34	$0.29	$2.47	$0.30	$2.46	$0.29	$3.44	$0.36	$0.00	$20.04
Contingency	$0.04	$0.34	$0.04	$0.36	$0.04	$0.36	$0.04	$0.50	$0.05		$2.80
Total Annual Spend	$0.35	$2.68	$0.33	$2.83	$0.34	$2.82	$0.33	$3.95	$0.41	$0.00	$22.85

21.4.4 Closure Capital Cost

At the end of the 20 year planned operation of the project, should the project not continue, the site and facilities would need to be reclaimed. With respect to the residue storage facility, which has in all likelihood reached its practical terminal size at 20 years, it will be necessary to carry out rehabilitation works on that facility. These works include:

- Shaping the upper surface of the facility to form a domed, free draining structure, once the contents are sufficiently dry.
- Installation of a HDPE liner over the shaped landform to prevent infiltration of water into the residue pile.

- Covering the liner with at least one metre of overburden.

No allowance has been made for closure costs of the process plant and remaining infrastructure components as it is likely that the plant will continue to operate beyond 20 years. There will also be some salvage value for components of the process plant that will offset significant portions of any process plant closure costs.

The total closure capital cost estimate for the process plant and infrastructure components of the project is US$5.1M, including contingency of US$0.6M.

21.4.5 Capital Cost Basis of Estimate

Base Currency and Estimate Base Date

All capital cost estimates are presented in United States Dollars (US$) with a base date of first quarter 2016 (1Q16) unless otherwise noted.

No allowance has been made for escalation between the estimate base date and the time at which commitments will actually be incurred, and payments made.

Estimate Class and Accuracy

The estimate has been prepared in accordance with Lycopodium's requirements for a Class 2 definitive feasibility study estimate.

The accuracy range for the estimate is +15% / -5%.

Qualifications and Assumptions

The following general qualifications and assumptions have been made in assembling the capital cost estimate for the process plant and infrastructure components:

- The Capital Cost Estimate (CCE) has been based on the implementation of an EPCM contracting strategy.

- Where the mine plan accommodates the use of overburden material for the construction of the residue storage facility, levee banks and roads, the cost of winning the material from the mine and hauling to the required site is covered in the mining costs. The costs to dump, move, and compact the material is included in the process plant and infrastructure costs.

- No dedicated construction camp will be provided for the project. Construction workers will be accommodated in Nyngan or will make use of the currently unused construction camp (built for the recently constructed AGL Nyngan Solar Plant). Rates for site work are inclusive of transport, accommodation and meals for the workforce.

- No dedicated operations camp will be provided for the project. Operating personnel will be accommodated in the Nyngan township.

- There is no allowance for unforeseen blasting and excavation of rock in the bulk earthworks.

Exclusions

The following items are excluded from the capital cost estimate:

- Sunk costs, including prior testwork, drilling, land acquisition and studies.

- Any upgrade to the existing intersection between Gilgai Road and the Barrier Highway, or any upgrade works to any other public roads.

- Escalation.

- Working capital, (which is included in cash flow estimates).

- Financing costs or interest costs during construction.

- Exchange rate variations.

- Australian Goods and Services Tax (GST).

Estimating Methodology

The capital cost estimate has been prepared and based on an EPCM contract execution strategy. An EPCM contractor will be engaged to complete all detailed engineering for the process plant and infrastructure, as well as manage the procurement of all equipment and off-site fabrication, and all on-site installation works.

Major site contracts will include:

- Earthworks (likely to be combined with mining pre-strip works).

- Concrete (including supply of all formwork, reinforcement, cast-in items and concrete batching plant).

- SMP installation (including installation of fabricated steelwork, fabricated platework, proprietary mechanical equipment and valves, and the supply and installation of pipework including insulation).

- E&I installation (including installation of proprietary electrical equipment and instruments, and the supply and installation of cables from HV to control).

- Prefabricated buildings (detailed design, supply and install).

The estimate has been prepared and based on the following key documentation:

- Process flow diagrams.
- HPAL area P&IDs.
- Mechanical equipment list.
- General process plant layout drawings.

Engineering Status

The design status varies across plant areas due to the level of detail available and actual design work undertaken. The design has utilised recently completed facility designs from other like projects and studies, and modified construction and as-built drawings of past project facilities. The level of design carried out varies from initial concept drawings through to reconfiguration of existing plant layouts and quantity take-offs generated specifically for this project.

Equipment sizes and materials of construction are as documented in the mechanical equipment list, and have been designed to suit the mass balance and process design criteria, while utilising information from previous similar plants where possible.

Estimate Methods of Calculation

Capital costs for the process plant and infrastructure area were compiled using the methods of calculation described in Table 21.8.

Table 21.8 Capital Cost Methods of Calculation

Discipline	Sub Items	Method
Earthworks – RSF, Ponds & Roads	Quantities	Derived by Knight Piésold based on preliminary designs for all structures.
	Unit Rates	Sourced from local contractors by Knight Piésold based on preliminary quantities for this project. Note that cost for excavation and haulage of mining pre-strip material is included in the mining costs.
Earthworks – Process Plant	Quantities	Quantities for bulk earthworks derived from plant layout. Detailed earthworks for foundations are included in concrete costs.
	Unit Rates	Rates as determined by Knight Piésold used for similar earthworks. Additional mobilisation costs allowed for potential advanced schedule requirements.

Discipline	Sub Items	Method
Concrete	Quantities	Quantities derived by area based on area layout and referencing against previous similar projects. Site geotechnical information indicates no special foundation requirements are necessary.
	Unit Rates	Rates sourced from multiple local and regional contractors based on preliminary quantities for this project. Rates are inclusive of detailed excavation, formwork, reinforcing steel, batching, placement, and surface finish. Separate rates provided for items such as pre-cast sumps, cast-in platework, concrete surface protection etc.
Steelwork	Quantities	Quantities derived by area based on preliminary structural designs or previous similar projects.
	Supply Rates	Supply rates sourced from multiple local and regional contractors (Australian) based on preliminary quantities for this project. Rates are inclusive of workshop detailing, supply, fabrication, painting and packaging onto transport.
	Install Rates	Install rates sourced from multiple local and regional contractors based on preliminary quantities for this project. Quoted installation hours normalised against Lycopodium database hours to determine productivity factor.
Platework	Quantities	Platework quantities for tanks based on preliminary design datasheet for each tank using sizing from the mechanical equipment list. Minor platework quantities estimated per item.
	Supply Rates	Supply rates sourced from multiple local and regional contractors (Australian) based on preliminary quantities for this project. Rates are inclusive of workshop detailing, supply, fabrication, painting and packaging onto transport.
	Install Rates	Install rates sourced from multiple local and regional contractors based on preliminary quantities for this project. Installation hours obtained for both site erected and shop fabricated tanks.

Discipline	Sub Items	Method
Mechanical Equipment	Supply Costs – Major Equipment	Multiple budget pricing received from international vendors against datasheets developed specifically for the project. Pricing provided and compiled using native currencies. Preliminary evaluation conducted to select appropriate vendor (not necessarily lowest).
	Supply Costs – Minor Equipment	Minor equipment pricing obtained from Lycopodium database of previous project orders for similar equipment.
	Install Costs	Labour rates sourced from multiple local and regional contractors based on preliminary manhours for this project. Labour rates are inclusive of tools and equipment, including cranage. Installation hours estimated by Lycopodium based on previous experience.
Piping	Supply Costs & Quantities	HPAL area valve quantities obtained from P&ID take-off. Budget pricing for valves received from multiple international vendors. HPAL area piping quantities obtained from P&ID and layout take-off. Budget pricing for supply, fabrication and installation of piping obtained from multiple contractors based on preliminary quantities and piping complexities. Remainder of area piping supply costs factored from the mechanical equipment supply cost based on previous experience and benchmarked against other projects.
	Install Costs	HPAL area piping and valve installation costs based on budget pricing as above. Remainder of area piping installation hours factored from mechanical installation hours based on previous experience and benchmarked against other projects.
Electrical & Instrumentation	Supply Costs	Multiple budget pricing received from regional vendors against datasheets developed specifically for the project for transformers, emergency generator, MCCs and switchgear. Database supply costs used for VSDs and instruments.
	Quantities	Instrument list generated for the project based on P&IDs and previous similar projects. Cable quantities derived from plant layout.
	Install Costs	Install rates sourced from regional contractor based on final quantities for this project.

Discipline	Sub Items	Method
Buildings	Quantities	Size of pre-fabricated buildings estimated on a m^2 basis from previous projects and approved by EMC.
	Unit Rates	Supply and installation of pre-fabricated buildings estimated as a m^2 rate based on previous similar projects. Building fit-out estimated based on previous similar projects.
Freight	Total Cost	Freight costs provided by fabricators for structural steel and platework. Freight estimated as a % of supply cost for equipment dependent on point of manufacture.
Import Duty	Total Cost	Import duty estimated as 5% of any equipment which has a nominated point of supply other than Australia.
Vendor Representatives	Total Cost	Estimate prepared based on specialist vendor representatives expected to assist with construction verification and commissioning.
Mobile Equipment	Total Cost	List of mobile equipment prepared and approved by EMC. Costs based on all new equipment supply.
Spares	Total Cost	Estimated as 6% of mechanical supply costs.
First Fills and Consumables	Total Cost	Quantities and costs of first fill reagents and consumables prepared from operating cost estimate.
EPCM Services	Total Cost	Separate deliverable based estimate prepared to cover design, procurement, construction management, project management and commissioning supervision. Cost of design for RSF, ponds and roads also included.
Owners Costs	Total Cost	A separate estimate has been prepared and approved by EMC to cover Owner's costs including: • Owner's project management team • Some additional testwork • Miscellaneous consultancy costs (excluded from EPCM services) • Licensing and permit costs (most notably for a water licence) • Insurance • Pre-production labour costs (prior to introducing ore to the plant).

Reference projects used for benchmarking include:

- The Mindoro Agata Nickel project in Philippines was used to benchmark the HPAL area relative discipline costs (similar flowsheet).

- The Tropicana Gold Project in Western Australia designed by Lycopodium and constructed in 2013, was used to benchmark site commodity and labour rates. It was determined that the rates used in the Nyngan Scandium project estimate are typically lower than Tropicana, that being reflective of a softening in market conditions and also a difference in project scale. The smaller Nyngan project enables the use of localised lower tier contractors of suitable capability.

Quantity Development

A summary of the total bulk material quantities contained within the initial capital cost estimate for the process plant and infrastructure and their derivation is summarised in Table 21.9.

Table 21.9 Initial Capital Cost Estimate Quantities

Classification	Quantity	Unit	Study Engineering %	Estimated %	Factored %
Earthworks – RSF, Ponds and Roads	499,700	m^3	90	10	-
Earthworks – Process Plant	14,400	m^3	70	30	-
Concrete	2,318	m^3	60	40	-
Concrete Acid Protective Coating	5,143	m^2	100	-	-
Structural Steel	239	t	80	20	-
Grating	465	m^2	70	30	-
Handrail	686	m	80	20	-
Cladding	4,173	m^2	60	40	-
Tankage & Platework – Carbon Steel	102	t	90	10	-
Tankage & Platework – Stainless Steel	14	t	100	-	-
Tankage & Platework – Rubber Lining	1,292	m^2	90	10	-
Mechanical Tagged Equipment	681	ea	100	-	-
Piping – HPAL	960	m	100	-	-
Piping – Overland	13,350	m	100	-	-
Piping – Remainder		area	-	-	100
Valves - HPAL	455	ea	100	-	-
Electrical Consumers	312	ea	100	-	-
Instruments	503	ea	100	-	-
Pre-Fabricated Buildings	711	m^2	80	20	-

Supply Costs

A total of 27 mechanical equipment supply packages were issued for budget pricing for a total value of US$19.3M, representing 92% of the total mechanical equipment supply cost for the project.

Mechanical equipment supply costs were obtained either by Lycopodium or Altrius as summarised in Table 21.10.

Table 21.10 Mechanical Equipment Supply Costs

Package No	Package Description	Lycopodium Supply Cost (US$M)	Altrius Supply Cost (US$M)	Total Supply Cost (US$M)
5000A	Ore Prep Plant	0.62		
5001	Ball Mill	0.21		
5006	Thickeners	2.65		
5007	Slurry Pumps	1.00		
5008	Autoclave Agitators	1.39		
5008A	Other Agitators	0.10		
5009	Autoclave Vessel	2.73		
5011	Cyclones	0.03		
5012	Flash & Splash Vessels	2.23		
5013	Positive Displacement Pumps	1.99		
5015	Acid Injection Pumps	0.16		
5017	Solvent Extraction Plant		1.64	
5018	Filters		0.12	
5018A	Media Filters		0.89	
5019	Peristaltic Pumps	0.12		
5026	Flocculant Plants	0.06		
5034	Heat Exchangers	0.44		
5035	Immersion Heater		0.03	
5037	FRP Tanks		0.48	
5039	Scrubbers	0.12		
5050	Dust Collector		0.02	
5057	Lime Mixing System	0.30		
5061	Cooling Tower	0.05		
5076	Steam Boiler	1.04		
5089	Centrifuge		0.27	
5090	Calciner		0.48	
5092	Fire Protection System		0.17	
Subtotal (Budget Pricing)		**15.24**	**4.10**	**19.34**
Other Mechanical Equipment Supply Cost (from historical pricing)				**2.78**
Total Mechanical Equipment Supply Cost				**21.12**
% of Mechanical Equipment Based on Budget Pricing				**92%**

Fabrication Costs

Budget enquiries were issued to Australian based contractors for the fabrication of platework (both carbon steel and various grades of stainless steel) and structural steelwork.

Fabrication rates were requested based on a preliminary bill of quantities for the project.

Rates provided were all inclusive of workshop detailing, supply of materials, fabrication, painting and loading onto transport.

Of the four responding fabrication bidders for both structural steel and platework packages, prices were within ± 4% of the average price.

Fabrication rates from a vendor on the lower end of the range were selected for the capital estimate.

Given the small quantities of structural steel involved in the project, it was not considered worthwhile to source pricing from Asian based fabricators. There is potential to further explore this option during the execution phase of the project.

Installation Costs

Budget enquiries were issued to east coast Australian based contractors for the major site works packages based on a preliminary estimate of quantities.

Quoted installation costs included direct labour, equipment, and contractors' indirect costs.

The labour component reflects the cost of the direct workforce required to construct the Project, being the product of the estimated working hours spent on site multiplied by the cost of labour to the contractor, inclusive of overtime premiums, statutory overheads, payroll burden and contractor margin.

Manhours for all disciplines are based on Australian norms for recent completed installations, with a productivity factor of 1.25 having been applied.

The equipment component reflects the cost of the construction equipment and running costs required to construct the Project. It also includes cranes, vehicles, small tools, consumables, PPE, and the applicable contractor margin.

Contractors' indirect costs encompass the remaining cost of installation and include items such as off-site management, on-site staff and supervision above trade level, crane drivers, mobilisation and demobilisation, R&R, meals and accommodation, and the applicable contractor margin.

Labour gang rates including equipment and contractor indirect costs for each major trade commodity are shown in Table 21.11.

Table 21.11 Standard Direct Labour Gang Rates

Activity Area	Direct Labor Cost/Hour US$/hr	Equipment Cost/Hour US$/hr	Total Hourly Rate US$/hr
Concrete Installation	$55.00	$21.00	$76.00
SMP	$91.00	$22.00	$113.00
Electrical and Instrumentation	$90.00	$12.00	$102.00

The following field indirect costs are included in the capital estimate:

- Project construction offices and establishment.
- Communications.
- Computers, IT services, servers, and telephones.
- Construction services that include power, water, fuel (facilities provided by the individual contractors), consumables, PPE and costs for meals and accommodation.
- Local indirect labour for installation support.

Contractor indirect costs are typically quoted as a percentage of the direct labour component. Contractor indirect costs by discipline are shown in Table 21.12.

Table 21.12 Contractor Indirect Costs

Activity Area	Indirect Costs % of Direct Costs (%)
Concrete Installation	37.0%
SMP	25.0%
Electrical and Instrumentation	12.0%

A separate allowance is made for the provision of trade labour from the SMP and E&I contractors to assist with plant commissioning.

Freight and Import Duty Costs

Freight for fabricated structural steel and platework has been estimated on a tonnage basis using rates provided by fabrication contractors. By way of example, freight for structural steel is estimated at US$134 /t.

Freight for mechanical, electrical and piping materials has been estimated on a percentage of supply cost basis considering the origin of manufacture. The average freight cost for mechanical equipment represents 6.2% of total supply cost.

Import duty has been assigned at 5% of equipment supply cost for any equipment with a supply location other than Australia. Equipment that may be partially manufactured outside of Australia although quoted with an Australian supply location, does not have any import duty applied.

Residue Storage Facility, Roads, and Ponds

Earthworks quantities for the construction each stage of the Residue Storage Facility and the construction of the roads, levees, and ponds have been extracted from 3D CAD models for each infrastructure elements.

The estimated cost for the construction of the first nine stages of the Residue Storage Facility and levees where material is sourced from the overburden removal operations exclude mining and haulage costs, with the overburden removal costs for the mining operation covering supply of the material to the centroid of the Residue Storage Facility and levee. The costs for the construction of the first nine stages for the Residue Storage Facility and levees earthworks have been estimated based on recently tendered rates from similar earthworks projects in Australia and include only for placement, spreading, moisture conditioning and trimming to form the embankment / levee to the design profiles.

The estimated cost for the construction of Stages 10 to 19 and for closure covers of the Residue Storage Facility where material is sourced from borrow pits include for winning, loading, haulage, placement, spreading, moisture conditioning and trimming to form the embankment / cover system to the design profiles. The costs for the construction of Stages 10 to 19 and for closure covers for the Residue Storage Facility have been estimated based on recently tendered rates from similar earthworks projects in Australia

The estimated costs for the construction of the ponds and roads have been estimated based on recently tendered rates from similar earthworks projects in Australia and include for excavation, haulage, placement, spreading, moisture conditioning, and trimming to form the embankments / roads to the design profiles.

Quantities for the geomebrane liners and flownet synthetic drainage layers which are required for the Residue Storage Facility and contaminated water ponds have been extracted from the 3D CAD models. Budget pricing for supply, installed and QA / QC of these liners has been obtained from specialist liner suppliers / installers.

Quantities for imported materials including road sheeting, rockfill and drainage gravel and drainage sand have been extracted from the 3D CAD Models. Budget pricing has been obtained from a local earthworks contractor for supply of these materials to site. The costs for placement of the materials, compaction and moisture conditioning (where required) have been taken from Knight Piésold's cost database from similar earthworks projects in Australia.

Management Costs

The Project will be implemented using an EPCM approach, whereby the EPCM Contractor will provide design, procurement, construction management, project management and commissioning supervision services on behalf of the Owner, based on the agreed project schedule.

The EPCM services cost estimate allows for the cost of home office and site staffing, sub-consultants, office consumables, equipment, and associated project travel. The engineering design component of the EPCM estimate for the home office has been derived from a deliverables based estimate required to complete the Project and has been benchmarked against previous Lycopodium experience on similar projects.

The EPCM costs for the process plant component of the Project represents approximately 14.3% of the direct costs (excluding Owner's costs and management costs) of the process plant facility.

The management costs also include the costs for the design of the RSF, ponds and roads.

Included in management costs is also an estimate for specialist vendor representatives expected to be required to assist with construction verification and commissioning.

Owners Costs

A separate estimate has been prepared and approved by EMC to cover Owner's costs including:

- Owner's project management team.
- Some additional testwork.
- Miscellaneous consultancy costs (excluded from EPCM services).
- Licensing and permit costs (most notably for a water licence).
- Insurance.
- Pre-production labour costs (prior to introducing ore to the plant). An average of three months labour costs for the complete operations team has been allowed for pre-production labour.

Other items included in the overall estimate of Owner's costs include:

- First fills (consumables, lubricants, fuel, and reagents).
- Mobile equipment.
- Project spares. An allowance has been included to cover both capital and initial operating spares.

Origin of Pricing

Table 21.13 summarises the source of pricing by major commodity, weighted by value of the direct permanent works (excluding temporary works, construction services, commissioning assistance, EPCM costs and contingency), including supply and installation.

Table 21.13 Sources of Pricing

Classification	Budget Quote %	Database %	Estimated %	Factored %	Allowance %
Earthworks (RSF/Ponds)	85.0%	15.0%	0.0%	0.0%	0.0%
Earthworks (Process Plant)	85.0%	15.0%	0.0%	0.0%	0.0%
Concrete	90.0%	10.0%	0.0%	0.0%	0.0%
Structural Steel	95.0%	5.0%	0.0%	0.0%	0.0%
Platework	60.0%	30.0%	10.0%	0.0%	0.0%
Mechanical Equipment	92.0%	6.0%	2.0%	0.0%	0.0%
Piping	40.0%	0.0%	0.0%	60.0%	0.0%
Electrical/Instrumentation	60.0%	30.0%	10.0%	0.0%	0.0%
Buildings	0.0%	90.0%	10.0%	0.0%	0.0%

Contingency

The contingency allowance is shown as a separate amount in the CCE and has been applied on a WBS line-by-line basis in accordance with Lycopodium's estimating guidelines.

Contingency has been provided to cover anticipated variances between the specific items included the estimate and the final total installed project cost. The contingency does not cover scope changes, design growth, etc., or the listed qualifications and exclusions.

Contingency has been applied in a deterministic manner by assessing the level of confidence in each of the defined item cost inputs. It should be noted that contingency is not a function of the specified estimate accuracy, and should be measured against the project total that includes contingency.

The contingency analysis applied has considered scope definition, materials / equipment pricing and installation costs, and for the initial capital cost amounts to 10.8% of the project cost.

A summary of the contingency percentages for selected major process plant areas is provided in Table 21.14.

Table 21.14 Contingency Summary

Nyngan Project Process Plant Contingency (US$M))	Applied Contingency (US$M)	Applied Contingency (%)
General	$0.14	6.0%
Earthworks	$0.67	15.0%
Concrete	$0.52	12.0%
Steel & Plateworks	$0.59	11.4%
Mechanical	$2.88	10.4%
Piping	$1.24	14.7%
Electrical & instrumentation	$0.72	8.3%
Buildings	$0.32	10.0%
Indirects	$0.93	10.0%
Owners Costs	$0.14	7.1%
Plant Capital Total	$8.14	10.7%

21.4.6 Foreign Exchange Rates

Whilst the capital estimate is presented in US$, the majority of costs are submitted in Australian Dollars (A$). Foreign currency exchange rates used in the estimate and the magnitude of foreign currencies used in the initial process plant and infrastructure capital estimate are summarised in Table 21.15.

Table 21.15 Foreign Currency Exchange Rates and Exposure

Currency of CapEx Estimate	Fx Rate Assumption US$/x	Portion of CapEx (US$M)	Portion of CapEx (%)
US Dollar (US$)	1.00	$4.3	5.60%
Australian Dollar (A$)	1.43	$66.7	87.70%
Euro (€)	0.89	$4.4	5.80%
South African Rand (ZAR)	12.50	$0.7	0.90%
Total		$76.10	100.00%
Note: Direct costs only, contingency excluded			

A strengthening A$, relative to the US$, beyond the base rate of US$1.00 = A$1.43 (or A$1.00 = US$0.70), will result in higher capital cost in US$ terms. The opposite is also true.

21.5 Process Plant and Administration Operating Costs

This section of the report contains the operating cost estimate for the Nyngan Scandium Project processing plant and related infrastructure, and outlines the philosophy and basis on which the estimate was developed. The Processing Plant component of the operating cost estimate is based on the process design criteria, mass balance, process flowsheets and mechanical equipment list.

21.5.1 Accuracy of Estimate

The methodology and data collection strategies applied during the development of the operating cost estimate are in accordance with Lycopodium's standards for a Definitive Feasibility Study and are sufficient to support a ± 15% level of accuracy.

21.5.2 Process Plant and Administration Operating Cost Summary

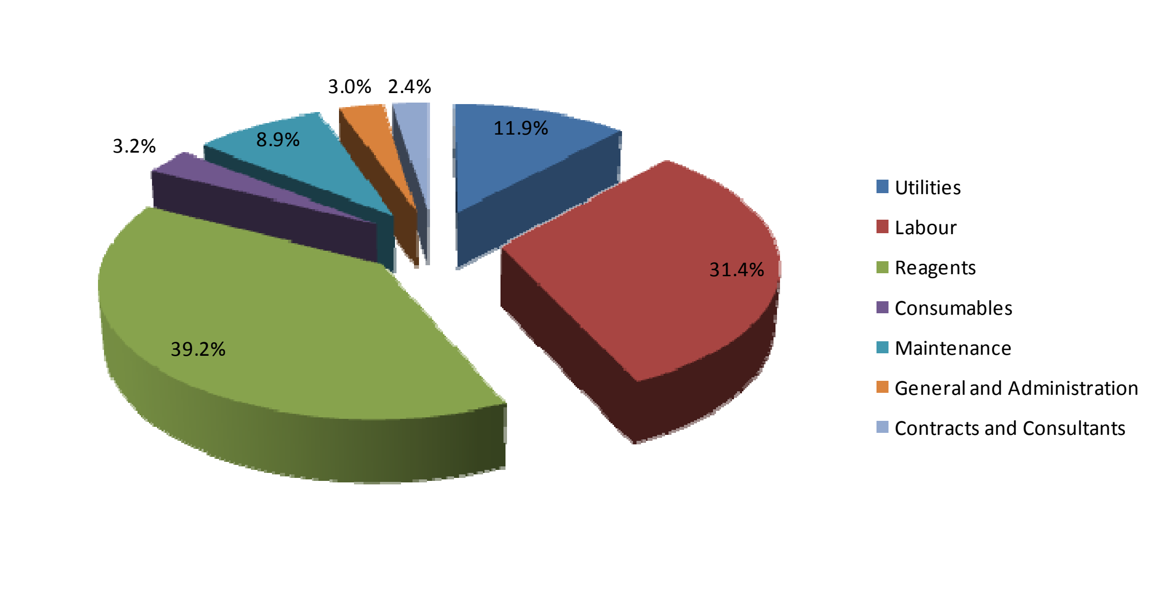
The Nyngan Scandium Project process plant and administration operating cost estimate is summarised in Table 21.16. Cost estimates are shown in US dollars and summarised by the major Cost Items, along with an indication of the annualised operating cost in US dollars per tonne of ore processed and the split between fixed and variable cost components.

Table 21.16 Operating Cost Summary

Plant Operating Cost Item	Annual Cost (US$)	Annual Unit Ore Cost (US$/tonne)	Percent of Total (%)	Annual Fixed Cost (US$)	Variable Unit Cost (US$/tonne)
Utilities	$ 2,237,674	$29.84	11.9%	$266,268	$26.29
Labour	$ 5,902,990	$78.71	31.4%	$5,902,990	$0.00
Reagents	$ 7,368,187	$98.24	39.2%	$0	$98.24
Consumables	$ 601,872	$8.02	3.2%	$0	$8.02
Maintenance	$ 1,666,821	$22.22	8.9%	$973,330	$9.25
General and Administration	$ 561,800	$7.49	3.0%	$561,800	$0.00
Contracts and Consultants	$ 455,000	$6.07	2.4%	$345,000	$1.47
Total	$18,794,343	$250.59	100.0%	$8,049,388	$143.27

Figure 21.1 shows the relative division of the process plant operating costs in a graphical form, highlighting the major operating cost items.

Figure 21.1 Operating Cost Summary by Cost Item



An examination of Figure 21.1 indicates that the largest components of the processing operating cost are reagents at 39%, followed by labour costs at 31% and utilities (power, water, fuel) at 12%. A more detailed discussion and breakdown of these cost items can be found in Section 21.6.8.

21.5.3 Estimate Development

The process plant operating cost estimate is internally consistent with other study documentation and was developed using data obtained from the following sources:

- Process Design Criteria (Doc. No. 3185-000-PRPDC-0001).
- Mass Balance (Doc. No. 3185-000-PRMBL-0001).
- Mechanical Equipment List (Doc. No. 3185-000-MELST-0001).
- Capital Cost Estimate (Doc. No. 3185-000-ESEST-0001)
- Process Flow Diagrams (Drwg. Nos. 3185-000-PRPFD-0001 to 0034).
- Manning and Organisation schedule.
- Labour rates including on-costs.
- Reagent and Consumable unit costs.
- Diesel, Water and Power unit costs.

- Transport / logistics costs.
- Administration costs.
- Vendor budget quotations for reagent and operating consumable unit costs.
- Vendor estimates of equipment operating consumable unit consumption rates.

21.5.4 Estimate Exclusions

The following items are excluded from the operating cost estimate:

- Escalation.
- Contingency.
- Environmental / Rehabilitation / Closure costs.
- Royalties / land compensation charges.
- Corporate overheads.
- Regulatory and licence costs.
- Project finance charges.
- Amortisation, depreciation, financing and accounting effects.
- Product Insurance and marketing costs.
- Taxes, duties and subscriptions.
- Carbon taxes.
- Product freight charges.
- Product refining charges.
- Any residue storage facility discharge treatment requirements (e.g. water treatment).
- Demurrage costs.

21.5.5 Base Date and Exchange Rates

The base date of all estimates is Q1 2016. The operating cost model base currency is the United States Dollar (US$). The majority of the operating cost information was supplied in Australian Dollars (A$), and converted to US$ at a conversion rate of US$0.70 = A$1.00.

The base date and exchange rates utilised for the operating cost derivation are consistent with the capital cost estimate.

21.5.6 Start-up Costs

The operating cost estimate is inclusive of all production costs from the commencement of the commissioning on ore feed phase through to the end of production.

The estimate excludes the following start-up and cessation costs:

- Pre-commissioning costs (included in capital cost estimate).
- Initial inventory costs (included in capital cost estimate).
- Pre production costs (included in capital cost estimate).
- Decommissioning costs.
- Rehabilitation costs.

21.5.7 Operating Cost Items

The operating cost estimate has been assembled through a collection of data to satisfy the following seven main cost item categories:

- Reagents.
- Utilities.
- Consumables.
- Labour.
- Maintenance Expenses.
- General and Administration Expenses.
- Contract and Consulting Expenses.

Each Cost Item contains a number of sub-cost items.

21.5.8 Process Plant Operating Costs Item Development

Reagents

Reagents for the Nyngan Scandium project account for approximately 39% of the overall process plant operating costs. The two major items within this category which contribute 75% of the reagent costs are sulphuric acid (54%) and hydrated lime (21%). Sulphuric acid is consumed in the high pressure acid leach (HPAL), whereas hydrated lime is used in the neutralisation of the final slurry prior to tailings disposal.

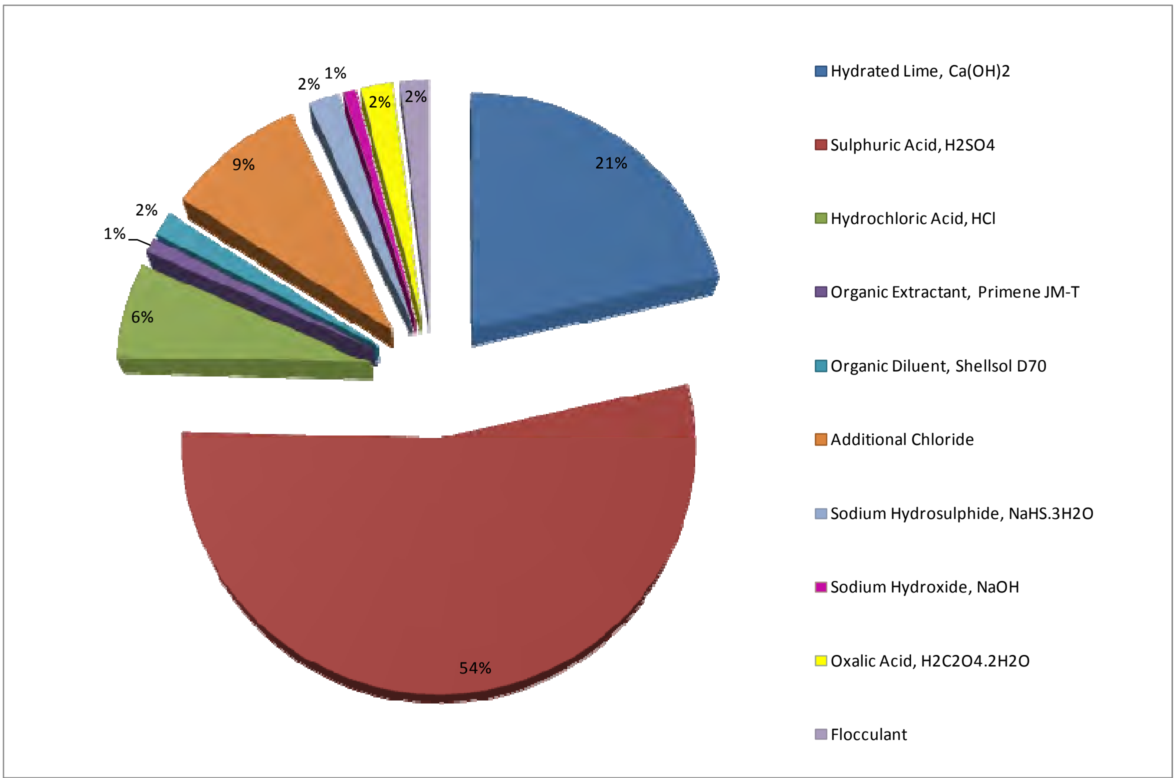
The reagent consumption requirements for the process plant were based on reference plant, testwork consumption rates and industry standards. Reagent unit prices were the result of supplier budget quotes or prices from recent projects where budgeted quotes were not obtainable. A summary of the annual usage and cost for reagents used in the process are shown in Table 21.17.

Table 21.17 Reagent Annual Usage and Cost Summary

Plant Reagent Operating Cost Item	Reagent Quantity (tonnes p.a.)	Annual Cost (US$)	Annual Unit Ore Cost (US$/tonne)
Hydrated Lime, Ca(OH)2	9,128	$1,586,067	$21.15
Sulphuric Acid, H2SO4	21,002	$3,969,284	$52.92
Hydrochloric Acid, HCl	1,244	$461,339	$6.15
Organic Extractant, Primene JM-T	3	$73,660	$0.98
Organic Diluent, Shellsol D70	76	$114,455	$1.53
Magnesium Chloride, MgCl2.6H2O	1,402	$667,233	$8.90
Sodium Hydrosulphide, NaHS.3H2O	167	$146,344	$1.95
Sodium Hydroxide, NaOH	110	$57,110	$0.76
Oxalic Acid, H2C2O4.2H2O	159	$152,481	$2.03
Flocculant	50	$140,215	$1.87
Total Reagents	n/a	$7,368,187	$98.24

Figure 21.2 shows the relative proportion of cost attributed to each reagent.

Figure 21.2 Reagent Cost Summary



Utilities and Consumables

Utilities and Consumables for the Nyngan Scandium project account for approximately 12% and 3% respectively of the overall process plant operating costs.

Items within the Utilities category include:

- Power costs.
- Water costs.
- Diesel.
- Liquid Petroleum Gas (LPG).

Any required make-up water will be provided to the process plant site from the Cobar service line adjacent to the Barrier Highway, approximately 5 km from the project site. This water will be piped under pressure to a raw water pond on site where it will be supplemented by water from site based sediment and event ponds and mine pit water. All water will be treated through a water filter treatment plant on site, with additional treatment for potable and demineralised water requirements.

EMC Metals Australia has supplied a fixed and variable water operating cost from their discussion with water brokers in the region. These figures are as follows:

- Fixed maintenance cost of A$20,000 per annum.
- Variable cost of A$1,170 per ML of water consumed.

LPG will be used as the fuel source for the operation of the steam boiler for production of HP steam for the HPAL. LPG will be delivered to site and transferred to a pressurised 50 t bullet on site. This will provide approximately six days of storage. A price of A$0.50 /L has been supplied by ELGAS, with an additional US$18,000 per annum for LPG site storage.

Power consumption for the process plant has been calculated based on the mechanical equipment and subsequent electrical load list. During normal plant operation, the overall absorbed power requirement for the process plant is 1.3 MW. For this study, Essential Energy has supplied a fixed and variable tariff for connection into the existing 33kV supply which runs adjacent to the Barrier Highway, approximately 5 km from the project site. These figures are as follows:

- Fixed connection fee of A$7,358 per month.
- Variable cost of A$0.104 /kWh.

Table 21.18 shows the required power and subsequent annual cost by major plant area.

Table 21.18 Power Usage and Cost Summary

Electrical Power Requirements Processing Plant	Installed Power (kW)	Max Continuous Power Draw (kW)	Average Power (kW)	Annual Power Consumption (kWh)	Annual Power Cost (US$)	Annual Unit Power Cost Per Ore Tonne (US$/tonne)
Feed Preparation	245	152	130	1,136,786	$82,440	$1.10
Pressure Acid Leach	656	318	272	2,385,074	$172,966	$2.31
CCD Circuit	280	108	92	807,265	$58,543	$0.78
Solvent Extraction	109	50	43	372,630	$27,023	$0.36
Product Precipitation/Purification	239	170	146	1,277,077	$92,614	$1.23
Neutralization and Tailings	295	117	100	877,706	$63,651	$0.85
Reagents	166	50	43	376,957	$27,337	$0.36
Water and Air Services	932	349	304	2,665,625	$193,311	$2.58
Switchrooms and Buildings	324	160	160	1,402,379	$101,701	$1.36
Totals	3,246	1,474	1,290	11,301,499	$819,586	$10.93

Diesel is required for the process plant mobile equipment fleet. The required consumption has been calculated based on the number, type and average operating time for each vehicle. An annual consumption of 290 kL is required, which based on the Australian three month moving average diesel price of A$1.22 /L, results in an annual diesel operating cost of US$247,500.

Items within the Consumables category include:

- Scrubber liners.
- Ball Mill liners, trommel panels and grinding media.
- Cyclone spares.
- Raffinate, Scandium Oxalate and Scandium Oxide filter consumables.
- Product packaging drums.
- Laboratory consumables.
- General consumables.

Cost for scrubber liners, Ball Mill consumables and cyclone spares are based on vendor data. Filtration consumables have been estimated based on an eight week change out cycle. Product drum requirement is based on a 20 kg/drum capacity. Laboratory and general consumables are based on an estimated annual cost by Lycopodium.

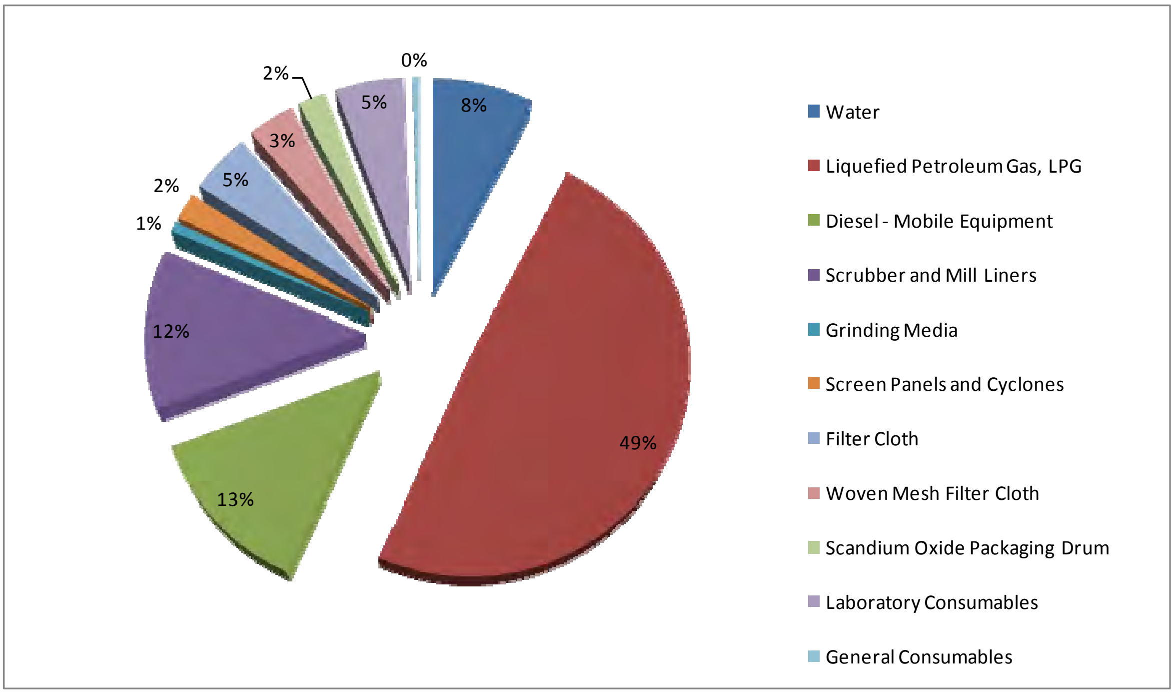
A summary of the annual usage and cost for utilities and consumables used in the process are shown in Table 21.19.

Table 21.19 Utilities and Consumables Annual Usage and Cost Summary

Item	Annual Consumption Quantity	Annual Cost (US$)	Unit Cost (US$/t)
Water Consumption - Pipeline to Plant (m3)	90,000	$ 73,710	$ 0.98
Water Usage (annual fee)		$ 14,000	$ 0.19
Raw Water Treatment - R.O.Plant (m3)	74,250	$ 62,370	$ 0.83
Liquified Petroleum Gas, LPG (m3)	2,739	$ 958,686	$ 12.78
Diesel Fuel - Mobile Equipment (L)	289,834	$ 247,518	$ 3.30
Scrubber Liners	1.5	$ 157,500	$ 2.10
Ball Mill Liners	1.5	$ 78,750	$ 1.05
Ball Mill Trommel Screen Panels	4.3	$ 19,717	$ 0.26
Cyclone Spares	2.0	$ 21,000	$ 0.28
Grinding Media (65mm diameter)	32.0	$ 15,211	$ 0.20
Raffinate Polishing Filter	6.5	$ 45,500	$ 0.61
Scandium Oxalate filter	6.5	$ 68,250	$ 0.91
Scandium Oxide Filter	6.5	$ 45,500	$ 0.61
Scandium Oxide Packaging Drum	1.9	$ 40,445	$ 0.54
Laboratory Consumables	1.0	$ 100,000	$ 1.33
General Consumables (brooms/shovels, etc)	1.0	$ 10,000	$ 0.13
Totals		$ 1,958,157	$ 26.10

Figure 21.3 shows the relative proportion of cost attributed to each utility / consumable.

Figure 21.3 Utilities and Consumables Cost Summary



Labour cost

The Nyngan processing plant will require a workforce of 73 personnel. The process plant will operate 24 hours a day, seven days a week, on a 12 hour shift, four panel roster. The workforce will include both day and shift personnel, depending on the job position. It is anticipated that the majority of the workforce will be recruited from the regional area, which includes a number of existing mines and mineral processing operations.

Operating labour costs include remuneration for all personnel required for the operation of the processing plant and general and administration facilities. Operating labour costs accounts for approximately 31% of the total operating cost for the plant.

The manning numbers and positions were developed by Lycopodium with input and agreement from EMC. Remuneration rates for employees for both process plant and general and administration personnel were based on information from the 2105 Hays Salary Guide for Resources and Mining in New South Wales (NSW), with acknowledgement of some increased salary rates for personnel in key positions and with specialised expertise in high pressure acid leach mineral processing.

There has been no inclusion in the labour operating cost for operator training or commissioning personnel. These labour items have been capitalised in the owner's costs.

Labour burdens included in the base salaries cover annual leave and sick leave. Additional overheads and on-costs incurred in the total annual labour costs include:

- Annual Superannuation.
- Workers compensation.
- Payroll tax.
- Training.
- Long service leave allowance.

Total on-costs were estimated at 12%, plus superannuation at a standard 10%.

A summary of manning numbers, along with the corresponding annual labour costs for the process plant and general and administration personnel, can be viewed in Table 21.20.

Table 21.20 Labour Cost Summary

Description	Position	Type	Total Number of Personnel	Annual Labour Cost/Person A$	Total Annual Labour Cost US$	Labour Cost/tonne US$/t
Management	Process Plant Manager	Day	1	$ 268,290	$ 187,803	$ 2.50
	Metallurgical Superintendent	Day	1	$ 243,900	$ 170,730	$ 2.28
	Accountant - Office Manager	Day	1	$ 170,730	$ 119,511	$ 1.59
	HSE Advisor	Day	1	$ 134,145	$ 93,902	$ 1.25
	Laboratory Manager/Chief Chemist	Day	1	$ 158,535	$ 110,975	$ 1.48
	Maintenance Planner/Superintendent	Day	1	$ 146,340	$ 102,438	$ 1.37
	Site Engineer	Day	1	$ 158,535	$ 110,975	$ 1.48
	Procurement / Accounting Clerk	Day	1	$ 97,560	$ 68,292	$ 0.91
	IT - Instrumentation, Comms Analyst	Day	1	$ 134,145	$ 93,902	$ 1.25
	Secretary / Receptionist	Day	1	$ 48,780	$ 34,146	$ 0.46
	Subtotal Management		10		$ 1,092,672	$ 14.57
Supervisors	Metallurgist	Shift	4	$ 146,340	$ 409,752	$ 5.46
	Shift Foreman	Shift	4	$ 121,950	$ 341,460	$ 4.55
	Security Supervisor	Day	2	$ 85,365	$ 119,511	$ 1.59
	Subtotal Supervisors		10		$ 870,723	$ 11.61
Process	Laboratory Technician	Day	2	$ 85,365	$ 119,511	$ 1.59
	Control Room Operator	Shift	4	$ 121,950	$ 341,460	$ 4.55
	Process Operator Crusher/Mill	Shift	8	$ 97,560	$ 546,336	$ 7.28
	Process Operator Leach/CCD/Neut	Shift	8	$ 97,560	$ 546,336	$ 7.28
	Process Operator SX-EW	Shift	4	$ 97,560	$ 273,168	$ 3.64
	Process Operator Oxalate	Day	4	$ 97,560	$ 273,168	$ 3.64
	Process Operator Reagents	Shift	4	$ 97,560	$ 273,168	$ 3.64
	Process Operator General/Relief	Shift	4	$ 91,463	$ 256,095	$ 3.41
	Warehouse Foreman - Plant	Day	1	$ 91,463	$ 64,024	$ 0.85
	Subtotal Process		39		$ 2,693,266	$ 35.91
Maintenance	Mechanics/Fitters	Day	1	$ 121,950	$ 85,365	$ 1.14
	Mechanics/Fitters	Shift	4	$ 140,243	$ 392,679	$ 5.24
	Electricians	Day	1	$ 121,950	$ 85,365	$ 1.14
	E&I Technicians	Shift	8	$ 121,950	$ 682,920	$ 9.11
	Subtotal Maintenance		14		$ 1,246,329	$ 16.62
	Project Totals		73		$ 5,902,990	$ 78.71

Maintenance

Maintenance costs cover both the process plant and general services. For the process plant, maintenance costs have been covered as a varying percentage of installed mechanical cost by operational area, based on typical industry standards. General maintenance includes estimated annual amounts for maintenance manuals, software and training, along with control system maintenance.

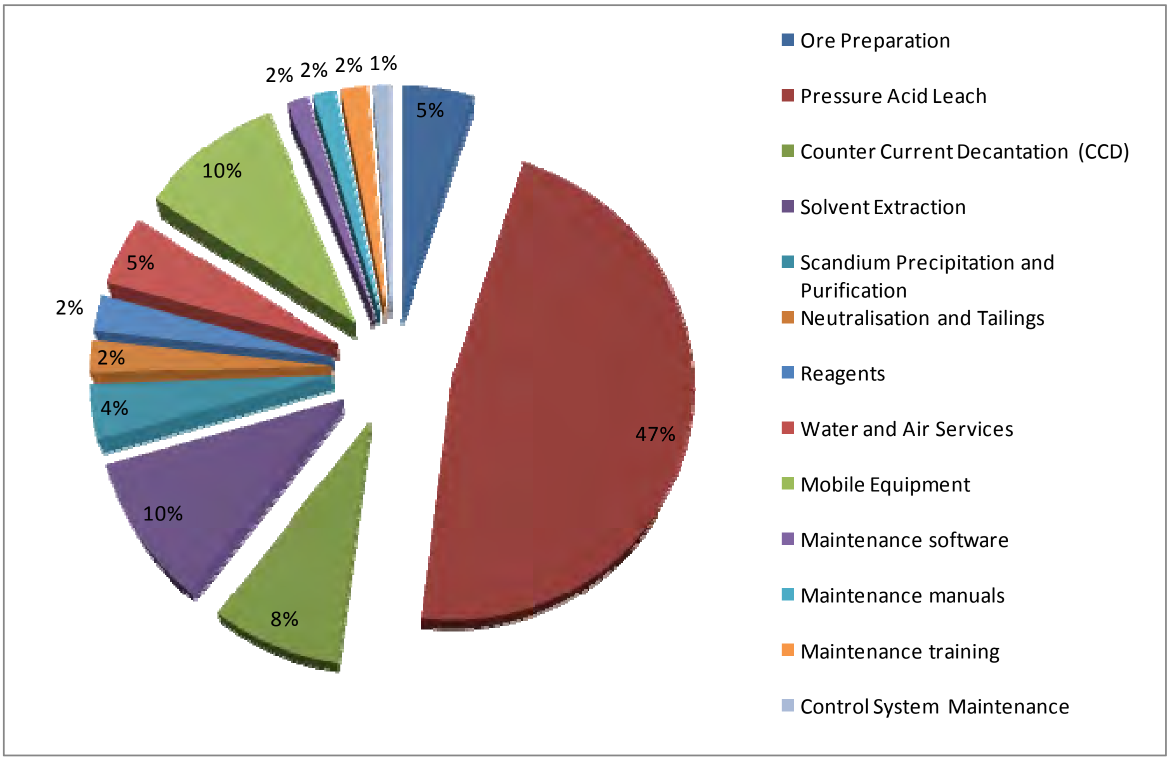
Maintenance staff labour has been included separately in the labour cost category. Table 21.21 shows the allocation of maintenance costs by area. The HPAL area represents the most significant annual maintenance cost (approximately 47%).

Table 21.21 Maintenance Cost Annual Summary

Area	Percent of Installed Equipment	Installed Equipment Cost (US$)	Annual Cost (US$)	Cost/Tonne (US$)
Plant Maintenance				
Ore Preparation	5.0%	$ 1,654,000	$ 82,700	$ 1.10
Pressure Acid Leach	7.0%	$ 11,201,956	$ 784,137	$ 10.46
Counter Current Decantation (CCD)	4.0%	$ 3,498,122	$ 139,925	$ 1.87
Solvent Extraction	4.0%	$ 4,274,261	$ 170,970	$ 2.28
Scandium Precipitation and Purification	4.0%	$ 1,562,555	$ 62,502	$ 0.83
Neutralisation and Tailings	2.5%	$ 1,559,749	$ 38,994	$ 0.52
Reagents	3.0%	$ 1,376,205	$ 41,286	$ 0.55
Water and Air Services	3.0%	$ 2,705,209	$ 81,156	$ 1.08
Mobile Equipment		$ 1,035,455	$ 165,150	$ 2.20
Subtotal-Plant Maintenance		$ 28,867,514	$ 1,566,821	$ 20.89
Maintenance - General				
Maintenance software			$ 25,000	$ 0.33
Maintenance manuals			$ 25,000	$ 0.33
Maintenance training			$ 30,000	$ 0.40
Control System Maintenance			$ 20,000	$ 0.27
Subtotal-General Maintenance			$ 100,000	$ 1.33
Total Maintenance Cost			$ 1,666,821	$ 22.22

Figure 21.4 shows the relative proportion of maintenance cost attributed to each process plant area.

Figure 21.4 Maintenance Cost Summary



General and Administration Costs

General and Administration Expenses cover all other process and administrative expenses related to the process plant facility but not accounted for in the previous categories. In general, these expenses have been determined on a dollar allowance basis. These expenses are generally inclusive of:

- Communication expenses.
- Business travel and accommodation.
- Training and safety supplies.
- Medical supplies.
- Office and general supplies.
- Emergency freight.
- Insurances (equipment and vehicle insurance, industrial special risk etc.).
- Recruitment and advertising expenses.
- Limited government permits, licensing and legal fees.

- Other operational overheads.

General expenses accounts for approximately 3% of the total operating cost for the plant. A summary of general expense requirements is presented in Table 21.22.

Table 21.22 General and Administration Cost Summary

Item	Unit Cost	Annual Cost (US$)	US$/tonne
Telecommunications	$5000 per month	$ 60,000	$ 0.80
Insurances	0.5% of Plant CapEx	$ 200,000	$ 2.67
Stationery	Allowance	$ 15,000	$ 0.20
Office Cleaning	Allowance	$ 25,000	$ 0.33
Postage & Freight	Allowance	$ 15,000	$ 0.20
Computer Supplies & Support	Allowance	$ 30,000	$ 0.40
First Aid Costs	$100/ person	$ 7,300	$ 0.10
Entertainment, Catering	Allowance	$ 25,000	$ 0.33
Banking Fees	Allowance	$ 10,000	$ 0.13
Safety, Clothing	$1000/person	$ 73,000	$ 0.97
Training	$500/person	$ 36,500	$ 0.49
Travel & Accommodation	Allowance	$ 20,000	$ 0.27
Environmental Licence	Allowance	$ 10,000	$ 0.13
Control System Licences	Allowance	$ 5,000	$ 0.07
Rates	Allowance	$ 10,000	$ 0.13
Miscellaneous	Allowance	$ 20,000	$ 0.27
Total Miscellaneous Costs		$ 561,800	$ 7.49

Contracts and Consultant Expenses

A general philosophy has been applied of limiting operating personnel to those tasks and responsibilities considered essential to the operation. Certain functions have been deemed to be more appropriately carried out by external contractors and consultants.

Contract expenses relate generally to agencies that supply goods or services to the project on a renewable contract basis. In general, these expenses have been determined on a dollar allowance basis and include items such as:

- Specialist maintenance and engineering services such as major pump overhauls, crane servicing, gearbox overhauls, etc.

- External laboratory analyses for environmental testing, product analysis and third party QA / QC.

- Specialised laboratory equipment maintenance and licensing.

- Vendor supplied site storage vessels.

Consultants expenses accounts for the provision of specialist consulting services to internal project departments. In general, these expenses have been determined on a set hourly rate basis and time allowance with a travel cost component and includes consulting services in the following areas:

- Plant Control System.
- Maintenance.
- Technical and Process specialists.

Contract and Consultant expenses accounts for 2.4% of the total operating cost for the plant. A summary of contract and consultant expense requirements is presented in Table 21.23.

Table 21.23 Contracts and Consultants Expenses Cost Summary

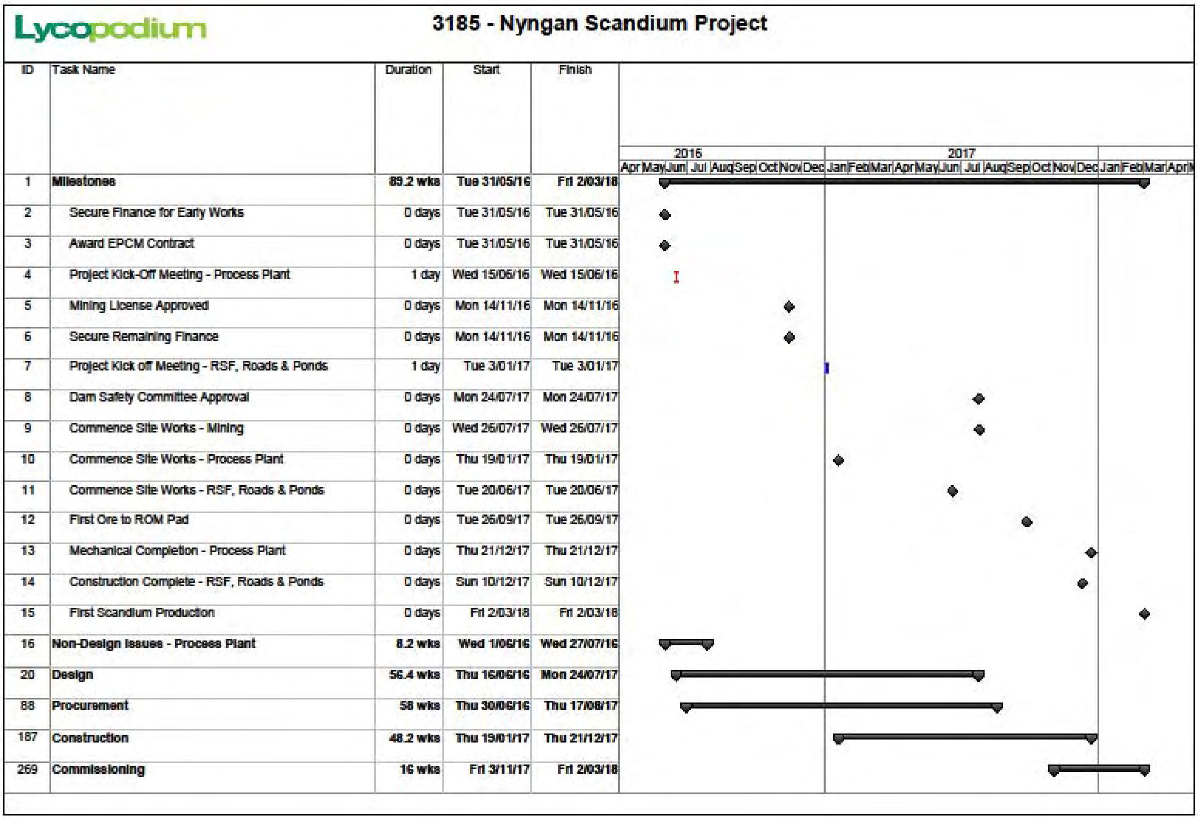
Expense Description	Cost US$	/Unit	Annual Unit Quantity	Cost/Year (US$)	US$/tonne
Consulting					
Consulting Services (Maintenance)	$16,000	week	2	$ 32,000	$ 0.43
Consulting Services (Process / Mechanical)	$16,000	week	4	$ 64,000	$ 0.85
Consulting Services (DCS control system)	$16,000	week	1	$ 16,000	$ 0.21
Plant Maintenance					
Off-site maintenance services	$50,000	lot	1	$ 50,000	$ 0.67
Specialist maintenance services	$50,000	lot	1	$ 50,000	$ 0.67
Testwork					
Metallurgical Testwork (External)	$200	assay	100	$ 20,000	$ 0.27
Environmental Testwork	$200	assay	200	$ 40,000	$ 0.53
External Product Analysis	$300	assay	200	$ 60,000	$ 0.80
External Check Analysis (QA/QC)	$300	assay	100	$ 30,000	$ 0.40
Lab Maintenance Contract					
ICP-OES	$25,000	lot	1	$ 25,000	$ 0.33
XRF	$30,000	lot	1	$ 30,000	$ 0.40
Carbon-sulphur Analyser	$5,000	lot	1	$ 5,000	$ 0.07
AAS	$10,000	lot	1	$ 10,000	$ 0.13
PSA	$5,000	lot	1	$ 5,000	$ 0.07
Other					
ELGAS LPG Tank Rental - Annual Fee	$18,000	lot	1	$ 18,000	$ 0.24
Total Specialist Consulting Costs				$ 455,000	$ 6.07

21.6 Project Implementation Schedule

A project implementation schedule has been prepared and a summary schedule is shown as Figure 21.5.

This schedule shows an overall duration from commencement of detailed design to first production of scandium oxide to be 89 weeks. Activities on the critical path of the schedule include the fabrication, delivery and installation of the autoclave, flash and splash vessels in the HPAL area of the plant.

Figure 21.5 Summary Implementation Schedule



ID	Task Name	Duration	Start	Finish
1	**Milestones**	**89.2 wks**	**Tue 31/05/16**	**Fri 2/03/18**
2	Secure Finance for Early Works	0 days	Tue 31/05/16	Tue 31/05/16
3	Award EPCM Contract	0 days	Tue 31/05/16	Tue 31/05/16
4	Project Kick-Off Meeting - Process Plant	1 day	Wed 15/06/16	Wed 15/06/16
5	Mining License Approved	0 days	Mon 14/11/16	Mon 14/11/16
6	Secure Remaining Finance	0 days	Mon 14/11/16	Mon 14/11/16
7	Project Kick off Meeting - RSF, Roads & Ponds	1 day	Tue 3/01/17	Tue 3/01/17
8	Dam Safety Committee Approval	0 days	Mon 24/07/17	Mon 24/07/17
9	Commence Site Works - Mining	0 days	Wed 26/07/17	Wed 26/07/17
10	Commence Site Works - Process Plant	0 days	Thu 19/01/17	Thu 19/01/17
11	Commence Site Works - RSF, Roads & Ponds	0 days	Tue 20/06/17	Tue 20/06/17
12	First Ore to ROM Pad	0 days	Tue 26/09/17	Tue 26/09/17
13	Mechanical Completion - Process Plant	0 days	Thu 21/12/17	Thu 21/12/17
14	Construction Complete - RSF, Roads & Ponds	0 days	Sun 10/12/17	Sun 10/12/17
15	First Scandium Production	0 days	Fri 2/03/18	Fri 2/03/18
16	**Non-Design Issues - Process Plant**	**8.2 wks**	**Wed 1/06/16**	**Wed 27/07/16**
20	**Design**	**56.4 wks**	**Thu 16/06/16**	**Mon 24/07/17**
88	**Procurement**	**58 wks**	**Thu 30/06/16**	**Thu 17/08/17**
187	**Construction**	**48.2 wks**	**Thu 19/01/17**	**Thu 21/12/17**
269	**Commissioning**	**16 wks**	**Fri 3/11/17**	**Fri 2/03/18**

22.0 ECONOMIC ANALYSIS

22.1 Basis of Estimate

The economic performance of the project, as outlined in this Feasibility Study (DFS), has been valued using a constant dollar cash flow forecast, based on predicted revenue, costs and capital requirements. The cash flow stream has been discounted by various discount rates to generate Net Present Values (NPV's) for a 21 year project plan, including an initial construction year. Both pre-tax and after-tax NPV results are presented, at various discount rates. Discounted cash flow-internal rate of return ("DCF-IRR" or "IRR") results are also presented, again on both a before-tax and an after-tax basis. The effects of changes in key inputs has also been assessed and presented in a sensitivities review.

This DFS is based on a finalised flow sheet design for the project. No results are included for any alternative process designs, and no expansion cases have been presented. This DFS does combine the best currently known options for process design and project development for this scandium resource, as supported by completed test work.

All project returns are shown on a 100% owned basis. The Nyngan Scandium Project is 100% owned by EMC Metals Australia Pty. Ltd., which is in turn 80% owned by SCY and 20% owned by Scandium Investments LLC. (SIL), a private Nevada Corporation, owned by a group of US-based investors.

Project returns are presented on a 100% equity basis. The cash flow model is constructed with annual revenue and cost inputs, plus scheduled annual capital cost inputs. No leverage has been applied to the economics or the financial results - all project capital is assumed provided from equity sources. No leasing of capital items has been assumed for plant or infrastructure, although periodic contract mining rates do assume contractors will provide their required equipment.

The cash flow model is a constant dollar model, and no inflation is assumed in costs, revenues, or margins. NPV discount rates need to be viewed as constant dollar rates as well.

Annual cash flows are discounted back to 'time zero', specifically 1 January 2017 (beginning period convention), to arrive at NPV and IRR calculations.

22.2 Cash Flow Model – Financial Summary

The project exhibits strong financial returns from initial capital investment of US$87.1M, with the direct mechanical items sourced in either US dollars (US$), Euros (€) or Australian Dollars (A$), and all local erection, installation and infrastructure sourced in Australian dollars (A$). All project revenues, capital costs, operating costs, and financial returns have been converted to US$, and presented in this DFS in US$, unless otherwise noted.

Project after-tax NPV (10% discount rate) is US$177.5M, generating an IRR of 33.1% and a 3.3 year payback on initial invested capital. Project investment spending to date, and through to commencement of detailed design and construction, is considered sunk cost and is not a part of the financial returns. Financial returns from the economic model are shown in Table 22.1.

Table 22.1 Project Financial Returns Summary

Nyngan Scandium Project Financial Returns Summary	Pre-Tax Economic Return	After-Tax Economic Return
Constant Dollar **Net Present Value (US$ M)**		
6% Discount	$421.6	$287.6
8% Discount	$334.8	$225.3
10% Discount	$268.1	$177.5
Internal Rate of Return (IRR)	41.1%	33.1%
Payback (Years)	2.8	3.3

NOTE: Based on a scandium oxide selling price of US$2,000 /kg Sc_2O_3

Investment (construction) is planned for 2017, which is year zero of the cash flow model, followed by initial year production in 2018, which is the first of 20 years of production at the average rate of 37,840 kg of scandium oxide product per year, terminating in 2037.

Project annual cash flow projections are shown by year in Table 22.2.

Table 22.2 Cash Flow Projections for the Nyngan Scandium Project

Nyngan Project Key 20 Year Results	2017 Year 0	2018 Year 1	2019 Year 2	2020 Year 3	2021 Year 4	2022 Year 5	2023 Year 6	2024 Year 7	2025 Year 8	2026 Year 9	2027 Year 10
Production (kg oxide)	0	26,244	59,023	75,008	75,213	75,008	75,008	75,008	75,213	75,008	75,008
Revenue (net royalty)	$ -	$24,879,479	$57,798,785	$72,968,585	$71,614,061	$69,072,104	$72,348,173	$71,939,343	$72,177,652	$70,748,622	$70,749,302
Net Income	-$1,752,230	$3,708,444	$24,172,212	$29,929,955	$30,189,294	$28,841,440	$30,848,247	$31,501,865	$32,593,877	$31,508,478	$31,299,778
Capital Spending	$ 82,140,571	$ 5,000,000	$ -	$ 425,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow	-$82,198,175	$5,751,883	$30,811,307	$35,619,540	$36,052,961	$34,118,740	$35,597,817	$35,776,479	$36,441,029	$34,970,915	$34,415,971

Nyngan Project Key 20 Year Results	2028 Year 11	2029 Year 12	2030 Year 13	2031 Year 14	2032 Year 15	2033 Year 16	2034 Year 17	2035 Year 18	2036 Year 19	2037 Year 20	21 Year Total
Production	75,008	75,213	75,008	75,008	75,008	75,213	75,008	75,008	75,008	75,213	1,436,429
Revenue (net royalty)	$ 72,585,738	$ 71,943,436	$ 72,282,594	$ 73,382,879	$73,168,964	$ 74,020,805	$ 74,912,718	$ 80,150,737	$ 86,040,671	$ 89,801,044	1,422,585,689
Net Income	$ 34,188,597	$ 32,213,185	$ 34,396,566	$ 33,671,353	$35,428,548	$ 34,361,230	$ 36,881,912	$ 38,243,032	$ 44,855,844	$ 41,096,702	638,178,328
Capital Spending	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	87,565,571
Cash Flow	$ 36,993,170	$ 34,737,302	$ 36,668,270	$ 35,715,887	$37,268,629	$ 36,017,302	$ 38,372,378	$ 39,584,451	$ 47,063,121	$ 54,445,195	634,224,171

22.3 Capital Cost Summary

The initial capital cost for the project is US$87.1M. The financial model includes a construction and pre-commissioning year (2017) with a capital cost outflow of US$82.2M to initiate production in Q1 2018. An additional US$5.0M of construction cost falls into

Q1 2018. Working capital totalling US$2M is not in the initial capital cost, but is accumulated over the 2018 to 20 period as production ramps up, reflecting 30 day payment terms on product shipments.

Sustaining plant and operations capital is provided as an annual expensed contingency, and totals US$3.6M over the life of the project. Sustaining tailings pond capital is similarly provided for and expensed annually to operating costs, and totals US$22.4M over the life of the project. While these costs are often treated as capital items, and the initial tailings pond cost is included in the project capital cost, these ongoing expenses have been taken through the income statement and cash flow annually, due to their annual recurrence. They are not treated as sustaining capital items, as presented. They are also treated as cash unit production costs, where those figures are provided.

The initial capital cost is spread over a number of areas, but the high pressure autoclave systems (HPAL), leaching and neutralisation circuits are the most significant capital items, totalling direct mechanical costs of US$33M or 38% of total costs. EPCM costs, Owners costs, and all contingency allowances total US$21.6 M or 25% of total costs.

Details of the elements of capital are presented in Table 22.3.

Table 22.3 Nyngan Capital Cost Summary

Nyngan Project Capital Cost Summary (millions)	Initial Project Capital Cost (US$M)
Mining Capital	
Pre-Stripping Cost	$1.72
Mining Equipment	contractor
Vehicles/Site Equipment	$1.26
Mining Subtotal	$2.98
Processing Plant	
Plant Earthworks	$0.69
Ore Preparation	$3.02
HPAL Circuit	$19.66
CCD Circuit	$5.38
Solvent Extraction Circuit	$6.63
Product Recovery Circuits	$2.94
Tailings Processing	$2.27
Reagent Storage	$0.37
Process Plant Subtotal	$40.96
Infrastructure/Site Costs	
First fills/Spares	$4.83
Evaporation Ponds-Tailings Dam	$2.34
Haul and Access Roads	$1.54
Utilities and Plant Services	$10.46
Construction Costs	$3.91
Plant Infrastructure	$6.78
Infrastructure Costs Subtotal	$29.86
General Development Costs	
EPCM Costs	$10.41
Owners Costs	$2.93
Development Costs Subtotal	$13.34
Total Project Capital Cost	$87.14
NOTE: Total capital costs include contingency of $8.26M plus freight and duty costs of $2.56M	

22.4 Operating Cost Summary

Annual cash operating costs are incurred in A$, but are shown in the summary table below in US$, having applied a A$1.00:US$0.7 exchange rate to convert local costs. The single largest processing cost is sulphuric acid (H_2SO_4), followed by labour costs and other reagents used in the solvent extraction circuits. Transport does contribute to these costs, as the property is in a rural location, but utilities are accessible and the pressure-based leach (HPAL) system is more efficient on almost all input quantities than atmospheric process systems previously tested.

The cash flow inputs reflect the key operating assumptions described in Table 22.4.

Table 22.4 Key Operating Costs Summary

Nyngan Project OpEx Mine/Process Expense	Average Annual Cost US$ M	Unit Cost/ Processed Tonne US$/tonne	Unit Cost/ Oxide kg US$/kg
Mining Costs			
Stripping Cost	$0.5	$7.49	$14.27
Mining Costs	$0.8	$10.96	$20.88
Total Mining Costs	$1.3	$18.45	$35.15
Processing Cost			
Labor Cost	$5.9	$82.19	$156.60
Utilities Costs	$2.2	$29.99	$57.15
Reagents	$7.1	$98.24	$187.19
Consumables	$0.6	$8.02	$15.29
Maintenance	$1.6	$22.80	$43.44
General	$0.16	$2.23	$4.24
Total Processing Costs	$17.5	$243.48	$463.92
General Costs			
Tailings Pond Costs	$1.1	$15.60	$29.72
Site G&A Costs	$0.6	$7.82	$14.90
Consultants & Marketing	$0.5	$6.76	$12.88
Total General Costs	$2.2	$30.18	$57.50
Annual Cash Operating Cost	$21.0	$292.10	$556.57

22.5 Project Scope

The cash model is based on a 20-year mine plan to process limonite resources only. Saprolite resources underlie the limonite, and they tend to hold lower scandium grades and require different leaching parameters to be effectively processed. SCY has completed adequate testing to determine that campaign-processing one resource type at a time, or potentially concurrently through separate process streams, is economically desirable as to cost and recovery.

The project will process 1.44 Mt of limonite resource out of a total 8.9 Mt of measured and indicated (M&I) limonite resource, at a planned average head grade of 408ppm, somewhat higher than the 277ppm average limonite resource (M&I) grade. The higher grade is achieved by mine location in higher grade sections of the resource. The overall resource (limonite and saprolite, plus minor amounts of included hematite and bedrock material) totals 16.8 Mt at 235ppm. Planned resource consumption, as outlined in this 20 year DFS, represents approximately 8.6% of the total available M&I resource.

Please refer to Sections 14 to 16 for further discussion on the ability of the mine plan to achieve these higher initial grades. The project plan calls for a 12 month construction program throughout 2017, wet commissioning in January to February 2018, followed by initial ramp-up production beginning in March 2018. The project is planned to reach annual nameplate capacity of 38 tpy scandia production in 24 months, in December 2019.

22.6 Basis of Review Estimate

Sales revenues are based on SCY pricing knowledge in the market today, independent spot market pricing done at the time of this report, direct conversations as to off-take and pricing with key customers, and an existing off-take agreement with a customer capable of processing scandia into master alloy or aluminium alloy. The market for scandium oxide is not developed, or at all transparent. Based on these market discussions, the Report establishes an average long term FOB price for oxide of US$2,000 /kg. See Section 19 for further detail.

22.7 Currency Exchange Rate Assumptions

The cash flow model is expressed in US dollars (US$), and any locally-sourced or Australian currency-based costs have been converted at an exchange rate of A$1.00:US$0.70. The US$ rate as of the writing of this report is US$0.75 (4 April 16).

The Australian dollar traded historically at or above parity with the US$ from 2011 through much of 2013, when it began a weakening trend against the US$ and other currencies. The currency settled into the A$1.00:US$0.75 range in 2015 and hit lows in the A$1.00:US$0.68 range in September 2015, repeated again in January 2016.

The Nyngan Project has exposure to a change in the A$ / US$ relationship, because operating costs are largely in Australian dollars, while revenues are expected to be denominated in US dollars, and with international customers. The project requires a 20-year view on exchange rates, although it will be most sensitive to rates in 2017, as that is the construction year for the project, and approximately 70% of the construction costs were bid in Australian dollars. This vendor bidding took place predominantly in Q1 2016, when the exchange rate was A$1.00:US$0.69 to 0.71. Banks and financial institutions offer forecasts, and the consensus offered on Bloomberg indicates A$0.71 cents for the first half of 2017, A$0.74 cents by the end of 2017, and A$0.75 cents as the broker-consensus forecast for full year 2018. The range of individual broker estimates in these years varies from A$1.00:US$0.67 to 0.89, with approximately 50% of the opinions at or under A$1.00:US$0.75.

Figure 22.1 Recent A$/US$ Exchange Rates

Source: Yahoo Finance, Historical Fx Rate Chart

22.8 Mine Closure and Salvage Costs

The cash flow model includes US$5.2M in costs for tailings pond closure, expensed one year after the final year of operation, which is 2038. The pond will likely have reached its optimal size at this time, and would need to be reclaimed in any event. The model does not include any costs for demolition of facilities, or recovery of value for equipment or facilities in the form of salvage. The site would be a suitable industrial site, with utilities services in place, perhaps suited to a solar farm similar to the AGL 102 MW solar farm located close to the mine site. This report did not conduct detailed investigations of alternate site uses for the project facility after 20 years, because the Measured and Indicated scandium resource is considerably larger than the current project would consume, allowing for either expansions of capacity, extensions of the 20-year initial time period of operation, or both. One or both of these project extensions is viewed as more likely, based on markets for product, than a closure of operations in 20 years.

22.9 Taxes and Royalties

The property is burdened by five royalties, each different as to amounts and the circumstance to which they have been established. Each has been modelled and included in the cash flow analysis. The royalties fall under two categories: revenue-based and profit-based, defined and detailed as follows:

- Revenue-Based Royalties, Levied on Revenue (less freight).
  - **Jervois Mining Limited Royalty**. 1.7% of actual sales prices on oxide, subject to a 10 tpy minimum once production commences, and a 12 year time period to expiry

- **Lenders Royalty**. 0.2% of actual sales prices on oxide, subject to a cap of US$370,000 total payout, expected to be approximately 2.5 years of production

- **New South Wales Mineral Royalty**. 4% on actual sales prices, but refining, processing, and freight costs may be deductible for calculation of royalty payable. The royalty runs in perpetuity

- **Jennings Royalty**. A 0.7% royalty payable on actual sales prices of scandium products or other mineral products, net of any freight costs. The royalty runs in perpetuity.

- NPI's – Net Profit Royalties, levied on Pre-Tax Income:

  - **Plumbum & Canateal Royalty**. 1.5% on actual sales prices, but all costs of production are allowable deductions, so this is a percentage on earnings before tax. The royalty runs in perpetuity.

Australian Federal corporate taxes are currently 30% on pre-tax income generated from Australia-source business assets and entities, and 30% is the long-term tax rate assumption applied to the project. There are opportunities for this rate to be reduced in 2016 (28% proposed), but the rates have not been made into law as of the writing of this report, and the current rates have been retained and applied.

Australia offers attractive research tax credits, referred to as an R&D Tax Concession Program. These credits are intended to encourage technology application in new businesses, and SCY anticipates that the Nyngan Project, as the first primary scandium mine / mill in Australia, would qualify. The new program offers a 45% refundable tax offset (equivalent to a 150% tax deduction) in advance of production, and a 40% non-refundable tax offset (equivalent to a 133% tax deduction) after revenues exceed A$20M. Foreign R&D spend is also eligible now, so long as it is matched by Australian-based R&D work. The cash flow model assumes A$1.5M in eligible benefits will generate a US$0.45M credit on company tax payable in the first year of operation, 2017.

Australia levies a Goods and Services Tax ("GST") on sales of most items. GST has not been included in the cost of all consumables that make up operating costs, and therefore no allowance has been made in the cash flow for recovery of the tax, which would otherwise be recoverable. Export sales of product are exempt from GST, and no Australian sales of product are assumed in the cash model.

22.10 Sensitivities to Key Variables

Various project economic and operating risks to the base case development plan were assessed and can be seen below. The risks were segregated into three categories, as follows:

- Sensitivity to product pricing assumptions, as shown in Table 22.5.

- Sensitivity to other operating financial parameters, such as production cost, capital cost, and exchange rate changes. Product pricing variances are shown again, but in scale to the other variants in this table (± 10%). These sensitivities are shown in Table 22.6.

- Sensitivity to production and operating parameters, such as mill recoveries, mill availabilities, the production ramp-up timeframes to nameplate capacity, and resource head grade assumptions, as shown in Table 22.7.

As illustrated in the three tables below, the project generally maintains IRR's of 30% under negative variances of 10% over most of the typical exposure elements in operations.

- Product price sensitivity beyond 10% is significant, although pricing variances would need to approach high cost producer cash costs to drop the IRR below 20%.

- Exchange rates are an exposure area, as the project is a US-functional currency project, with virtually all operating costs and a majority of the initial capital spend grounded in Australian dollar terms. The FX rate used in the DFS reflects the Q1 2016 rate at the time capital and operating cost bids were submitted. Australian sourced equipment, which benefited significantly from the weak A$ during this timeframe, may not remain competitive against Asian or US capital item bid options at some of the unfavourable exchange rate scenarios explored in the sensitivities table.

Table 22.5 Sensitivity to Product Price

Project Financial Sensitivity to Product Price	**Constant Dollar (after Tax) Project NPV at Various Discount Rates and Various Oxide Product Prices (US$)**					
Product Price (US$/kg)	**$1,200**	**$1,500**	**$2,000**	**$2,500**	**$3,000**	**$3,500**
Constant Dollar						
Net Present Value (US$ M)						
6% Discount	**$82.4**	**$159.7**	**$287.6**	**$414.9**	**$542.2**	**$669.4**
8% Discount	**$55.1**	**$119.3**	**$225.3**	**$330.9**	**$436.3**	**$541.7**
10% Discount	**$34.3**	**$88.3**	**$177.5**	**$266.1**	**$354.7**	**$443.1**
Internal Rate of Return (IRR)	**15.2%**	**22.4%**	**33.1%**	**42.8%**	**52.0%**	**60.6%**

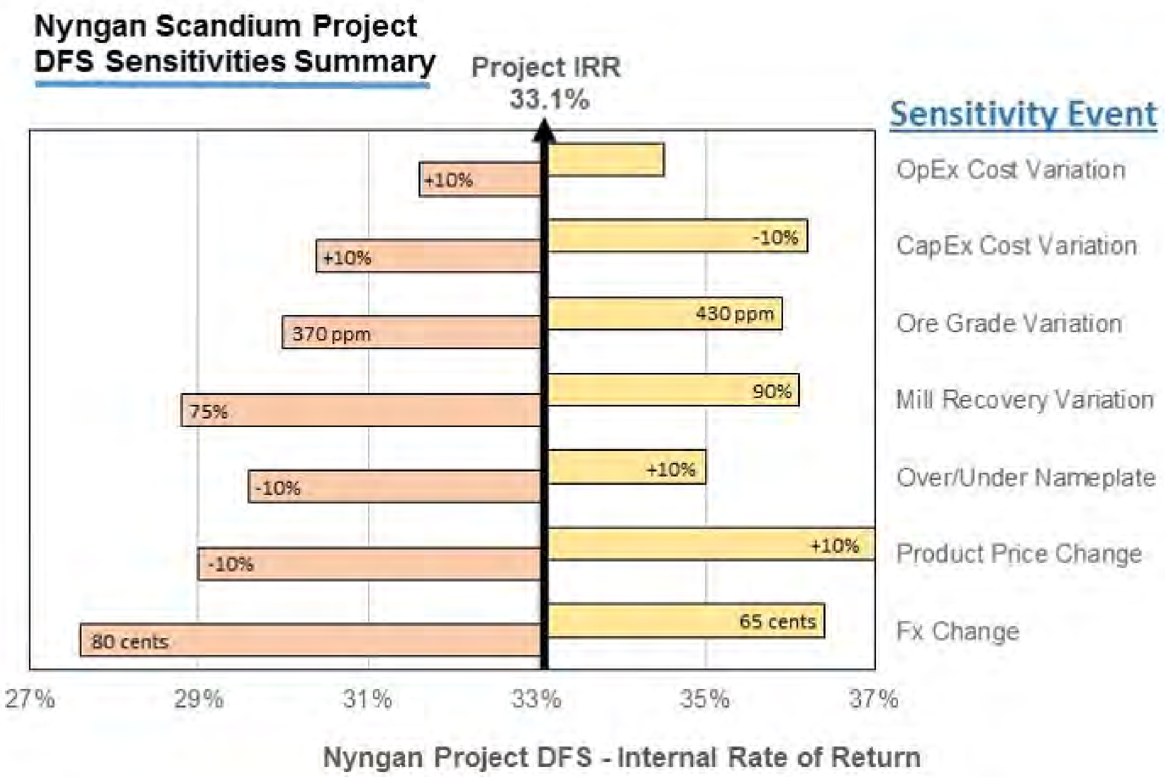
Table 22.6 Financial Parameters Sensitivity

Sensitivity to Financial Parameters	NPV (10%i) US$ M	IRR (%)
Feasibility Study Result	$177.5	33.1%
Operating Cost Sensitivity		
Cost Increase (10%)	$166.3	31.6%
Cost Decrease (10%)	$188.7	34.5%
Price Sensitivity		
Lower Realized Oxide Price (10%)	$142.0	29.0%
Higher Realized Oxide Price (10%)	$212.9	37.0%
Capital Cost Sensitivity		
Higher Capital Cost (10%)	$169.6	30.4%
Lower Capital Cost (10%)	$185.4	36.2%
Fx Sensitivity ($0.70)		
US$/A$ @ $0.80	$150.3	27.6%
US$/A$ @ $0.75	$163.9	30.2%
US$/A$ @ $0.65	$191.3	36.4%

Table 22.7 Sensitivity to Operating Parameters

Sensitivity to Operating Parameters	NPV (10%i) US$ M	IRR (%)
Feasibility Study Result	$177.5	33.1%
Mill Recoveries (83.7%)		
Recovery Decrease (75%)	$140.7	28.8%
Recovery increase (90%)	$204.2	36.1%
Mill Availability (85.6%)		
Availability Decrease (82%)	$169.4	32.2%
Availability Increase (90%)	$187.1	34.1%
Initial Ramp to Capacity (2 Years)		
Slower Production Ramp (3 Years)	$163.5	30.0%
Faster Production Ramp (1 Year)	$199.1	40.3%
Ore Grade Sensitivity (409ppm)		
Lower Plant Feed Grade (370ppm)	$148.8	30.0%
Higher Plant Feed Grade (430ppm)	$201.1	35.9%
Over/Under Design Capacity		
Lower Throughput by 10%	$147.3	29.6%
Lower Throughput by 20%	$117.0	26.0%
Higher Throughput by 10%	$200.0	35.0%

Figure 22.2 Sensitivities Diagram



23.0 ADJACENT PROPERTIES

The area is generally agricultural and as such there are no significant adjacent mineral properties.

EMC-A has another Exploration Licence to the south of the deposit within trucking distance, known as Honeybugle. This property has also shown scandium enriched laterites but is still at the exploration stage.

24.0 OTHER RELEVANT DATA AND INFORMATION

24.1 Project Risks

24.1.1 Overview

Risk management is an integral component of project management and provides project managers with a set of tools to assist with project planning and execution. Additionally, risk management provides assurance to key stakeholders that a credible and structured process has been undertaken in identifying, evaluating, analysing and treating the risks associated with the project development and the project's jurisdiction. Assurance and confidence is achieved by demonstrating that:

- Risks to the project have been identified, assessed and categorised.
- Risks have been mitigated, as much as possible.
- "Remaining" or "inherent" risks associated with the investment opportunity are clearly stated and the future variance in the project has been documented as much as possible to limit impact on the project resulting from unidentified risks.

An initial risk register has been prepared for the project. This risk register has been populated by the following contributing companies:

- SCY/EMC-A.
- Lycopodium.
- Altrius Engineering.
- Knight Piésold.
- Mining One.
- RW Corkery.

Risks have been categorised into the following areas:

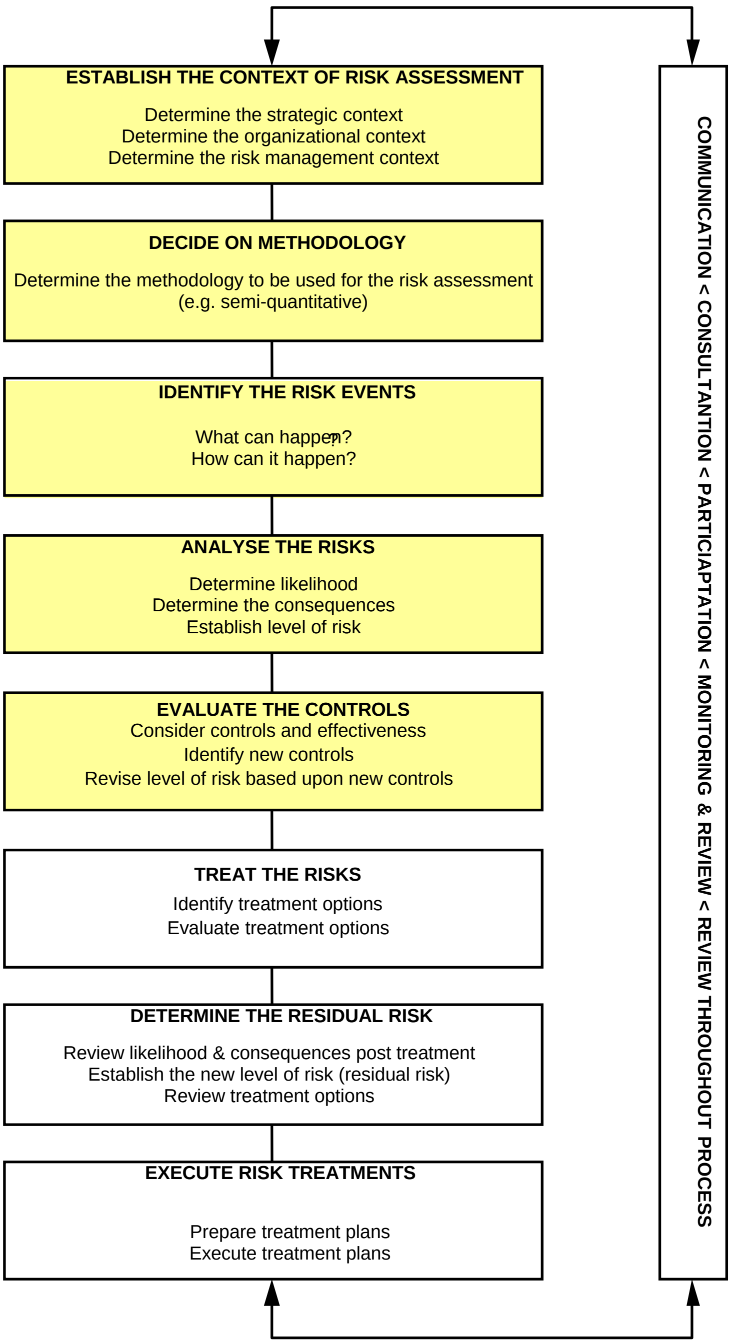
- Political.
- Environmental.
- Health and Safety.
- Contract.

- Commercial.
- Client.
- Resources.
- Technical.
- Program.
- Physical.

24.1.2 Risk Assessment Process

The risk identification process was based on guidelines provided by Lycopodium. An overview of the risk assessment process is presented in Figure 24.1.

Figure 24.1 Risk Management Process



The first two steps in Figure 24.1 relate to the context and method utilised in the risk assessment process.

24.1.3 Risk Definitions

Risk

Risk is defined as the chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood.

Risk Assessment

A risk assessment provides the project with a structured process for identifying and responding to risks that may affect the project's achievement of objectives. It is the overall process of risk analysis and risk evaluation.

Consequence

The impact is the effect on the project phase if a given event occurs. Consequence criteria are defined in Table 24.1.

Likelihood

Likelihood represents the possibility that a given event will occur. Likelihood criteria are defined in Table 24.2.

Risk Ranking

The ranking of risks based upon an assessment of the likelihood and consequence. This provides a mechanism for prioritising action plans. Risk rankings are defined in Table 24.3.

Risk Control

That part of risk management, which involves the implementation of policies, standards, procedures and physical changes to eliminate or minimise diverse risks.

Note: The implementation of controls provides two potential benefits:

- To reduce the likelihood and/or the consequences if the event occurs.
- May provide additional "upside" benefits as a result of the new control, e.g. a new control implemented to mitigate a risk event, may increase capacity of the process, thus having a direct financial (or other) benefit.

Risk Appetite

The level of risk an organisation is willing to take to achieve the desired return.

Risk Response

Control measures for the treatment of risk have been considered as follows:

- Elimination.
- Substitution.
- Isolation.
- Administration.
- Training.
- Personal Protective Equipment (PPE).

Table 24.1 Risk Consequence Criteria

Level	Rating	Health & Safety	Environmental	Community	Legal Compliance	Estimated Cost*
1	**Insignificant**	First Aid Injury (FAI)	No or very low environmental impact Impact confined to small area	Isolated complaint No media enquiry	Minor technical / legal compliance issue unlikely to attract a regulatory response	> $1,000
2	**Minor**	Medical Treatment Injury (MTI) Restricted Work Injury (RWI)	Low environmental impact Rapid cleanup by site staff and/or contractors. Impact contained to area currently impacted by operations.	Small numbers of sporadic complaints	Technical / legal compliance issue which may attract a low level administrative response from regulator. Incident requires reporting in routine reports (eg. Monthly).	> $10,000
3	**Moderate**	Single Lost Time Injury (LTI)	Moderate environmental impact.	Serious rate of complaints, repeated complaints from the same area (clustering). Increased local media interest	Breach of regulation with possible prosecution and penalties. Continuing occurrences of minor breaches Incident requires immediate (within 48 hours) notification	> $100,000
4	**Major**	Multiple Lost time Injuries (LTI)	Major environmental impact.	Increasing rate of complaints, repeated complaints from the same area (clustering).	Major breach of regulation resulting in investigation by regulator.	> $1,000,000

Level	Rating	Health & Safety	Environmental	Community	Legal Compliance	Estimated Cost*
		Admission to intensive care unit or equivalent Serious, chronic, long term effects	Considerable cleanup effort required using site and external resources Impact may extend beyond the lease boundary	Increased local/national media interest	Prosecution, penalties or other action likely	
5	**Catastrophic**	Fatality(s) or permanent disability	Severe environmental impact. Local species destruction and likely long recovery period Extensive cleanup involving external resources Impact on a regional scale.	High level of concern or interest from local community National and/or international media interest	Serious breach of regulation resulting in investigation by regulator Operation suspended, licenses revoked	> $10,000,000

***Cost - includes estimated costs for cleanup, remedial measures or financial liability**

Table 24.2 Risk Likelihood Criteria

Level	Description	Criteria
A	Always / Certain	• The impact will occur. • The impact occurs in all circumstances. • The impact occurs daily.
B	Likely	• The impact is expected to occur. • The impact will occur in most circumstances. • The impact occurs weekly / monthly.
C	Possible	• The impact will probably occur. • The impact has occurred before. • The impact will occur under some circumstances. • The impact occurs annually.
D	Unlikely	• The impact could occur at some time. • The impact has happened elsewhere (possibly recently). • The impact occurs every ten years or so.
E	Rare	• The impact may occur in very exceptional circumstances. • A similar incident has occurred elsewhere. • Almost impossible.

Table 24.3 Risk Levels

Likelihood	Consequence				
	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
Always	H	H	E	E	E
Likely	M	H	H	E	E
Possible	L	M	H	E	E
Unlikely	L	L	M	H	H
Rare	L	L	M	M	H

Risk Level	Priority	Example Action
Extreme	1	Cease activity or task; detailed research and planning required
High	2	Senior management attention; immediate corrective and preventative action required
Moderate	3	Management responsibility assigned; corrective and preventative action plan developed
Low	4	Manage by routine procedures; accept risk

24.1.4 Risk Management Plan

The risk register will be an essential tool for the ongoing management of the project risk profile. Moving forward, it will be maintained by the EMC-A team and be reviewed frequently, with mitigating strategies being reviewed for effectiveness and modified if necessary.

As the project proceeds through the next phases of the development lifecycle, risks will change in accordance with activities carried out during these phases. To ensure that existing risks are reviewed, and new risks identified and assessed, risk assessment will be undertaken during each subsequent phase of the project. The risk assessment outcomes will provide a solid foundation for the development of action plans to address the perceived risks.

24.1.5 Identified Extreme Risks

A summary of the extreme risk events identified in the initial risk register and the proposed new control measures Table 24.4, by area.

Table 24.4 Identified Extreme Risks

Area / Risk ID	Risk	Proposed Control Measure
Political		
Environmental		
Health and Safety		
Resources		
Technical		
TEC-3-04	Unable to connect to grid power. The existing 33kV supply line has insufficient capacity to supply power to the plant. It requires an upgrade, and this must be undertaken by the responsible party, Essential Energy. There is some risk that this work may not be completed in time for plant start-up.	The progress of Essential Energy in upgrading the 33kV supply line needs to be monitored during detailed design. If there is some doubt over their ability to deliver, alternatives such as additional diesel generators should be incorporated into the plant.
TEC-4-0025-02	Lower than expected settled residue density due to lower % solids sent to facility (thickener problems)	Additional thickener testing of multiple samples at final design stage. Additional tailings testing at a range of % solids at final design stage
TEC-8-01	Insufficient demand for product	Marketing strategy involves direct contact with businesses that can select scandium-content materials, reducing the likelihood that intermediary distributors won't effectively sell the product to end-use customers
Program		
Physical		

24.2 Opportunities

A number of opportunities have been identified during the course of the study. These include:

- ***Alternative Sulphuric Acid Supply***. Currently, it is intended to ship sulphuric acid to site from a NSW coastal port. It is possible that by the time the Project is built that an alternative supply of sulphuric acid will be available from the Dubbo

Zirconia Plant located approximately 200 km from the site. This would likely result in a reduced cost of sulphuric acid supply.

- ***In-Pit Residue Disposal*.** There is some potential that residue streams may be able to be stored within the mine pit at a future point (say year 10 of operation) rather than being stored in the above-ground residue storage facility. If this were to occur, the future costs of raising the walls of the residue storage facility would be reduced.

- ***Reduction in Residue Storage Facility Liner Requirements*.** Recent test work results have indicated that the concentration of chromium VI in the residue may be effectively managed to significantly lower levels than the concentration indicated in the residue testing conducted by Knight Piésold for the original design of the RSF. If this test work can be confirmed, it has the opportunity to reduce the liner requirements within the RSF.

- ***Removal of Regeneration Stage in Solvent Extraction*.** Recent test work has indicated the potential to remove the regeneration stage in the solvent extraction circuit, without a negative impact on either recovery or product purity. Further test work may confirm this potential.

- ***Reduction in HCl Acid Consumption*.** Recent test work has indicated the potential to reduce the HCl and chloride concentrations in the solvent extraction strip liquor, without a negative impact on either recovery or product purity. Further test work may confirm this potential.

- ***Increase in Product Purity*.** Recent test work involving optimising the calcination temperature for the oxalate and alternative wash solutions has indicated the potential to produce higher purity scandium oxide product. If scandium oxide can be produced at 99.9% purity, this is likely to attract a premium in the market, with customers who require this purity level.

25.0 INTERPRETATION AND CONCLUSIONS

25.1 Technical

This Technical Report details the engineering and study work that examines continuous high pressure acid leaching of the Nyngan scandium deposit and subsequent processing to produce a scandium oxide product. The basis for the design has been dedicated test work specifically addressing the flowsheet that has been developed by Lycopodium and Altrius Engineering Services. The flowsheet used in the PEA for the project has been superseded and improved. Some aspects of the flowsheet are the subject of patent applications and have not been detailed fully to avoid potential voiding of patent claims. Overall processing facility recovery of scandium is 83.7% and product purity has increased substantially compared to the process that was detailed in the PEA.

The Lycopodium and Altrius Engineering Services technical teams have reviewed the test work that forms the basis of the flowsheet detailed in this report, and are satisfied that HPAL leaching, followed by solvent extraction with a primary amine and scandium oxalate precipitation and calcination has been demonstrated by test work and process modelling to be a viable process flowsheet. It is noted that the full process has not been piloted in a locked cycle fashion, and as a result there remains some technical risk with respect to build up of impurities in recycle streams. However, it is considered that sufficient margin has been allowed in the design to accommodate this risk. Additional test work has been recommended in Section 26.1.3 to address this. Dr. Nigel Ricketts has personally directed some of the test work to ensure that it meets the requirements to develop capital and operating costs to the level required for a definitive feasibility study.

Resource definition is at a suitable level for project development. The current process plant design is suitable for the limonite portion of the resource only. The 20 year mine plan defines and utilises Reserves in the Proven and Probable classification.

The Lycopodium technical team have developed a mechanical equipment list and process engineering variables which have been used to developed a capital cost estimate consistent with +15%/-5% accuracy. They have also developed a rigorous operating cost estimate, with reagent usage data provided by a fully converged METSIM mathematical model of the proposed process. The accuracy of the operating cost provided is ± 15% accuracy.

Mining costs have been developed by Mining One via a process of preliminary tendering with a number of local contractors. Pricing was based on preliminary scheduling and design and are subject to the costings for load and haul at the time of conducting this study and are consistent with a +15%/-5% accuracy. Additional services have been obtained from industry suppliers and have been built into the mining cost model accordingly.

The infrastructure for the project is excellent and well understood. Plans appear to be in place to continue with progression of these in the future. Evidence of suitable negotiations with government agencies and major suppliers was provided to the QPs.

Both water supply and electricity supply contracts will need to be finalised. Opportunities exist for negotiation on sulphuric acid and LPG gas supply contracts or even replacements with LNG as an alternative.

25.2 Commercial

In development of a capital cost estimate, the technical team has taken into account the relatively small size of the operation. The ability to employ modular design systems, consisting of modules of multiple pieces of equipment, has been considered, in particular. in the feed preparation and solvent extraction circuits.

The capital cost and operating cost estimates have been used in a financial model that is consistent with industry norms. The model includes provisions for sustaining capital costs and owner's costs.

A US$2,000 /kg sale price for scandium oxide has been used. This price is conservative based on current prices. This price is supported by a three year sales contract for approximately 27.5% of estimated plant production over the three year period, and 56% of estimated plant production in the initial production year.

An independent marketing study, commissioned by SCY has forecast growth in the scandium market exceeding the capacity of the proposed plant, by a factor of two to four times over the 10 year market demand estimate. The marketing study focussed this demand estimate on two principal market opportunities, while SCY considers many more potential markets to be viable as well.

26.0 RECOMMENDATIONS

26.1 Technical

26.1.1 HPAL Leaching

Further work in HPAL leaching is recommended to test a number of parameters which have design implications for equipment selection:

- Further test work on the optimum slurry density in the autoclave.
- HPAL work on the limonite material from the area known as the eastern pit, as this is potentially higher grade material.
- Examining process variables to attempt to reduce the soluble aluminium content in the leach solution.

26.1.2 CCD Circuit

Further work is recommended to examine a broader range of flocculants and coagulants to improve the CCD thickener underflow density in an effort to reduce soluble scandium losses

26.1.3 Solvent Extraction

Whilst the solvent extraction flowsheet appears to be robust, further solvent extraction test work is recommended on solution straight from HPAL operations, preferably utilising an extended pilot plant operation.

26.1.4 Tailings

While the Residue Storage Facility is relatively small, the tailings dam design will still need to be engineered. This activity should include test work on final settled density (once the CCD work has been concluded) and the effect of likely impurities in the decant water from the tailings dam when it is returned to the process water circuit.

26.1.5 Scandium Oxalate Precipitation

Scandium oxalate precipitation test work should be conducted on real HPAL solutions that have passed through solvent extraction in order to determine the following:

- Further definition of the operating window where high grade hydrated scandium oxalate is produced.
- Further definition of the operating window for calcination of the hydrated scandium oxalate precipitate, including potential differential thermal analysis.

26.1.6 Mining

Mining cost data and production data are consistent with the requirements of a feasibility study however further work is recommended to validate the robustness of the input assumptions, including:

- Extending test work on core to include mechanical properties of the lateritic material to validate the free dig assumptions applied in this study.
- Validating groundwater flow by conducting additional pump tests on a number of local bore holes.

26.2 General

The project has been shown to have developed a viable process flow sheet and modelled economic analysis has been shown at the DFS level to be attractive. The recommendation is therefore to proceed to project construction. The following engineering pre-work is recommended:

- Finalising / optimising the flowsheet with the recommended test work.
- Examining possible alternative project execution strategies.
- Additional specific and detailed discussions with vendors on the long lead items, in particular those associated with the autoclave.
- Commencement of long-term tailings stability studies.
- Advanced geotechnical studies to support mine engineering, Residue Storage Facility design, and process plant site design.

Marketing efforts should be continued, with the goal of developing further off-take arrangements. Increasing the surety that product produced from the Nyngan plant will have a ready market, at the projected price structure, will enhance the prospects of financing the project under favourable terms.

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