

Remediation and Valorisation of Mining-Influenced Waters (MIW)



Introduction

At Rio Tinto, we aspire to leave a positive legacy for future generations.

Although mining and processing activities extend over decades, we recognise that we are only temporary stewards of the land, and that other activities and land use will follow.

To mitigate the impact of this transition, we look for opportunities to innovate and implement best practice in progressive closure, remediation and repurposing, and where appropriate, long-term monitoring and maintenance.

Rio Tinto currently has 92 active legacy assets and several active mining sites around the world that are nearing end-of-life for their operations. All of these sites need to meet or exceed local regulatory requirements and community expectations as we transition them through closure.

Mining-Influenced Water (MIW) in these legacy/closure sites, if left unmanaged, can have a significant impact on the environment and local communities. Conversely, the resources in MIW, if managed effectively, present significant opportunities, including contributing to the circular economy, minimising environmental impacts and creating additional value from waste.

To accelerate the transition to sustainable mine water remediation, we're investing in a long-term, diversified research and development (R&D) program focused on changing the dynamics of MIW treatment.

By crowdsourcing solutions to this complex challenge, we hope to identify technology development projects we can support that will help deliver breakthrough positive outcomes for local communities and the environment.

Business Challenge

Do you have an idea that could add value to sustainable mine water remediation?

We are looking to partner with experts to find, develop, and validate **selective** solutions that can target and efficiently remove targeted constituents from mine-influenced water (MIW) to enhance water recovery, reduce residual wastes, and the recovery of resources to generate new revenue streams and offset closure costs.

The goal is to identify and implement treatment solutions that achieve:

- Specific removal of contaminants known to adversely affect downstream treatment processes and which limit or impede end uses and recovery processes
- Selective separation of high value constituents (e.g., Cu, Ni, Co, Li, Zn, Mn and rare earth elements (REEs)) from water and wastes in a high-quality form that is readily commercialised; and
- Develop new revenue opportunities from the development of local opportunities such as the production of a fit-for-purpose water supply for communities, industries, and agriculture.

MIW are complex due to their temporal variability both in quantity and quality. Additional efforts might be required to address recalcitrant contaminants. The selective removal of certain contaminants is crucial as these can have acute toxicity at low concentrations. This precise targeting might be particularly relevant for sites where water discharges have a direct impact on the receiving environment.

The characteristics of MIW generated at four Rio Tinto sites are presented in the Appendix. This should be used by applicants to guide their submissions and address the issues and potential these MIW flows represent for the project being submitted.

- **Site 1:** Medium flow acid mine drainage with very high concentration of metals, REEs and sulphates
- **Site 2:** High flow acid mine drainage with medium-high concentration of metals and sulphates
- **Site 3:** Alkaline seepage
- **Site 4:** Neutral MIW with high content of As, B and TDS

Solutions we seek

We are reaching out to the global research, technology, and innovation industry to catalyse the development of new R&D projects to achieve Rio Tinto's goals for this business challenge, which are to:

- Identify and support the development of MIW remediation solutions at every stage of technology readiness level (TRL)
- Stimulate the market to transfer solutions from other industries
- Deliver against Rio Tinto's Closure vision and the specific MIW treatment business challenge
- Encourage collaboration between:
 - players across a technology solution value chain (e.g. between research organisations, process engineering services and manufacturing/fabrication services)
 - different technology providers to bring integrated solutions that can deliver multiple benefits (e.g. selective metal recovery technology that is available in a versatile pre-fabricated package plant) and/or deliver end-to-end solutions (e.g. complete

treatment of wastewater to meet discharge requirements and upcycling/downstream processing of recovered constituents to maximise their market value)

- Capture key lessons for future developments/opportunities

We aim to develop projects with leading-edge solution providers uncovered in this campaign that will strive to overcome challenges identified at a number of Rio Tinto mining assets. As such, these projects will play an integral part in Rio Tinto's R&D pipeline of opportunities for the next three years and beyond.

Solutions in this area should be able to achieve at least one of the following:

- Address recalcitrant contaminants of concern while maintaining performance regardless of seasonal variations
- Present novel and high-performance techniques for selective separation compared to current state-of-the-art approaches across multiple pipe parity metrics
- Adaptable and avoiding one-off sorbents/solutes for a niche application; and/or
- Increase the value, quality and/or commercialisation value of removed constituents (i.e., integration with downstream processes)

Solutions do not necessarily need to meet full water treatment requirements (i.e. discharge quality), but must demonstrate a capability and the added value they would bring when integrated into a proven MIW treatment process.

The assessment of technology solutions submitted will in part be based on water, energy and carbon footprint pipe parity metrics. Submissions should consider the following when benchmarking presented solutions against state-of-the-art technologies and/or technologies commonly deployed for MIW treatment:

- Cost metrics, e.g.:
 - *Levelised cost of water (LCOW) per m³*
 - *Levelised cost of target metal per amount or metal contained in the water in one year (e.g., $LCCu = \text{total cost of the system to produce Cu at cathode purity (99.9\%)} / \text{amount of Cu in the water in the year}$).*
- Energy performance, e.g.:
 - *Total energy requirements*
 - *Type of energy required*
- Water treatment solution performance:
 - *% removal of various contaminants of concern*
 - *% purity/form of target metal(s) x efficiency of recovery (valorisation)*
 - *Selectivity of target metal(s) x efficiency of recovery (valorisation)*
 - *Others specific to the treatment (e.g., adsorption rates)*
- ESG, Sustainability, human health, e.g.,
 - *Air emissions*
 - *CO₂eq (Scope 1 and 2) for the solution*
 - *Land use impact / physical footprint*
 - *Health impact/hazards*
 - *Amount of reactive/hazardous (non-inert) sludge/waste generated*

- *Consumption of new chemicals, materials (cartridges, membranes, etc.) – regeneration/recycling capability*
- *Life cycle analysis (LCA), establishing carbon intensity of the overall system*
- Process Adaptability, e.g.,
 - *Ability to cope with variable input water qualities and quantities*
 - *Ability to produce variable output water quality*
 - *Ability to operate flexibly in response to variable energy inputs*
- Reliability and availability
- Scalability
- Easiness of implementation (technology risk = combination of technology gap + technology complexity)

Timeline

The crowdsourcing campaign is a two-stage process.

This initial phase (Concept Paper) will close for submissions on 28th April 2022. An initial shortlist of selected submissions will be contacted during the week of 23rd May to submit a Full Proposal for an R&D project (Stage 2), with details of this communicated at the time.

Submissions lodged after the closing date and time or lodged using an alternative to Pioneer Portal may be disqualified from the evaluation process and will be ineligible for consideration.

About your submission

We encourage you to include as much evidence to support the claims made in your submission in order to provide Rio Tinto with the confidence in the feasibility and effectiveness of your solution or concept.

We may elect to proceed with any, all, or none of the submissions. Similarly, there could be aspects of your solution that could work with other solutions, hence consider whether you would be willing to partner with other third parties. This will be discussed on an individual basis.

There should be an assessment of the Technology Readiness Level, as Rio Tinto is willing to fund and or cost share projects from US\$50,000 up to US\$2 million. This funding may be made available as a mix of cash and in-kind (e.g. site access for prototyping or testing, subject matter expertise, wastewater samples). Large private organisations or teams composed by multiple organisations are encouraged to contribute with at least 20% of the total project cost. Rio Tinto may consider the amount of cost share proposed when selecting applications for further discussions. Proposals linked to grant applications seeking co-funding will also be considered. These will be discussed on an individual basis, upon successful progression.

Rio Tinto's contribution could be provided through:

- R&D collaboration agreements
- R&D consultancy services or
- equity arrangements.

An R&D project should not include more than two stages of development, with each stage being typically classified as:

- Proof of Concept: Advancing a technology currently in TRL2 or TRL3 to TRL4

- Prototype/Pilot: Advancing a technology currently in TRL4 to TRL6
- Demonstration: Advancing a technology currently in TRL 6 to TRL7 or TRL8 (also from TRL7 to TRL8)

Rio Tinto are open to a wide range of project delivery timelines, from delivery periods of less than a year to multi-year projects of up to 5 years.

Rio Tinto will consider a mix of quantitative and qualitative criteria in determining whether to invite the submission of a Full Proposal and whether to select a Full Proposal for award negotiations. These criteria include:

- Impact and benefits of the proposed technology. This criterion involves consideration of the following:
 - *The extent to which the proposed concept will have a positive contribution to the business challenge*
 - *The extent to which the potential economic, social, and environmental benefits are identified*
 - *Demonstrated awareness of competing commercial and emerging technologies*
- Project implementation and solution development. This criterion involves consideration of the following:
 - *Identification of techno-economic challenges that must be overcome for the proposed technology to be commercially relevant*
 - *For TRLs>4, Mine water applications have been tested and a logical scale up process is proposed*
 - *Clear identification of auxiliary technologies needed for the solution to be implemented and deliver value*
 - *Additional research needed, pilot cost and facilities needed are clearly stated*
 - *Team/consortium in place with competencies to drive development to higher TRLs*

How to lodge your submission

Please submit via the form on the [Pioneer Portal](#) and ensure that you agree to the Terms and Conditions.

For further clarification email pioneerportal@riotinto.com.