



**Trans-Tasman Resources Ltd**  
**Offshore Iron Sands Project**  
**Flowsheet Optimisation Proposal**

CONFIDENTIAL

Project No: P5028

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P5028 – Trans-Tasman Resources Limited							
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## TABLE OF CONTENTS

1. INTRODUCTION.....	2
2. SCOPE OF WORK .....	3
2.1 Stage 1: Mineralogical Characterisation and Concept Testwork .....	3
2.1.1 Testwork Management and Supervision.....	3
2.1.2 Reporting.....	3
2.2 Stage 2: Optimisation Testwork .....	3
2.2.1 Testwork Management and Supervision.....	4
2.2.2 Flowsheet Development.....	4
2.2.3 Reporting.....	4
2.3 Stage 3: Process Design (outside of current scope).....	4
3. DELIVERABLES .....	5
3.1 Stage 1: Proof-of-Concept .....	5
3.2 Stage 2: Process Optimisation.....	5
3.3 Stage 3: Process Design (out of current scope) .....	5
4. SAMPLE REQUIREMENTS.....	6
5. COSTS .....	7
6. PERSONNEL .....	8
7. DELIVERY.....	10
APPENDIX A – PERSONNEL RESUMES .....	11
APPENDIX B – AGREEMENT FOR CONSULTING SERVICES .....	22
APPENDIX C – COMPANY CAPABILITY STATEMENT .....	47

## 1. INTRODUCTION

Alan Eggers, Executive Chairman of Trans-Tasman Resources requested that Damian Connelly, Director/Principal Consultant from METS Engineering Group Pty Ltd (METS) prepare a scope of work to design and manage testwork for the Offshore Iron Sands Project, located off the west coast of the North Island of New Zealand.

TTR propose to extract up to 50 million tonnes of seabed sediment per annum and process the sediment aboard a mining vessel producing approximately 5 Mtpa of iron ore concentrate for concentrate whilst re-depositing the remaining sediment on the seafloor in a controlled manner. The process has been piloted using different grade bulk samples. The iron concentrate contains high levels of phosphorous and manganese.

There has been a significant amount of capital that has gone into developing the project. It appears that a substantial portion of the capital has understandably gone into the development of the vessel-based processing plant and the associated marine complexities. Due to this, there is the concern that the flowsheet design has not been investigated to the extent required, and there may be room for optimisation. Changes to the flowsheet should be made at this point in the project development, where the money required to make changes is significantly less than when in operation. There is a potential to add value to the project by assessing possible by-products (i.e. zircon and garnet) and increasing iron grade to levels that become more attractive from a marketing perspective.

The following document outlines METS proposal to prepare and manage testwork with the aim of improving the current flowsheet. Throughout the proposed scope of work, METS will aim to:

- Be innovative with solutions – “go the extra mile”
- Produce results through experience and knowledge in this area
- Add value to the project – introduce concepts that may have previously not been considered
- Develop an ongoing relationship with our clients facilitating the next stage of study as required
- Produce a study report with interpretation – not simply a repeat of factual test results

## 2. SCOPE OF WORK

A staged approach has been selected for the overall scope of work. The following scope of work is envisaged based on the discussion between Alan Eggers and METS:

### 2.1 Stage 1: Mineralogical Characterisation and Concept Testwork

METS aim to characterise the iron sands prior to beneficiation testwork. The purpose of the mineralogical characterisation is to determine how the elements are distributed throughout the sand. This will assist in explaining the past results and form the basis of test plan development for concept work.

Following characterisation testwork METS will design concept testwork to assess options for improving the process flowsheet. Following analysis of the results METS will recommend if there is scope to proceed to Stage 2 of the proposed work.

Key outcomes from this stage of the testwork include:

- Classification of how elements are distributed amongst minerals
- Identification of potential to improve the current flowsheet

#### 2.1.1 Testwork Management and Supervision

METS will design a testwork programme to be conducted at the Iron Ore Technical Centre (IOTC) and provide ongoing management and supervision of the testwork. METS will go to the IOTC to view major tests, which enables on-the-spot decisions to be made if necessary.

#### 2.1.2 Reporting

METS will issue a metallurgical testwork draft report, which will later be updated and issued as a final report based on any feedback provided by TTR.

### 2.2 Stage 2: Optimisation Testwork

METS aim to further development process options identified in Stage 1 of the testwork programme with a larger scale optimisation testwork programme.

Key outcomes from this stage of the testwork include:

- Validation of suggested changes to the flowsheet
- Updated flowsheet
- Recommendations on the way forward

### **2.2.1 Testwork Management and Supervision**

METS will design the optimisation testwork programme to be conducted at the IOTC and provide ongoing management and supervision of the testwork. METS will go to the IOTC to view major tests, which enables on-the-spot decisions to be made if necessary.

### **2.2.2 Flowsheet Development**

Based on the outcomes of the optimisation testwork, METS will develop what it considers an 'optimal' flowsheet for TTR's iron sand project.

### **2.2.3 Reporting**

METS will issue a metallurgical testwork draft report, which will later be updated and issued as a final report based on any feedback provided by TTR.

## **2.3 Stage 3: Process Design (outside of current scope)**

METS have included an additional stage to the scope of work for consideration. Stage 3 of the scope of work describes the proposal to develop updated processing options based on the testwork in stage 1 and stage 2. METS can perform an engineering study after the testwork that includes the following:

- Process Description
- Mass Balance
- Mechanical Equipment List
- Capital Cost Estimation
- Operating Cost Estimation

### **3. DELIVERABLES**

The proposed scope of work is divided into three stages. The final deliverables for each stage of the project are as follows:

#### **3.1 Stage 1: Proof-of-Concept**

- Metallurgical testwork report
- Recommendations of the way forward

#### **3.2 Stage 2: Process Optimisation**

- Metallurgical testwork report
- Updated flowsheet
- Recommendations on the way forward

#### **3.3 Stage 3: Process Design (out of current scope)**

- Mechanical Equipment List
- Mass Balance
- Process Description
- CAPEX
- OPEX
- Final Report

The following assumptions will be used by METS for the project:

- All documents sent to the client will be in a read only format
- All meetings will be held at METS offices (teleconference facilities available)
- It is assumed that all testwork will be conducted in Perth based laboratories
- It is assumed that suitable samples for testwork are available now (if required)
- Client meeting/conference calls scheduled fortnightly with key METS team.

#### 4. SAMPLE REQUIREMENTS

METS recommends that if the optimisation stage is performed, then the sample should be the same as the concept testwork. METS request that **1-2 tonnes of representative feed** material be made available for the testwork.

If possible, METS also request that a sub-sample (20 kg) of unground concentrate be sent with the bulk sample. If there are any reserved feed and final concentrate samples from the pilot plant work, small sub-samples (5 kg) could be sent with the bulk sample and undergo the same characterisation testwork in order to benchmark the results.

METS preference of laboratory to undertake the metallurgical testwork is the Iron Ore Technical Centre (IOTC), a branch of ALS. The IOTC is located in Perth, which will allow METS personnel to view the testwork.

##### **Sample delivery details**

Iron Ore Technical Centre

Attention: Aden Tan

26 Rigali Way

Wangara, Western Australia 6065



## 5. COSTS

Based on the scope of work, reporting, project management, meetings and administration costs, the total cost of proposed work for stage 1 is estimated to be **AU\$57,291**. The total cost of stage 2 is estimated to be **AU\$91,950**. The breakdown for each stage of the project can be viewed in Table 1 below. Testwork costs are budgetary estimates only and are subject to an agreed scope and written quotations. The estimates for METS costs include a 7% administration fee. The cost for stage 3 has not been estimated and would be evaluated if the stage 2 results are promising.

**Table 1: Cost estimate**

Activity	Estimated Hours	Estimated Cost (\$AU) ex GST
Stage 1		
METS costs	89	\$17,291
Lab testwork estimate		\$40,000
<i>Stage 1 Subtotal</i>	89	57,291
Stage 2		
METS costs	169	\$31,950
Lab testwork estimate		\$60,000
<i>Stage 2 Subtotal</i>	169	\$91,950
<b>Total</b>	<b>258</b>	<b>\$149,240</b>

The price is an estimate only and is exclusive of GST and incidental reimbursable expenses such as travel, travel medical and courier costs. Any work requested outside the agreed scope will be charged according to METS schedule of rates seen in the table below.

**Table 2: Schedule of rates**

Role	Hourly Rate
Director/Principal Consulting Engineer	\$250
Senior Consulting Metallurgist	\$250
Process Engineer	\$180
Graduate Process Engineer	\$145

### Terms of Payment

Progress invoices will be presented for payment within 30 days of the end of the month during which the assignment is in progress.

### Acceptance

A valid purchase order is required as proof of acceptance of this proposal along with acceptance of our standard agreement for consulting services document. This document is provided in the email attachments.

### Validity

This proposal is valid for 30 days from the date hereon.

## 6. PERSONNEL

METS has assembled a team of technical and commercial specialists with appropriate skills and experience specifically to suit this project. The team members are listed in the table below.

**Table 3: METS personnel**

METS Employee	Title / Role
Damian Connelly	Principal Consulting Engineer
Denis Yan	Consulting Metallurgist
Brett Morgan	Process Engineer
Josh Brown	Process Engineer
Brendon Nicol	Graduate Process Engineer
Joshua Hirsch	Graduate Process Engineer



**Mr Damian Connelly (Director/Principal Consulting Engineer)** is a Consulting Engineer with extensive experience on a range of commodities. Experience has been gained in plant operations feasibility studies, detailed design, construction and commissioning, and all unit operations. A wealth of hands-on operating experience as a Foreman, Plant Metallurgist, Plant Superintendent, Chief Metallurgist and Project Manager, which has provided Damian with a solid base to mix with engineering and construction management. For the last 24 years he has worked as a Consultant Metallurgist for mining, banking and engineering companies which has provided him with a broad range of experience.



**Dr Denis Yan (Consulting Metallurgist)** has over 40 years of experience in mining and during this time has had vast experience in most mineral processing environments. Most of Denis' background is in senior university roles where he led substantial cutting edge research programmes and taught at the WA School of Mines as Programme Chair (Metallurgy). Denis is the author of 32 papers and the popular resource text in mineral processing, "Mineral Processing Design and Operations", Elsevier Amsterdam 2006. During the Iron Road Ltd project PFS Denis carried out the modelling of the SAG- ball mill flowsheet option using JKSimMet.



**Mr Brett Morgan (Process Engineer)** is a Process Engineer who specialises in process design and the development of metallurgical testwork programmes. Additionally he has completed numerous projects from scoping studies to definitive feasibility studies. His degree in Chemistry gives him a different perspective on the mineralogical problems that may be encountered during a testwork programme and the processing of an ore. Brett is proficient in the research and design of metallurgical test plans at all project stages, mass and heat balances, PFD construction, capital and operating cost estimations and process design. He is skilled in process simulation utilising industry standard software packages as well as various in house methods to confirm process design parameters.



**Mr Josh Brown (Process Engineer)** is a Process Engineer with a background and keen interest in the resource industry. He has had previous exposure to a range of processing plants including mineral sands wet and dry concentrators, synthetic rutile plants, a gold flotation concentrators and CIL circuits, nickel refinery, alumina refinery and titanium pigment plant. As an engineer at METS Engineering Group, some of the work Josh has been involved in includes testwork design and supervision, plant design, process simulation, product development, cost estimation and economic analysis. He has gained experience in a wide range of commodities including lithium, cobalt, titanomagnetites, gold, copper and more. Josh has been exposed to projects ranging from conceptual, scoping, feasibility and implementation stages.



**Mr Brendon Nicol (Graduate Process Engineer)** is a Graduate Process Engineer with experience in mineral consulting engineering. He completed a double degree in Chemical Engineering and Chemistry at the University of Western Australia and has gained industry experience with an internship at METS where he performed operating and capital costs estimations, developed flowsheets and mass balances for projects as well as making valuable contributions to metallurgical reports.



**Mr Joshua Hirsch (Graduate Process Engineer)** is a Graduate Process Engineer with operational and laboratory experience in iron ore processing. He has specific expertise in silica flotation, pressure filtration, plant surveying and magnetite concentration processing. He has completed a Bachelor of Engineering degree, majoring in Chemical and Process Engineering from the University of Western Australia. Joshua is a dedicated and hard worker who has demonstrated the ability to pick up new concepts quickly in a challenging work environment. He is comfortable with working on intellectually sensitive projects and is growing his experience by working on a number of various commodity projects.

## 7. DELIVERY

### Form

The report will be issued as a Portable Document Format (PDF) file, suitable for email.

### Reporting

METS will issue the reports in Portable Document Format (PDF). A fortnightly Project Status Report (PSR) will be issued. Meetings will be held to discuss milestones and future works. Reporting will be directed to Alan Eggers.

### Schedule

The timing for the metallurgical testwork design and management is subject to an agreed scope and the outcomes of the sighter testwork. Concept testwork generally has a variable scope and therefore timing. METS has estimated the timing, although this is subject to change.

- The metallurgical testwork report for Stage 1 is expected to be available **eight (8) working weeks** after the receipt of the bulk sample.
- The metallurgical testwork report for Stage 2 is expected to be available **eight (8) working weeks** after completion of Stage 1 of the project.

### Liability

The liability in respect of any claim arising out of or in connection with the services, the project or the relationship established by this agreement, whether arising in contract, in tort, in equity or by statute is limited to the repetition by METS in accordance with this proposal of any part of the services which are shown to be deficient. The terms and conditions of our consulting services can be viewed on our website for further details.

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## APPENDIX A – PERSONNEL RESUMES



**Damian Connelly**  
Principal Consulting Engineer

## EDUCATION AND QUALIFICATIONS

Bachelor of Applied Science, Adelaide University  
Chartered Professional (CP)

## PROFESSIONAL AFFILIATIONS

Fellow, Australasian Institute of Mining and Metallurgy (AusIMM). Fellow-Engineers Australia (FIEAust) Member, Mineral Industry Consultants Association (MICA) Society for Mining, Metallurgy, and Exploration, Inc-(SME) Member, Canadian Institute of Mining and Metallurgy (CIMM) Fellow, Australian Institute of Management (AIM) Member, South African Institute of Mining and Metallurgy (SAIMM) Member, Western Australian Chinese Chamber of Commerce (WACCC)

## KEY EXPERIENCE

Damian is a Consulting Engineer with extensive experience in the gold, copper, lead, zinc, uranium and iron ore industries with particular emphasis on gold. Experience has been gained in plant operations feasibility studies, detailed design, construction and commissioning, and all unit operations. He is an internationally recognised specialist in mineral processing having worked in North and South America, South East Asia, Africa and Europe.

A wealth of hands-on operating experience as a Foreman, Plant Metallurgist, Plant Superintendent, Chief Metallurgist and Project Manager has provided Damian with a solid base to mix with engineering and construction management.

The last 7 years he has worked as a Consulting Metallurgist for mining, banking and engineering companies have provided a broad range of experiences in many varied and some unique situations. Damian's industry based training courses (40) have been run on a regular basis, both in Australia and overseas, and are highly regarded and have been well attended. Damian is a Registered Expert Witness and has been engaged on many cases.

Damian is a Principal Engineer and oversees a staff of over 40 Engineers. He has authored and presented over 80 technical papers.

## AREAS OF PARTICULAR EXPERTISE

- Business and project development;
- Project and plant audits;
- Due diligence gold, base metals, vanadium, iron ore, industrial minerals;
- Competent Persons Reports;
- Engineering tenders;
- Plant design;
- Expert witness;
- Conceptual project development and troubleshooting;
- Metallurgical accounting/toll milling;
- Flotation – particularly column flotation;
- SAG milling, ball mills and crushing;
- CIP gold and refractory gold metallurgy;
- Process engineering and optimization;
- Heap and dump leaching, agglomeration;
- Solvent extraction copper cobalt/nickel/ uranium; and
- Smelting & roasting.



## RECENT PAPERS PRESENTED

- “Karouni Gold Project from Drill Core to Commissioning” METPLANT, Perth, September 2015
- “What is the Future for Magnetite Projects in Australia and Why Have Some of the New Projects Been so Problematic?”, IRON ORE CONFERENCE, Perth, July 2015
- “White Dam Dump Leach Gold Project Due Diligence and Actual Project Production Performance” ALTA 2015, Perth, May 2015
- “Maximising Project Value for Complex Phosphate Projects Containing Uranium and Lessons Learned” ALTA 2015, Perth, May 2015
- “Pipeline Design System Optimisation”, Slurry Pipelines Conference, Perth, November 2014
- “Occupational Health, Safety & Environmental Issues In Process Plants & The Role Of Good Design” COM 2014, Vancouver, Canada, September 2014
- “Pressure Leaching Tests on Aphrodite Refractory Gold Concentrate” COM 2014, Vancouver, Canada, September 2014
- “Scrubbing & Beneficiation of Wet Sticky Iron Ore & Materials Handling Issues” COM 2014, Vancouver, Canada, September 2014
- “Options For Removing Uranium & Thorium From Zircon Mineral Sands” ALTA 2014, Perth, May 2014
- “The Difficult Mineral Processing Issues with Processing Clay Ore” ALTA 2014, Perth, May 2014
- “Critical Issues with Water & Iron Ore Beneficiation Plants”, SME 2014, Salt Lake City, Utah, February 2014
- “Recovery of Cyanide from Tailings using Resins”, SME 2014, Salt Lake City, Utah, February 2014
- “Trends with Selection and Sizing Large Flotation Circuits - What’s available In the Market Place”, COM 2013, Montreal, Canada, October 2013
- “The Difficult Mineral Processing Issues with Processing High Clay Ores”, COM 2013, Montreal, Canada, October 2013.
- “Independent Mineral Processing Project Due Diligence”, COM 2013, Montreal, Canada, October 2013
- “ Mobile Crushing and Screening Plant Applications for Small to Medium Sized Iron Ore Projects”, AusIMM Iron Ore 2013, Perth, August 2013
- “The Selection Design and Application of Mill Liners for Large Wet Grinding Mills”, METPLANT, Perth, July 2013
- “Critical Issues with Developing Uranium Projects with Current Low Uranium Prices”. AusIMM International Uranium Conference, June 2013, Darwin, NT
- “Cyanide Destruction Recovery Options and Management strategies for Gold Plant Tailings”, ALTA, Perth, May 2013
- “Current Challenges with the Processing of Uranium Ores”, ALTA, Perth, May 2013
- “Critical Aspects of Low Grade Ore Beneficiation”, COM 2012, Niagara Falls, October 2012
- “The use of Qemscan for Ore Characterisation”, COM 2012, Niagara Falls, October 2012
- “Project Development of an ISL Project”, D Yan and D Connelly, AusIMM Uranium, Adelaide, 2012
- “Clarifying Solutions for Heap Leaching with WSO, IRR Wet Sticky Clay Ores, Perth, 2012
- “Latest Developments Transporting an Ore through a Pipeline”, IIR, Perth, 2012
- “Geometallurgical Mapping of a Complex Gold Ore Body to Manage Process Risk and Validate the Proposed Process Flowsheet”, ALTA,

## PROFESSIONAL EXPERIENCE

July 2001 – Present METS Engineering Group Pty Ltd

- Mineral Engineering Technical Services
- Director / Principal Consulting Engineer

Owner and founder of METS. Partnered with Sanderson, CDMS, Wilkie and TCT to form Midas Engineering Group. Involved in feasibility studies, projects, metallurgical testwork, review consultation and assessment, project commissioning, risk and plant assessments, project development testwork, plant audits and plant evaluations, due diligence on numerous projects, process reviews, designs and consultations, testing new process technology to recover titanium, and vanadium, updating financial models.



1999 – 2001 Worley Limited (Contract)

- Process Consultant

Due diligence assignments, desktop studies, involved in all aspects of projects such as audits and risk assessment studies, consulting clients, involved in developing a metallurgical test programme for Bulchina Project, feasibility studies.

1989 – 1999 Mineral Engineering Technical Services

- Consulting Metallurgist

Providing consulting services for numerous projects, technical audits, project development, feasibility studies, on-site problem solving, studies, technical reviews, crush size sensitivity testing and percolation testing, plant audits, capital and operating costs and test programs. Involved in diagnostic leaching to determine the nature and occurrence of gold losses in tailings samples.

1987 – 1989 Aztec Mining Ltd

- Consulting Metallurgist

Responsible for bench scale testwork, crushing and grinding parameter testwork – Project Manager for the Bounty Project. Metallurgical testwork and review of La Choya Heap Leach Project. Became Aztec representative at column flotation pilot plant trial at Amdel on Golden Grove ore.

1986 – 1987 Harbour Lights Mining Ltd

- Plant Superintendent

Responsible for mill operation and maintenance – increased mill throughput to 850,000 TPA rate and reduced operating costs. Project Became Manager EPCM for the sulphide project. Involved in detail design, equipment selection, and construction and commissioning. The project was completed below budget and ahead of schedule.

1985 - 1986 Kalgoorlie Mining Associates

- Technical Services Metallurgist

Improved Fimiston flotation gold recovery after circuit surveys and changes, increased life of reactivation kiln and initiated grinding circuit control.

1983 – 1985 Roxby Management Services

- Shift Metallurgist

Initially commissioned copper, gold, uranium plant, which was followed by intensive testwork to collect data for the feasibility study – evaluated various flotation cells, filters, pump test loops etc. – very complex metallurgy including leaching and copper uranium solvent extraction, excellent exposure – involved in feasibility study.

1979 – 1983

- Small Business Manager

Controlling thirty people, import, export, etc. – commercial management, marketing, ordering and control.

1977 – 1979 Hamersley Iron Pty Ltd

- Plant Metallurgist

CRA group transfer – crushing and screening testwork – Plant Metallurgist in the pellet plant – significant process improvements achieved – resigned when the plant closed due to lack of orders from the Japanese.





Denis Yan  
Consulting Metallurgist

## EDUCATION AND QUALIFICATIONS

Bachelor of Science (Metallurgy), University of New South Wales  
Master of Science (Metallurgy), University of New South Wales  
PhD Degree, University of New South Wales

## PROFESSIONAL AFFILIATIONS

Member, Australasian Institute of Mining and Metallurgy (AusIMM)

## KEY EXPERIENCE

Denis has over 40 years' of experience in mining and during this time has had vast experience in most mineral processing environments. This includes post-doctoral research in activated carbon in Newcastle-upon-Tyne (UK), copper smelting in Townsville and coal research at the University of New South Wales. Most of Denis' background is in senior university roles where he led substantial cutting edge research programmes in coal and base metal flotation and comminution and taught at the WA School of Mines as Program Chair (Metallurgy). Denis is the author of 32 papers and a popular resource text in mineral processing. Denis is an Adjunct Associate Professor at the WA School of Mines, Curtin University of Technology.

## AREAS OF PARTICULAR EXPERTISE

- Reverberatory furnace operation at Copper Refineries, Townsville;
- Coal flotation and gravity separation research at UNSW;
- Copper, pyrite and nickel sulphide flotation research at the WA School of Mines (WASM);
- Grinding research at WASM including the effect of grinding media on flotation chemistry and the effect of media size on energy efficiency;
- Ultrafine grinding research at WASM including construction of laboratory Tower mill and ISAmill;
- Lecturing in mineral processing for 22 years at WASM leading to authoring a textbook on mineral processing design;
- Gold extraction research including separation from antimony sulphide ores using pyrometallurgy;
- Over 25 years working with JKSimMet and 20 years teaching modelling and simulation at WA School of Mines;
- Over 8 years using and teaching LIMN at WA School of Mines; and
- Design of testwork programmes for various commodities including iron ore, uranium including in-situ leaching and vanadium-titanium.

## RECENT PUBLICATIONS

- The Metallurgical and Engineering Aspects of Successful Heap Leach Projects, The AusIMM International Uranium Conference, Perth, June 2011;
- Vanadium and Lithium Batteries for "Green" Cars, AusIMM Technical Presentation, June, 2010;
- Process Plant Design Considerations for High Silver Gold Ores, Precious Metals 10 Conference, Falmouth, UK, June, 2010;
- Processing of Uranium Ore Through to Yellowcake, METS Uranium Workshop, 2009;
- Implications of Mineralogy on Uranium Ore Process, ALTA, Perth 2008;
- Ultrafine Grinding in a Ball Mill, Presented at Ultrafine Grinding 06 Conference, Falmouth, UK, published in Minerals Engineering, Vol. 20, pp. 320-326, 2007;
- Mineral Processing Design and Operations-An Introduction, Elsevier, Amsterdam, 2006;
- Predicting the Performance of a Flotation Circuit that Incorporates Flash Flotation, Proceedings, Centenary of Flotation Symposium, AusIMM, June 2005;
- The Detection of Xanthate in Solution and on Sulfide Surfaces to Help Understand and Improve Mineral Separation on Industrial Plants, Proceedings, Centenary of Flotation Symposium, AusIMM, 6-9 June 2005;
- Dewatering of Fine Slurries by the Kalgoorlie Filter Pipe, Minerals Engineering, Vol 16, pp. 283-289, 2003;
- The Selective Flotation of Arsenopyrite from Pyrite, Minerals Engineering, Vol 16, pp. 1217-1220, 2003; and
- The Interaction of Flash Flotation with Closed Circuit Grinding, Minerals Engineering, Vol 16, pp. 1149-1160, 2003.



## MINERAL ENGINEERING TECHNICAL SERVICES - Consulting Metallurgist

- Technical consultant on vanadium projects including salt roast testwork on titaniferous magnetite for Barrambie and Mount Peake and PFS study on TNG Mount Peake hydrometallurgical processing;
- Co-patent holder on TiVan® hydrometallurgical process for vanadium, titanium and iron recovery from titaniferous magnetite and iron sands;
- Design of supervision of uranium leach testwork, including acid, alkali and in-situ leaching;
- Technical consultant on gold projects including due diligence of gold plants in Australia and Indonesia; Testwork and mass balancing and comminution simulation using JKSimMet and LIMN for Troy Resources Casposo and West Omai;
- Technical consultant on iron ore projects including JKSimMet modeling of comminution options for Iron Road, POSCO Roy Hill, Venus Metals, DTR data analysis for magnetite projects in Australia and overseas, manage LIMS and WHIMS testwork; and
- PFS Project manager for Archipelago Minerals, Co Dinh alluvial chromite project, developed and managed testwork programme, process design flowsheet, CAPEX and OPEX.

Technical consultant on:

- Heavy media and flotation of spodumene bearing pegmatite ore (Altura scoping study);
- Heavy media separation and gravity separation testwork on manganese projects (Spitfire, Hannans Reward);
- Extensive comminution and flotation testwork programme on phosphate deposit in Saudi Arabia; and
- Upgrading bauxite by heavy liquid separation and magnetic separation for Australian Bauxite.

## WESTERN AUSTRALIAN SCHOOL OF MINES (WASM) - Head of Undergraduate Studies/ Senior Lecturer (Mineral Processing)

Denis lectured and undertook research in the areas of nickel and copper sulphide flotation, comminution and modelling and simulation and gold research from 1985-2007. Adjunct Associate Professor, WA School of Mines, Curtin University, 2007-2015.

## THE SCHOOL OF MINING ENGINEERING (UNSW) - Project Scientist

Research project (NERDDC) on recovery of fine coal. During the 6 years as Project Scientist Denis made substantial contributions to the advancement of fine coal recovery methods.



**Brett Morgan**  
Process Engineer

## EDUCATION AND QUALIFICATIONS

Bachelor of Science (Extractive Metallurgy), WASM  
Bachelor of Science (Chemistry), Curtin University

## PROFESSIONAL AFFILIATIONS

Graduate Member, Australasian Institute of Mining and Metallurgy (GAusIMM)

## KEY EXPERIENCE

Brett is a Process Engineer who specialises in process design and the development of metallurgical testwork programmes. Additionally he has completed numerous projects from scoping studies to definitive feasibility studies. His degree in Chemistry gives him a different perspective on the metallurgical problems that may be encountered during a testwork program and the processing of an ore. Brett is proficient in the research and design of metallurgical testplans at all project stages, mass and heat balances, PFD construction, capital and operating cost estimations and process design. He is skilled in process simulation utilising industry standard software packages as well as various in house methods to confirm process design parameters.

Brett is capable of working on intellectually sensitive projects having worked on a number of different highly confidential projects over the last three years. The scope of his project experience covers gold, lithium, vanadium, iron, titanium, cobalt, copper, Carbon Capture and Utilisation (CCU), potassium sulphate and geopolymers.

## AREAS OF PARTICULAR EXPERTISE

- Experimental design
- Metallurgical testplan development and supervision
- Plant surveys and sample collection
- Sample preparation and analysis
- Process simulation and optimisation
- Process design
- SysCAD modelling
- Value improvement studies
- Formal presentations and public speaking

## PROFESSIONAL EXPERIENCE

- **METS Engineering Group Pty Ltd** – Process Engineer
- **Barrick Mining Services** – Metallurgy Vacation Student



**Josh Brown**  
Process Engineer

## EDUCATION AND QUALIFICATIONS

Bachelor of Engineering (Hons.) – Chemical Engineering  
Bachelor of Science – Extractive Metallurgy

## PROFESSIONAL AFFILIATIONS

Graduate Member, Engineers Australia  
Graduate Member, AusIMM

## KEY EXPERIENCE

Josh is a Process Engineer with a background and keen interest in the resource industry. He has had previous exposure to a range of processing plants including mineral sands wet and dry concentrators, synthetic rutile plants, gold flotation concentrators and CIL circuits, nickel refinery, alumina refinery and a titanium pigment plant. As an engineer at METS Engineering Group, some of the work Josh has been involved in includes testwork design and supervision, plant design, process simulation, product development, cost estimation and economic analysis. He has gained experience in a wide range of commodities including lithium, cobalt, titanomagnetites, gold, copper and more. Josh is exposed to projects ranging from conceptual, scoping, feasibility and implementation stages and has also delivered both office and site based training courses.

## AREAS OF PARTICULAR EXPERTISE

- Testwork design, management and supervision
- Process flowsheet design
- Mass and energy balances
- Modelling (SysCAD, Aspen HYSYS, MATLAB, Excel)
- Physical and chemical laboratory experience (sample preparation, gravity concentration, flotation, leaching etc.)
- Wet chemistry assaying and results interpretation
- Research and report writing

## PROFESSIONAL EXPERIENCE

- **METS Engineering Group Pty Ltd** - Process Engineer
- **Iluka Resources** - Vacation Employment



**Brendon Nicol**  
Process Engineer

## EDUCATION AND QUALIFICATIONS

Bachelor of Science(Chemical Engineering), University of Western Australia  
Bachelor of Science(Chemistry), University of Western Australia

## PROFESSIONAL AFFILIATIONS

Graduate Member, Engineers Australia

## KEY EXPERIENCE

Brendon Nicol is a Graduate Chemical Engineer with experience in mineral consulting engineering. He completed a double degree in Chemical Engineering and Chemistry at the University of Western Australia and has gained industry experience with an internship at METS where he performed operating and capital costs estimations, developed flowsheets and mass balances for projects as well as making valuable contributions to metallurgical reports.

Brendon is a dedicated, hard worker who has demonstrated the ability to pick up new concepts quickly in a challenging work environment. Brendon's background in chemistry has provided him with a solid understanding of laboratory operations and tests such as XRF, ICP and AAS which provides him with deeper insight into metallurgical testwork results.

## AREAS OF PARTICULAR EXPERTISE

- Process Flowsheet Design
- Mass and Energy Balances
- MATLAB modelling
- Sample preparation and experimental studies.
- Research and data analysis
- Report writing and editing
- Public speaking
- Excel VBA modelling
- Microsoft Office
- Microsoft Visio
- Mathematica

## PROFESSIONAL EXPERIENCE

- **METS Engineering Group Pty Ltd** - Process Engineer
- **METS Engineering Group Pty Ltd** - Process Engineering Intern



Joshua Hirsch

Graduate Process Engineer

## EDUCATION AND QUALIFICATIONS

Bachelor of Engineering (Chemical), University of Western Australia

## PROFESSIONAL AFFILIATIONS

Graduate Member, Engineers Australia

## KEY EXPERIENCE

Joshua Hirsch is a Graduate Process Engineer with operational and laboratory experience in iron ore processing. He has specific expertise in silica flotation, pressure filtration, plant surveying and magnetite concentration processing. He has completed a Bachelor of Engineering degree, majoring in Chemical and Process Engineering from the University of Western Australia.

Joshua is a dedicated and hard worker who has demonstrated the ability to pick up new concepts quickly in a challenging work environment. He is comfortable with working on intellectually sensitive projects and is growing his experience by working on a number of various commodity projects.

## AREAS OF PARTICULAR EXPERTISE

- Process flowsheet design
- Mass and energy balances
- MATLAB modelling
- Sample preparation and experimental studies.
- Research and data analysis
- Report writing and editing
- Public speaking
- Excel VBA modelling.

## PROFESSIONAL EXPERIENCE

- **METS Engineering Group Pty Ltd** - Graduate Process Engineer
- **Karara Mining Ltd** - Vacation Student

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**APPENDIX B – AGREEMENT FOR CONSULTING SERVICES**

## Agreement for Consulting Services Standard Terms and Conditions

### Definitions:

“**Agreement**” is defined in clause 1.

“**Client**” means *client engaging METS services*, its representatives and authorised agents.

“**Company**” means METS – *METS Engineering Group ABN 92 625 467 674*

“**Engagement Letter**” means the letter or proposal document from the Company to the Client.

“**Fees**” means the fees payable to the Company by the Client for the Services as set out in the company’s schedule of rates.

“**Project**” is defined in the Engagement Letter.

“**Reimbursable Expenses**” means all expenses reasonably incurred by the Company in performing the Services, or as defined in the Engagement Letter.

“**Relevant Law**” and “**Relevant Jurisdiction**” are defined in the Engagement Letter.

“**Services**” means the services to be provided by the Company to the Client as stated in the Engagement Letter and such further services as are agreed between the Client and the Company.

### Standard Conditions of Contract:

#### The Agreement

The “Agreement” means the agreement for the Company to provide the Services to the Client. The Agreement comprises of the Engagement Letter, these Standard Conditions of Contract and any other documents referred to in the Engagement Letter and /or Proposal. The Agreement represents the entire understanding of the parties and supersedes all prior agreements, arrangements, representations or understandings (if any) of the parties in respect of matters dealt with by this Agreement. The documents which are part of the Agreement are mutually explanatory. If there is any ambiguity or discrepancy in the documents, the order of precedence shall be firstly the Engagement Letter, secondly these Standard Conditions of Contract and thirdly any other documents referred to in the

Engagement Letter, unless the parties agree otherwise in writing.

#### Retrospectivity

The Agreement applies to the performance of the Services regardless of whether the Agreement was in force at the time the Services were performed.

#### Providing the Services

The Company must exercise reasonable care, skill and diligence in providing the Services.

The Company will provide the Services in a manner which, where it is within the Company's control, facilitates the timely completion of the Project.

1. The Company will, where required by this Agreement and practicable, coordinate the provision of the Services with the activities of other parties engaged by the Client and at the direction of the Client.
2. The Client must provide details, access and permissions required for the Company to provide the Services.
3. If the Company considers the Client has not sufficiently complied with clause 6 to enable the Company to provide the Services in accordance with this Agreement, the Company will advise the Client. The Client must then promptly provide the further assistance necessary.

#### Change in Scope of Services

4. If the Company or the Client becomes aware of any matter which will change or has changed the scope or timing of the Services or the Project, then it will as soon as practicable give notice to the other party of the matter and as far as practicable, details of the change.





## Work at the Client's Premises

5. Where servants, agents or sub-contractors of the Company carry out work at the Client's premises, the Company, its servants, agents or sub-contractors carrying out work at the Client's premises will comply with any reasonable direction of the Client regarding occupational health and safety. The Client must maintain at those premises the safety procedures, equipment and standards necessary to comply with any Relevant Law and to ensure a safe workplace. For that purpose any servants, agents or subcontractors of the Company are deemed to be under the control of the Client. The Client is fully responsible for, and must indemnify and hold harmless the Company against any claim, loss or damage of any kind whether for breach of contract or statutory duty, negligence or otherwise, arising in any way out of the failure of the Client to comply with the requirements of this paragraph.

Where servants, agents or sub-contractors of the Company carry out work under the direction of the Client, the Client will be fully responsible for, and must indemnify and hold harmless the Company against any claim, loss or damage of any kind, whether arising in contract, in tort, in equity or by statute connected in any way with the Services, Project or relationship established by this Agreement, in respect of the acts or omissions of the Company, its servants, agents or sub-contractors.

## Rectification Work

6. Notwithstanding any other clause of this Agreement, the liability of the Company in respect of any claim arising out of or in connection with the Services, the Project or the relationship established by this Agreement, whether arising in contract, in tort, in equity or by statute is limited to the repetition by the Company in accordance with the Agreement of any part of the Services which is shown to be deficient.

## Services provided for Exclusive Benefit of Client

7. The Services are provided for the exclusive benefit of the Client and the Company

accepts no liability to any person other than the Client in respect of any claim arising out of or in connection with the Services, the Project or any relationship established by this Agreement whether arising in contract in tort, in equity or by statute. If the Client allows any third party to enjoy the benefit of the Services, the Client will be fully responsible for, and must indemnify and hold harmless the Company against any claim by that third party arising out of or in connection with the Services, the Project or any relationship established by this Agreement, whether arising in contract, in tort, in equity or by statute.

## Mutual Limitations of Liability

Notwithstanding any other clause of this Agreement, the liability of the Client and the Company to each other must be reduced proportionately to the extent that a breach of contract, the failure to comply with a Relevant Law, or the negligent act or omission of a party or its consultants, agents or other contractors contributed to the loss, damage, costs, claims, liability, expense, outgoing or payment incurred by the other party.

Notwithstanding any other clause of this Agreement, neither Party is liable to the other under this Agreement, in tort, in contract, in equity, by operation of statute or otherwise for any kind of:

- (a) indirect or consequential loss or damage;
- (b) loss of opportunity;
- (c) loss of revenue;
- (d) loss of profit or anticipated profit;
- (e) loss of contracts;
- (f) loss of goodwill;
- (g) loss arising from business interruption; or
- (h) liability arising out of or in connection with pollution or contamination;

arising out of or in connection with this Agreement incurred or suffered by a party, or any other person.

## Insurance

10. The Company and the Client must each have insurance cover for any loss or damage in adequate amounts and for the risks each bears under this Agreement as required by statute or otherwise as is reasonable in the circumstances. The Company and the Client must each have a Public Liability insurance policy for an amount



adequate to cover any risk that party bears under this Agreement.

### **Force Majeure**

11. If the Company or the Client become unable in part or whole to perform this Agreement as a result of force majeure it must promptly notify the other party and suspend performance under this Agreement (other than under clauses 16, 17 and 18) while the force majeure continues and resume performance as soon as practicable.

### **Confidential Information**

12. (a) "Confidential Information" means all information which, by its nature or by the circumstances of its disclosure, is or could reasonably be expected to be regarded as confidential to a party and includes concepts, technical and operational information owned or used by a party and details of any clients, customers or suppliers of a party.
- (b) The Company must not disclose, or allow to be disclosed to any person, any of the Confidential Information of the Client without the prior written consent of the Client.
- (c) The Client must not disclose, or allow to be disclosed to any person, any of the Confidential Information of the Company without the prior written consent of the Company.
- (d) The Company must only use Confidential Information for the purpose for which it was disclosed and must not make use of Confidential Information or any part of it to the competitive disadvantage of the Client.
- (e) The Client must only use Confidential Information for the purpose for which it was disclosed and must not make use of Confidential Information or any part of it to the competitive disadvantage of the Company.
- (f) The Company shall be entitled to retain a copy of all documents related to the Project for its records, subject to its continuing obligations under this clause.

### **Intellectual Property**

13. (a) "Intellectual Property" means any concept, product or process developed, discovered or used by the Company in the course of providing the services, and copyright in all drawings, specifications, software and other documents provided by the Company.
- (b) The Client is entitled to a royalty free license to use the Intellectual Property in connection with the Services only, subject to the Company receiving full payment for the Services.
- (c) Intellectual Property remains the property of the Company. The Intellectual Property must not be disclosed to third parties without the Company's permission. The supply or use of any of the Intellectual Property prior to full payment being made to the Company does not imply granting of a license for its use.
- (d) Subject to clauses 8 and 9, the Company warrants to the Client that any document, material or design provided by the Company does not infringe the Intellectual Property rights of any third party and indemnifies the Client against breach of that warranty. Subject to clauses 8 and 9, the Client warrants to the Company that any document, material or design provided by the Client does not infringe the Intellectual Property rights of any third party and indemnifies the Company against breach of that warranty.

### **Duration of Agreement**

14. Subject to clause 16, the Agreement continues until completion of the Services unless either party gives at least 7 days' notice in writing to the other Party to terminate this Agreement. If the Agreement is terminated by the Client for any reason other than the default of the Company or by the Company for the default of the Client, then the Client shall (without prejudice to the Company's accrued rights) pay to the Company all Fees due together with reimbursement of any costs and expenses incurred in contemplation of it providing the Services. If the Client terminates the Agreement as a result of a default of the Company, then the Client shall pay the Company all Fees due. Where Fees are



payable other than on an hourly rate basis the Fees payable pursuant to this clause shall be calculated on a pro rata basis up to and including the date of termination.

15. Subject to clauses 15 and 19(ii), each party must continue to perform its obligations under this Agreement until the date of termination. Clauses 5, 6, 7, 8, 9, 12, 13, 19(i), 25 and 26 survive the termination of this Agreement for whatever reason.

16. If:

(a) in respect of all or part of the business or assets of either the Company or the Client:

- (i) a liquidator or provisional liquidator is appointed;
- (ii) A receiver, receiver and manager, trustee, controller, official manager or similar officer is appointed;
- (iii) An administrator is appointed, whether under Part 5.3A of the Corporations Law or otherwise; or
- (iv) An application is made for the appointment of an administrator, liquidator or provisional liquidator; or

(b) either the Company or the Client:

- (i) is unable to pay its debts as and when they fall due;
- (ii) is insolvent or presumed to be insolvent under any law; or
- (iii) is an insolvent under administration as defined in section 9 of the Corporations Law or an action is taken which could result in that event; or

(c) either the Company or the Client commits a substantial breach of this Agreement;

Then the other party may immediately terminate the Agreement by giving written notice.

## Fees and Payment

17. The Fees are calculated for performance of the Services. If:

(a) the Company is required to perform services different or additional to those specified in the Engagement Letter as the Services; or

(b) the nature of the Services changes; or

(c) the cost associated with the provision of the Services is increased due to the imposition of, or increase in, the amount of any government tax, fee or charge; or

(d) the Services are suspended other than by reason of breach by the Company;

The Company will be entitled to an additional fee agreed between the Client and the Company or, if no agreement is reached, then as reasonably determined, by the Company.

18. The Company may submit invoices to the Client for payment of its Hourly Fees, Administration Charge (5% of hourly fees) and Reimbursable Expenses (charged at plus 10%) at monthly intervals on the last day of each month and at the completion of the Services. Invoices must be supported with evidence to the Client's satisfaction substantiating the amounts claimed in the invoice. Payment of the amount referred to in an invoice is due within 30 days of the date of the invoice.

19. If the Client does not pay the amount of the invoice when it is due the Company is entitled to:

- i) charge interest to the Client at the rate of 1.25% per month from the date of the invoice until the date of payment in full; and
- ii) Suspend the provision of the Services until the date of payment in full.

20. If the Client disputes any part of any invoice submitted by the Company, the Client must pay the undisputed balance in full. In the event that any part of a disputed amount is subsequently agreed or determined to be due, the Client must pay interest in accordance with clause 19(i) on the amount withheld.

21. The Company may include in an invoice and recover from the client, in addition to the Fees and Reimbursable Expenses, the amount of



GST lawfully required to be remitted by the Company in relation to the Services.

### **No Assignment**

22. Neither the Company nor the Client may assign its respective rights and obligations under this Agreement without the written consent of the other party.

### **Direct Engagement**

23. No company employee or representative may undertake work directly for a client or any related or associated business of the client whilst performing the engaged services or within a period of twelve months. Should consent be given by the company for a company employee or representative to be offered and accept a position with the client a placement fee payable by the client applies. This fee will be 20% percent of the total annual remuneration (cash + superannuation etc).

### **Relevant Law and Jurisdiction**

24. The Services to be performed pursuant to the Agreement will be performed in accordance with the Relevant Law.
25. The Courts of the Relevant Jurisdiction have non-exclusive jurisdiction to resolve any dispute arising out of this Agreement or the performance of the Services unless the parties otherwise agree in writing to an alternative dispute resolution procedure.

### **Severance**

26. If any part of the Agreement is contrary to law, it will not affect the enforceability of other provisions, or parts of provisions.



Signed on behalf of METS – **METS Engineering  
Group Pty Ltd**

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**Print**

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**Signature, date**

Signed on behalf of **'The Client'** as acceptance of  
clauses 1 to 26 inclusive:

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**Print**

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**Position / Title**

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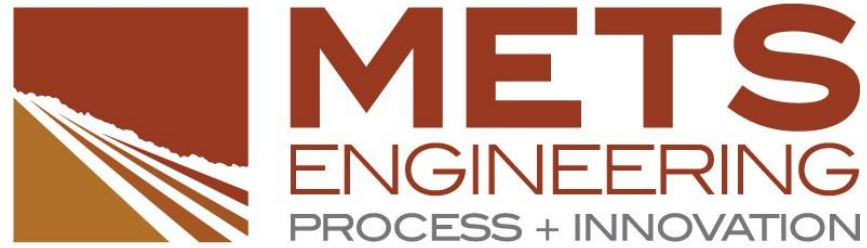
**Company**

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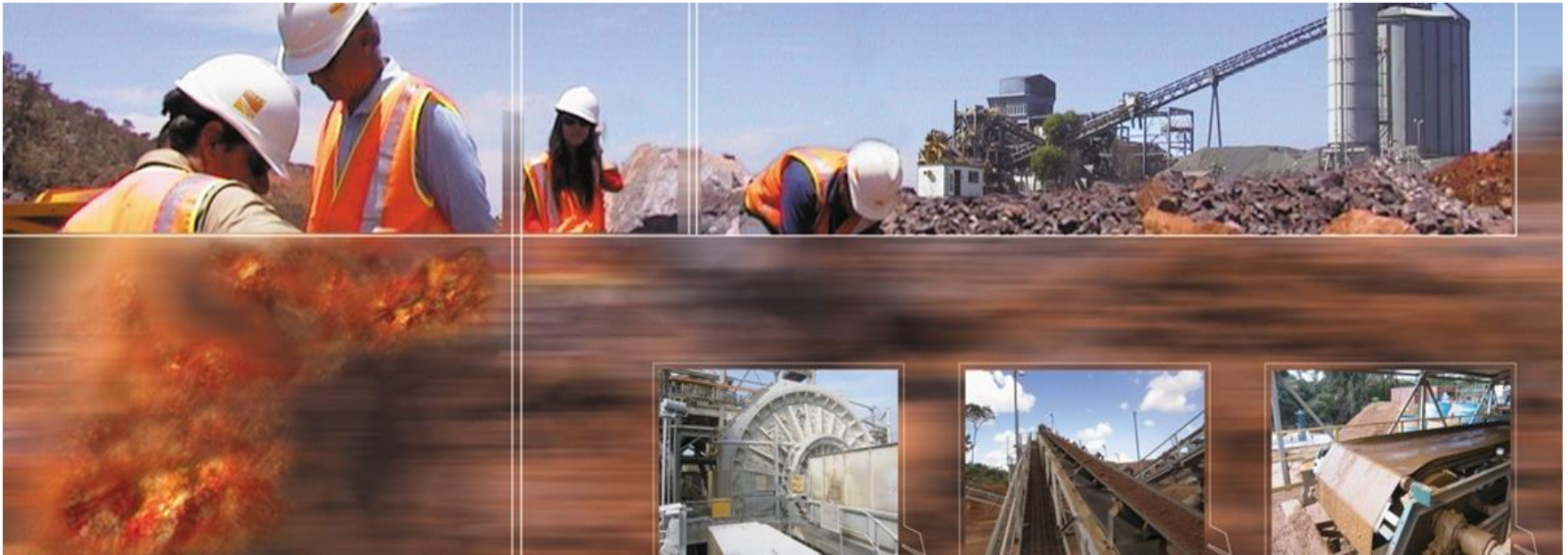
**Signature, date**

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**APPENDIX C – COMPANY CAPABILITY STATEMENT**



## METS Capability Statement



**METS Engineering Group Pty Ltd**  
Level 3 44 Parliament Place West Perth WA 6005  
PO Box 1699 West Perth WA 6872  
P: (+61 8) 9421 9000

ABN 92 625 467 674

W: [www.metsengineering.com](http://www.metsengineering.com)  
E: [info@metsengineering.com](mailto:info@metsengineering.com)

## Our Purpose

Provide engineering and technical solutions that are responsive to our clients' needs

### OUR EXPERTISE

- MINERAL PROCESSING
- HYDROMETALLURGY
- PYROMETALLURGY
- TESTWORK PLANS & MANAGEMENT
- ENGINEERING STUDIES
- OPTIMISATION
- PROJECT CAPITAL REDUCTION
- PRODUCT INNOVATION
- SPECIALIST SERVICES
- UNIQUE SOLUTIONS
- SKILLS HIRE
- INVESTIGATIONS
- GREENFIELD & BROWNFIELDS

### ALL COMMODITIES

- ALUMINA
- COPPER
- GARNET
- GOLD
- GRAPHITE
- IRON ORE
- KAOLIN
- LEAD/ZINC
- LITHIUM
- MINERAL SANDS
- NICKEL/COBALT
- POTASH
- RARE EARTH
- URANIUM
- VANADIUM
- OTHERS

### WORKING GLOBALLY

- AUSTRALIA
- AFRICA
- ASIA
- EUROPE
- MIDDLE EAST
- NORTH AMERICA
- SOUTH AMERICA

### TRAINING

WE SHARE OUR KNOWLEDGE WITH THE INDUSTRY

40+ TRAINING COURSES

POPULAR COURSES INCLUDE:

- ✓ MINERAL PROCESSING
- ✓ METALLURGY FOR NON-METALLURGISTS
- ✓ HEAP LEACHING
- ✓ LITHIUM
- ✓ GOLD EXTRACTION
- ✓ FLOTATION
- ✓ ADVANCED MINERAL PROCESSING

### WHY METS?

- EST. 1988
- 30 YEARS EXPERIENCE
- WORKED ON 5,000+ MINERALS JOBS
- JUNIOR TO MID TIER MARKET SPECIALISTS
- WORK GLOBALLY
- INNOVATORS
- SPECIALISTS
- SERVICE DELIVERY
- CONTINUOUS IMPROVEMENT





# Why Partner with METS?

## GLOBAL

Since 1988 we have worked with clients in Perth, Australia or as remote as Guyana, South America

## EXPERIENCED

Have worked on 5,000+ mineral jobs over the last 30 years

## INNOVATORS

Unique solution finders. We are not scared to challenge conventional wisdom to overcome project issues

## SPECIALISTS

We are experts in mineral processing across the life cycle of a project

## SERVICE DELIVERY

We engage our clients at each stage through fortnightly progress status reports

## CONTINUOUS IMPROVEMENT

We are committed to the advancement of technology and processing within the resources industry



# Mineral Processing – Testwork

- Mineral Processing
- Engineering Design
- Training
- Specialist Services

Mineral Processing is our core speciality.

## Testwork

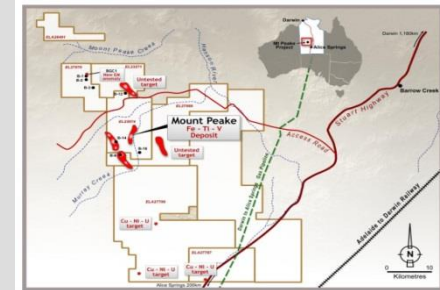
- Development, sighter or detailed
- Test plan development
- Testwork descriptions
- Quotes & evaluations
- Laboratory management & testwork supervision
- Interpretation of results & reporting
- All commodities

## Experience

- Mineralogy & interpretation
- Crushing, grinding, flotation, leaching, thickening, filtration, BIOX, POX, UFG, roasting, magnetic and electrostatic separation, solvent extraction, reful classifiers, Kelsey jigs, dense media separation

## Case Study

Project Name : *TNG TiVan Project*



METS was approached by TNG to conduct metallurgical testwork on samples from Mount Peake located 235km away from Alice Springs.

In addition to conducting the testwork, METS created an economically viable process dubbed “TiVan” capable of extracting Vanadium, Titanium and Iron from the Mount Peake Deposit.



- Mineral Processing
- Engineering Design
- Training
- Specialist Services

METS have completed 400+ studies.

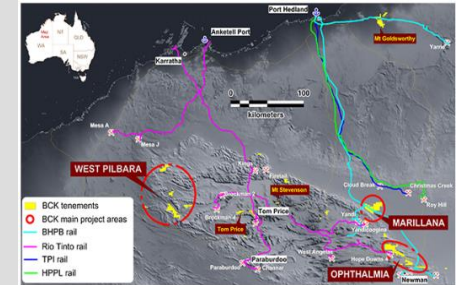
## Operational Studies

- Conceptual/scoping studies
- Pre-Feasibility Studies (PFS)
- Feasibility Studies (FS)
- Definitive Feasibility Study (DFS)
- Process optimisation
- Process integration
- Mineralogy & interpretation
- Analysis CAPEX & OPEX
- Equipment design, specification and selection
- Summary reporting



## Case Study

Project Name: *Marillana Iron Ore Project*



METS was selected to evaluate and identify sections of a DFS study with risks that could impact the efficiency and operating conditions of the plant that was to be built.

The Marillana site is located approximately 100km north of Newman in WA's Pilbara region. In addition to the review of the DFS, METS also produced a FEED report which provided detailed solutions for the identified sections with risks.



- Mineral Processing
- Engineering Design
- Training
- Specialist Services

**METS has experience performing the following for mineral processing applications.**

## **Process**

- Plant audits, de-bottlenecking, simulation and metallurgical accounting

## **Mechanical**

- Maintenance audits and strategies
- Design and costings
- Failure analysis

## **Civil & Structural**

- Design, drafting and costing

## **Piping**

- Design, material selection and layout

## **Power & Electrical**

- Design, drafting, costing and energy audits

## **Instrumental & Control**

- Engineering design, specification and selection

## **Value Engineering**

- Cost savings, in both capital and operation expenditure

## **Case Study**

**Project Name: *Karouni Gold Plant Design***



METS was selected to design a gold plant suitable for processing deposits from the Karouni site located 180km southwest from Georgetown in Guyana.

The design of this plant required METS to work with the Civil, Power and Drafting divisions in MIDAS group.



- Mineral Processing
- Engineering Design
- Training
- Specialist Services

METS provides **customised** and **in-house training courses** that give participants increased technical awareness and practical expertise no matter what their level of experience.

All of our services can be delivered at our premises or on-site if required.

## Courses

- Mineral Processing (flagship course)
- Advanced Mineral Processing
- Process Plant Design and Optimisation
- Metallurgical Accounting
- Water Management in Mining
- Heap Leaching
- Sensible Cost Cutting Workshop
- Metallurgy for Non-Metallurgists
- Mineral Specific Courses – Iron ore, Lead, Zinc, Uranium Workshops, Nickel and Gold Extraction Short Courses
- Process Control Fundamentals
- Project Management Course
- Fundamentals of Feasibility Studies
- METS Customised Courses

## Case Study

Project Name: *Ma'aden Phosphate Customised Training*



METS was requested to present a training course tailored specifically to Ma'aden on site.

The course spanned across 3 days and was attended by 90 operators.

Additionally METS recommended a training charter to Ma'aden which evaluates the theoretical and practical knowledge of Ma'aden's operators.



- Mineral Processing
- Engineering Design
- Training
- **Specialist Services**

METS provides expert consulting services and advice to the industry internationally.

### **Operational**

- Process plant audits
- Operational reviews
- Operating manuals

### **Water and Waste Water**

- Water and waste water review
- Tailings Storage Facility (TSF) management review
- Environmental impacts review

### **Financial Institution Services**

- Due diligence reporting and audits
- Investor review

### **Legal Services**

- Expert witness

### **Simulation & Optimisation**

- 3D drawings
- Mass and energy balance
- Circuit modelling
- Crushing and milling
- Monte Carlo simulation
- Conveyor design

### **Risk Management**

- Facilitating formal risk assessment workshops
- Conducting HAZOPS and HAZID studies
- Identifying potential project risks and proposing mitigation strategies
- Identifying potential opportunities through risk assessment

### **Consulting Services**

- Technical review
- Financial modelling
- Metallurgical consulting
- Electrical compliance review
- Gold plant security review
- Competent person review
- Engineering services
- Plant equipment review
- Critical spares review
- Risk review

- Energy auditing
- EPCM
- Project definition
- Cost estimate
- Scheduling and project management
- Procurement
- Close out

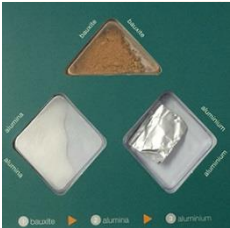
### **Dust Management**

- Audits
- Control Strategies

### **People for Plants**

- Specialist labour hire to the mining, oil and gas, and construction industries





## Alumina

Client	Service
<ul style="list-style-type: none"> <li>Alcoa Alumina</li> </ul>	Various projects including characterising different bauxite ore types, mill surveys, specific surveys, various testwork
<ul style="list-style-type: none"> <li>Worsley Alumina</li> </ul>	Due diligence when Reynolds sold their interest including digestion studies and efficiency upgrade
<ul style="list-style-type: none"> <li>Australian Bauxite</li> </ul>	Testwork and consulting for Direct Shipping Ore including washing trials to meet specification
<ul style="list-style-type: none"> <li>Guinea Bauxite Project</li> </ul>	Assistance with feasibility study
<ul style="list-style-type: none"> <li>Guinea</li> </ul>	Bauxite Project Consulting
<ul style="list-style-type: none"> <li>Aughinish Alumina</li> </ul>	Studies and process improvements
<ul style="list-style-type: none"> <li>Confidential Client – Expert Witness</li> </ul>	Issue over a Alumina Smelter in Canada  Attended supreme court in Melbourne on behalf of our client
<ul style="list-style-type: none"> <li>High Purity Alumina</li> </ul>	Scoping Study
<ul style="list-style-type: none"> <li>High Purity Alumina</li> </ul>	Testwork

### Case Study

Project Name: *Bauxite Hardness Reduction*



METS were engaged by Worsley Alumina to investigate pre-leaching in order to reduce the bond ball mill index and increase mill throughput.





## Copper

Client	Project	Service
• Blackthorn Resources	Kitumba Project	Scoping Study
• National Iranian Copper Co	Sarchesmeh Project	Concentrator Plant Expansion
• Citadel Resources	Jabal Sayid Project	Pre-Feasibility Study
• Zambezi Resources	Kangaluwi Project	Metallurgical Consulting & Testwork
• Snowden Mining Consultants	CopperCo Lady Annie Project	Heap Leach Review
• Genesis Minerals Ltd	Merceditas Project	Metallurgical Testwork
• Lippo Group	Copper Smelter Technology	Review & Site Visits
• Aditya Birla	Nifty Operations	Cathode Prediction Project Optimisation
• Birla Nifty Pty Ltd	Nifty Operations	Heap Leach Site Visit & Restart Estimate
• Sandfire Resources	De Grussa	Metallurgical Testwork
• Golder	Asmara Copper Project	Due Diligence
• CIC	Batu Hijau	Project Review
• Audley Capital	Mantos Blancos	Due Diligence
• Audley Capital	Mantovere	Due Diligence
• Standard Chartered	Lafayette	Bank Due Diligence

### Case Study

Project Name: *Sungun Copper Project*



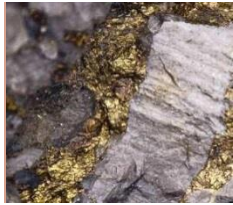
METS was involved in the upgrading of a copper plant located in northern Iran by providing basic plant design.

Overall, METS design resulted in reduced CAPEX and improved copper production.





# Project Experience



## Gold

### Over 300+ gold projects

Client	Project	Service
• Aphrodite Gold	Aphrodite Gold Project	Testwork
• Troy Resources NL	Ultra Fine Grinding	Expert Advice
• Nex Metals Explorations Ltd	Kookynie Gold Project	Orient Well Dump Leach
• Confidential	Ad Duwayhi Gold Project	Feasibility Study
• Acil Tasman Pty Ltd	Kimberley Study	Tanami Regional Minerals Study
• Mercator Gold	Meekathara Gold Project	Due Diligence
• Glencoe Gold	Pilbara Gold Project	Confidential
• La Mancha Resources	Frogs Leg Project	Underground Metallurgical Testwork
• Agincourt Resources Ltd	Andhorinhas Project	Due Diligence
• Homestake Gold of Australia	Not applicable	Mineral Processing Course
• Sons of Gwalia	Carosue Dam Operations	Metallurgical Accounting Audit
• Archipelago Resources	Toka Tindung Project	Confidential
• GBM Minerals Engineering Consultants	Centamin Sakurai Project	Testwork Review
• Tanga Resources	Confidential	Sighter Metallurgical Testwork
• St Barbara Ltd	Marvel Loch	Risk Assessment
• Shandong Gold Mining Ltd	Confidential	Technical Due Diligence
• Troy Resources	Casposo	Detailed Design
• Troy Resources	Karouni	Detailed Design & Commissioning

### Case Study

Project Name: *Syama Gold Project*



METS was selected to provide training services at a gold mine in Mali, West Africa.

METS sent an experienced metallurgical engineer to provide a variety of safety courses such as safety induction and PPE (Personal Protective Equipment) training.



# Project Experience

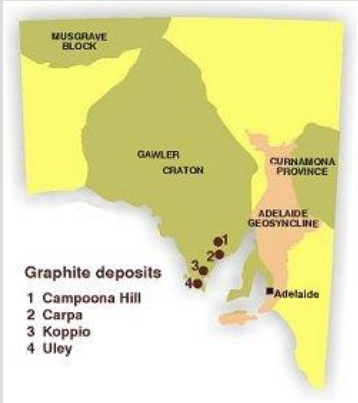


## Graphite

Client	Project	Service
• TNG Limited	Graphite Beneficiation Projects	Testwork
• Castle Minerals Ltd	Kambale Graphite Project	Testwork
• Castle Minerals Ltd	Kambale	Graphite Testwork
• Eagle Bay Resources	Uley Graphite Project	Confidential
• GRUS	Yalbra Graphite	Due Diligence
• Monax Resources	Graphite	Testwork Advice
• Bank – Confidential	Graphite Project	Due Diligence
• Bank - Confidential	Confidential	Graphene Opinion
• GLG Group	Confidential	Graphite Overview
• METS	Course Development	Graphite Course

### Case Study

Project Name: *Uley Graphite*



Graphite was discovered in the area of the Uley project in the early 1800s and it was mined intermittently from the 1920s until 1993, when it was placed on care and maintenance. When in production, the open cut mine was capable of producing up to 14,000 tonnes of graphite concentrate annually.

METS was asked to review a project aimed at restarting a mine which was on care and maintenance.



# Project Experience



## Iron Ore

• TTR	NZ Iron Sand	Scoping Studies
• Goldman Sachs	Confidential	Iron Ore Review
• Minotaur	Mutooroo Iron Ore Project	Confidential
• Venus Metals	Yalgoo Iron Ore Project	Testwork & Scoping Study
• Iron Road Ltd	Gawler Iron Project	Testwork
• Iron Road Ltd	Confidential	Pre-Feasibility Study
• Brockman Resources	Marillana	FEED review
• Posco	Roy Hill	Design Review
• FMG	Iron Bridge North Star	Magnetite Project Review
• Behre Dolbear Australia	Argyle Project	Due Diligence
• Behre Dolbear Australia	Tallering Peak	Process Review
• Shree Minerals	Hematite	DSO Testwork
• A&M Minerals	Malobog Iron Sands Project	Testwork
• Scandinavian Resources	Kiruna Project	Testwork
• Accent Resources	Confidential	Due Diligence
• Rio Tinto	Mt Tom Price	Metallurgical Work
• Rio Tinto	Warrieder Project	Preliminary Metallurgical Assessment
• Rio Tinto	Paraburdoo	Metallurgical Work
• Portman Mining	Confidential	Magnetite Study
• Confidential	Jackson MacDonald	Expert Witness

### Case Study

**Project Name: Roy Hill Iron Ore Project**



METS was asked to review the current design for the Roy Hill project with the aim of identifying issues that would inhibit the plant from producing 22 Mtpa of iron ore.

The review highlighted certain equipment sizing and the plant arrangement to be potential issues that can limit iron ore production.

Recommendations were made by METS to mitigate these issues.



# Project Experience



## Lead / Zinc

• Magellan Metals Pty Ltd	Reagents Facility	Engineering Design & Purchase Reagent System
• Magellan Metals Pty Ltd	Reagents Facility	Bagging Options Study
• Aztec Resources	Golden Grove Project	Commissioning
• Western Metals	Parys Mountain Base Metals Project	Metallurgical Consulting
• Bass Metals	Hellyer Project	Treatment Study
• Bass Metals	Hellyer Project	Plant Valuation Bass Metals
• Trafford Resources	Beltana Project	Due Diligence
• Western Metals	Parys Mountain Base Metals Project	Metallurgical Consulting
• Zinc Corporation	Broken Hill	Plant Operations
• METS	Myrtle Lead-Zinc Project	Metallurgical Testwork
• BHAS	Lead Zinc Smelter	Plant Projects

### Case Study

Project Name: *Myrtle Lead-Zinc Project*



METS performed metallurgical testwork on samples extracted from the Myrtle deposit.

Testwork conducted highlighted the applicability of flash flotation in conjunction with DMS (Dense Media Separation).



# Project Experience



## Lithium

Client	Project	Service
• Altura	Pilgangoora Project	PFS Metallurgical Testwork
• Altura	Pilgangoora Project	Scoping Study
• Talison	Greenbushes	Spodumene Metallurgical Testwork
• Snowden	Lithium project	Project Due Diligence
• Galaxy Resources	Mt Cattlin	Due Diligence
• Galaxy Resources	Shanghai Refinery	Due Diligence
• Galaxy Resources	Brine Project	Due Diligence
• Confidential	Lithium Project	Due Diligence for Bank Finance
• Confidential	Confidential	Lepidolite Testwork
• CPR Talison	Greenbushes	Due Diligence
• Viking Ashanti	Thialand	Lithium
• Confidential	Bene Project	Lepidolite
• Confidential	Confidential	Due Diligence for Bank Funding
• Confidential	Confidential	Spodumene Processing
• Viking Mines	Confidential	Lepidolite
• METS	Course Development	Lithium Processing Course

### Case Study

Project Name: *Mount Cattlin Due Diligence*



- On site for due diligence for project finance
- Visited Jiangsu refinery
- Provided advice to bank on project risk and technical issues



# Project Experience

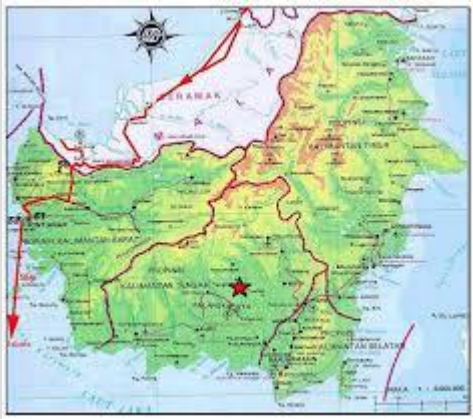


## Mineral Sands

Client	Project	Service
• GMA Garnet	Confidential	Confidential
• Tronox Cataby	Confidential	Confidential
• Cable Sands Bunbury	Confidential	Confidential
• Kalimantan Mineral Sands	Confidential	Feasibility Study
• Astron-Victorian Mineral Sands	Donald Project	Confidential
• Australian Zircon	Murray Basin	Confidential
• TTR	Iron Sands NZ	Confidential
• Confidential	ZUP	Zircon Due Diligence
• Confidential	Radioactivity	Zircon Testwork
• Sembiru Mineral Sands	Kalimantan	Feasibility Study
• Confidential	Confidential	Synthetic Rutile Consulting
• TNG	Confidential	Confidential
• Archipelago	Vietnam Mineral Sands	Confidential
• TIWEST	Confidential	Consulting Work
• Crystal	Confidential	Consulting Work
• MZI	Confidential	Confidential

### Case Study

Project Name: Sembiru Mineral Sands



METS was requested to undertake a Feasibility Study for a zircon/ilmenite project based at Sembiru in Kalimantan. The testwork was previously done by the Client.

This involved developing a flowsheet to produce HMC and an offsite dry plant. It included CAPEX and OPEX with financial outcomes.

The project key was achieving a high quality zircon product.



# Project Experience



## Nickel / Cobalt

Client	Project	Service
• Black Swan Nickel	Kalgoorlie	Due Diligence
• Thundelarra	Thundellara Nickel Project	Project Review
• Cawse Nickel	Nickel Plant	Labour Hire - Contract Metallurgist
• Independent Engineers	Honeymoon Well	Due Diligence
• Windarra Nickel	Windarra Nickel	High Talc Ore
• Snowden	Macedonian Nickel Smelter	Due Diligence
• Snowden	Kosovo Nickel Smelter	Due Diligence
• YTC Nickel	Confidential	Due Diligence
• Thundelarra	Copernicus	BFS (Bankable Feasibility Study) Review
• Confidential	Kuhmo Nickel Project	Confidential
• Vulcan Resources Nickel	Finland Project	Due Diligence
• Golder	Brazilian Nickel Smelter	Due Diligence
• Ray Couche	Kwinana Residues	Cobalt Pilot Plant
• CRC	Heterogenite Flotation	Investigation
• McCrae Clough	Nickel Cobalt Project	Testwork
• Halcyon Resources	Canegrass Cobalt Project	Testwork
• Corazon	Mt Gilmore Cobalt	Testwork

### Case Study

Project Name: *Ferronickel Due Diligence*



Evaluate cost drivers and process improvements for two existing ferro nickel smelters faced with high costs and low nickel prices.



# Project Experience



## Potash

Client	Project	Service
• Errawarra Resources Ltd	Burkeys Feldspar	Scoping Study
• Errawarra Resources Ltd	Errawarra Potash Project	Pre-Feasibility Study
• Ord River Diamonds Ltd	Combined Sulphuric Acid and Potash	Metallurgical Consulting
• ActivEX Ltd	Lake Chandler Potash	Flowsheet
• METS	Potash Extraction	In-House R&D

### Case Study

Project Name: *Errawarra Potash Project*

**ERRAWARRA**  
 Carbon Capture Technology

METS are developing a new process for the production of potash using carbon capture technology for Errawarra Resources Ltd.

METS completed a testwork programme and pre-feasibility study for the developed process and evaluating the economic feasibility of implementing the potash plant in Western Australia.





# Project Experience



## Uranium

Client	Project	Service
• AMC Consultants	Confidential	Uranium Consulting
• Contact Uranium Ltd	Kamushan Project	Metallurgical Testwork
• Uranex NL	Manyoni Project	Testwork Planning & Management
• Uranex NL	Thatcher Soak Project	Testwork Management
• Uran Ltd	Grants Ridge Project	Mine Water Issues
• Jackson Gold	Rio Colorado Project	Polymetallic Study
• Encounter Resources	Hillview Project	Testwork
• Reliance Industries Ltd	Confidential	Uranium Processing Advice
• AIG Congo	Hinda Uranium Project	Metallurgical Testwork
• Extract Resources	Husab Project	Metallurgical Testwork

### Case Study

**Project Name: Hinda Uranium Phosphate Project**



METS was approached to develop metallurgical test plans and to supervise metallurgical testwork to investigate the amenability of processing the Hinda Uranium Phosphate ore.

METS identified beneficiation techniques which could be used to achieve good recoveries for both the phosphate and the uranium minerals.



# Project Experience

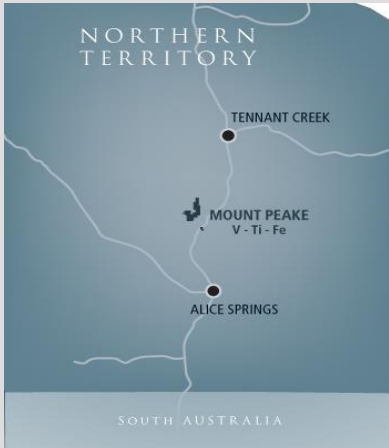


## Vanadium

Client	Project	Service
• Coates Vanadium	AMP	Testwork
• Reed Resources Ltd	Barrambie Project	Pre-Feasibility Study
• Vanadium Australia Ltd	Windimurra Project	Metallurgical Testplans
• Quest Minerals Ltd	Victory Bore Project	Scoping Study
• Behre Dolbear Australia	Mustavaara Project	Comprehensive Review
• TNG Ltd	Mt Peake	Testwork
• TNG Ltd	Mt Peake	Scoping Study
• TNG Ltd	Mt Peake	Pre-Feasibility Study
• TNG Ltd	Mt Peake	Pilot Plant
• TNG Ltd	Mt Peake	Feasibility Study
• TMT Ltd	Gabanintha	Sighter Testwork
• TMT Ltd	Gabanintha	PFS Testwork
• Audalia Resources Ltd	Medcalf	Testwork
• Confidential	Exploration Project	Testwork
• Venus Metals	Youanmi	Testwork
• Venus Metals	Youanmi	Technical Review
• Confidential	SA Dumps	Recovery Advice

### Case Study

Project Name: *Mount Peake Project*



METS designed a metallurgical testwork programme to study the amenability of the Mount Peake deposit to hydrometallurgical processing.

METS collaborated with TNG to develop and patent a new hydrometallurgical process capable of extracting titanium, vanadium and iron from titanomagnetite.





## Other Minerals

Commodity	Client	Project	Service
• Cement	Lafarge	Confidential	Crushing Plant Expansion
• Chromite	Archipelago Resources	Co Dinh Project	Metallurgical Testwork
• Attapulgite	Confidential	Confidential	Activation Work
• Feldspar	Confidential	Confidential	Glass Making
• Garnet	GMA Garnet	Various Projects	Various
• Kaolin	WA Kaolin	WA based Project	Due Diligence
• Kaolin	Rio Tinto	Kaolin Project	Pilot Plant
• Limestone	UWA	Confidential	Consulting regarding ultra fine grinding for Agriculture
• Platinum	Confidential	Kimberley Platinum Project	Confidential
• Platinum	Niplats	Speewah Project	Confidential
• Platinum	Thundellara Exploration Ltd	East Kimberley	Confidential
• Phosphate	Confidential	Cummins Range REO Project	Confidential
• Phosphate	Confidential	Hinda Uranium Phosphate Project	Confidential
• Phosphate	Client located in Saudi Arabia	Confidential	Confidential
• Rare Earths	Confidential	Lynas Project	Confidential
• Quartz	Viking	High Purity Quartz	Confidential
• Salt	Onslow Salt Pty Ltd	Onslow Salt Project	Confidential

### Case Study

Project Name: *Reid Pilot Plant Verification*



METS was contacted to evaluate a pilot plant based on a novel process created by Reid Technologies, which is used for the carbon capture and utilisation (CCU) to produce a fertiliser product.

METS made use of on-site monitoring during plant operation, assays to conduct this evaluation and developed monitoring methods. The evaluation conducted highlighted possible risks with the process, opportunities for process optimisation and the way forward.





## Other Minerals (cont.)

Commodity	Client	Project	Service
Sulphur	WMC	Grinding	Metallurgical Consulting
Specular Hematite	IMDEX	Confidential	Paint Application
Talc	WMC Talc	Three Springs Beneficiation	Confidential
Talc	WMC Talc	Three Springs Auto Talc Mixing Unit	Confidential
Tungsten	Hazelwood Resources	Cooke's Creek Project	Confidential
Zircon	Confidential	Zircon Milling Project	Confidential
Zircon	Confidential	Zircon Cleaning Project	Confidential
Zeolites	Quantum Filtration Media	Zeolite Project	Due Diligence
Diatomaceous Earth	Confidential	Confidential	Filter Aid

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# Recent Technical Papers

Date	Conference	Title
2018	<i>Battery Minerals</i>	Critical Metallurgical Aspects For Battery Mineral Projects
2018	<i>Mineral Sands</i>	Will Titanium Hardrock Be A New Source Of Titanium Pigment
2017	<i>ALTA 2017, Perth WA</i>	Lithium Extraction From Complex Ores
2017	<i>ALTA 2017, Perth WA</i>	Double Refractory Gold
2017	<i>Mineral Sands 2017, Perth WA</i>	Technical Options For Producing Premium Zircon
2016	<i>ALTA 2016, Perth WA</i>	Beneficiation Of Spodumene Into Concentrate And Further Processing To Produce Battery Grade Lithium Carbonate
2016	<i>ALTA 2016, Perth WA</i>	Processing High Clay Gold Ores
2015	<i>MetPlant 2015, Perth WA</i>	Karouni Gold Project From Core Drill To Commissioning
2015	<i>ALTA 2015, Perth WA</i>	White Dam Dump Leach Gold Project Due Diligence And Actual Project Production Performance
2015	<i>ALTA 2015, Perth WA</i>	Maximising Project Value For Complex Phosphate Projects Containing Uranium And Lessons Learned
2015	<i>Iron Ore 2015, Perth WA</i>	What Is The Future For Magnetite Projects In Australia And Why Have Some Of The New Projects Been So Problematic?
2015	<i>ALTA 2015, Perth WA</i>	White Dam Dump Leach Gold Project Due Diligence And Actual Project Production Performance
2015	<i>ALTA 2015, Perth WA</i>	Maximising Project Value For Complex Phosphate Projects Containing Uranium And Lessons Learned
2014	<i>Informa 2014, Perth WA</i>	Pipeline Design System Optimisation
2014	<i>COM 2014, Vancouver BC</i>	Scrubbing And Beneficiation Of Wet Sticky Clay Ores



# THANK YOU

## Americas

- Canada
- Argentina
- Bolivia
- Brazil
- Chile
- Ecuador
- Dominican Republic
- Guyana
- USA

## Europe

- Bulgaria
- Finland
- Georgia
- Greece
- Greenland
- Macedonia
- Serbia
- Russia

## Africa

- Congo
- Egypt
- Ghana
- Guinea
- Mauritania
- Namibia
- Sierra Leone
- Tanzania
- Zambia
- Zimbabwe
- South Africa
- Mali
- Mozambique
- Liberia

## Asia & Middle East

- China
- India
- Indonesia
- Kyrgyzstan
- Iran
- Kazakhstan
- Saudi Arabia
- Malaysia
- Philippines
- Vietnam
- North Korea
- Laos

## Australasia

- Australia
- New Zealand
- Papua New Guinea