THE UNIVERSITY OF MELBOURNE

April 20th, 2015

Christine McDonald
Secretary – Senate Environment and Communications References Committee
Parliament House Canberra ACT 2600
Email: ec.sen@aph.gov.au

Dear Ms McDonald,

On behalf of the Waterway Ecosystem Research Group (http://thewerg.org) at the University of Melbourne, I would like to thank you for your invitation to make a submission to the Inquiry into stormwater resource in Australia. We are cognisant that the committee will likely receive a large number of submissions. We therefore aim to be concise in our submission, focussing on key principles, rather than exploring the full range of technical, institutional and economic issues surrounding the management of urban stormwater. We assure you, however of our willingness to contribute further to the Enquiry, by providing specific technical information that may be required. We are happy to do this in a verbal or written format, or by providing specific scientific or technical papers that may be helpful. Our group is one of Australia's leading research groups on urban stormwater and its links to waterway health, and we value the opportunity to contribute our expertise to this valuable process.

**Our submission in a nutshell**

- Urban stormwater runoff is the primary cause of the poor health of our cities' streams, rivers, and coastal waters.
- Urban surfaces produce much more runoff than undeveloped land: the excess runoff volume from most Australian cities is similar to or greater than total water demand.
- So urban stormwater is both a threat to the environment and a large, untapped resource.
- Stormwater can provide very large augmentation of main water supplies, even in very dry years, using small storages, if there is sufficient demand for the water.
- While stormwater has traditionally been managed at large scales, for instance at the outlet of catchments, there is no evidence of economies of scale.
- Urban liveability and environmental protection will be maximised if stormwater runoff is retained and dealt with near its source.
- Effectively managing both the threat and opportunities presented by stormwater will require integrated governance that regulates discharge of stormwater to stream ecosystems and provides incentives to use it through appropriate harvesting systems.

**Stormwater is simultaneously a threat and a resource**

As the Committee's terms of reference identify, urban stormwater runoff is both a threat (to the environment through changed flow and water quality regimes in rivers downstream) and an opportunity (through the water resource it provides). Most efforts at managing urban stormwater to date have been singularly focussed, typically aiming only to reduce the threat (primarily the threat of flooding, but more recently also the threat posed to the health of receiving waters), ignoring the resource. In the last few years, there has been increasing attention paid to the resource, but often this has been independent of what is necessary to mitigate the threat to the environment posed by urban stormwater.

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The 'independent' approach has led to sub-optimal outcomes. For example, mitigation measures have been limited in their ability to protect receiving waters, primarily because the volume of runoff produced remains too large to restore flow and water quality regimes necessary to support healthy aquatic ecosystems. Perhaps even worse, harvesting projects conducted without consideration of the receiving waters have often resulted in further degradation through, for example, harvesting baseflows (which are critical to ecosystem health, and are not stormwater), rather than reducing the threat posed by runoff.

*Optimal solutions to the stormwater "problem" will only be achieved by an approach which simultaneously considers the threat and the resource. Regulatory, institutional and economic arrangement thus need to simultaneously:*

1. *Provide incentives to use the resource (in a way that also benefits receiving waters)*
2. *Provide disincentives to leaving the stormwater threat unmitigated.*

**The magnitude of the threat**

Stormwater is the primary driver of the degradation of streams, estuaries and embayments in Australia's cities, and indeed in cities around the world {Walsh, 2005 #2;Roy, 2009 #3}. In most Australian cities, wastewater is now relatively well managed, meaning that its threat to receiving waters has been reasonably well mitigated. The same cannot be said for urban stormwater runoff, which remains generally unmitigated.

The threat of urban stormwater runoff to streams is severe: major loss of ecological values is observed if only a very small proportion of a catchment is developed and drained conventionally (Walsh & Kunapo 2009). The ecological health of streams flowing from urban catchments is generally much worse than degraded rural streams, with greatly reduced biodiversity and failing to provide ecosystem services that could be provided by healthy streams (e.g. retention and treatment of pollutants; safe water bodies for primary contact; urban amenity). While the degraded state of urban streams is almost universal, work by our research group has demonstrated that healthy urban streams are possible, if uncontrolled flows of urban stormwater runoff are prevented from reaching streams (Walsh, Fletcher & Burns 2012).

*Without an appropriate regulatory, institutional and economic framework, stormwater runoff will continue to degrade receiving waters, with consequences both for aquatic ecosystems and for the human communities that depend on them.*

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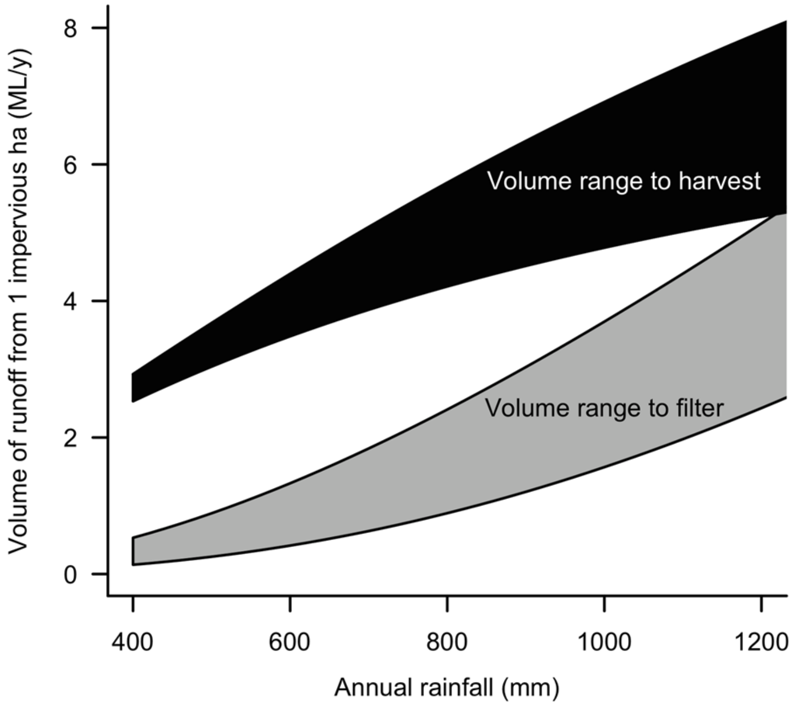


**Figure 1.** Annual volume of runoff from 1 ha of impervious surface (from the relationship between impervious runoff coefficient and annual rainfall shown in Figure 2), partitioned into two parts: the volume that needs to be passed through infiltration systems (or catchment soils) to restore lost subsurface flows (grey polygon), and the volume that needs to be retained in the catchment and not delivered to the stream (through evapotranspirational loss or through use and export from the catchment through the wastewater stream). For each part, a range is indicated between situations in which the target streamflow is predicted by the grassland curve (more stream flow, less retention in catchment) or by the forest curve (less streamflow, more retention in the catchment) of Zhang et al. (2001). (Source Walsh, Fletcher & Burns 2012)

## The magnitude of the resource

In most Australian cities, the excess[1] volume of stormwater runoff is significantly greater than the total water demand (Mitchell, McMahon & Mein 2003). Harvesting of this water clearly provides a very large "new" water resource that could, with appropriate treatment, serve a wide range of end-uses. Unlike other water resources, stormwater runoff is also a resource that grows with increasing urban development.

## Demand is the key

The flipside of this large available resource is that it needs to be used to reduce the degradation and threat caused by urban runoff. The effects of urban stormwater runoff on water quality and flow regimes of streams are manifold and complex (Walsh *et al.* 2005). There is increasing evidence that redressing the problems of increased frequency and magnitude of flood flows, increased pollution, and decreased dry-weather flows requires a substantial reduction in the total volume of water reaching the stream (Walsh *et al.* in review). For instance, our group have determined that the maintenance of the intermittent flow regime of Kororoit Creek to the west of Melbourne following the development of its catchment will require the loss[2] of at least 80% of the runoff generated by the development (Duncan *et al.* 2014).

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[1] i.e. runoff in excess of that which would have been produced in the natural (pre-developed) state (Walsh et al. 2012)

[2] through harvesting and use so that it either flows to the wastewater system or is taken up by plants and returned to the air.

Given the large excess of runoff produced by impervious areas (Figure 1), the volume *required* to be harvested will typically be sufficient to meet the entire water demand for a given urban development. While this might seem like a positive, it means that protection of receiving waters can only be achieved if sufficient demand can be found for the water. In practice, this will mean that cities need to find new demands for stormwater, potentially providing substantial co-benefits in greening our cities.

Protecting receiving waters from the threat of urban stormwater requires that sufficient demand be found to reduce the volume of runoff near to its natural (pre-developed state). Such an objective will require that: (i) stormwater is harvested, treated appropriately and then fed into the broader potable water supply network; or (ii) appropriate urban planning is put in place to ensure that high-demand non-potable uses (e.g. agriculture, water-using industries) are placed closed to urban areas; or (iii) sufficient areas of vegetation are retained in the urban landscape (much larger than is typical in urban developments) to maintain pre-development evapotranspiration rates, and urban stormwater runoff is directed to these vegetated areas. Barriers to achieving such an objective include potential 'competition' from recycled wastewater (the combined volume of the two resources will far exceed the likely demand for water in a given area).

Priority should be given to ensuring that stormwater harvesting is applied in a widespread way throughout urban areas, and that harvesting systems are connected to sufficient demands to ensure that the volume of runoff is reduced to near-natural levels. Doing so will reduce costs and areas required for filtration systems that are needed to provide water quality and flow regimes to sustain healthy aquatic ecosystems.

**Issues and misperceptions of scale and storage**

There is a common misperception that stormwater harvesting stores need to be very large to achieve a supply reliability comparable to that achieved by large water supply dams. Such logic is fundamentally flawed. Stormwater harvesting should be considered in the context of its role as part of an overall integrated urban water supply system. In this context, stormwater harvesting complements the high degree of inter-annual security supplied by traditional centralized strategies, such as water supply reservoirs. Given this complementarity, stormwater harvesting storages (e.g. rainwater tanks) do not need to be sized for high level of volumetric security (Mitchell *et al.* 2008).

For example, a storage volume of 25 litres per square metre of roof (equivalent to 5000–6000-litre storage for an average house) or road area would retain 99.6% of runoff, in Melbourne[3] if there were sufficient demand (as would be achieved, for instance, by plumbing roof-top tanks on a multi-storey building into all of the building's toilets, or by directing the runoff to a treatment system for augmentation of the potable water supply). Such a harvesting system would greatly reduce the cost and area required for infiltration systems that are required to retain and treat unharvested runoff, to restore lost baseflows. If such systems were applied to every roof of Melbourne, they would supply 60% of Melbourne's total water demand. A similar situation exists in most Australian cities and towns.

Stormwater runoff is less dependent on long-term climate variations than are traditional forested catchments, because the rainfall required to generate runoff from an impervious surface is only around 1 mm, independent of preceding dryness, while the "initial loss" in a forested catchment can exceed 25 mm (Hill, Mein & Siriwardena 1998).

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[3] with similar statistics in other cities

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There is also a common misperception that economies of scale mean that stormwater is most cost-effectively tackled at the large-scale, downstream at or near the outlet of a catchment. There are two important problems with this assumption. Firstly, available data simply do not support the assumption that larger scale systems are cheaper. For example, in the Little Stringybark Creek Project (details of this exemplar project are provided below), no economies of scale were found (Figure 2). Melbourne Water maintains a database of many hundred stormwater treatment and harvesting systems constructed around Melbourne, which shows a similar lack of economy of scale[4]. Secondly, the net benefits to the community in terms of stream protection and liveability are maximized by approaches which deal with stormwater as close as possible to its source (Fletcher, Andrieu & Hamel 2013; Fletcher *et al.* 2014). Perhaps most importantly, stormwater runoff needs to be intercepted and dealt with before it reaches a waterway. Allowing it to degrade upstream waterways, while then providing downstream infrastructure to intercept, treat and potentially harvest stormwater, is fundamentally flawed, because it leaves all upstream ecosystems unprotected.

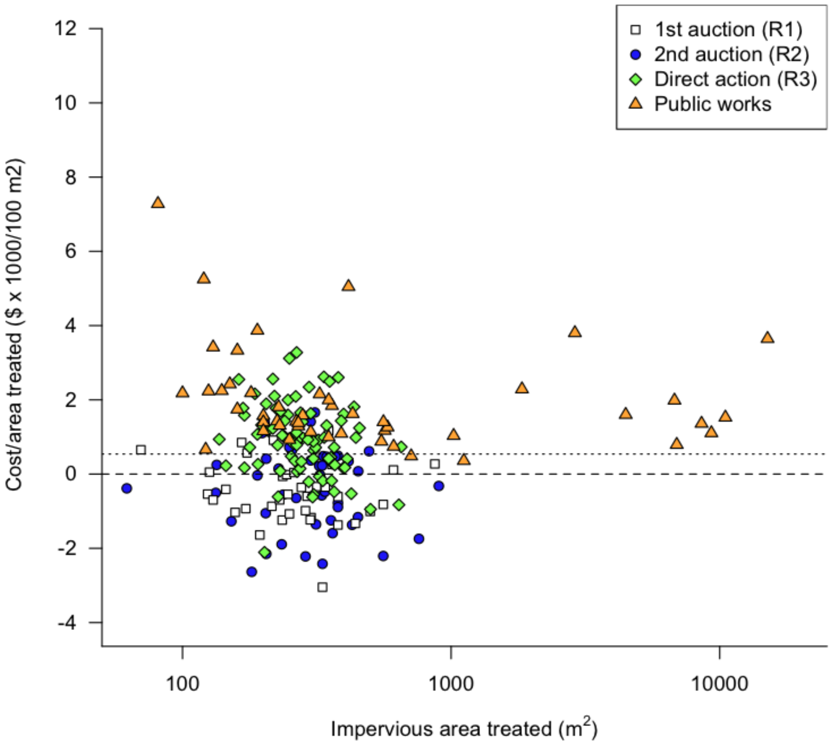


Figure 2. Total cost of stormwater retention works constructed as part of the Little Stringybark Creek project (see: www.urbanstreams.unimelb.edu.au), minus of the value of water provided. There is no clear economy of scale.

*In managing the urban stormwater threat and opportunity, attention should be paid to the appropriate combination of scales, with a focus on dealing with runoff at or near source. As an example, rainwater tanks, applied to each building, not only provide direct community benefits, but they then reduce the magnitude of the mitigation effort required downstream (e.g. construction of stormwater infiltration systems, raingardens, precinct harvest systems).*

**Financial and community benefit**

An approach to stormwater management that makes use of runoff as a water resource, and which protects our streams and bays from degradation, offers genuine cost-savings to the Australian community. These savings have been demonstrated by two recent cost-benefit

[4] Matthew Potter, personal communication.

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analyses, one conducted by the Queensland Government (see: http://waterbydesign.com.au/businesscase/) and one conducted by the Victorian Dept. of Land, Water and Planning (formerly the Office of Living Victoria). The benefits which accrue to communities include (i) water supply provision (see for example, Figure 2, which shows that many of the stormwater harvesting and retention systems constructed had a negative net cost, after taking into account the value of water supplied) (ii) flood mitigation (see for example: Burns *et al.* in press), (iii) urban amenity and enhanced human health (de Graaf & van der Brugge 2010; Lee *et al.* 2014).

*Given the clear benefit – both financial and more broadly - to the community through the appropriate management of urban stormwater, we urge the committee to be bold in attempting to deliver more than just incremental change.*

**Institutional arrangements**

Under current arrangements around Australia there are several important technical, economic, social and institutional barriers to integrated management of urban stormwater. We will not go into these in great detail, given the extensive literature on the topic (Morison & Brown 2011), but we will make 3 points:

1. If the simultaneous threat and opportunity of stormwater are to be managed in an integrated way, then there needs to be a "head of power" to take oversight. For example, while stormwater harvesting is a critical prerequisite to reducing the impacts of stormwater runoff on receiving waters, if it is conducted solely with a view to maximizing the resource, there is the potential to instead further degrade receiving waters (Knights & McAuley 2009).
2. Currently the synergies between managing the threat posed by stormwater and its opportunity as a resource are limited by the lack of effective regulation to minimize or avoid stormwater impacts. While targets exist for stormwater peak flows in most jurisdictions (because of a concern for flooding) and for stormwater quality in a few jurisdictions, stormwater is still not generally managed in a way that properly protects receiving waters by ensuring that both the flow and water quality regimes remain in a state which will support healthy stream ecosystems (Burns *et al.* 2012). *At the same time as incentives are required to encourage the appropriate harvesting of stormwater, suitable disincentives (through regulation) are required to prevent the discharge of stormwater runoff to streams.* Indeed, the success of reducing the environmental threat caused by wastewater has been largely due to the regulations in nearly all Australian jurisdictions which prevent its uncontrolled discharge to receiving waters. A similar approach needs to be taken to the management of urban stormwater.
3. Certainty around 'ownership' of the stormwater resource is required to facilitate investment. The enquiry should consider the merits of facilitating the involvement of water authorities and municipalities as "providers" of stormwater services (treatment, mitigation and supply as a resource), overseen by a suitable body with the power to ensure optimal outcomes.

**An exemplar: the Little Stringybark Creek Project**

As noted in the introduction to this submission, the Waterway Ecosystem Research Group (WERG) is one of Australia's leading groups studying the link between urban stormwater and the health of aquatic ecosystems. The most important project being conducted by WERG is the Little Stringybark Creek project (see: www.urbanstreams.unimelb.edu.au). This project is testing the feasibility of retrofitting the stormwater system of an entire urban catchment, with the aim of restoring the flow and water quality regime in the Little Stringybark Creek near to

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their pre-development condition (Fletcher *et al.* 2010; Walsh *et al.* 2015). The project is a partnership with state and Commonwealth Government ($800k was contributed to the project by the Caring for our Coasts scheme), along with the Victorian Government, the local water authorities (Melbourne Water and Yarra Valley Water), municipality (Yarra Ranges Council), and of course the community. Part of the project has involved several reverse auctions, where homeowners bid for rainwater harvesting systems, raingardens and infiltration systems to be installed on their properties (Bos & Brown 2015; Nemes *et al.* in press). The project has also resulted in the piloting of an "Environmental Significance Overlay" for the area, which requires any new development appropriately manage stormwater (Burns, Wallis & Matic 2015; Prosser, Morison & Coleman 2015). The Little Stringybark Creek project has been the subject of delegations from decision-makers and scientists from around the world, and the team has been invited to present lessons from the project in the USA, China and Europe. We would be delighted to host a visit by the SECRC to the Little Stringybark Creek project area, and to discuss the technical, social, economic and institutional insights from the project to date.

**Conclusion**

We include here below a list of the papers we have cited in making this submission. As noted previously, we would be happy to provide both these papers and other relevant technical reports, as required by the Committee. We would also be delighted to provide any further input – either verbally or in written form. We wish the Committee the best in their deliberations, and thank you for the opportunity to provide input to such an important process.

Sincerely,

Prof. Tim Fletcher Assoc. Prof. Chris Walsh

*PTO for list of references*

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