From Trials to Success: Leveraging Vegetation for Safe and Stable Mine Landforms

AusIMM NZ Branch Conference 2026

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okane

Land Acknowledgement



Source: B. Johnson, 2023.

Introduction



Source: Okane, 2023.

Case Study #1 - Cover System

Mine Closure 2022 - M Tibbett, AB Fourie & G Boggs (eds)
© 2022 Australian Centre for Geomechanics, Perth, ISBN 978-0-6450938-4-1
doi:10.36487/ACG_repo/2215_27

Marra Mamba South Waste Rock Dump cover system field trial autopsy, Tom Price Mine, Western Australia

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Abstract

Cover systems are layered materials designed to create an interface between underlying waste rock material and the receiving environment. Two cover system field trials were constructed on the Marra Mamba South (MMS) Waste Rock Dump (WRD) at Tom Price Mine in 2003: Test Plot One (TP1) comprised banded iron formation (BIF) and Test Plot Two (TP2) comprised oxidised Mount McRae Shale (MCS). Both test plots used the moisture 'store-and-release' cover design concept that acts to limit infiltration of atmospheric water, provide a buffer layer reducing the potential for upward migration of salts, and support resilient native vegetation growth. The aim of the field trials was to assess the performance of the constructed cover systems. Okane completed an in situ autopsy of the MCS test plot in 2021, prior to decommissioning of the field trials. The autopsy provided an opportunity to assess the geotechnical and geochemical evolution of the cover system material after 17 years of climate cycling, measure the influence of cover system material type on plant health, determine root distributions through the cover system material, and decommission in situ performance monitoring equipment. Material characterisation of the cover system material included the analysis of fertility, element enrichment and mobility, particle size distribution, and soil water retention. Results were compared to similar works carried out over the 17-year lifespan of the field trials to indicate the degree to which the cover system degraded over time. Vegetation root analysis and tap root tracing indicated the presence of Acacia and Senna species roots within the cover system material (0–2.4 m) and extending to 3 m into the underlying waste rock. Roots of native grass species (Poaceae) were present in the cover system material but were not detected in the underlying waste rock. Material characterisation findings indicate the MCS is a suitable material for cover system design from a stability perspective and to support the establishment of native vegetation cover. Findings on root depth analysis can be used to inform suitable seed mixes to minimise risks related to potentially acid forming WRDs. The autopsy demonstrated minimal degradation of the MCS cover system profile over its 17-year lifespan and indicated that MCS is a suitable material for use in store-and-release cover systems for landforms in the Pilbara.

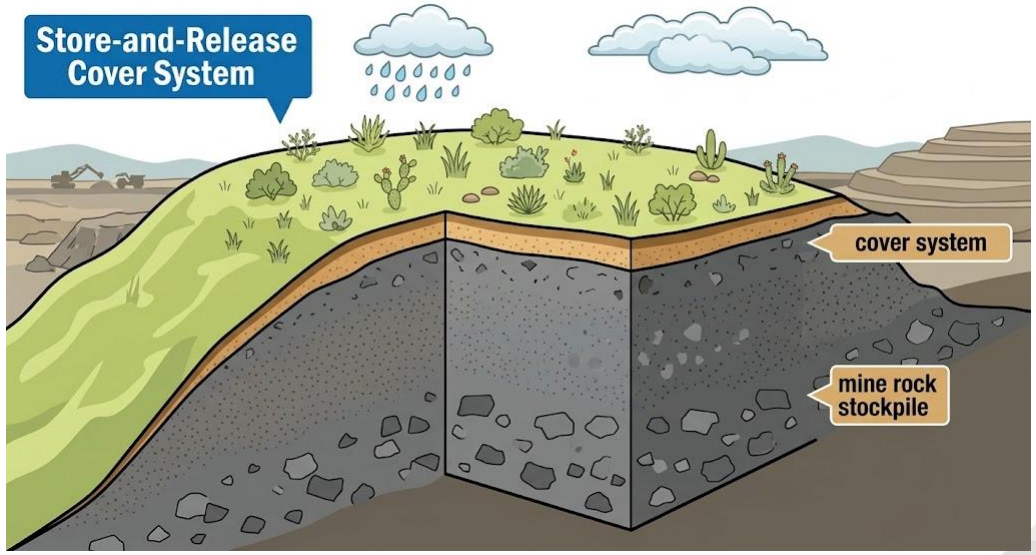
Keywords: *cover system, store-and-release, cover trial autopsy, rehabilitated cover trials, root depths*



Source: B. Johnson, 2024.

Cover System 101

A cover system is a multi-layered barrier constructed over mine rock designed to physically and hydrologically isolate the material from the surrounding environment.



Source: Okane, 2026.

Case Study #1 - Cover System

Investigate how two cover systems have evolved over their 17-years of life and undertake an assessment and analysis of vegetation growth and development.



Source: B. Johnson, 2021.





Source: B. Johnson, 2021.

Case Study #2 – Growth Media

Key objectives of Project Grow:

- Determine if varying ratios of CID material (mine rock) and topsoil can create a sustainable growth medium, comparable to an undisturbed natural environment.
- Evaluate the viability and germinability of native vegetation keystone species.
- Inform Yandi closure landform design through an embedded growth media trial.



Source: Okane, 2025.

Case Study #2 – Growth Media

Treatments assessed:

- Topsoil.
- Mine rock CID material.
- Fertiliser (NPK fertiliser & Gypsum).
- Two seed mixes (Grasslands & Shrub and Grasslands).

12 plot factorial design, with six different growth media ratios.



Source: Okane, 2025.

Case Study #2 – Growth Media

Plot 1- 100 % topsoil

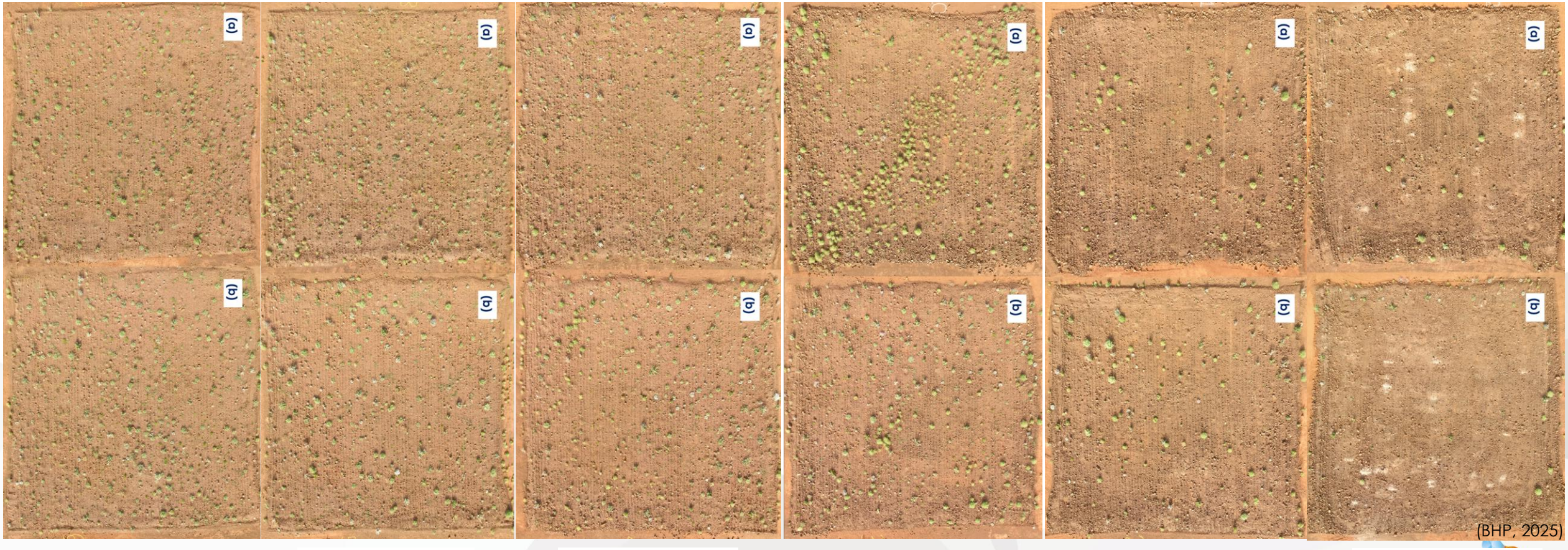
Plot 2 - 80% TS / 20% CID

Plot 3 - 60% TS / 40% CID

Plot 4 - 20% TS / 80% CID

Plot 5 - 100% CID

Plot 6 - 100% CID + Fertiliser



(BHP, 2025)

Plot 7- 100 % topsoil

Plot 8 - 80% TS / 20% CID

Plot 9 - 60% TS / 40% CID

Plot 10 - 20% TS / 80% CID

Plot 11 - 100% CID

Plot 12 - 100% CID + Fertiliser

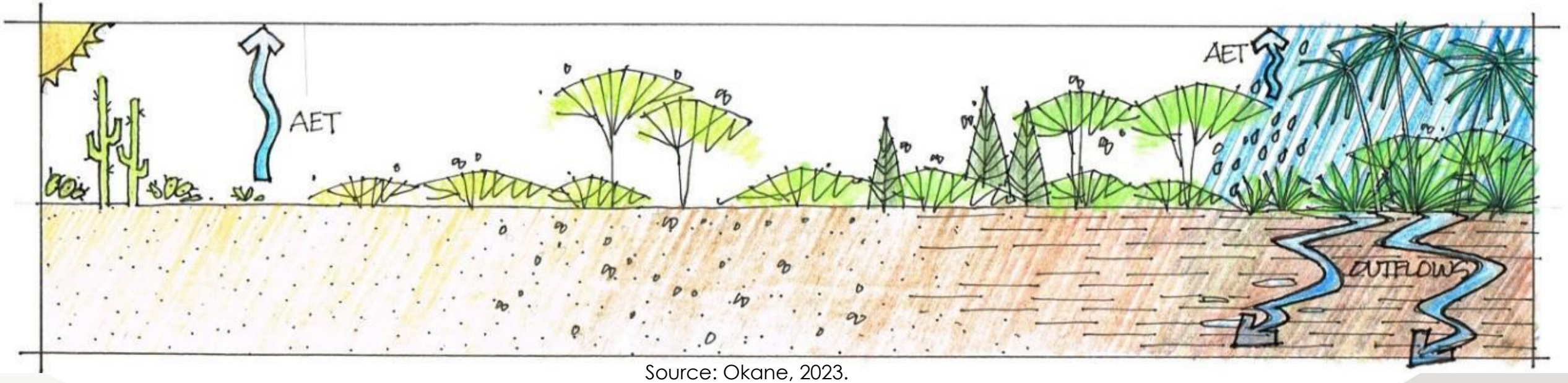
Case Study #2 – Growth Media, Next Steps

- Ongoing annual monitoring of existing trials.
- Growth media environmental DNA (eDNA) testing.
- Utilise results to support development of a scalable alternative growth media strategy.



Trial plot growth media eDNA testing (Source: Okane, 2026).

Case Study #3 – Vegetation



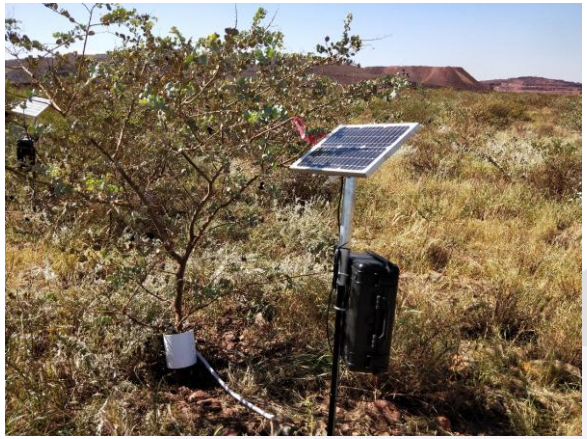
Source: Okane, 2023.

Case Study #3 – Vegetation

Data Collection

- Plant germination rates.
- Plant establishment success.
- Plant density, diversity, and cover.
- Continuous monitoring of soil water content.
- Continuous monitoring of net percolation with lysimeters.
- Electrical resistivity tomography.
- Continuous measurement of sap flow in plants (when mature).





Source: B. Johnson, 2022.

Conclusion



Source: B. Johnson, 2023.



Source: B. Johnson, 2021.



Source: B. Johnson, 2023.

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