A new approach for establishing stormwater objectives

Une nouvelle approche pour établir les objectifs de gestion des eaux pluviales

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RÉSUMÉ

En Australie, la réduction de la charge polluante est généralement le principal objectif en matière d'amélioration de la gestion des eaux pluviales urbaines. Il s'agit le plus souvent de réduire le pourcentage de la charge totale de matières solides en suspension, d'azote total et de charges totales dans les nouveaux aménagements urbains. Dans le cadre de l'examen de ces objectifs, nous avons proposé une nouvelle approche qui tient compte d'un certain nombre de résultats de cours d'eau différents, plutôt que d'une simple réduction de la charge polluante. Cette approche reflète le développement de la potamologie en Australie, qui a démontré que l'amélioration de la qualité de l'eau à elle seule n'améliore pas les résultats pour les cours d'eau et qu'il faut donc redoubler d'efforts pour élaborer des systèmes de traitement des eaux pluviales qui tiennent compte des paramètres hydrologiques, de la protection et de la restauration des habitats naturels, des caractéristiques esthétiques et du lien avec la végétation. Cet article met en lumière l'historique des objectifs et propose une approche pour établir de nouveaux objectifs pour les cours d'eau urbains touchés par le ruissellement des eaux pluviales urbaines.

ABSTRACT

In Australia, the use of pollutant load reductions are typically the major urban stormwater improvement objective. These typically refer to a percentage load reduction in total suspended solids, total nitrogen and total loads to be achieved in new urban developments. As part of reviewing these objectives, we have proposed a new approach that considers a number of different waterway outcomes rather than a simple load reduction. It reflects development in waterway science in Australia which has demonstrated that water quality improvement in isolation does not result in improved waterway outcomes and that more effort on developing stormwater treatment systems that address hydrology, habitat protection and restoration, visual amenity and vegetation connectivity are required. This paper highlights the history of objective development and provides a proposed approach for setting new objectives for urban waterways impacted by urban stormwater runoff.

KEYWORDS

Urban, stormwater, objectives, planning, waterway health.

1 BACKGROUND

Within Australia, our current focus in developing urban stormwater objectives stems from the mid to late 1990s, when new policies for environmental protection were released. One of the focus areas for these new policies was the management of urban stormwater runoff. A series of water quality objectives were also developed to protect and enhance community agreed Environmental Values consistent with the Australia's National Water Quality Management Strategy. Local governments responded to this by developing approaches that required assessments of compliance with concentration-based water quality objectives to be considered in new urban developments. The challenge then became how to assess whether the responses put in place were sufficient and cost-effective to achieve Council policies and objectives for water quality management. Concurrent with this requirement was monitoring and research being undertaken on stormwater quality and treatment device performance, all of which ultimately led to the development of the MUSIC (Model for Urban Stormwater Improvement Conceptualisation, eWater Solutions) stormwater quality modelling software.

The results of these early approaches were that concentration-based objectives on their own were able to be manipulated quite easily to demonstrate compliance. The monitoring of stormwater quality at the time suggested that while some reductions in concentration may be possible for some land use changes (e.g. from a dairy or piggery to an urban land use), these did not account for the change in hydrological response producing greater runoff volumes, and therefore greater overall loads of pollutants. For these reasons, local governments moved towards pollutant load reductions from the developed future land use as it could be demonstrated that this would also address the concentrations of pollutants in most cases. The only issue not resolved by this approach was the pre-existing land use condition, such that in particular development types, land use change would result in an overall increase in loads (this is mostly associated with total nitrogen (TN)). In many jurisdictions in Australia, the current requirement is to reduce TN loads by 45% on new urban development. That means that 55% of the pollutant load is still going to the waterway. Depending on what the land use was previously, this can increase the downstream loads of TN significantly, as the graph in Figure 1 shows. The same may also be true for total suspended solids (TSS) and total phosphorus (TP), but typically, TN is most likely to present a load increase regardless of the pre-development land use.

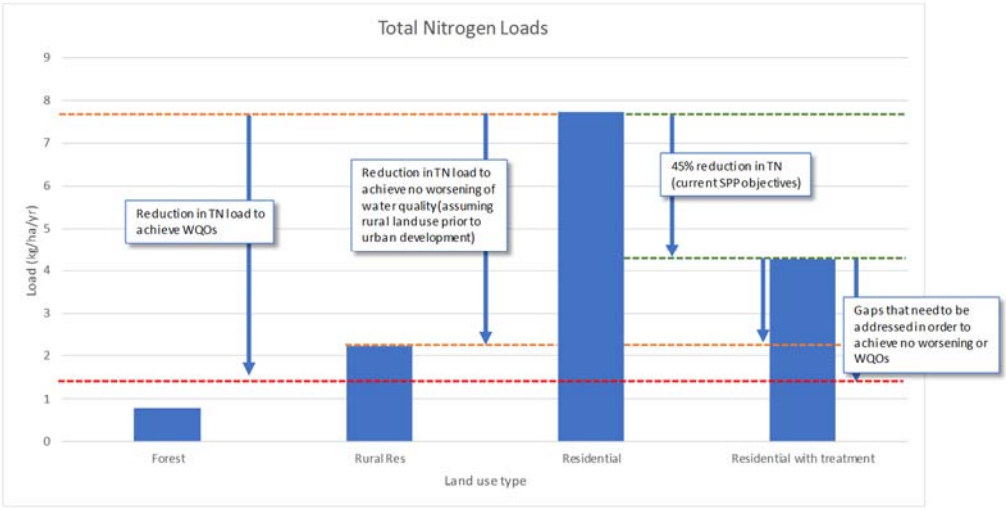

Figure 1. Loads from different land uses

This meant that design objectives which are focused around pollutant load reductions are therefore able to address reductions in loads from future land use, but do not consider whether this is an increase or decrease from the predevelopment case.

A summary of recent Australian waterway science suggests that water quality related targets are not sufficient to achieve healthy urban waterways through their application to urban stormwater management. Further work is needed to understand the hydrologic criteria and the ecological responses needed in urban waterways and how these may also provide connection to other waterway objectives.

Through examining the history of the development of the current objectives and some of the implementation issues which have arisen, we have identified that there is a disconnection between:

a) the strategic intent for waterway management;

b) the management responses we are currently delivering; and

c) the waterway outcomes we are hoping that they achieve.

It should be recognised that the existing urban stormwater objectives have provided the impetus to drive a level of stormwater management in urban developments and the guidance, frameworks and supporting activities associated with these have led to widespread action to improve stormwater management. We therefore believe that a new approach should recognise this and at least consider the existing objectives as the minimum standard for urban development into the future, though also recognising that further actions are required that link the strategic intent and management responses for urban stormwater runoff to the outcomes we want to achieve in our urban waterways.

2 A NEW APPROACH

2.1 Planning for Waterway outcomes

There are no current policy requirements for a planning process around waterway management and outcomes. While many plans have been created over the last 20-30 years in across most jurisdictions, there hasn't been a consistent process developed to understand the existing condition and ecosystem services of a waterway, whether those conditions and services are meeting current and future values for a waterway, and if not, mapping out a process to enhance the waterway to meet those values in the future.

What we believe is needed is for effective waterway planning to be required under policy or regulation, but the delivery of waterway planning must not be solely burdened on local governments which is currently largely the case. Most waterways flow across more than one jurisdiction, and in many areas of Australia, community involvement in waterways is strong. Waterway planning therefore needs to allow for community involvement through existing efforts from waterway groups, environmental groups, Non-Government Organisations as well as local and state agencies (including water utilities). The process needs to identify what we already have in our waterways, what we want for them in the future and the pathways to move from one to the other. This will allow us to know what needs to be "protected" and what needs to be "enhanced" and will therefore drive the development of design objectives that can allow us to do both.

We have therefore proposed the development of a waterway asset management planning framework as a consistent approach to planning for waterway outcomes which encompasses these elements. The purpose of establishing a proper planning process is to enable a consistent approach to the understanding of existing and future conditions that then lead to identifying design objectives that are directly connected to the outcomes needed for waterways The approach outlined above is likely to identify a range of different objectives, not all that will apply to urban stormwater management, but likely to still be highly relevant to managing development impacts on waterways. From this process, a series of values, criteria and objectives that link together in an evidence-based framework, will be able to supplement minimum standards such as current load based objectives, or completely replace them. It will also provide a much stronger set of linkages between the strategic intent, design objectives, management responses and the desired waterway outcomes.

2.2 Declaring waterway outcomes and strategic intent

A strategic intent of is a declaration of the future pathway of waterway health. For example, it may be that simply protecting existing waterway condition in the face of urban growth may be the most appropriate way of providing waterway outcomes that are acceptable to the community and that does not result in an excessive cost burden on existing residents while still requiring future development to effectively manage their impacts. The strategic intent therefore needs to be developed through consideration of the issues, community expectations and future changes that may occur within government jurisdictions. This would obviously be linked to a clear planning process.

2.3 Establishing clear linkages

It has become obvious in Australia that there is significant disconnection between the urban stormwater objectives we currently have and the outcomes we want to achieve in our waterways. This partly reflects the objectives we have, but also the lack of clear connection between the various policies which are

driving the management of stormwater impacts on urban waterways, and the responses to those to comply with the objectives.

Developing policies that have clear linkages between the waterway outcomes that are desired for a waterway and objectives to achieve those would allow for the implementation of management responses to cover a wider range of waterway outcomes needed to protect or enhance the environmental values.

2.4 Integration and System Thinking

The existing urban stormwater objectives drive management responses that are largely focussed on achieving water quality outcomes. Obviously, this does not support the design process to consider other potential benefits of implementing those responses. This has largely been the reason for developing the Living Waterways approach (see http://hlw.org.au/initiatives/waterbydesign/water-sensitive-urban-design-wsud). The intent of this framework is to encourage designers to consider the range of potential benefits of effective, integrated stormwater management through the implementation of the full scope of Water Sensitive Urban Design. It is not isolated to water quality outcomes and provides designers with opportunities to maximise the benefits of proper integration of stormwater management through providing a scoring system that provides a way to understand the potential co-benefits if a broader outcome than just water quality is considered. The Living Waterways framework therefore facilitates both integration and consideration of system thinking.

2.5 Equitable management of stormwater impacts

In setting urban stormwater objectives to drive the management of stormwater impacts, we need to realise that not all of the burden of this can be borne by new urban development. In many cases, there are significant impacts from the runoff of existing urban and non-urban areas. The management of this runoff also needs to be addressed through the implementation of stormwater retrofit programs, improvements in practices in rural areas, addressing construction site runoff and community behavioural change (amongst others). The imposition of design objectives that require development to manage impacts greater than those caused by the development is not equitable, but also, there needs to be consideration that the development impacts may not be addressed through compliance with the existing SPP design objectives.

What is therefore needed is a process by which the design objectives can ensure that new urban development (both in greenfield and brownfield applications) achieves at least a minimum consistent standard. In addition, there may be requirements on those developments to contribute to additional trunk infrastructure to ensure that the stormwater impacts from development are mitigated. This would address the issue where the existing design objectives may not result in the stormwater impacts from development being fully mitigated.

BIBLIOGRAPHY

Duncan, H.P., Fletcher, T.D., Vietz, G., Urrutiaguer, M., 2014. *The feasibility of maintaining ecologically and geomorphically important elements of the natural flow regime in the context of a superabundance of flow (Technical Report No. 14.5)*, Melbourne Waterway Research-Practice Partnership. Melbourne Waterway Research-Practice Partnership.

Li, C., Fletcher, T.D., Duncan, H.P., Burns, M.J., 2017. *Can stormwater control measures restore altered urban flow regimes at the catchment scale?* Journal of Hydrology 549, 631–653. https://doi.org/10.1016/j.jhydrol.2017.03.037

McIntosh, B.S., Aryal, S., Ashbolt, S., Sheldon, F., Maheepala, S., Gardner, T., Chowdury, R., Hartcher, M., Pagendam, D., Hodgson, G., Hodgen, M., Pelzer, L., 2013. *Urbanisation and Stormwater Management in South East Queensland – Synthesis and Recommendations (Technical Report No. 106),* The Urban Water Security Research Alliance. The Urban Water Security Research Alliance.

Meals, D., Dressing, S., Davenport, T., 2010*. Lag Time in Water Quality Response to Best Management Practices: A Review.* J Environ Qual 39, 85. https://doi.org/10.2134/jeq2009.0108

Miller, J.D., Kim, H., Kjeldsen, T.R., Packman, J., Grebby, S., Dearden, R., 2014. *Assessing the impact of urbanization on storm runoff in a peri-urban catchment using historical change in impervious cover*. Journal of Hydrology 515, 59–70. https://doi.org/10.1016/j.jhydrol.2014.04.011

Walsh, C.J., Fletcher, T.D., Burns, M.J., 2012. *Urban Stormwater Runoff: A New Class of Environmental Flow Problem*. PLoS ONE 7, e45814. https://doi.org/10.1371/journal.pone.0045814