Presentation

Improved Method for Predicting Brine Evaporation Rate

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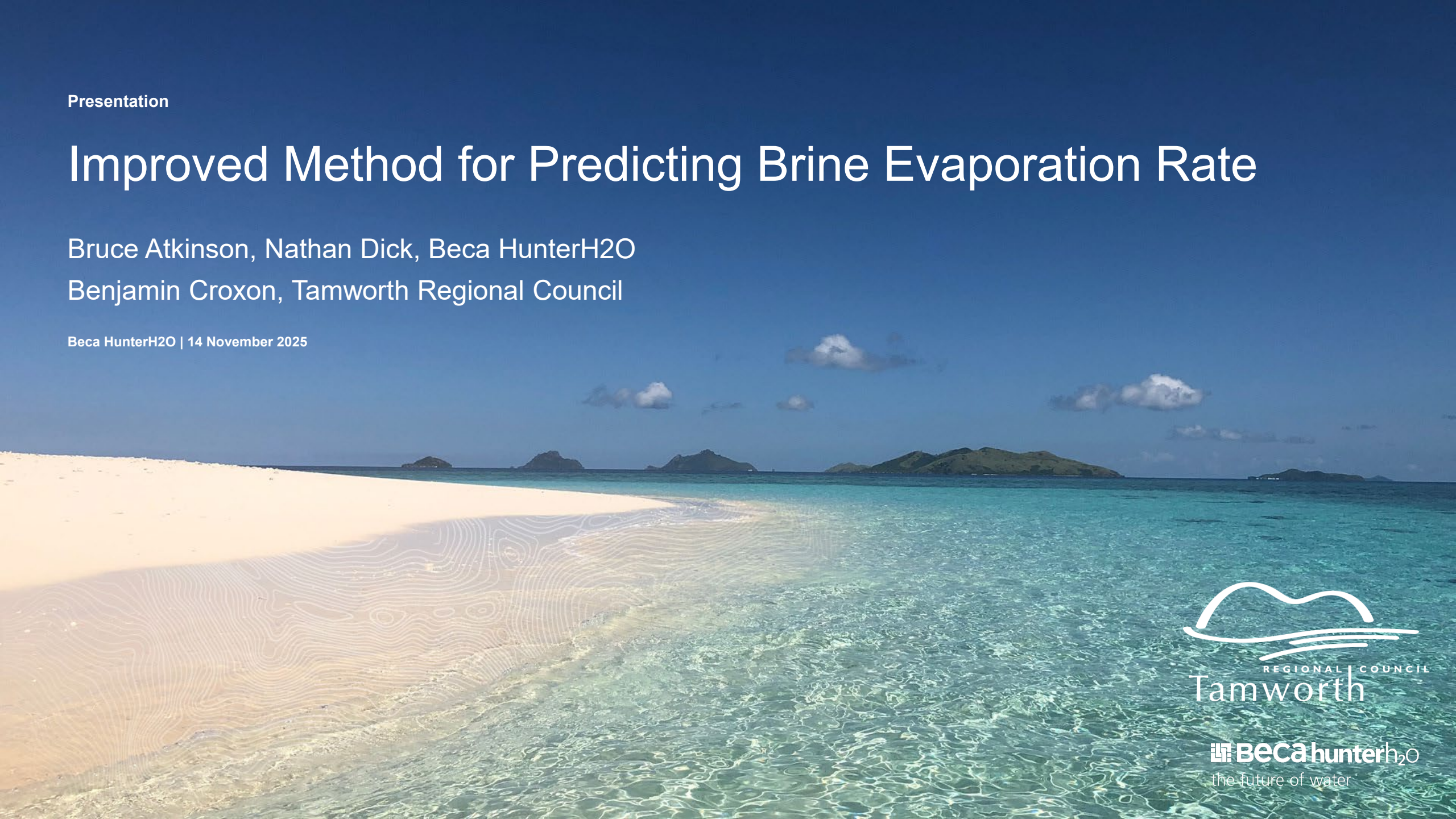
Beca HunterH2O | 14 November 2025



Topics

- Driver/Objective
- Planning and Experimental
- Data Assessment Approach
- Project Implications

Managing Saline Residuals

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Drivers

- Inland location
- Mixed-salt brine from proposed 12 ML/d Water Purification Facility
- Advanced RO generating average 220 m^3/d at 5 to 8% salt
- Long-term salt emplacement only current option
- No benefit from ZLD, as underlying salt storage volume for 50 years of operation is ultimate volume driver
- Published brine evaporation basis – very basic average factors from AWWA Manual M69:

Factor	Purpose as applied to Net Average Evaporation (Pan A Evaporation less rainfall)
0.70	Difference between lagoon evaporation of fresh water versus Class A pan evaporation
0.70	Salinity Factor
0.83	"Safety Factor"
0.41	Overall factor applied to pan data for net average evaporation rate

Objective

- Develop sufficient information to facilitate design of dual-purpose brine evaporation and storage lagoons to last for 50 years of operation

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Planning

Option	Advantages	Disadvantages
Small-scale lined earthen lagoon (1:4 batter on internal walls) emulating full-scale depth **Minimum area requirement 35 x 35 m**	Emulates full-scale configuration and lining Eliminates shading on lagoon	Average depth much lower than full-scale (shallow-angle lagoon walls) High construction cost Large salt quantity to establish experiment (large water volume) High remediation cost More difficult access to instruments
Tank emulating full-scale depth	Low cost (PE tank) Earthen insulation accommodated by providing earthen surround to tank Small land area (10 m x 10 m) Easy access to instrumentation Minimum tank area to net and fence.	Need to maintain minimum of 300 mm tank wall freeboard for storm events – leading to some tank shading. {shading minimised by progressively cutting down tank wall whilst maintaining minimum freeboard}

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Experimental set-up – Installation

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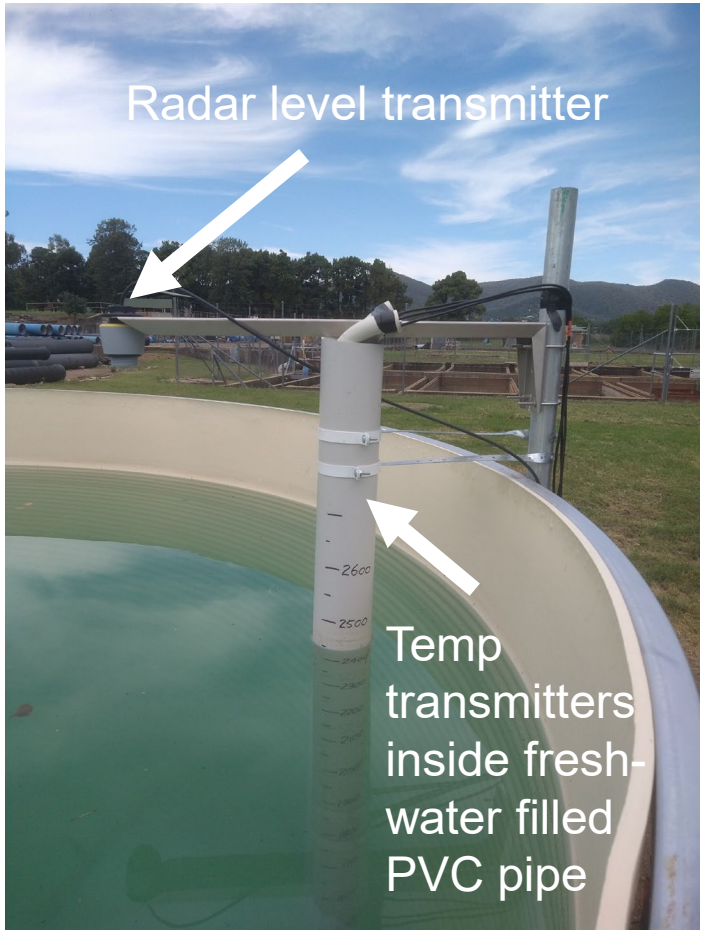
Experimental set-up



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Experimental set-up – dedicated Weather Station

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Experimental set-up – bird netting

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Experimental set-up – progressive wall cut-downs

Experimental set-up – algae growth

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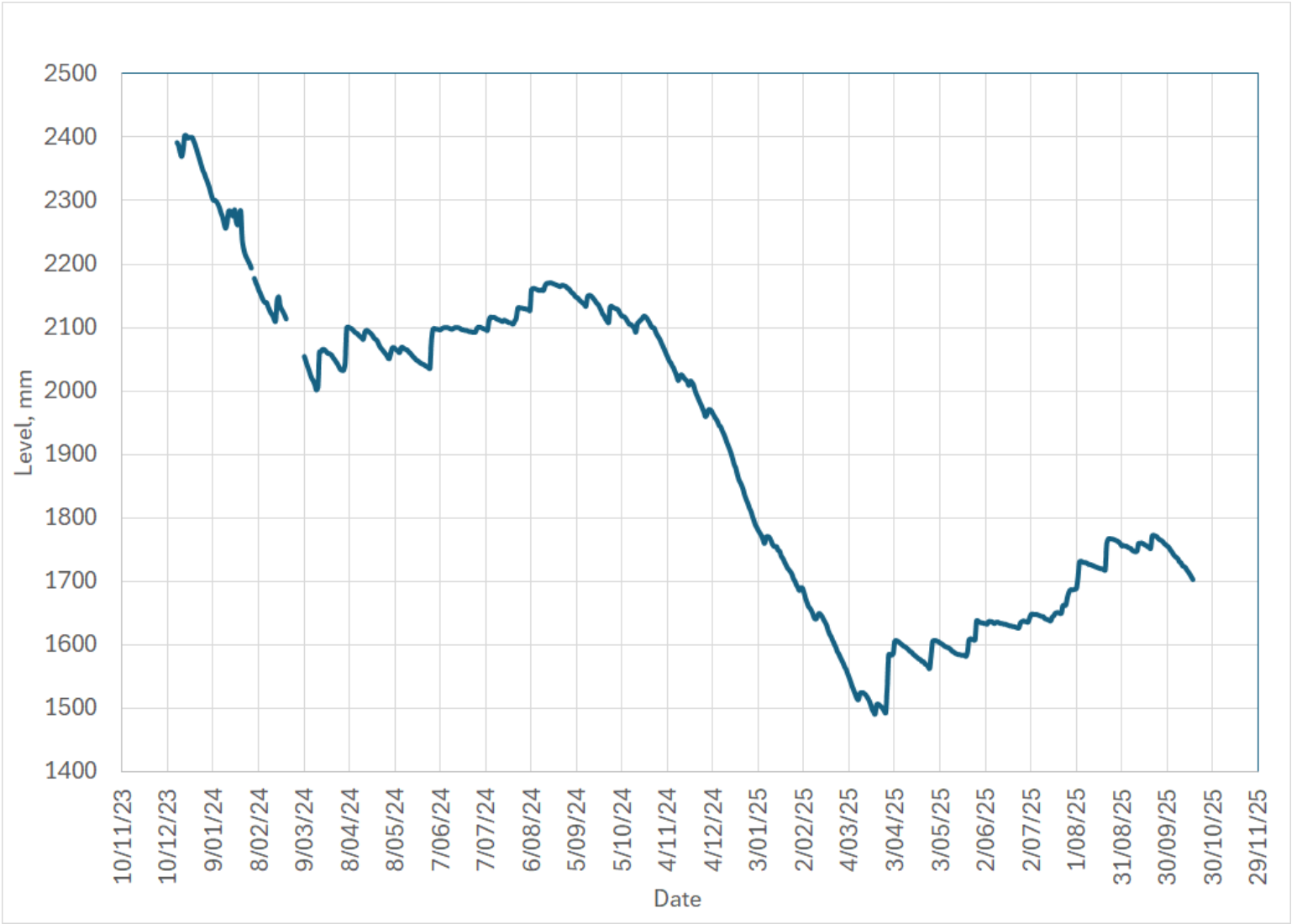
Brine tank level

4.5% salt



6.3% salt

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Preliminary Data Assessment

Experimental data: Scikit-learn Python library utilised to implement and compare the results from a range of regression models with a ‘gradient boosting model’ to correlate measured weather data with actual evaporation

Subsequent model:

- daily timestep
- Assumed salinity factor (1- Volume Fraction Salt)
- 50 years of operation using SILO gridded (actual) climate data 24/11/1970 to 24/11/2024

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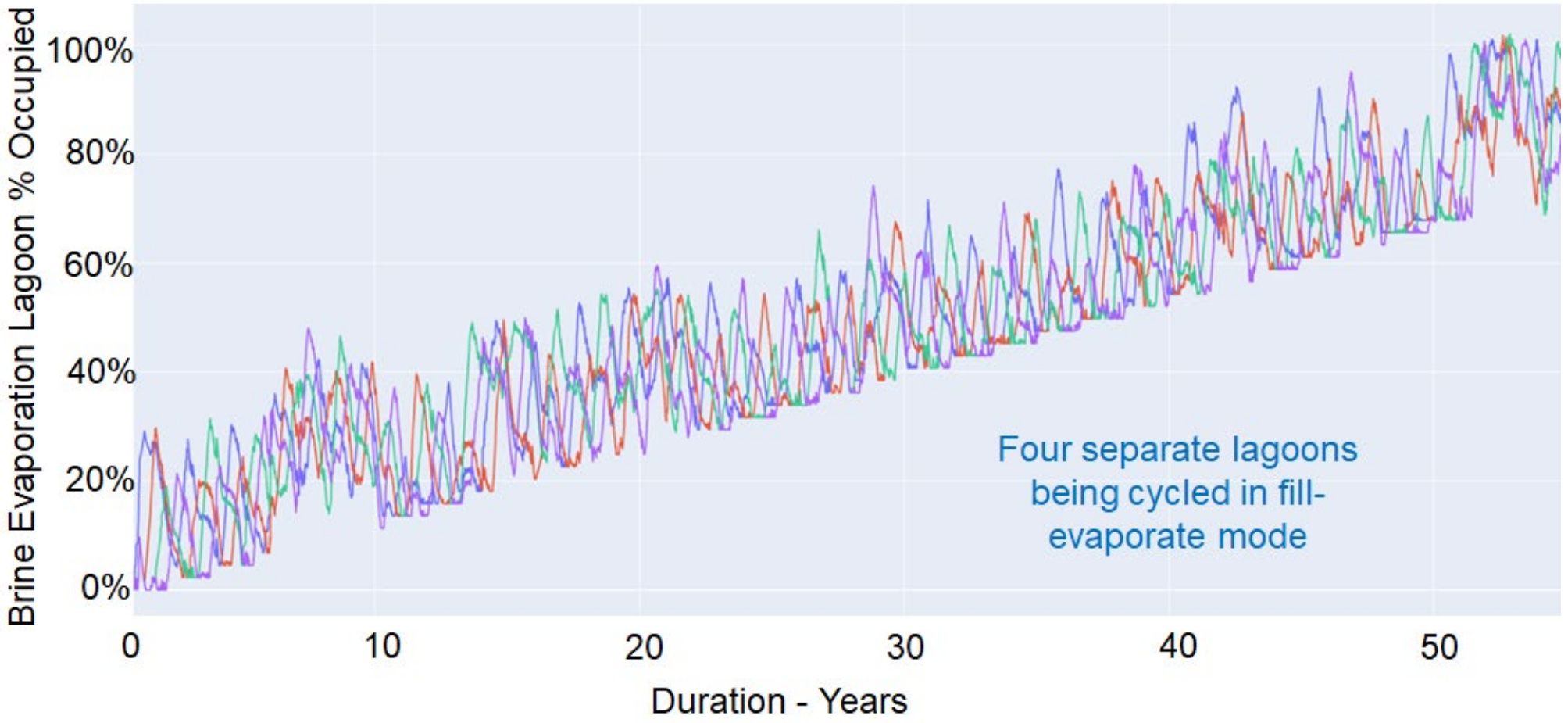
Model output



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Summary

- Experimental design required compromises – shading from tank freeboard
- Average evaporation when modelled at daily timestep over full project life less than the AWWA M69 factor of 0.41 x Pan Evap
- Significant freeboard to be allowed for weather events
- Approach allows evaporation rate to be modelled in any climate, using the correlations from this experiment in conjunction with site-specific detailed weather records
- This case: changed design from 4 x 135 ML to 4 x 170 ML lagoons

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