Meet Dr. Eflow: A web application to aid in the design, review, and adjustment of regulated environmental flow releases

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Key points

- Planning regulated flow releases on Australian rivers is complicated by balancing the needs of irrigation water transport and environmental flow concerns.
- Traditionally, environmental flow planners have relied on spreadsheet manipulation to create and update flow plans.
- In order to support this, the web application Dr. Eflow was created to aid in the construction, modification, and comparison of environmental flow hydrographs.

Abstract

Introducing the tool for the 'Development and review of environmental flows' (Dr. Eflow). This stems from the challenge faced by environmental flow planners in regulated systems, who need to balance flow characteristics that support waterway ecological values whilst working within operational limits and meeting local and downstream water requirements. This challenge is becoming increasingly difficult with uncertainty in rainfall patterns and ever-changing operational and environmental water management requirements. The development of yearly, seasonal, monthly and daily flow regimes requires constant adjustments to planned operational and environmental flow releases.

To support the environmental flow planning process, Streamology developed the tool in partnership with the Goulburn Broken CMA. The web-based application assists flow planners in creating, editing, and assessing flow plans for both freshes and base flows. The tool enables users to quickly visualise and adjust hydrographs, and to obtain key statistics to assess whether the parameters of environmental flow actions are met. Using this tool, the user can create a library of hydrographs for environmental flows and variable baseflow releases based on flow statistics (e.g., maximum discharge, duration, variability metrics). Additionally, the application allows the user to rapidly assess and compare flow plans and historical flow records using state-of-the-art flow metrics and data visualisation. This software has helped the Environmental flow planners at GBCMA rapidly refine their flow plans and design flows that provide a naturalised, variable hydrograph while maintaining ecological values, riverbank stability, and ecosystem health in an increasingly complex water resources management environment with competing demands.

Keywords

Environmental flows, Integrated water management, Data Visualisation, Technological Applications

Introduction

Regulated flows in rivers can be managed to reduce negative impacts and enhance positive benefits (Poff & Matthews, 2013). However, doing so requires addressing many of the oversimplifications inherent in typical regulated flow releases, which cannot be readily addressed with currently available tools or simple computational methods. For instance, year-on-year flow releases and 'standard' annual flow regimes reduce diversity and ignore interannual variability. Within-year streamflow characteristics, such as constant base flows, can accelerate riverbank erosion through notching and undercutting (Figure 1). Likewise, excessive fall rates can lead to large-scale erosion (Green, 1999). Furthermore, poor sequencing of fresh-event planning can prevent important faunal responses, such

as fish spawning. By designing flow releases with hydrologic variability and characteristics common in natural flow events, appropriate durations, peaks, and event shapes, riverine ecosystems can thrive.

In Victoria, environmental watering actions for regulated waterways are developed annually by Catchment Management Authorities (CMAs). These actions are developed for a range of climatic and consumptive water-delivery scenarios and reflect long-term ecological objectives in the context of current ecological conditions.

Watering actions include variable base flows, multiple freshes of differing magnitude and ecological risk mitigation flows. The risk mitigation flows can be used to manage recession flows from storage after unregulated flow events or to address poor water quality. The delivery of watering actions is complex, with proposed flows often requiring adjustments to accommodate unregulated tributary flows, operational deliveries, and downstream environmental needs.

To support the needs of environmental flow planners and managers, we have created Dr Eflow, a specialised web application to aid in the creation, collaboration, and comparison of environmental flow plans. This web app has been used by environmental flow managers to aid in regulated flow releases of environmental water, intervalley transfers, and irrigation water for seasonal flow planning at the Goulburn Broken Catchment Management Authority (GBCMA), and has allowed for more rapid creation of hydrographs that deliver the necessary amount of water and benefit, without damaging the waterway ecosystem. Additionally, the visualisations aid in communicating planning decisions to stakeholders.

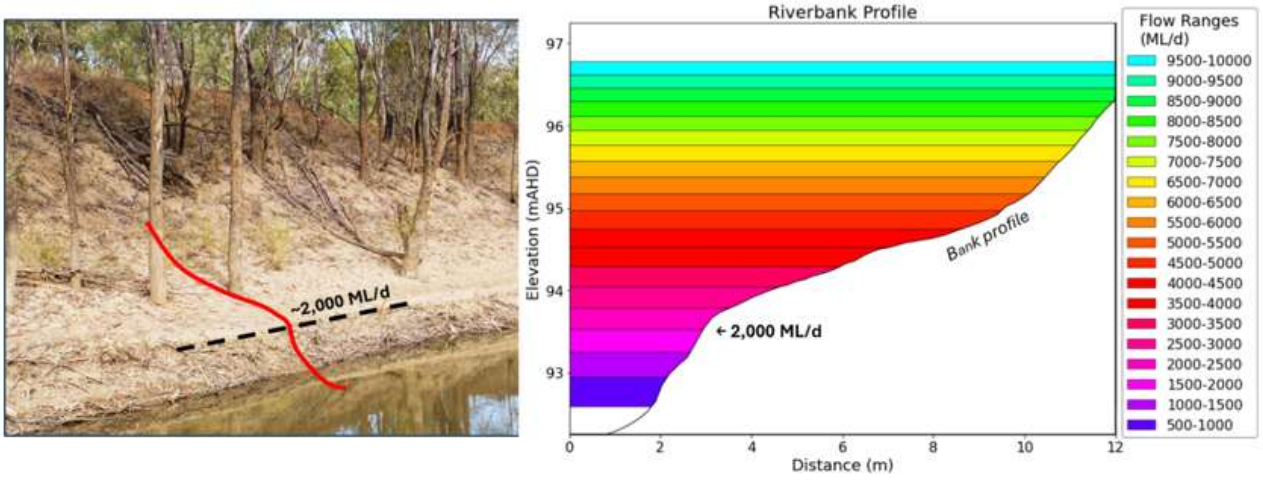

Figure 1 Left: photograph of surveyed riverbank, with toe profile outlined where the operational releases stay constant, as well as the typical operational base flow level marked. Right: cross-sectional profile of riverbank, with flow magnitudes plotted along the elevation of that riverbank. This figure shows an example of a riverbank subject to near-constant operational baseflows of ~2,000 ML/d

How the flow planning process used to be implemented

Planning environmental flows traditionally involved multiple spreadsheets and significant manual data manipulation to achieve the desired flow characteristics for each environmental watering action. Each year a new spreadsheet was created and environmental watering actions from previous years were copied and manually adjusted to meet the desired requirements, including rise and fall rates, maximum height, duration and shape. There was no visualisation of where the proposed water delivery would sit on the riverbank profile and key statistics and volumes were not always available without manual manipulation of data.

Inter-year variability is an important consideration for environmental water planning. Prior to Dr. Eflow, comparing historic environmental flows required data for each individual flow, necessitating complex and time-consuming spreadsheet manipulation.

Any adjustments to the designed environmental flow would require repeating the manual process described above.

How Dr. Eflow improves the flow planning process

To streamline the current flow planning process for GBCMA, we created the Dr. Eflow web application with the following key features available through a web application interface that help managers improve their environmental flow planning process.

Hydrograph builder

Using Dr. Eflow, environmental flow planners can construct natural-looking flow hydrographs for any planning horizon, weekly, monthly, or annual, with full control over volume, timing, and rate of change. Automated statistical and flow-analysis overviews help managers ensure hydrographs align with scientific environmental recommendations and operational requirements.

The hydrograph builder removes much of the manual editing of spreadsheets by allowing planners to start from previous events or plans, and create events with multiple peaks and varying rising and falling rates that are “bank aware” visualisations that show how edits affect key metrics (Figure 2), and the distribution of flows along the bank line (Figure 3).

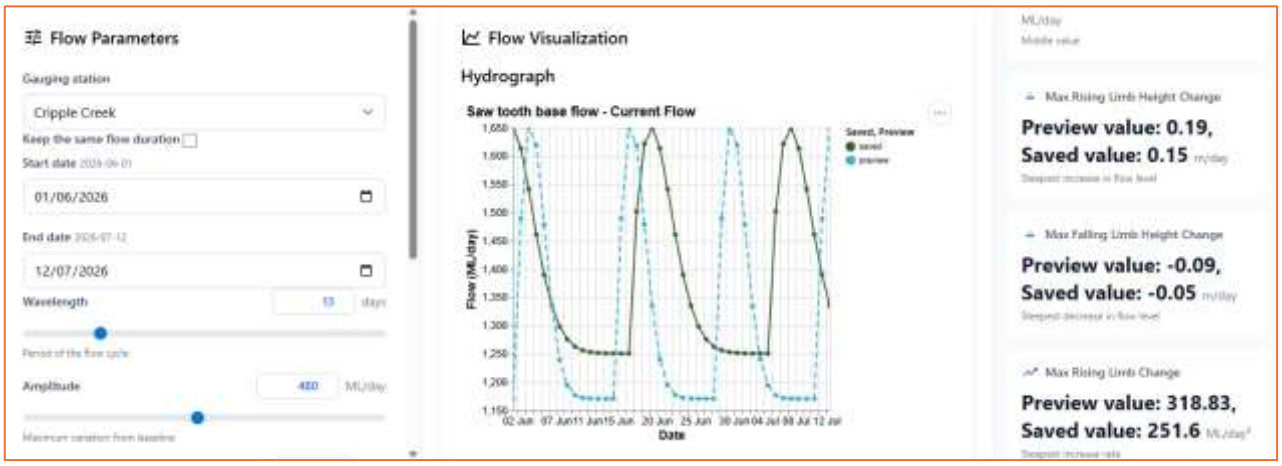

Figure 2 Screenshot of flow creation page

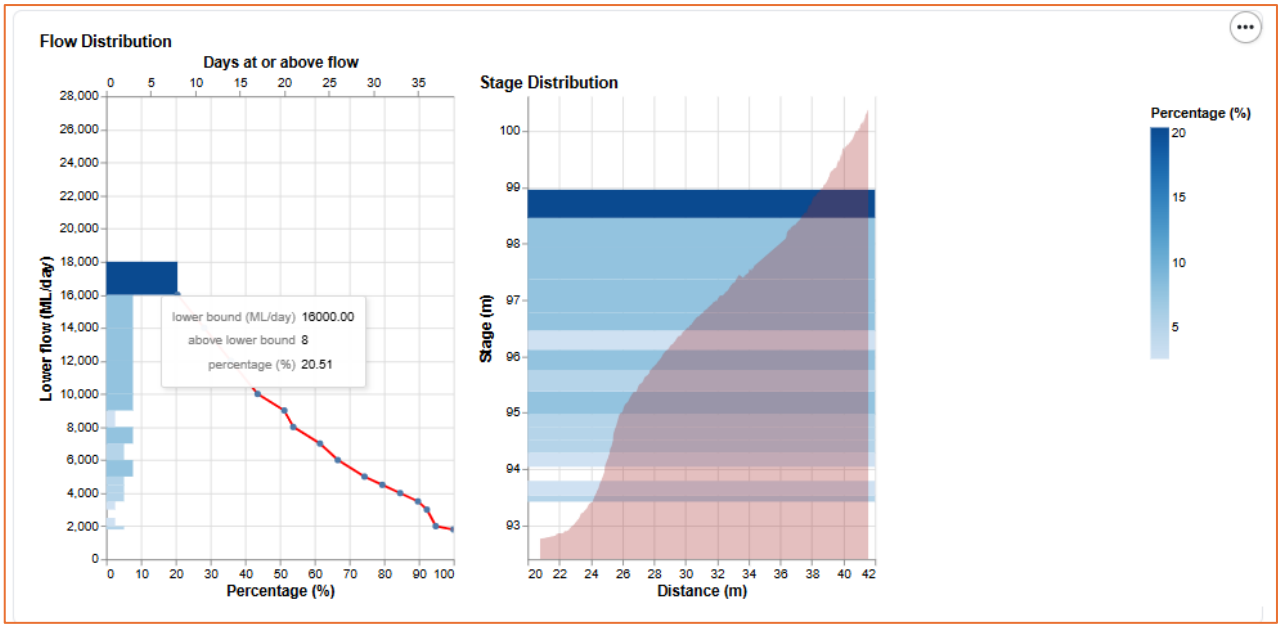

Figure 3 Screenshot of bank comparison page, where the percentage of time at each stage level is visualised

Historical comparison

Environmental water managers can also benchmark their flow plans against the historical record and against each other, to ensure appropriate variability for their system. This part of the web application shows hydrographs lined up, as well as metrics for each flow plan or historical time period (Figure 4).

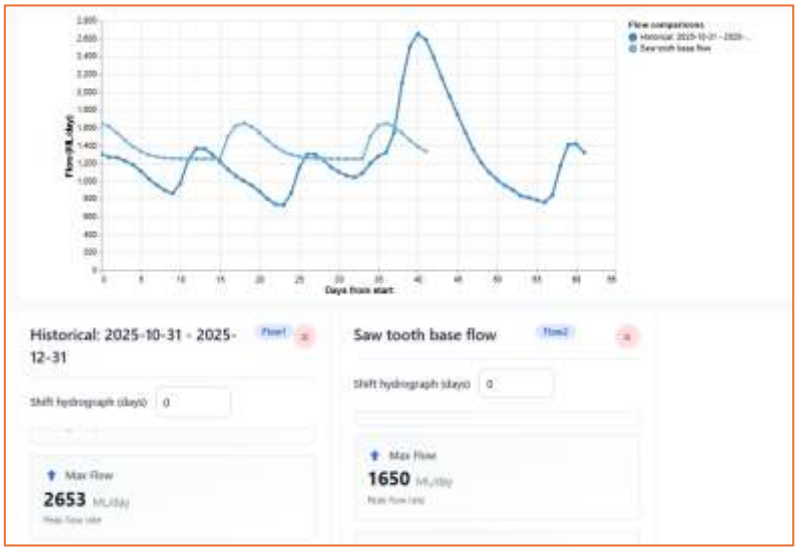

Figure 4 Example flow comparison dashboard

Constraint compliance and custom metrics

Dr. Eflow has many metrics available “out of the box” (e.g. total flow volume) that are measured for each flow plan. However, flow planners can set their own operational constraints and custom metrics (e.g. minimum volumes, maximum rates of rise and fall, along parts of the hydrograph) and let Dr. Eflow flag conflicts before they become problems.

Communicate flow planning logic with stakeholders

Dr. Eflow also serves as a communication tool, making flow-planning decisions transparent and scientifically justified. It can also integrate with existing water management systems and models, so that flow plans can feed directly into the broader operational environment. Additionally, the app supports uploading and downloading of hydrographs as CSV spreadsheets.

Conclusions

The implementation Dr. Eflow has greatly streamlined the flow planning process for GBCMA flow planners and has helped the environmental flows team create defensible flow plans more efficiently. While this project has produced helpful outcomes during the 2026/2027 flow planning season, future improvements are on the horizon, including new flow-creation tools and the construction of full-flow plan scenarios from sequences of flow events.

Acknowledgements

Dr. Eflow was co-designed by Streamology and the Environmental Water team at the Goulburn Broken Catchment Management Authority. The Dr Eflow software application and all associated visualisations and text are copyrighted by Streamology.

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