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When does a road become a river? Why hydrologists and water planners need to move beyond averages

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EDITORIAL

When does a road become a river? Why hydrologists and water planners need to move beyond averages

At a recent Canberra Hydrological Society meeting, Phillip Prentice from Info4Eco, in the context of urban flooding, asked the question 'when does a road become a river?' Looking at maps of flash flooding predictions in Canberra using the latest 'big data' systems, it was easy to see that it was unclear in a flash flood that what would typically look like roads instead became channels for water flow.

Indeed, recently there have been examples of cars floating down roadways in the US, UK, Europe and Australia. In an increasingly unnatural world (Abramovitz 2001), many of our understandings of what is 'natural' are indeed coming under scrutiny. Since there are now UNESCO heritage listings of 'novel' ecosystems such as the Ord River (see Camkin 2011 for a useful review of the history of this place) and we still classify flooding, cyclone, drought or bushfire damage to (potentially poorly cited or constructed) properties as 'natural disasters' (Taylor 2018), it is easy to see that this distinction of what is 'natural' or 'unnatural' is becoming blurred. Thus looking again at whether a road can really be considered as a river, we can go back to the Oxford Dictionary definitions and see how a river is perceived. Firstly, a river can be defined as 'A large natural stream of water flowing in a channel to the sea, a lake or another river' or more simply as 'A large quantity of a flowing substance'. Obviously, under the second definition a road could be defined as a river and potentially under the first if again our interpretation of 'natural' is as flexible as current common usage!

Why is such a seemingly silly and perhaps confusing question important? First, it is importantly linked to the issue of responsibility of water engineers, planners and developers. If we have best available evidence that now shows 'sometimes' (not on average), a road becomes a river and that naturally it becomes a channel for the flow of water, and this can lead to significant property damage or hazards to human life and health, then don't we have the responsibility to understand 'when' and 'how' this is likely to occur? It also obviously has ramifications for issues like flood insurance, where the differences between riverine flooding and 'rain falling from the sky'[1] again become extremely blurred and instead we will need to more accurately determine the risks and likely conditions under which individual properties will become subject to flooding, regardless of whether it occurs in a known or unintentionally created river-like environment that we are increasingly developing the tools to understand. Even in Australian Rainfall and Runoff (Ball et al. 2016), it is clearly said that the interactions of 'overland' and 'fluvial' flood types (their classifications) are subjective (Book 9, Chapter 3.5.3) and that flood estimators need to go back to first principles to understand them and their interactions.

In this Issue of the Australasian Journal of Water Resources, we have articles contributing to a re-thinking of these challenges and more generally a move beyond averages, as well as many other articles from both Australia and New Zealand.

Our first article by McMahon and Kiem (2018) attacks the averages challenge head on by examining whether floods in South East Queensland indeed occur randomly (that there is a statistical 'Average Exceedence Probability' (AEP) that is the same for a flood each year) or whether there are periods where there are higher probabilities of having large floods than others. From the evidence they have gathered, there seems to be a pretty strong signal that floods in this region of Australia are not random and instead are more likely every 40 years for a period of 5 years, linked to a range of hydroclimatic factors such as the Interdecadal-Pacific Oscillation (IPO) and ENSO (El Niño/Southern Oscillation). This obviously has important ramifications for policymakers, planners and hydrologists in terms of what level of flooding risk is expected in rainier periods as opposed to drier periods, and that the relevance of AEP use in such regions for property design and protection might need to be rethought.

Our next article by Coombes (2018) also treats this issue directly in terms of not only urban flooding but in rethinking the whole transition from storm water to urban water cycle management. Specifically, the author outlines the history and current challenges associated with now moving beyond comfortable and traditional storm water drainage models and assumptions. Such changes are embedded in the transition in guidance to practitioners between the 1987 and 2016 versions of Australian Rainfall and Runoff (ARR)[2] in the urban book, where there is now capacity, data systems and knowledge available to take a whole-of-systems approach to understanding and addressing the challenges of urban water management as outlined in the Inquiry into Stormwater Management by the Australian Senate (2015) that included the increasing aforementioned property losses due to urban flooding. Such a systems approach requires hydrologists and water planners to better comprehend and use up-to-date tools and techniques for spatial, temporal and behavioural variability linked to integrated water systems management and the human decisions driving it.

Our next articles are not specifically focussed on this issue of moving beyond averages, but they, each in their own way, represent a shift beyond traditional approaches to water management or question assumptions in current water research.

First of all, Hall et al. (2018) take a look at the international Sustainable Development Goals, focusing on Goal 6 (the water goal), how a number of experts see the goals interacting and how the Australian Government is set up to deal with these interacting and multiple goals. They suggest that interactive systems approaches and processes for understanding goal connections can provide a positive method of engaging researchers and government officials in strategic planning, defining responsibilities for goal implementation and development of collaborative cross-governmental policy mechanisms where accountability for goals are shared.

Berkett et al. (2018), focusing on freshwater management in New Zealand, carry on elements of the theme of collaboration and moving beyond traditional consultation approaches. Specifically, they suggest typical approaches 'can marginalise community and indigenous views and give insufficient weight to economic and social consequences of planning decisions' (Berkett et al. 2018). In response, their work suggests the importance of broadening the definition of 'relevant science' to include multiple types of knowledge, including those that inform social, economic and cultural values. They also suggest that effective scientists in collaborative management become effective facilitators of learning and exchange rather than top-down 'informers or experts'. Such views from New Zealand will hold much relevance in both Australian and Pacific contexts for water scientists, planners and managers.

Our next three papers then turn back to more technical questions. Specifically,

Loveridge and Rahman (2018) have focused on the history of the Monte Carlo approach in Australia and highlighted the need for the probabilistic nature of the rainfall runoff process to be taken account of when undertaking flood estimation modelling. One conclusion is that good commercial software is required to promote advancement of using these Monte Carlo techniques for design flood estimation. Srinivasan and Suren (2018) then investigate the movement of sodium fluoroacteate from RS5 baits in both surface and groundwater on the West Coast of the South Island in New Zealand. The findings showed that for a particular event most of the rainfall infiltrated into the soil but little contamination from baits was detected. Finally, the paper by Singh, Griffiths, and McKerchar (2018) provides 'Temporal patterns for design hyetographs in New Zealand'. Data from stations with 30 years of records have been clustered into regions and then analysed to determine hyetographs. This paper has progressed the development of analysis of rainfall for flood estimation for NZ. The authors have alerted users of their analysis that more data from more sites are needed to progress work in understanding temporal rainfall pattern distributions with different return periods and for durations less than one hour. It is obvious that significant attention and funding is required in NZ to advance this work to that which has been achieved in Australia in the 2016 version of Australian Rainfall and Runoff.

For something a little different, French and Jones' (2018a) Technical Note on blockages examines the design aspects of blockages from a different perspective. This is a problem that has been addressed in Book 6 Chapter 6 of the 2016 edition of 'Australian Rainfall and Runoff'. The conclusion reached by the authors of the note is that there is a decided lack of data to come up with any method for obstruction by flood-borne debris and that in their opinion it is best to do nothing in design unless there is a specific reason and economic justification to do otherwise. It is important for practitioners and users of ARR to highlight what they think are inadequacies in the document so that robust discussions can be had to advance our design methods.

Lastly, in this edition we have a discussion by French and Jones (2018b) on 'Recommended practice for hydrologic investigations and reporting' by RJ Nathan and TA McMahon (2017) with the reply by the authors (Nathan and McMahon, 2018). The issues raised in the discussion relate to design flood estimation and its treatment in the recent revision to Australian Rainfall and Runoff, highlighting the many reasonable approaches that were in the paper. In the reply by Nathan and McMahon, it was stated that their paper was directly related to the hydrological investigations relevant to Environmental Impact Statements and their reply refers to this broader context.

We hope you enjoy the issue.

Notes

1. In Flood Insurance definitions http://understandinsurance.com.au/types-of-insurance/flood-insurance.
2. ARR 2016 is available at arr.org.au.

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