2.1 Optimizing flow regimes in the context of a superabundance of water

Summary

Hydrology is a fundamental driver of stream health, through its effects on water quality, channel morphology and hydraulic stress. Impervious areas result in total runoff volume being increased approximately fivefold. While there is increasing emphasis on returning more natural hydrology, unless there is adequate stormwater harvesting demand, achieving near-natural runoff volumes is difficult. This project will determine whether ecologically important components of the flow regime can be maintained at levels likely to sustain healthy ecosystems, even when total runoff volume remains significantly higher than natural. The project will provide important guidance to Melbourne Water in existing and new urban areas.

Research Theme

Assessment of stream management activities

Timing

2013-2014

Project Team

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Deliverables

- Project directions workshop with all interested Melbourne Water experts.
- Development of communications brief in consultation with all interested MW staff; this will include a list of all possible processes and policies which this project should inform, and their timelines.
- Detailed project scope developed in consultation with all interested Melbourne Water experts (scope to include finalised list of catchments, plus details of scenarios to be tested)
- Initial results workshop; discussion of initial results and their implications, discussion of directions for continuation of Phase 1
- Project report outlining "Managing flow regimes within the context of excess stormwater runoff; implications for Mellbourne Water policy and practice"
- Journal paper"Feasibilty of flow regime restoration with a superabundance of water"
- Seminar and workshop on project findings and implications, possibly in conjunction with Clearwater

Background

Urbanisation results in gross disturbance to the hydrology and water quality of receiving waters such as streams. Significant gains have been made in recent times in improving water quality, through the development of technologies such as constructed wetlands, swales and bioretention systems. Management of hydrology has had less attention, with the exception of flood management. However, returning flow regimes towards the pre-development level has an important role in protecting waterways:

1. As flow is a primary driver of water quality (through the mobilisation and subsequent transport of contaminants), returning more natural flows will go a long way to improving water quality.
2. Flows are a primary driver in themselves of ecosystem health, through impacts on channel morphology and direct impacts on habitat and organisms.

Increased attentention to flow regimes in recent years has seen a focus on techniques such as stormwater harvesting, passive irrigation of green spaces, and infiltration (e.g. Burns et al., 2012; Walsh et al., 2012). Returning pre-development runoff volumes requires that approximately 80% of runoff to be prevented from entering the stream (Burns et al., 2013). However, investigations have shown that in typical urban areas, this can be difficult (assuming current

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regulation and industry practice) (Poelsma et al., 2013). It is therefore important to understand whether ecologically important components of the flow regime can be maintained at levels likely to sustain healthy ecosystems, even where the appropriate runoff volume cannot be returned to the desired level. Such a study could help guide Melbourne Water

The aim of this project is to see if it is possible to mitigate flow impacts on streams, even where the total volume of runoff cannot be restored to at or near natural levels. The project would provide guidance on stormwater management approaches in the situation where stormwater intensity or other techniques cannot be applied with enough intensity to restore natural flow regimes.

The aim of this project test the feasibility and challenges of mitigating ecologically important flow impacts (e.g. frequency and magnitude of peaks, loss of baseflows, frequency and duration of dry spells, etc) on urban streams, when total volume of runoff cannot be restored to near-natural levels. The project would provide direct guidance to Melbourne Water to (i) set policy for development and (ii) implement stormwater control measures to maximise stream health outcomes in the context of 'sub-optimal' stormwater harvesting. It will, for example, help provide guidance in the design and location of stormwater harvesting systems.

Methods

The first phase of this work (proposed for Year 1) will be undertaken using detailed modelling undertaken, for a series of case study catchments, with the models calibrated to measured flow data in these catchments. We will select ecologically and geomorphologically flow metrics from (i) the study of relationships between flow metrics and ecological health conducted by Burns et al. (in review) and (ii) other literature, including that cited above. We will select case study catchments which cover (i) flow types (e.g. perennial and perennial) and a range of urban density , and test various stormwater management strategies to see how close these ecologically and geomorphically important flow metrics can be returned to levels likely to support healthy stream ecosystems. We will thus compare the flow metrics to (i) measured or predicted (depending on the case-study catchments) pre-development flows and, if possible, (ii) flow metrics predicted by existing ecohydrological models (Burns et al., in review) as supporting healthy stream ecosystems. This dual approach, if proven feasible, will provide more explicit information to Melbourne Water on the likely degree of impacts to waterway values for differing levels of hydrological 'restoration' .

The modelling will be undertaken using MUSIC, but use the more sophisticated approach to developing and evaluating model structures proposed by Hamel & Fletcher (in press). Depending on the outcomes of this Phase 1, we may consider a future project ("Phase 2") which then attempts to test the approaches using an empirical study (preferably in the field, but possibly using a flume-based approach). We believe it is prudent not to propose Phase 2 in detail until we have the results of Phase 1.

The project will commence with a scoping workshop to be conducted in September 2013, which will aim to (i) reach agreement on final scope, (ii) select final catchments, (iii) select final stormwater strategy scenarios to implement, (ii) agree on formatting requirement