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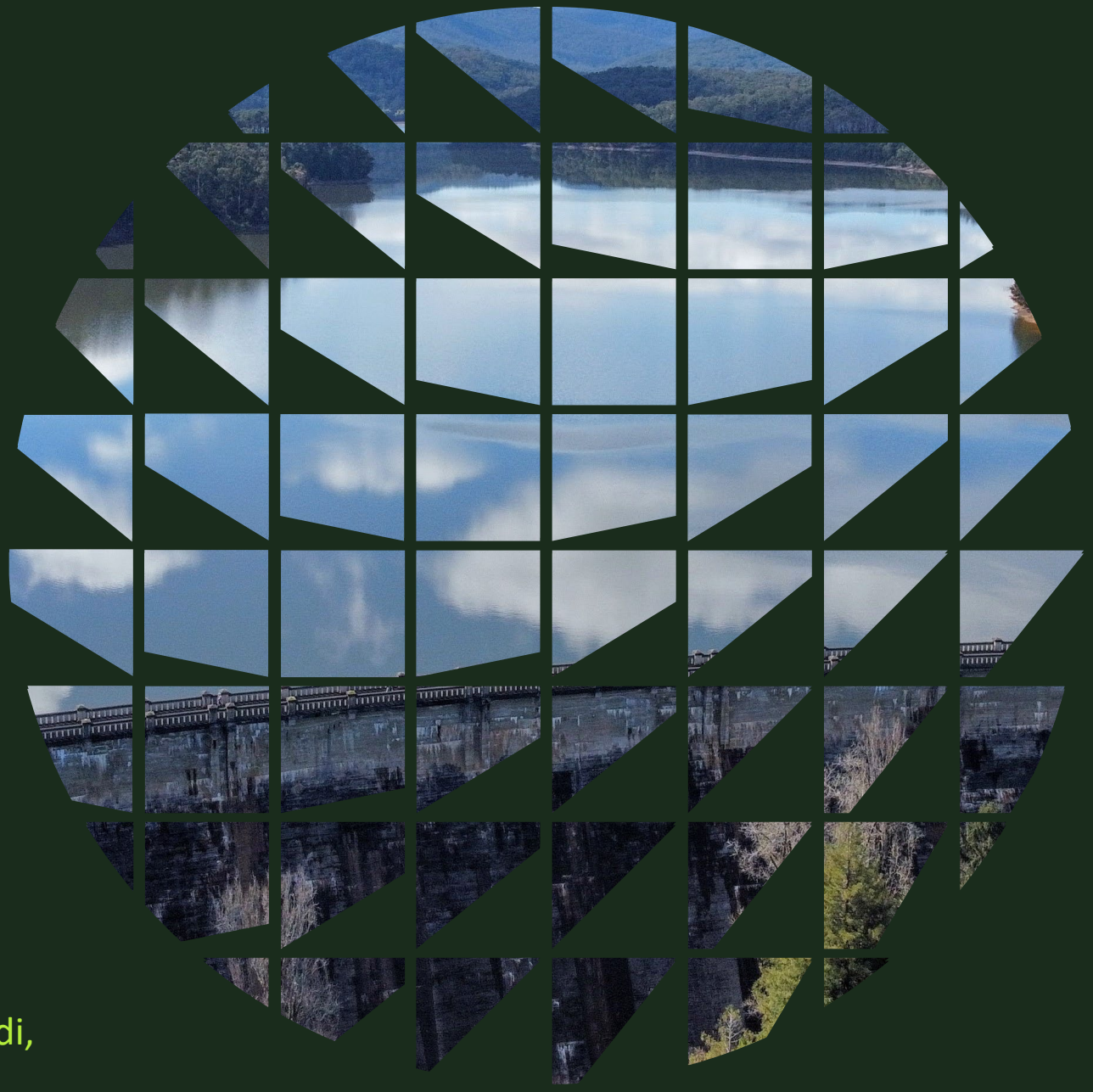


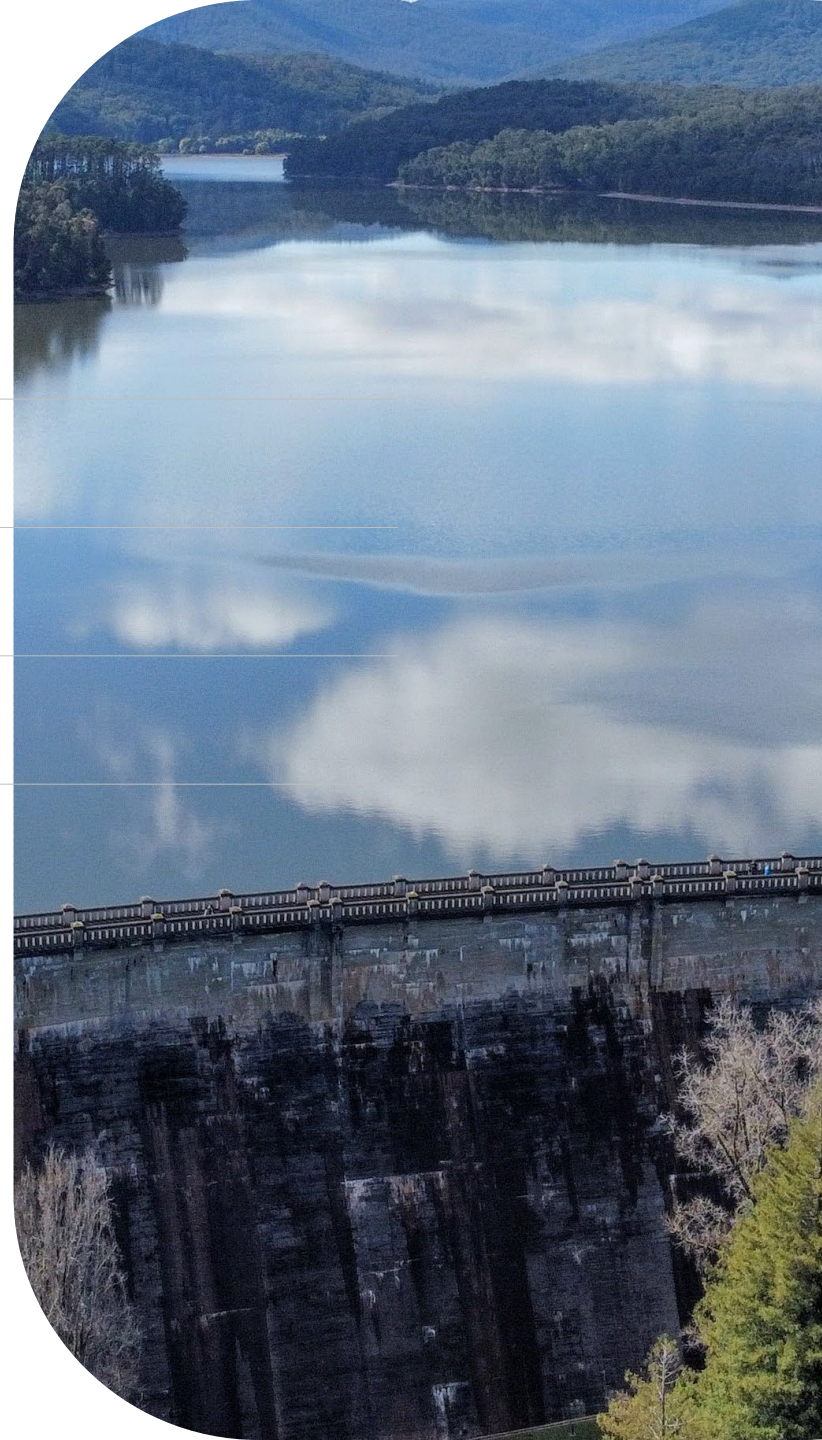
NEXT WATER 2025

Hydrological modelling to mitigate bushfire-related risks to water security

Petter Nyman, Joel Rahman, Paul Richards, Jabbar Khaledi, Gary Sheridan

Outline

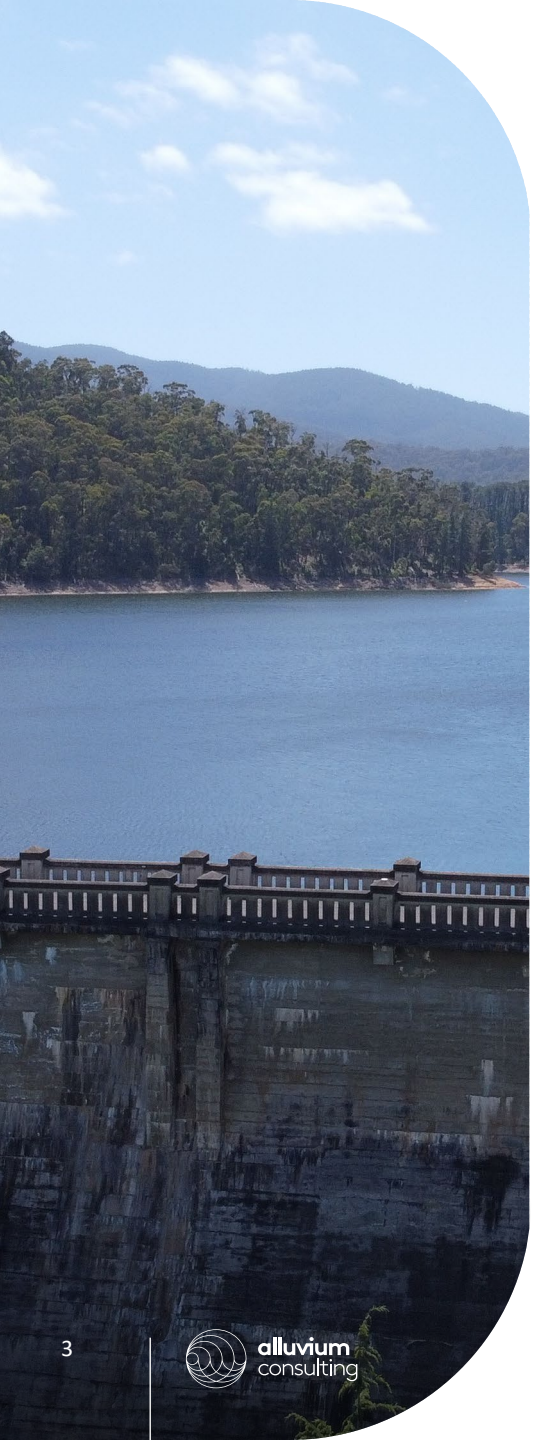
- The need for a model of bushfire impacts on water quality
- The science – translating research into practical tools
- The model – linking post-fire processes with rainfall-runoff in Source
- Next steps



Acknowledgements:
Research collaborators: Gary Sheridan (University of Melbourne)

Water RA Partners: Melbourne Water, Water NSW, SA Water, Water Corporation, SEQ Water, Hunter Water

External funding: The project is being conducted under the Disaster Ready Fund and has received Commonwealth financial support.

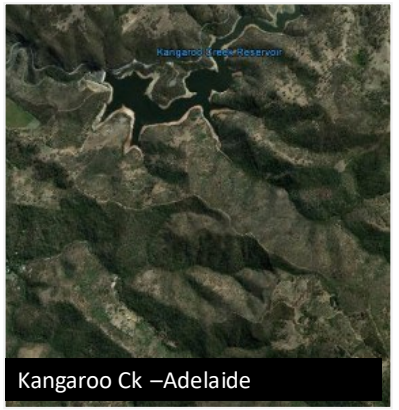


Forested catchments for potable water

- Forested catchments - natural treatment and a steady supply, including for our biggest cities
  - Melbourne (~80%), Sydney 80-90%), Canberra (>80%)
  - Perth and Adelaide: less important for supply, but forests surround the storage reservoirs that support the water supply system

- Bushfire represents a threat to these systems.
  - Increased turbidity → issues for treatability and effectiveness of UV
  - Organics → treatment by-products
  - Risk in terms of the cost of treatment and reliability of the supply
- The magnitude of the risks and the opportunities for managing them are not well understood


Cotter – Canberra


Kangaroo Ck –Adelaide


Nattai – Sydney

Thomson – Melbourne Water

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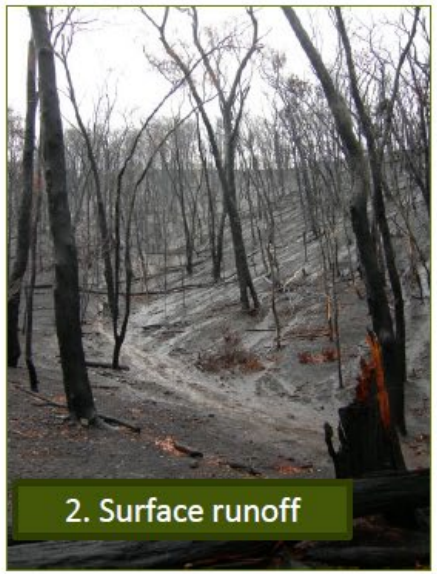
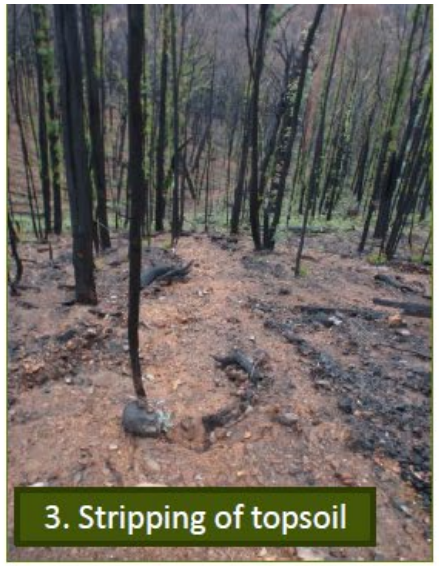
Bushfires introduce risk to water supply





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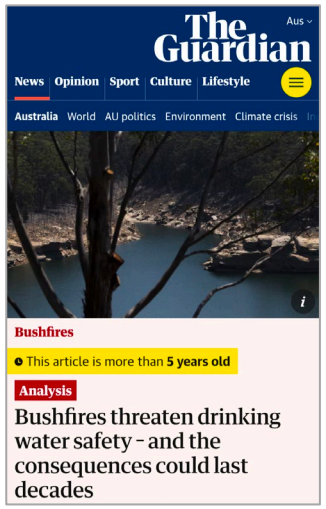
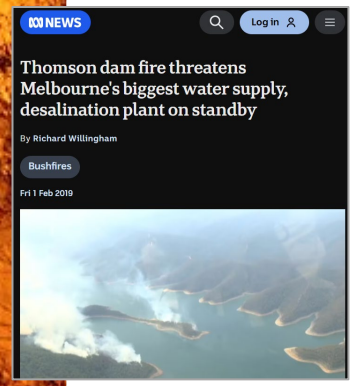
Bushfires introduce risk to water supply

Bushfires introduce risk to water supply





- **2019-20 bushfire season** (WaterNSW)
  - WaterNSW had to implement special management strategies
  - Adjusting offtakes, additional filtration
- **2019 Thomson Dam fire** (Melbourne Water)
  - A February 2019 fire burnt 6,300 hectares of the forested Thomson catchment.
  - Spurred subsequent work to identify high-risk debris-flow locations and mitigate.
- **2005 Perth Hills bushfire** (Water Corporation)
  - Affected the catchment of the Mundaring Weir. Turbidity plume was managed through in-stream dosing.
- **2003 Canberra (**Actew, now Icon)
  - Water restrictions, new treatment plant

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Bushfires introduce risk to water supply

Journal of Hydrology **15** (1972) 77–96 © *North-Holland Publishing Company*

HYDROLOGIC EFFECTS OF A BUSHFIRE IN A CATCHMENT IN SOUTH-EASTERN NEW SOUTH WALES

J. A. H. BROWN

Snowy Mountains Engineering Corporation, Cooma, N.S.W., Australia

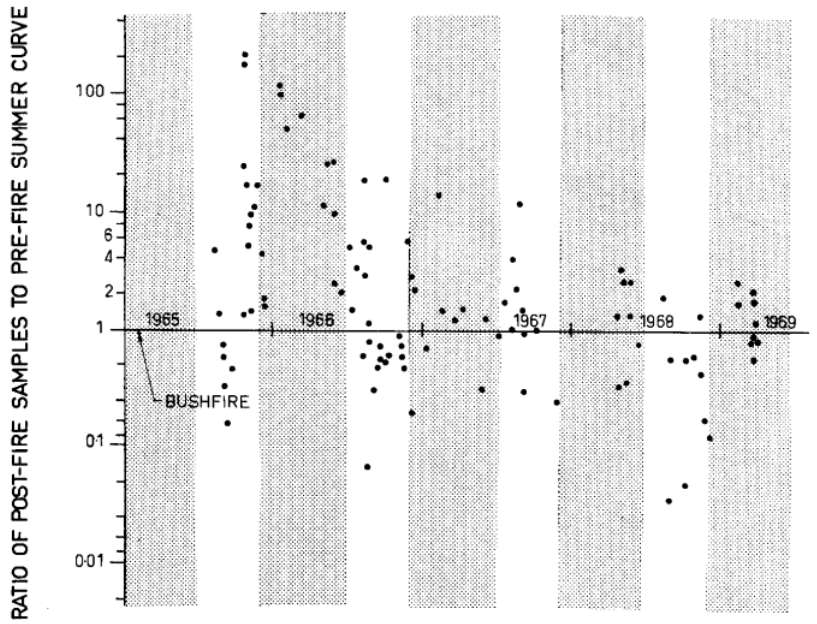


Fig. 9. Wallaces Creek: diagram showing time trend in suspended sediment concentrations.

Water Research 218 (2022) 118510

Contents lists available at ScienceDirect

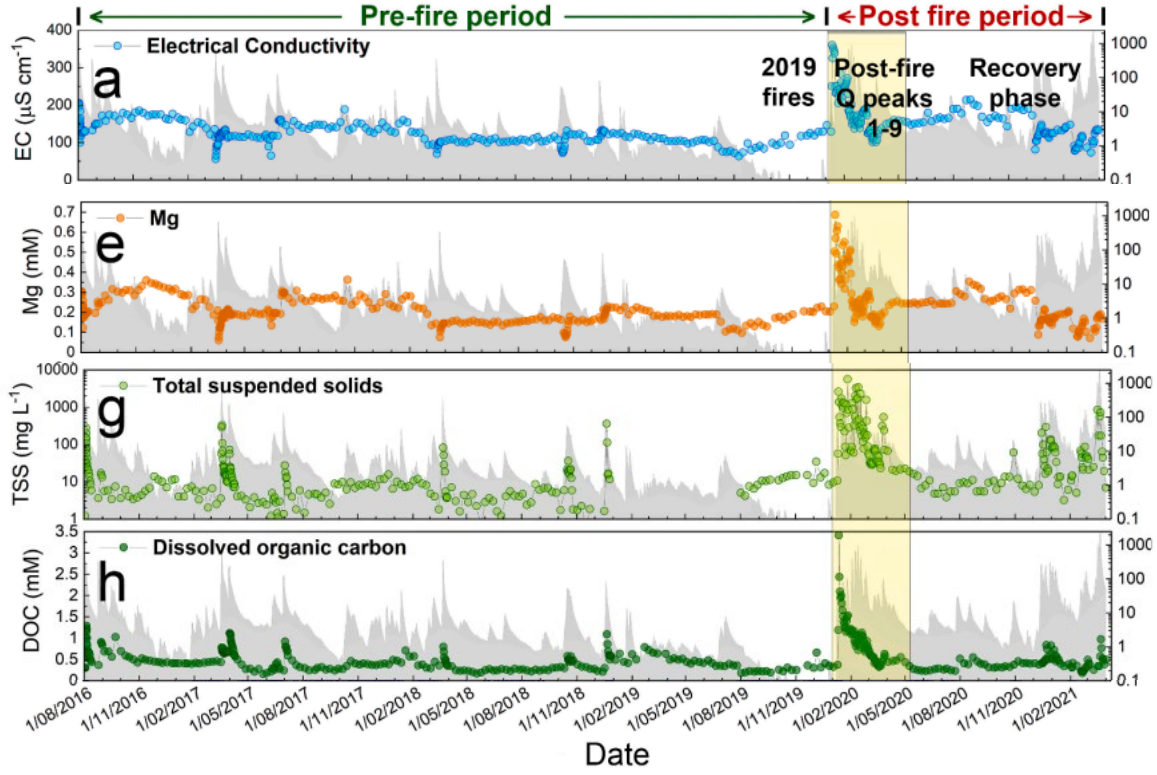
Water Research

journal homepage: www.elsevier.com/locate/watres

Drought, megafires and flood - climate extreme impacts on catchment-scale river water quality on Australia's east coast

Scott G. Johnston *, Damien T. Maher

Southern Cross Geoscience, Faculty of Science and Engineering, Southern Cross University, Lismore, NSW 2480, Australia



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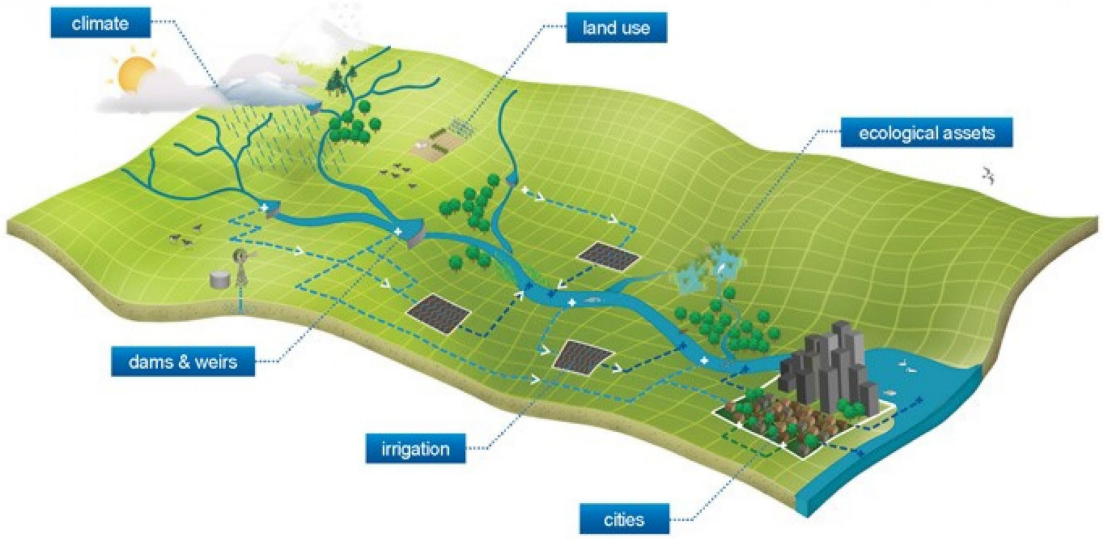
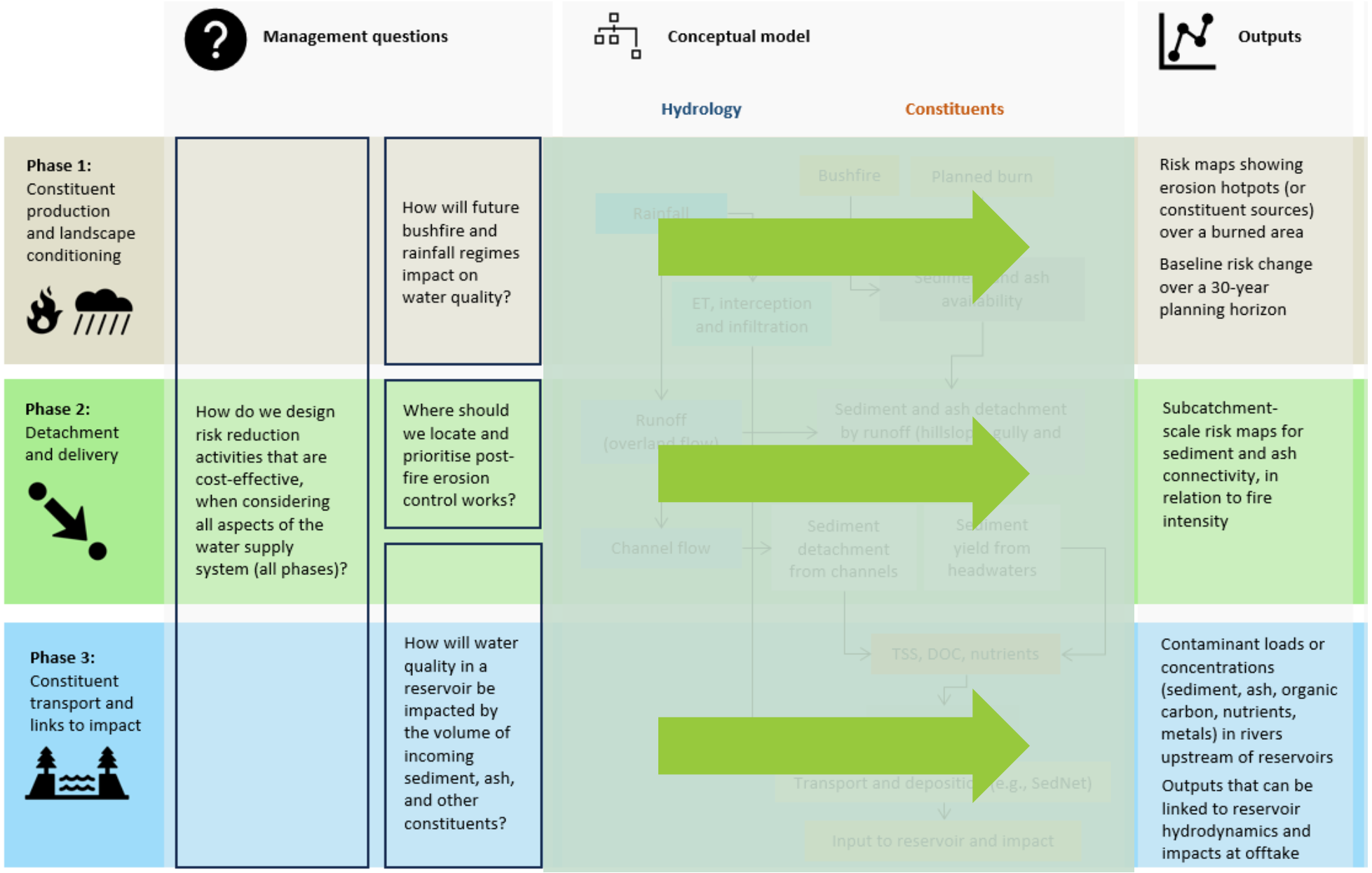
What do water utilities need?

- Ability to answer key management questions – practical decision support.
  - Where is the threat coming from? **Mapping**
  - How much is likely to be delivered in the reservoir after a planned burn or bushfire? **Sediment transport**
  - What can we do about it? Reservoir management, vegetation management, post-bushfire erosion control, and upgrades to treatment systems. **Links to management levers**
- Representation of key sources of risk
  - **Hillslope erosion** and **debris flows**
  - **Sediment** and **nutrients** as a minimum.
- Integration with existing practices:
  - Existing modelling platforms
    - **eWater Source**, hydrodynamics (**AEM3D**), fire simulators (**Phoenix**)
  - IT systems, free of data security and licensing issues
  - Capacity for maintaining and updating the modelling

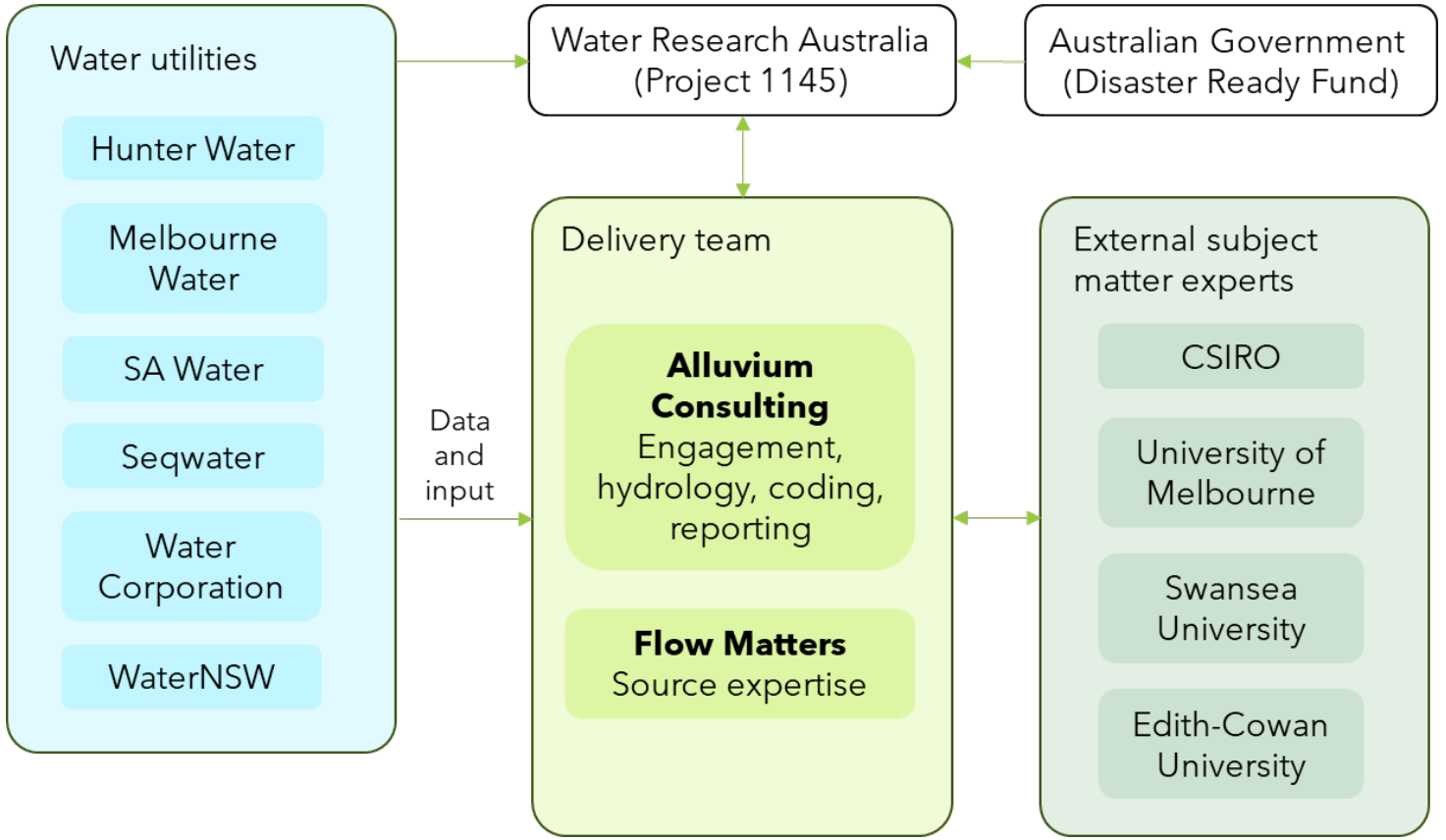


This project



This project

- Scoping (2023) ✓
- Model development plan (2024) ✓
- Model development (2024-26) ✓
- Library structure and pre-processing ✓
- Modules (erosion and debris flows) ✓
- **Integration with rainfall-runoff model** — We are here
- Expand model implementation
- Case studies and documentation
- Handover and web app



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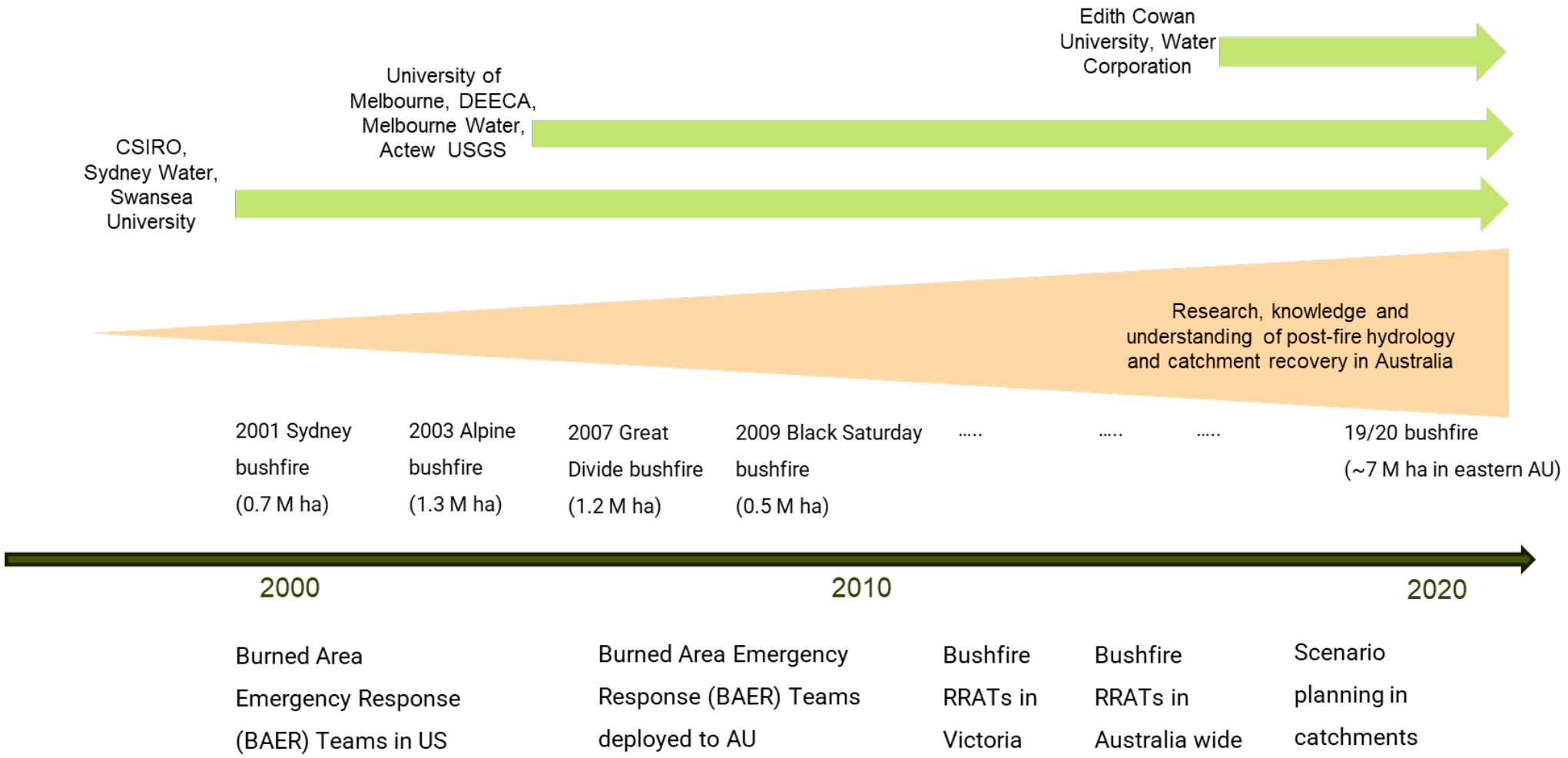
The science is mature



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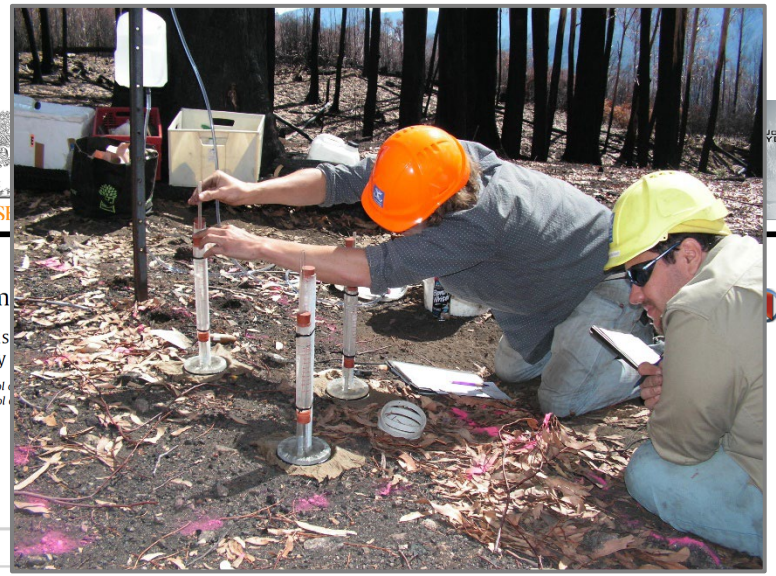

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There are examples of research uptake

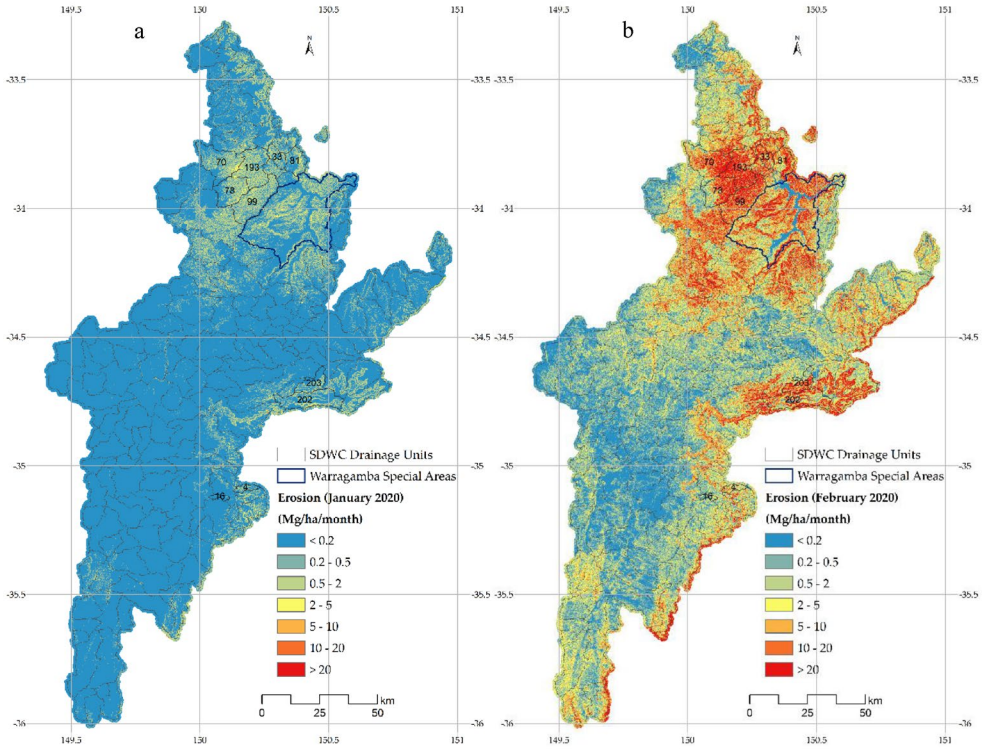
remote sensing

MDPI

Article

Rapid Assessment of Hillslope Erosion Risk after the 2019–2020 Wildfires and Storm Events in Sydney Drinking Water Catchment

Xihua Yang [1,2,*], Mingxi Zhang [2], Lorena Oliveira [3], Quinn R. Ollivier [3], Shane Faulkner [3] and Adam Roff [1,4]



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Check for updates

Water Resources Research

RESEARCH ARTICLE

10.1029/2019WR026185

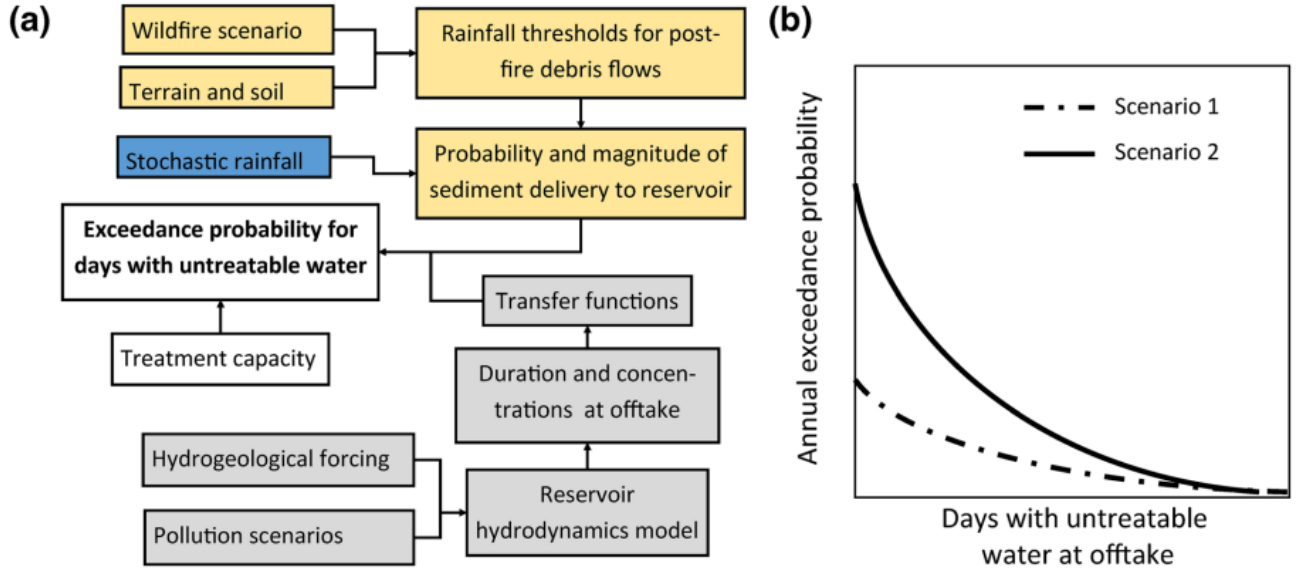
Probability and Consequence of Postfire Erosion for Treatability of Water in an Unfiltered Supply System

Petter Nyman[1,2], Peter Yeates[3], Christoph Langhans[1,4], Philip J. Noske[1], Nadav Peleg[5], Christine Schärer[5], Patrick N. J. Lane[1], Shane Haydon[6], and Gary J. Sheridan[1]

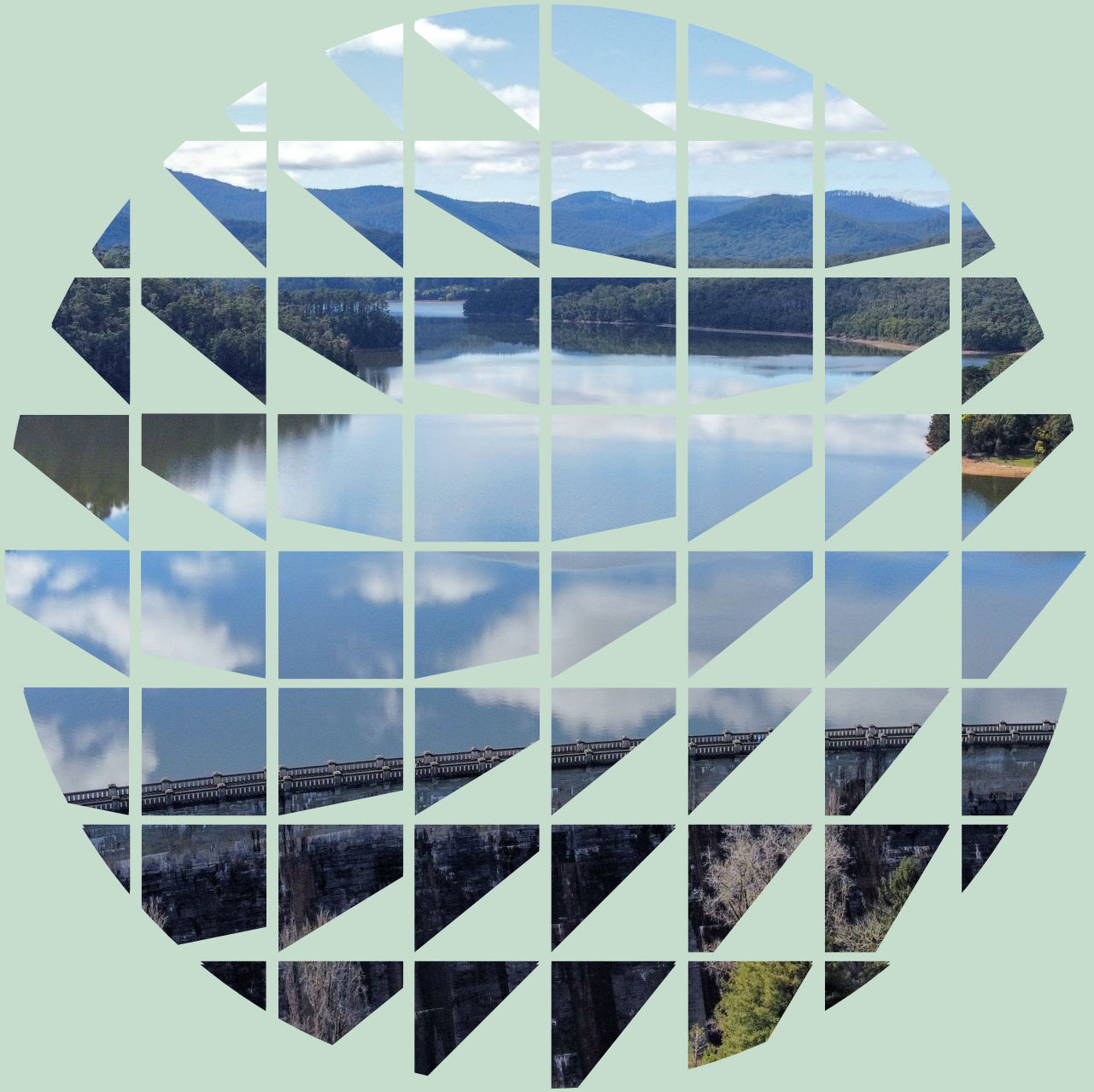
[1]School of Forest and Ecosystem Science, University of Melbourne, Parkville, VIC, Australia, [2]Alluvium Consulting, Cremorne, VIC, Australia, [3]Hydronumerics Pty Ltd, Docklands, VIC, Australia, [4]Netherlands Environmental Assessment Agency (PBL), The Hague, AV, The Netherlands, [5]Institute of Environmental Engineering, ETH Zurich, Zurich, Switzerland, [6]Melbourne Water Corporation, Melbourne, VIC, Australia

Key Points:

- Consequence of wildfire for an unfiltered water supply system is modeled based on erosion, stochastic rainfall, and reservoir hydrodynamics
- There is a 10–30% chance that water is untreatable for >1 year due to high suspended sediment concentration after a high-severity wildfire

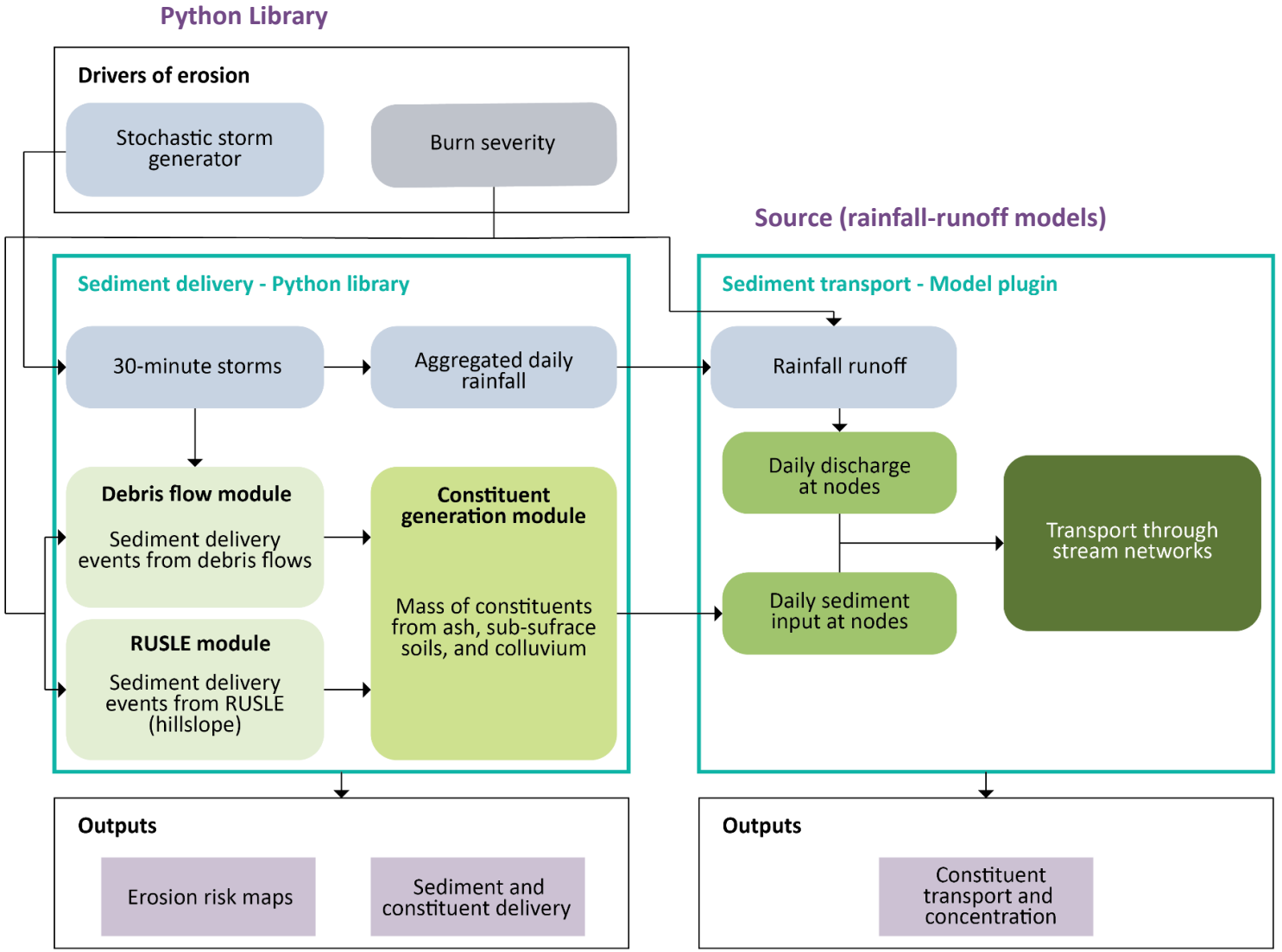


Model development and application



Erosion model linked with rainfall–runoff

- **Pyraingen** – stochastic whether generator for representing rainstorms (6 min intensity)
- **Sentinel or Landsat Satellite Images** for measuring fire severity
- Open-source DEM (**STRM**) for representing topography and drainage network.
- **TERN/CSIRO** soil property data (clay content)
- Database on **post-fire nutrient loads** from literature
- **Erosion modules** from published literature



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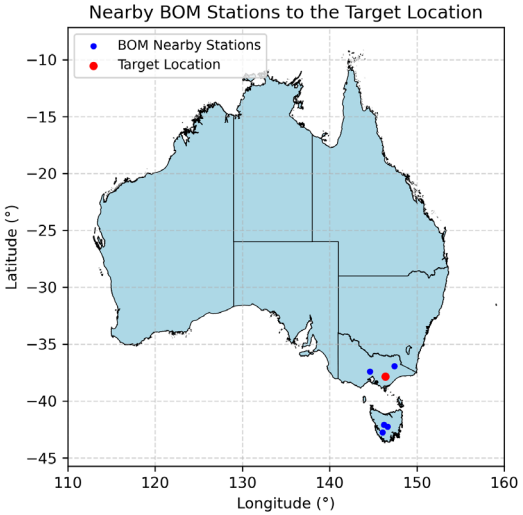
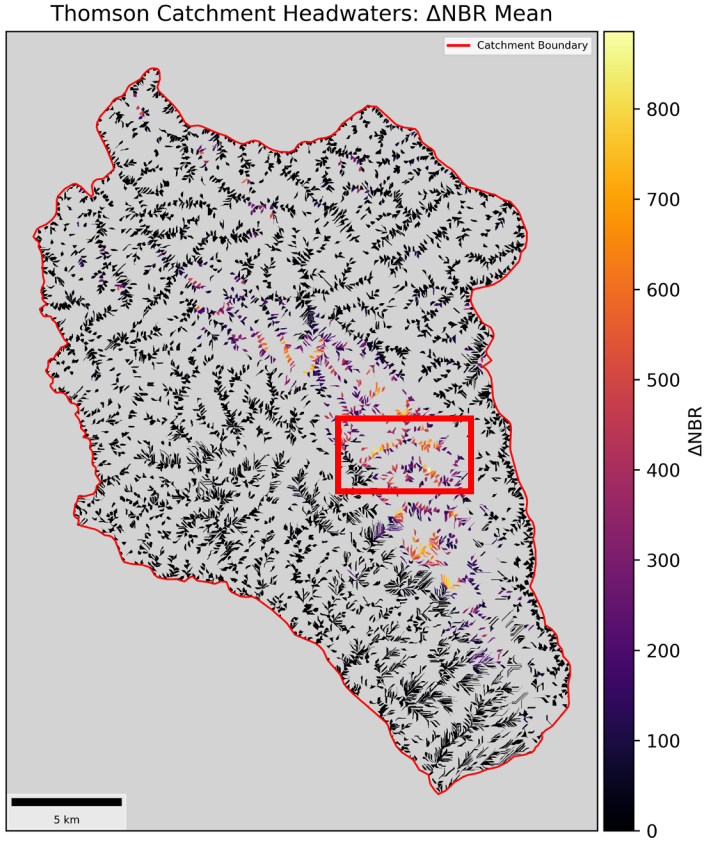
Drivers– fire and rainstorms

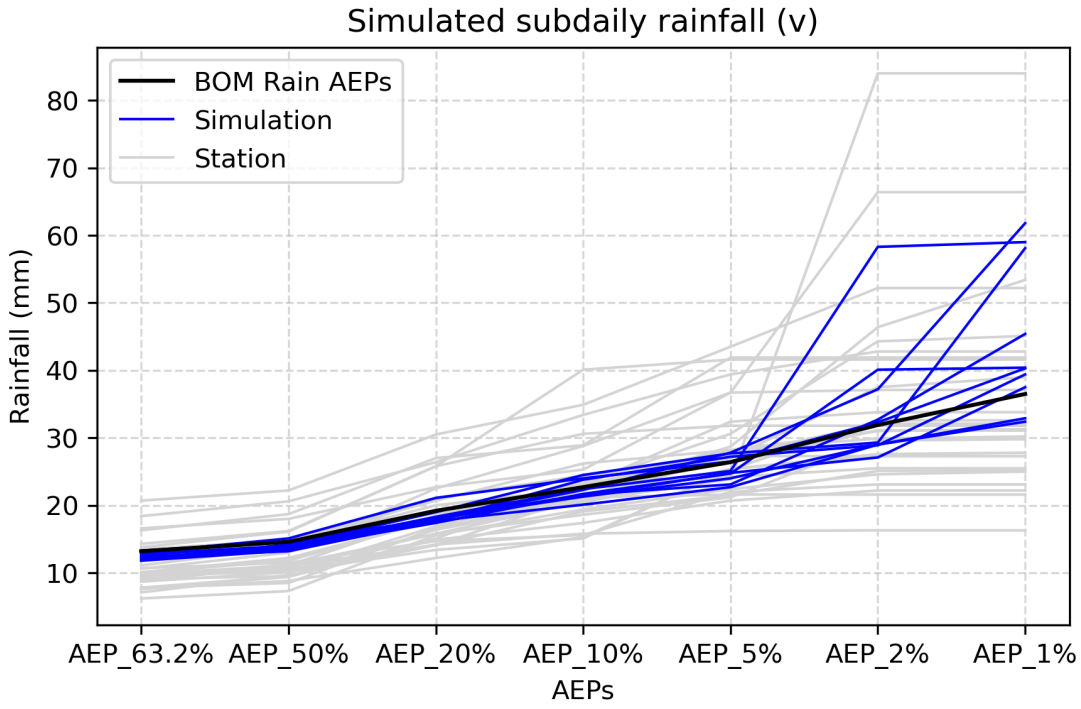
	Pre/Post-fire	Satellite Name	Time of Image	Cloud Cover (%
0	Pre-fire	sentinel-2b	2018-12-24T00:17:14	0
1	Pre-fire	sentinel-2b	2018-10-25T00:14:53	1.3
2	Pre-fire	sentinel-2b	2019-01-13T00:17:17	1.7
3	Pre-fire	sentinel-2b	2018-10-25T00:14:53	5
4	Pre-fire	sentinel-2b	2019-01-03T00:17:16	11.7
5	Pre-fire	sentinel-2a	2018-11-19T00:17:12	12.6
6	Post-fire	sentinel-2a	2019-05-18T00:17:22	0.9
7	Post-fire	sentinel-2b	2019-05-23T00:17:27	1.4
8	Post-fire	sentinel-2b	2019-05-03T00:17:26	10.5
9	Post-fire	sentinel-2b	2019-03-24T00:17:18	11.7
10	Post-fire	sentinel-2b	2019-06-02T00:17:26	17.3

Fire severity

Rainfall regime







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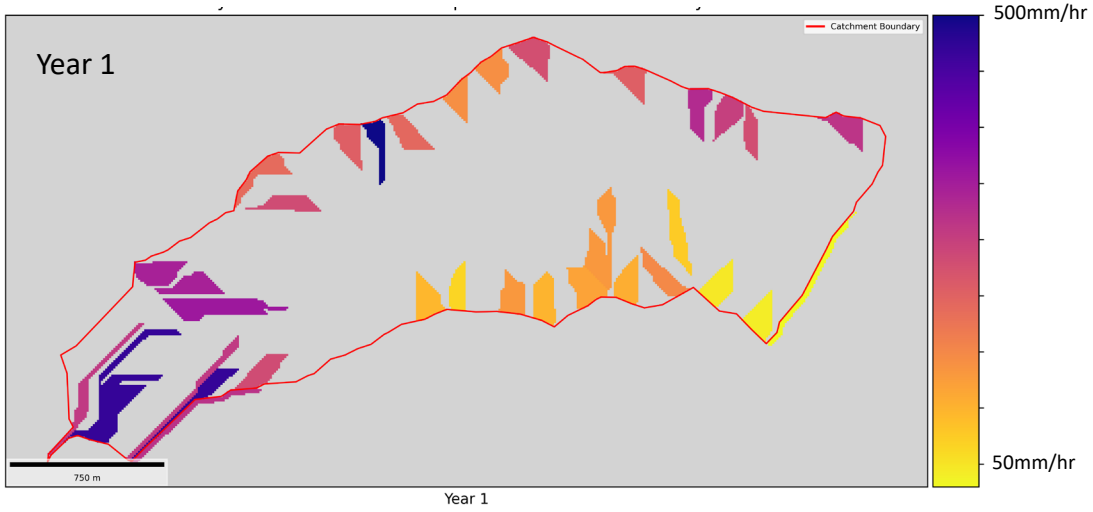
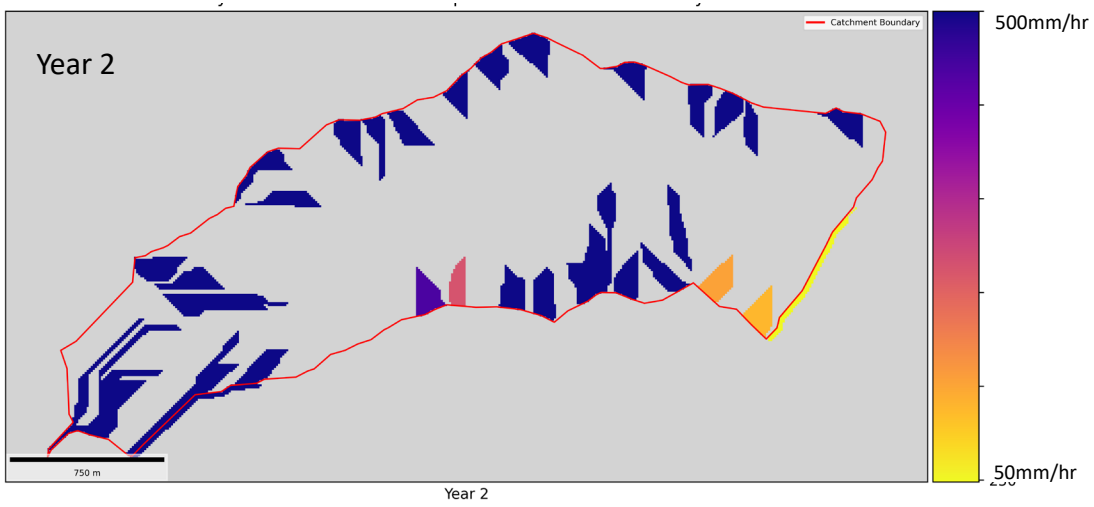
Progress to date – erosion potential

Rainfall thresholds – **debris flows**

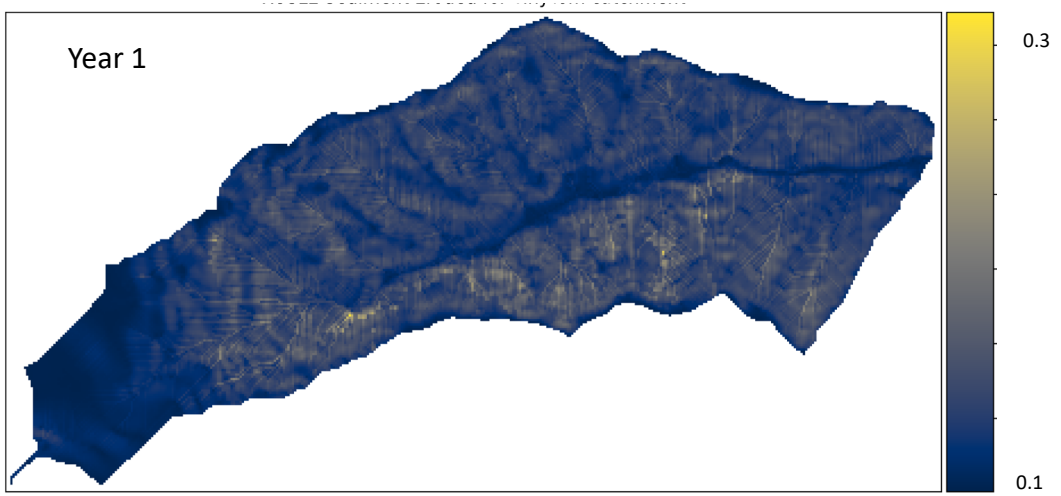


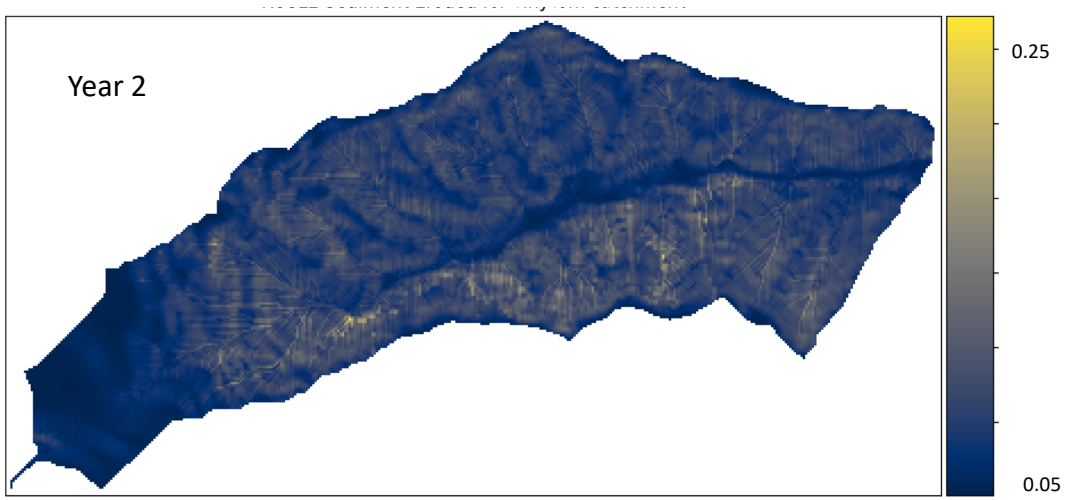
Year 1



Year 2

Erodibility – **hillslope erosion**





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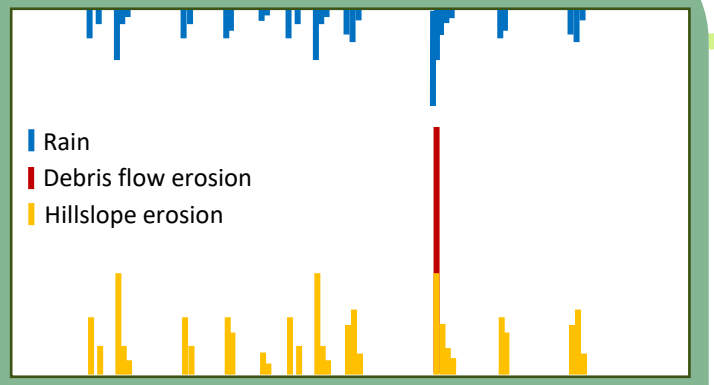
Integration with Source

Rainfall

Hillslope erosion and debris flow modules



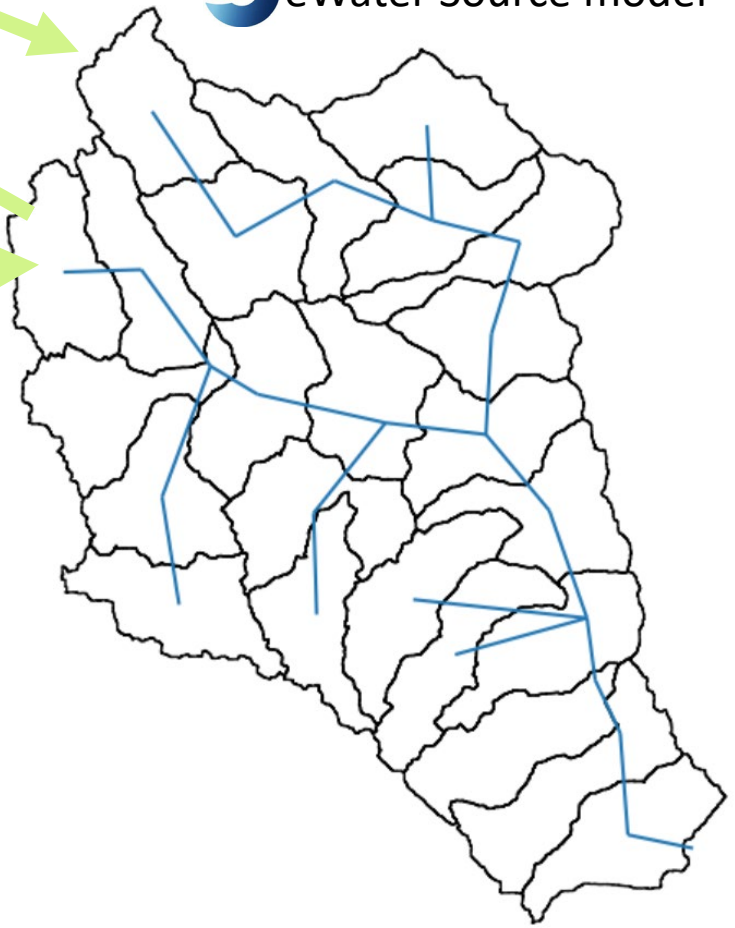
Daily time series of sediment delivery, aligned with model subcatchments

Delivery module

Aligns erosion and debris flow sediment with existing modelled runoff – avoids anomalies such as impossibly high concentrations.

Modelled runoff

eWater Source model



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Conclusions and next steps

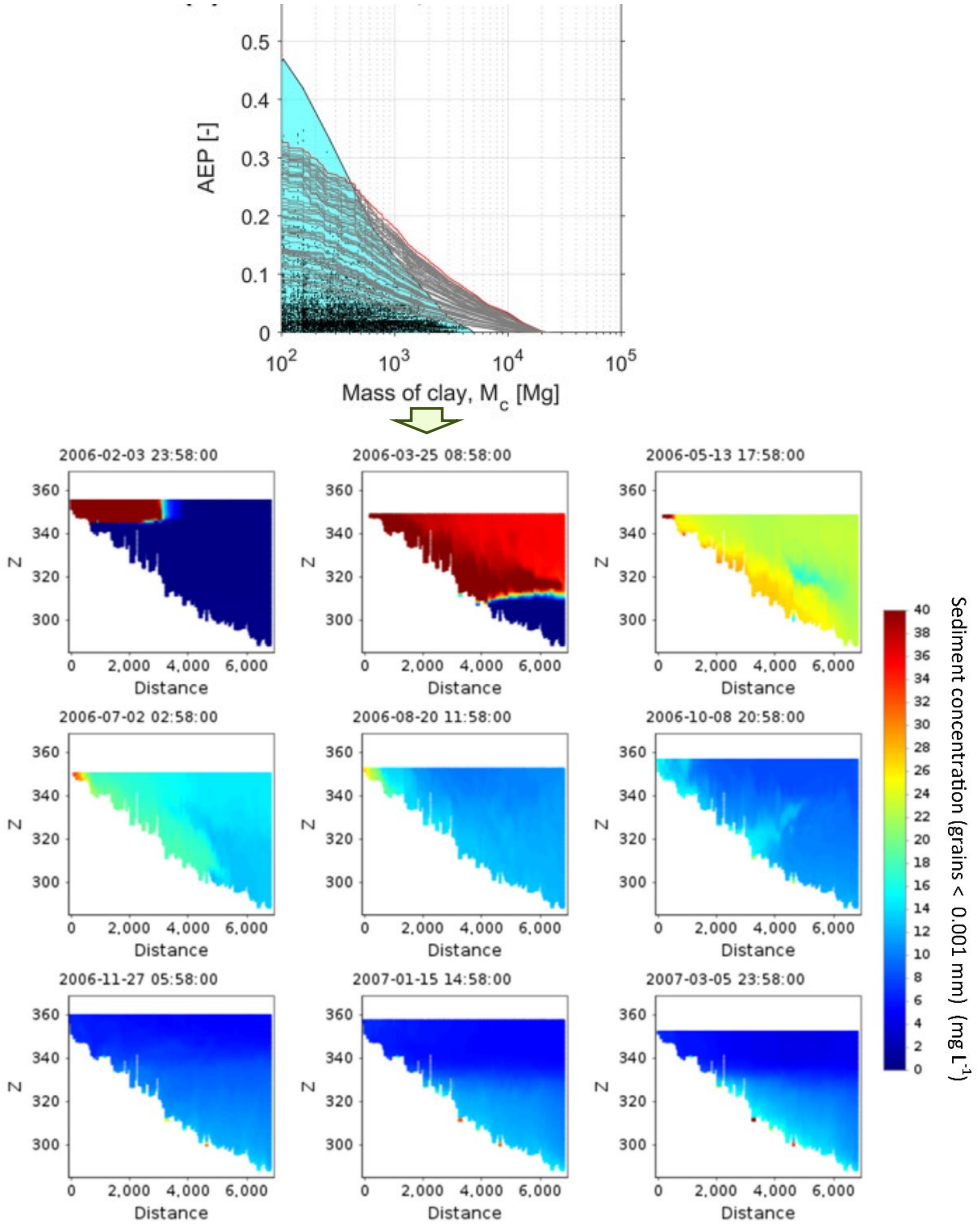
Nationally consistent but with options to make it regionally bespoke.

Integration with **Source catchments** – the most workable approach for quantifying contaminant mobilisation at the landscape scale.

A tool to help guide **strategic planning**, **risk assessment**, and **incident response**.

Ultimately intended to help maintain a **safe and secure water supply** following bushfires.

Post-fire risk assessments



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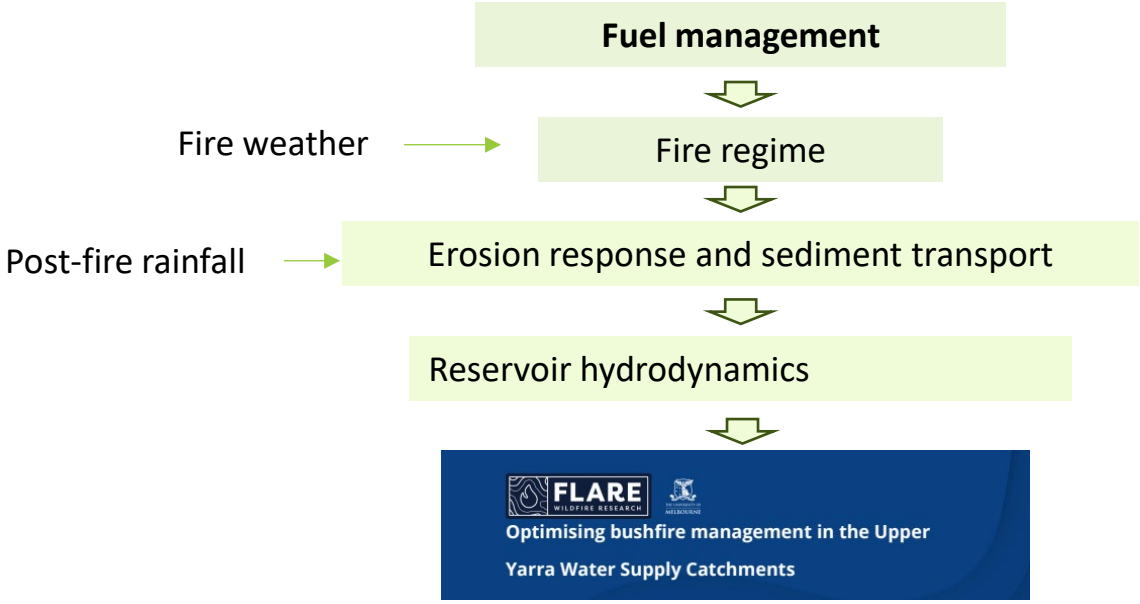

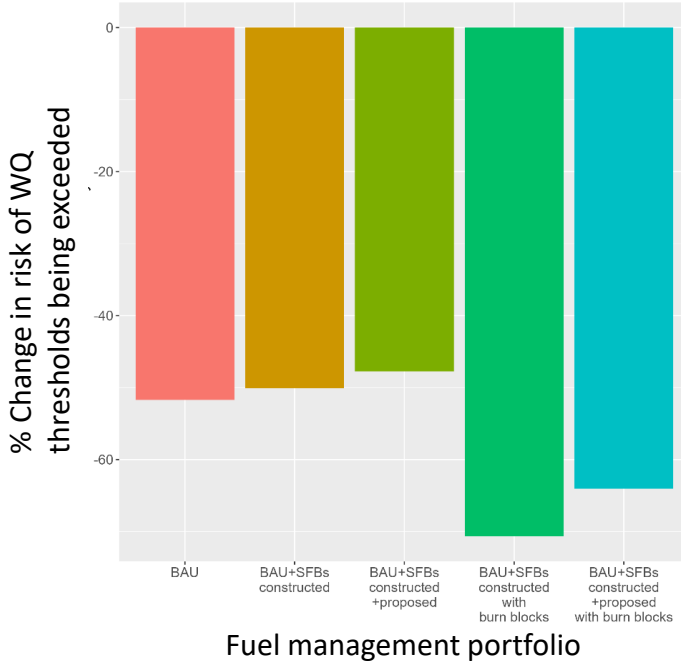

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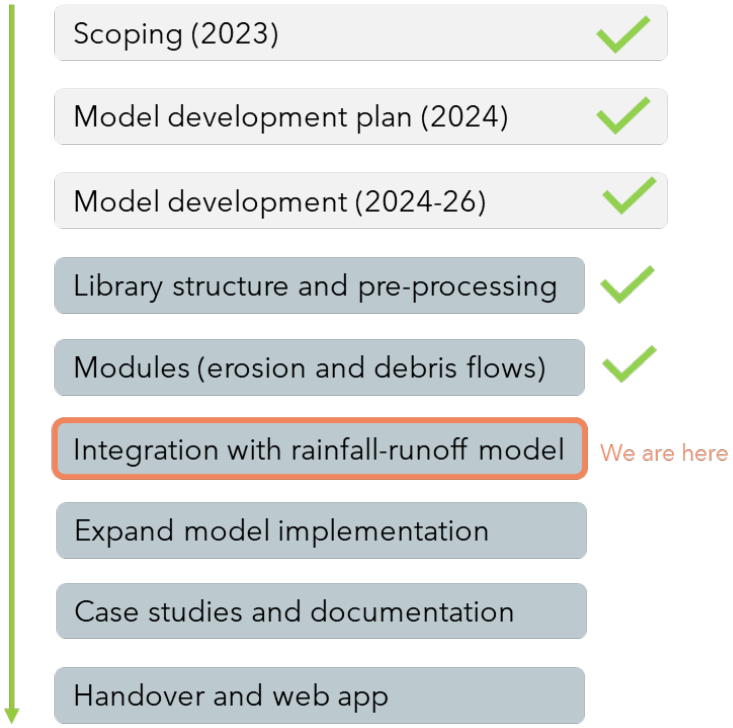
Conclusions and next steps

- Testing and validation of erosion modules
  - How do they work across different hydrological settings?
  - Approach to calibration for local conditions
- Methods for integration with Source
  - Working with existing source models where we have had fires
    - MW, waters + others
- Embedding and testing for user experience
  - Webapp
- Additional functionality
  - Spatially variable rainfall
  - Links to outputs from fire simulation models



Thank you

Acknowledgements

This is WaterRA project 1145 and would not be possible without the support and participation of the project partners.

The project is being conducted under the Disaster Ready Fund and has received Commonwealth financial support.

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