Safe, sustainable management of mine tailings while exploring options for a non-tailings future

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Outline

Key take-aways

Drivers of the research funded by MRIWA

MRIWA enabled projects and scholarships

Examples of outcomes from funded projects

Concluding comments

Take-aways

- MRIWA funding provided support for addressing both current imperatives and long term, blue-sky potential solutions
- Some projects benefit from an initial, limited scale (proof of concept) project, followed by a more substantial project(s)
- Opportunities were provided for making new industry contacts

Key driver of the research funded by MRIWA

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MRIWA enabled projects

Research Projects

1. Tailings Storage Facilities Characterisation – Quantifying Seepage Losses (M0430)
2. Safe, sustainable management of filtered tailings (M0510)
3. Feasibility of electrokinetic in situ leaching (M0450)
4. Towards a mechanistic understanding of electrokinetic in situ leaching (M0544)

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MRIWA supported PhD students

1. **Feasibility of electrokinetic in situ leaching – Evelien Martens (M0455).**
2. **Feasibility of effective metal recovery from tailings material via electrokinetic in situ leaching – Bishenka Mahaulpatha ((M10452).**
3. **Integrating field monitoring and numerical modelling to better quantify the stability of tailings storage facilities – Alexandra Halliday (M10408).**
4. **Accelerating consolidation of mine tailings using electro-osmosis dewatering technology – Nilan Jayasiri**

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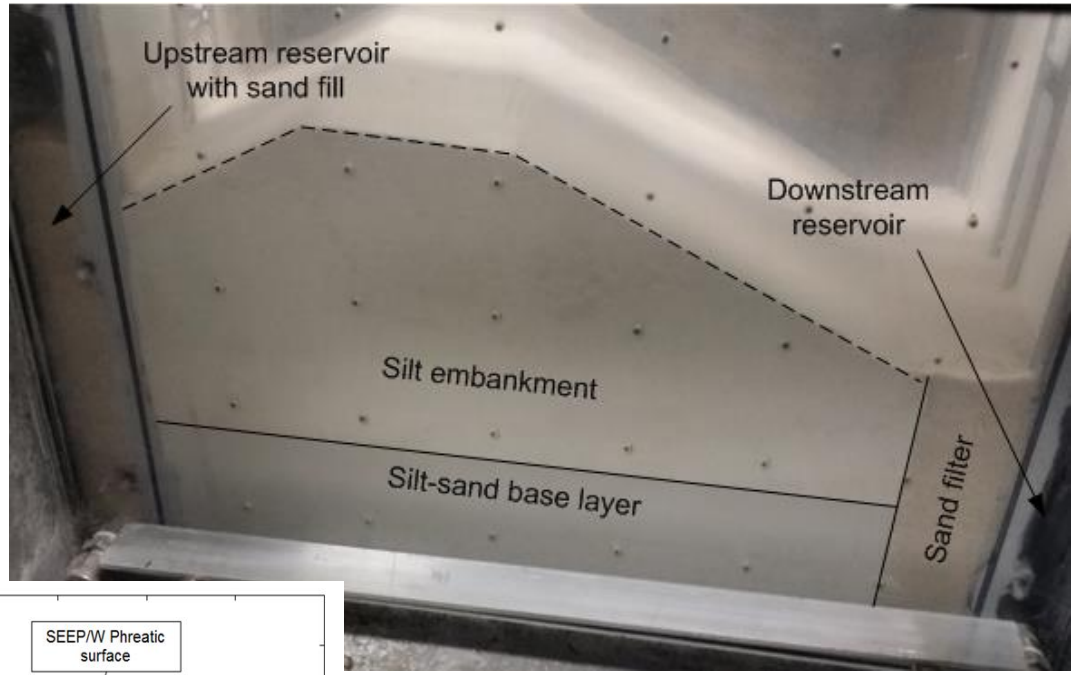
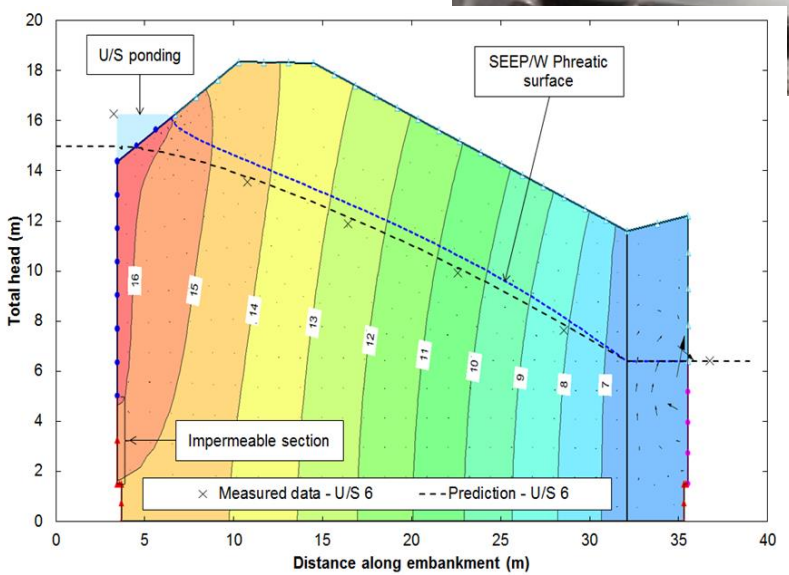
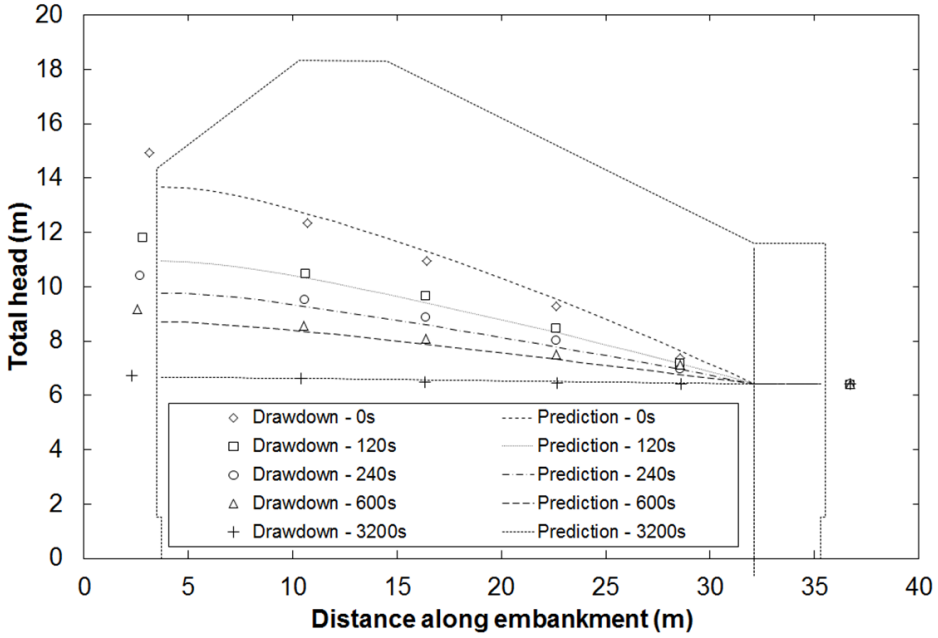
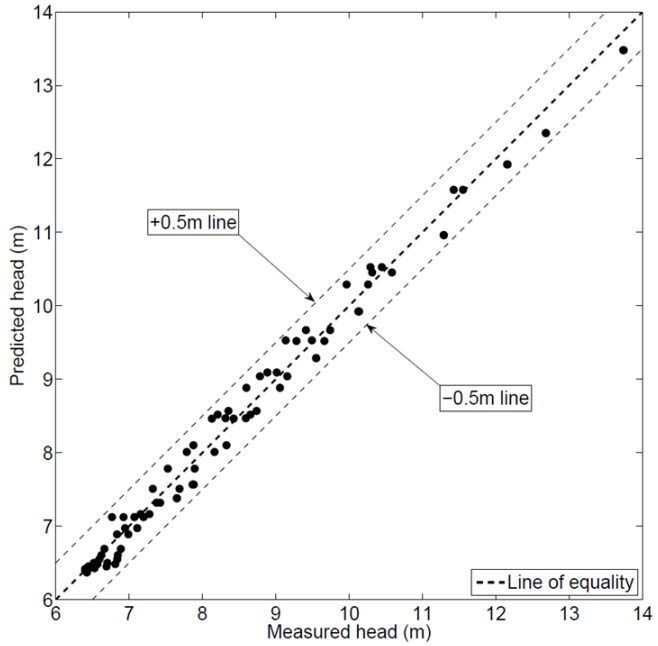
Quantifying seepage losses





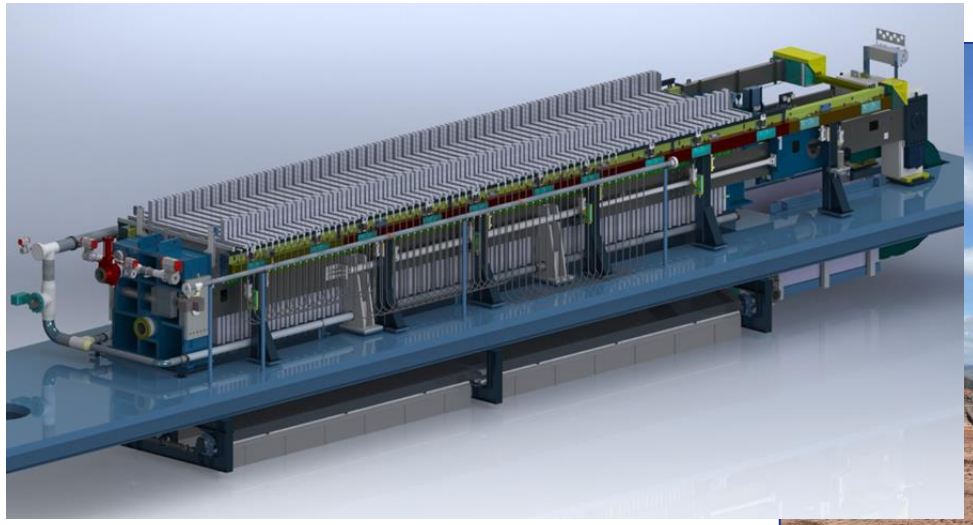
Quantifying seepage losses – closure considerations





- Predictions fall above and below the line of equality
- Maximum error of ±0.4m, similar to steady-state, again regardless of hydraulic gradient.
- Maximum drawdown times of ~3200s, or ~ 370 days at $n = 100$.

Evaluating alternative tailings management techniques: filtration (M0510)



Filtered tailings enable the construction of an engineered fill, compacted to a density that can ensure zero susceptibility to liquefaction

Evaluating alternative tailings management techniques: filtration (M0510)

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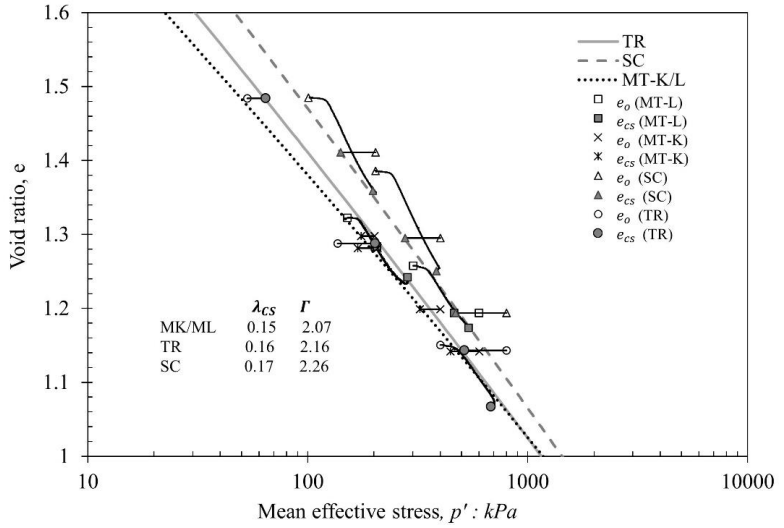
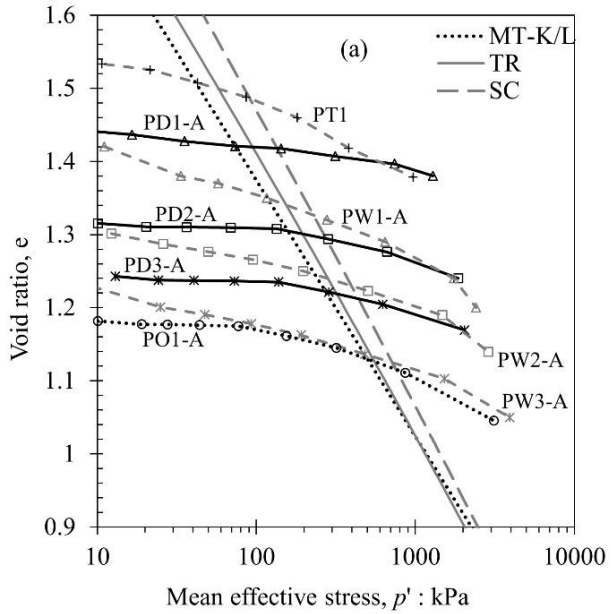
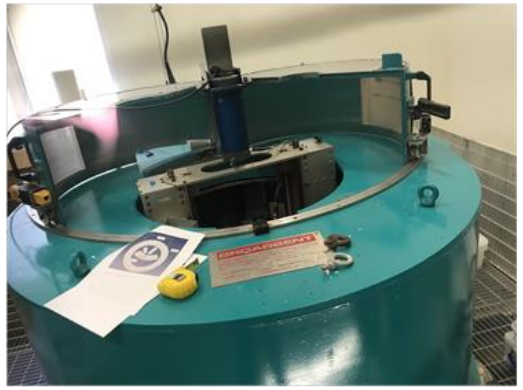
To evaluate potential susceptibility to liquefaction, it is now commonplace to evaluate the Critical State Condition.

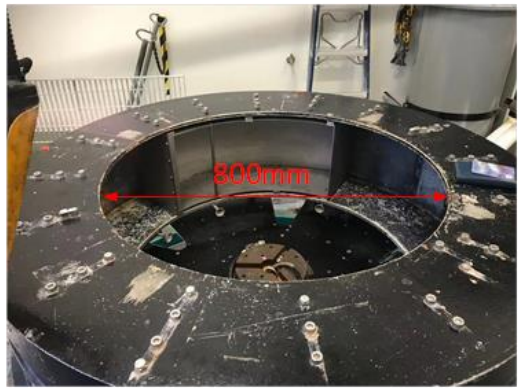
This project highlighted previously unrecognised problems with current standardised techniques for characterising red mud (bauxite residue).





Flowability of filtered tailings





Results showed that filtered tailings were not susceptible to large flowslide type failures – IF placed and compacted adequately

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Imagining the invisible mine

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Project M0450 - Feasibility of electrokinetic in situ leaching

SCIENCE ADVANCES | RESEARCH ARTICLE

ENGINEERING

Toward a more sustainable mining future with electrokinetic in situ leaching

Evelien Martens[1,2], Henning Prommer[1,3]*, Riccardo Sprocati[4], Jing Sun[1,3,5], Xianwen Dai[6], Rich Crane[7], James Jamieson[1,3], Pablo Ortega Tong[1,3], Massimo Rolle[4], Andy Fourie[2]

Metals are currently almost exclusively extracted from their ore via physical excavation. This energy-intensive process dictates that metal mining remains among the foremost CO_2 emitters and mine waste is the single largest waste form by mass. We propose a new approach, electrokinetic in situ leaching (EK-ISL), and demonstrate its applicability for a Cu-bearing sulfidic porphyry ore. In laboratory-scale experiments, Cu recovery was rapid (up to 57 weight % after 94 days) despite low ore hydraulic conductivity (permeability = 6.1 mD; porosity = 10.6%). Multi-physics numerical model simulations confirm the feasibility of EK-ISL at the field scale. This new approach to mining is therefore poised to spearhead a new paradigm of metal recovery from currently inaccessible ore bodies with a markedly reduced environmental footprint.

Plus

Feasibility of electrokinetic in situ leaching – Director's scholarship for Evelien Martens (M0455)

M0450 + M0455 proved the concept was viable – led to M0544 - Towards a mechanistic understanding of electrokinetic in situ leaching
Industry sponsors BHP, Newcrest, Newmont and Evolution Mining

Electrokinetic dewatering – stabilisation of fine-grained tailings

Accelerating consolidation of mine tailings using electro-osmosis dewatering technology – Nilan Jayasiri

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Field test

Deep treatment is feasible, at low power consumption. Use of solar energy is viable

Field test of viability of EK dewatering of super-fine clay tailings (>80% finer than 75µm

One week later

Concluding comments

- MRIWA funding provided support for addressing both current imperatives (preventing catastrophic failures of tailings storage facilities) and long term, blue-sky potential solutions (in situ leaching; EK dewatering of super-soft tailings)
- Some projects benefit from an initial, limited scale (proof of concept) project, followed by a more substantial project(s) – the EK in situ leaching project
- Opportunities were provided for making new industry contacts – a successful Proof of Concept project can lead to interested engagement by industry.

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