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The challenges and rewards of collaborative environmental flow modelling

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Abstract: The recent transition from REALM (Perera et al. 2005) to eWater Source as the software platform for water resource modelling presented Melbourne Water with the opportunity to improve modelling support not just for water resource planning but also for environmental flow planning. This is for two key reasons: 1) the Source software supports a daily timestep required to adequately represent environmental flow requirements in our rivers and releases from upstream reservoirs to meet these requirements; and 2) the Source software also provides in-built functionality for representing environmental 'freshening flow' events, where water is released over several days to meet a specific ecological target flow. Integrating this functionality into our water resource modelling can be used to meet environmental flow tactical and strategic decision support needs such as modelling future climate change impacts on environmental flow and releases.

Building environmental freshening flows into the Melbourne Water's water resource planning model followed an iterative process typical of model development. This included understanding the environmental flow needs, operations and entitlements, translating these to model requirements, implementing and testing these in the model, reporting and fixing bugs or adding required features, and validating results with environmental flow managers. This process was repeated multiple times as we identified additional requirements during testing and validation. Additional data and model developments were also required to improve daily hydroclimate and demand timeseries model inputs and representation of daily timescale operations.

Two key challenges emerged during model development that increased the development timeframe considerably. Firstly, simply modelling the environmental flow recommendations as documented in the environmental flow studies (e.g. recommended flow rate over number of days) often led to insensible results. To achieve sensible model results, we needed to understand and model how these recommendations would be managed and delivered in practice, e.g. how the required time between planned flow events is determined. This involved multiple discussions with environmental flow managers to identify, understand, and document operational practice and conditions, and to validate the model results. Secondly, it emerged that the available software functionality did not always behave as expected or meet our needs, particularly combined with the use of the 'NetLP' network optimisation algorithm; resolving this required further learning into how the model and software functions, development of workarounds, and engagement with the software vendor.

To ready the model for its first application to environmental flow planning, we needed to identify when the model reached the stage of adequately representing the environmental flow requirements and releases. Broadly speaking, adequate representation meant that the release volumes, frequency, timing and number of successful events mostly matched our expectations based on current operational practice. This was done through analysing model results in a compliance tool developed by Jacobs, as well as through consultation with environmental flow managers aided by graphical representation of modelled releases and flows during freshening flow events.

By taking the time to develop a deeper understanding and representation of environmental flow management and modelling, we were able to build a model that model developers and environmental flow planners could understand, trust, and that provided meaningful results. The development process identified further model improvements to be made, including representing restrictions on irrigation diversions during low flow periods, better representation of how water orders are split between storages, and improvements to flow forecasting to better match reality. So far, the model has been used to generate expected flow and releases in our key waterways (Yarra and Tarago) under various climate change scenarios to support an assessment of potential shortfalls in delivery under climate change.

REFERENCES

Perera BJC, James B and Kularathna MDU (2005) Computer software tool REALM for sustainable water allocation and management. Journal of Environmental Management 77(4), 291–300

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