EXPLORING LIMITS USING INTEGRATED MODELLING AND THE WHEEL OF WATER GRAPHIC

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Rationale

The National Policy Statement for Freshwater Management (NPS) requires that clear limits on the use of water resources are established for all freshwater bodies in New Zealand. Further, recent reports to the government from the Land and Water Forum propose that there is merit in shifting from adversarial to more science-informed collaborative approaches to setting and managing within limits. These changes recognise the interrelationship between land and water and the health of people, ecosystems and communities.

Although these reforms are designed to achieve better long term outcomes for our communities and our environment, their implementation presents many challenges for resource managers, scientists and stakeholders alike. The 'Wheel of Water' research program is a three year government funded multi-agency project that is researching collaborative decision making and water resource management in the context of these reforms. As part of this program, we have been exploring some specific challenges such as: i) the need for integrated models to explore the consequences of alternative limits; ii) the requirement that limits must be set for all water bodies in New Zealand within relatively short timeframes; and iii) the need for the complex information from these tools to be presented to collaborative governance groups in a way that is both clear and transparent, and which best supports their decision making.

In this paper we describe some technical tools that have been developed to assist limit setting processes including a limit simulator and water wheel diagrams; the former being a high level rapid assessment integrated model and the latter being a graphical communication tool. We will present our findings in the context of a case study application in the South Canterbury Coastal Streams (SCCS) water management zone.

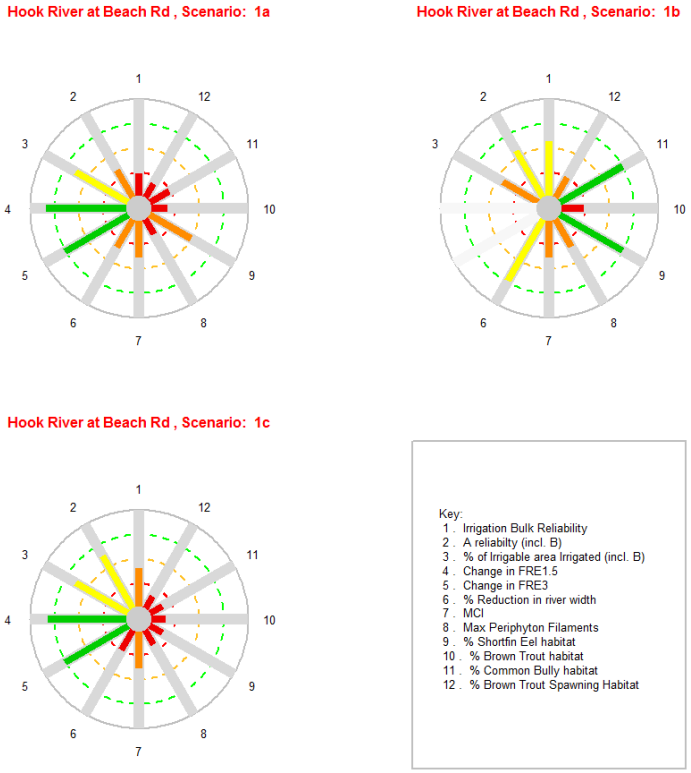
Application

We used the limit simulator to explore the outcomes of alternative minimum flow and total water allocation in 17 different streams within the SCCS zone. The limit simulator is a series of fast running empirically based models that are connected due to having some key state and flux variables in common The simulator concurrently evaluates a range of instream indicators (e.g. habitat, MCI, periphyton) and resource use indicators (e.g. water reliability and production potential). The spatial framework for the limit simulator is a digital representation of the New Zealand river network provided by the River Environment Classification (REC) (Snelder and Biggs, 2002).

The empirical relationships were developed based on national datasets. While this constrains the accuracy and flexibility of the model, it does lead to a tool that can be applied everywhere throughout New Zealand at very limited computational expense. The models are particularly useful for assessing the impacts of water management scenarios in areas with limited measured data and are most reliable when they are used to predict patterns and make assessments across broad areas, rather than for specific sites. Tests of a range of the model predictions against measured data within the SCCS zone, indicate that in most cases the model components performed well, even at specific sites.

We simulated three alternative scenarios within each catchment: status quo consented allocation; NES default minimum flow and allocation levels; and a more resource enabling scenario. For each stream, we produced "water wheel" diagrams for each of the three scenarios (Figure 1). The water wheel diagrams provide a visual summary of the outcomes for all indicators under each scenario, and helped to highlight the trade-offs between outcomes made for each scenario.

Figure 1: Example 'water wheel' diagrams



Conclusions

Using the limits simulator and water wheel diagrams we were able to both simulate and communicate outcomes under each of the alternative water management scenarios. Overall, the assessment indicated that even under the most resource use enabling scenario, the total water that can be allocated from surface water resources within the SCCS zone is much less than the potential demand from the irrigable area within the catchment. The assessment also made transparent the trade-offs between instream indicators (e.g. habitat) and water use indicators because, in general, aquatic habitat reduces and reliability increases as minimum flows decrease. These findings helped to focus subsequent modeling in the SCCS zone (using more detailed and demanding models) to examine more complex scenarios that included consideration of impacts of importing water into the catchment.

Looking to the future of limit setting within New Zealand, it is likely that a variety of integrated models could be used to inform limit setting processes, each with varying levels of detail but also development and computational time requirements. With the need for limits to be set nationwide within relatively short timeframes, we consider that rapid assessment tools such as the limits simulator will play a key role in the process. Rapid assessments may be appropriate in many low risk/pressure situations or as a basis for stratification of risks across broad regions as an initial part of setting water resource limits.

References

Snelder, T. H. and Biggs, B. J. F., 2002. Multi-scale river environment classification for water resources management, Journal of the American Water Resources Association, 38(5), 1225–1240,