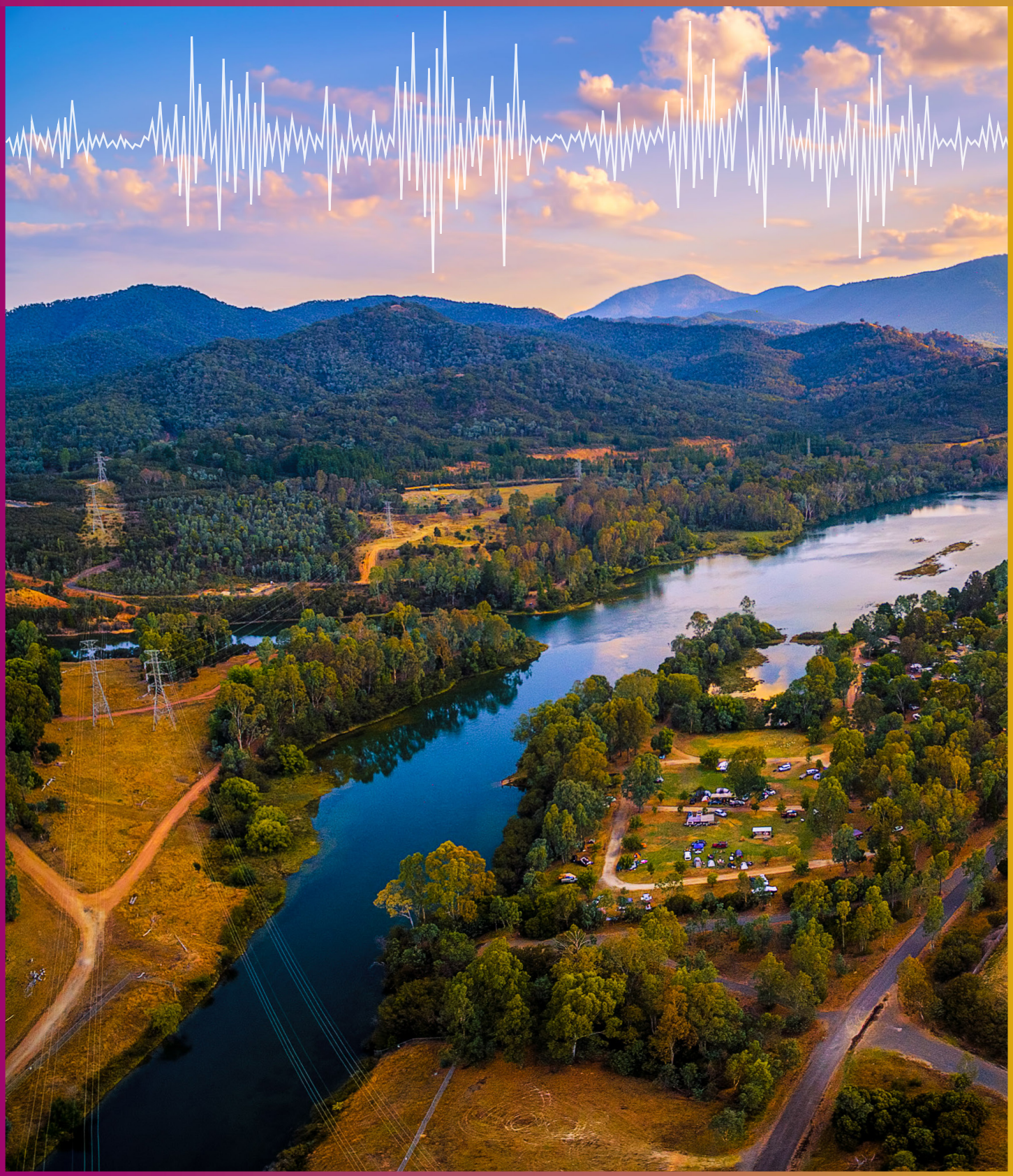
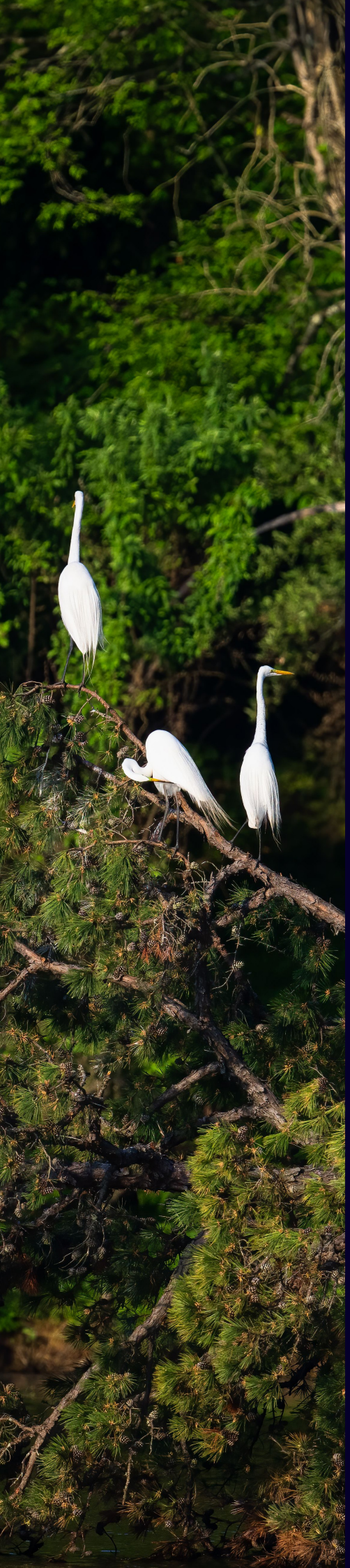
SCIPOD

RE-EVALUATING HOW WE ASSESS AND MANAGE RIVERS IN RESPONSE TO CLIMATE CHANGE

Professor Avril Horne & Dr Andrew John





Re-evaluating How We Assess and Manage Rivers in Response to Climate Change

Understanding and successfully managing river flows is vital for sustaining human communities, the river environment, and its ecosystems. However, the methods currently used to assess river flow needs are limited in the face of increasing pressures from an uncertain and changing climate. Academics at the University of Melbourne are rethinking the approach to these assessments. This includes work by Professor Avril Horne, Dr Andrew John and their collaborators to present a more integrated and holistic method, which provides much-needed room for learning over time, and to understand the vulnerability, robustness, and adaptability of river flow regimes.

Rivers support a huge variety of flora and fauna that rely on healthy floodplains and waterways. Rivers are vital to our existence, supplying fresh water for domestic needs, industry and agriculture. Infrastructure such as dams has become an important element of enabling hydroelectric power generation and long-term water storage to manage variable water supply.

The Goulburn River, part the Goulburn Broken Catchment within the wider Murray-Darling Basin in Victoria, Australia, is no different. Despite taking up only 2% of the land area, the Goulburn River Basin provides 10% of annual flows to the Murray-Darling Basin, with its catchment spanning 1.6 million hectares.

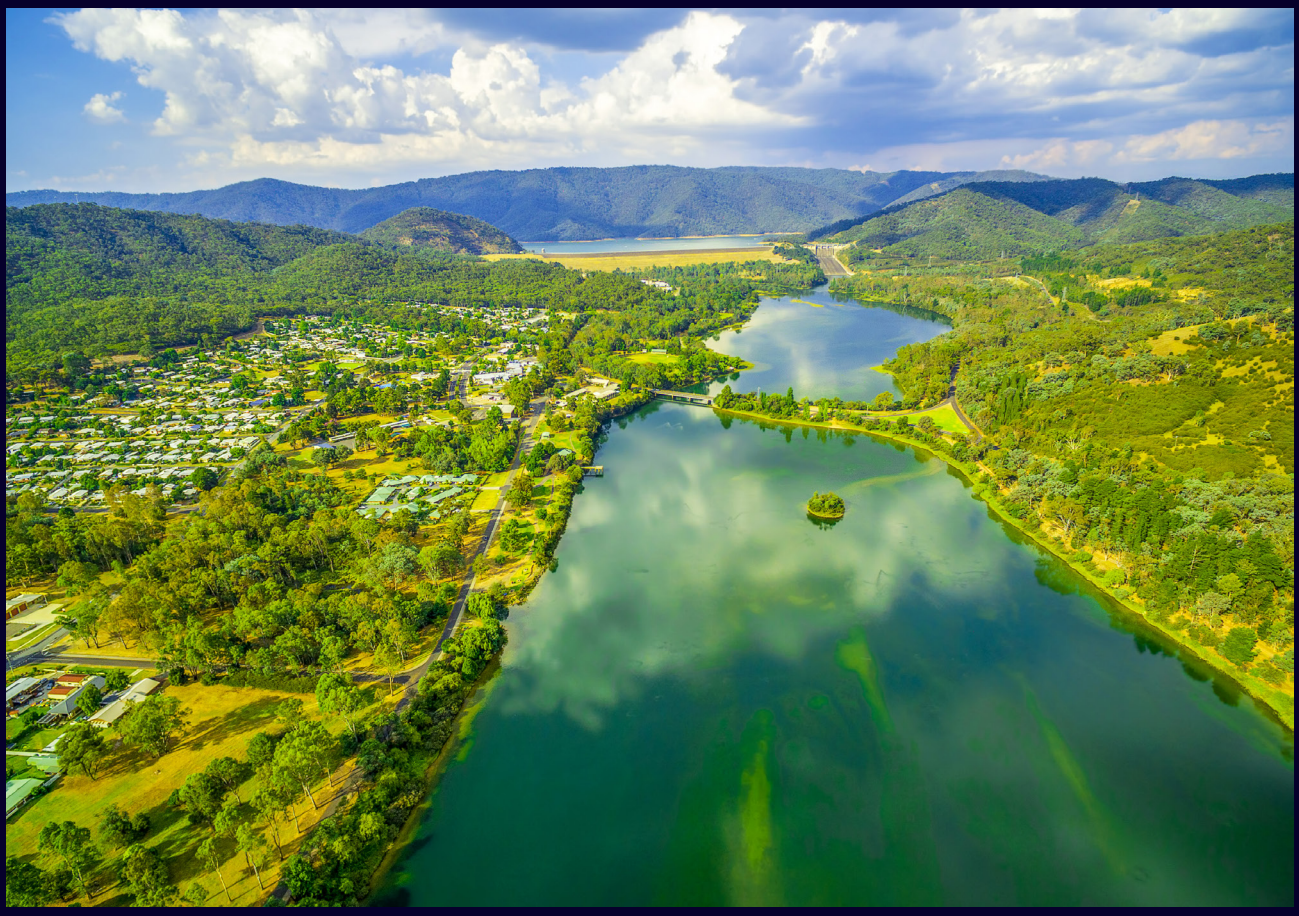
Flow in the river is regulated, primarily by Lake Eildon in the upper catchment, which is used to distribute water primarily for downstream agriculture demands. Water is also released to meet environmental needs along the river.

However, managing these river flows and environmental needs is becoming increasingly challenging as climate change continues to impact water availability and quality. As such, the uncertainty associated with climate change is posing challenges for river managers to manage this vital resource successfully and efficiently.

Environmental flows are well-recognised management tools used to protect and restore river ecosystems. Environmental flows assessments are used to determine the amount and timing of water necessary to do this.

However, current assessment methods do not fully acknowledge that the climate is changing. Instead, traditional assessment methods typically assume a ‘stationary’ climate. On top of this, many assessment methods stem from the physical sciences, and fail to successfully incorporate social influences or important local knowledge.

Keen to change the way we think about, and therefore assess and manage our rivers, Professor Avril Horne and Dr Andrew John of The University of Melbourne have worked to change the way we approach assessments.



In a study published in the journal *Frontiers in Environmental Science*, Professor Horne, Dr John and their colleagues evaluated a range of assessment methods and created a holistic socio-environmental assessment approach. Their new technique incorporates key aspects of some of the existing methods, heavily includes participation from stakeholders, and directly acknowledges uncertainty.

In order to glean the necessary knowledge to inform the new method, the team held workshops to lay out objectives for the management of the Kaiela – the stretch of river downstream from the Goulburn Weir. Participants in these workshops included agency representatives, scientists, community members and a Yorta Yorta representative, the Traditional Owners of this region.

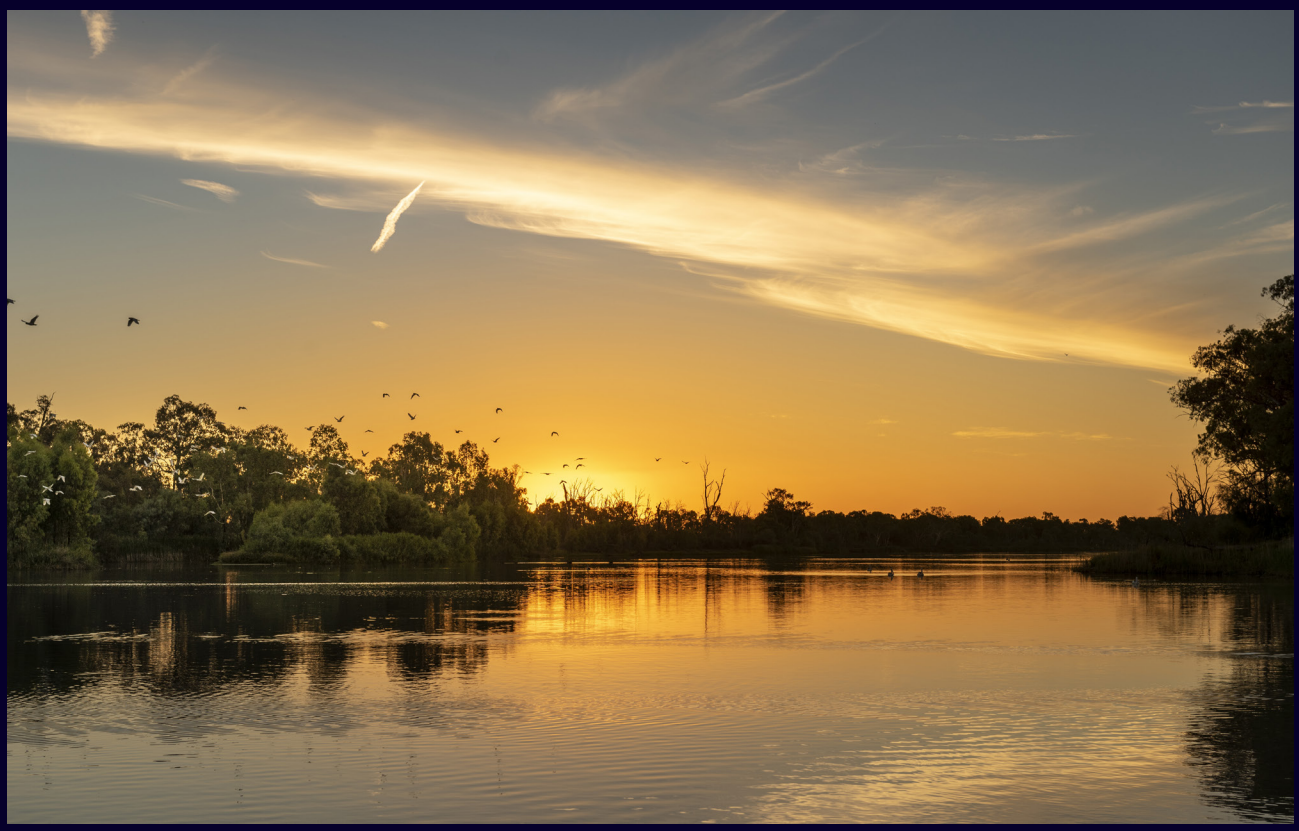
Participants were encouraged to provide contributions to areas outside of their initial interest or expertise. This provided a greater input of knowledge and ensured that the participants' diverse perspectives were represented. Objectives for the river were driven by stakeholders, focusing on biodiversity and self-sustaining populations of fish, turtles, platypus and vegetation. Processes such as instream productivity and channel formation were recognised as core means to achieve these objectives.

Mechanistic, process-based ecological models were produced to represent each of these objectives. By modifying flow and environmental conditions, Professor Horne and Dr John were able to see how varying ecological factors may be affected in a changing future.

A key factor of the team's assessment method is that at each stage throughout the discussion, modelling and monitoring of the system, the participants are informed and provided with the opportunity to be flexible with their requirements. This allows participant-led feedback loops to develop, resulting in a highly adaptive management process.

Professor Horne, Dr John and their colleagues then used the ecological models and flow recommendations to demonstrate environmental flow vulnerabilities, robustness, and potential adaptation, under uncertain future climate change. This is informed by climate stress tests to explore how different ecological systems respond to changes in environmental inputs such as rainfall or temperature. Thus, the methods can provide important indications as to how various ecological systems will respond to varying degrees of climate change.

The team used models to project the conditions of key environmental objectives under climate change. They then tested three adaptation options to address vulnerability under climate change, and modelled them individually and in combination, giving a total of seven adaptation scenarios and current conditions.



Constraints on flow rates to avoid inundating low-lying private infrastructure means that large quantities of water cannot be delivered downstream, to reconnect floodplains to the Goulburn River. By relaxing these constraints, the researchers found that managed high flows assisted key ecosystem processes, buffering against the impacts of a drying climate, and may also free up space in reservoirs to intercept later inflows of water. This option also requires less additional water to be recovered from other water users to the environment.

Overall, the team found that there are significant benefits for ecological outcomes when some adaptation options are combined. Interestingly, the improvements were greater than the sum of the benefits of those options individually, which may have implications for how rivers can be adapted through time as climate change intensifies.

The challenges and uncertainties posed by a changing climate require us to re-evaluate how we assess and manage river environments. Professor Horne, Dr John and their team have developed an integrated assessment method that draws heavily on the needs of stakeholders, and allows for continual learning, flexibility, and adaptation. The inclusion of stress tests has allowed this approach to inform the management of rivers under a range of plausible climate futures.

The team's new method will improve the ability of the environment, communities, and other stakeholders to have access to sufficient water in the future. By making the whole process inclusive of community members, the researchers have shown that the protection of river ecosystems are paramount to all.

Thus, by allowing decision-making to be made cohesively between all stakeholders, key environmental objectives can be worked towards with not just one vision in mind, but for the good of the greater river catchment area as a whole.

This SciPod is a summary of the papers 'Not Just Another Assessment Method: Reimagining Environmental Flows Assessments in the Face of Uncertainty', doi.org/10.3389/fenvs.2022.808943, and 'Robust Climate Change Adaptation for Environmental Flows in the Goulburn River, Australia', doi.org/10.3389/fenvs.2021.789206.

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