UNIVERSITY OF TECHNOLOGY, SYDNEY

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SPATIAL *and* TEMPORAL EFFECTS *on* URBAN RAINFALL / RUNOFF MODELLING

by

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Certificate of Authorship

I certify that the work in this thesis has not previously been submitted for a degree, nor has it been submitted as part of requirements for another degree.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of this thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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ABSTRACT

SPATIAL and TEMPORAL EFFECTS on URBAN RAINFALL / RUNOFF MODELLING

KEY WORDS: Urban Stormwater, Spatial, Temporal, Rainfall, Runoff, Models, Hydrology.

ABSTRACT: Although extensive worldwide literature on urban stormwater runoff exists, very few publications describe runoff development in terms of its basic building blocks or processes and their individual and accumulative significance in response to varying inputs and boundary conditions. Process algorithms should respond accurately to varying input magnitudes and characteristics as well as to changes in antecedent conditions.

The present state of estimation errors involved in many current numerical simulation techniques has been reviewed in this thesis. A significant amount of errors that are presently encountered for have been explained in terms of undefined process response not explicitly included within many modelling methodologies.

Extensive field monitoring of intra-catchment rainfall and runoff within an urban catchment at Giralang in Canberra, which is typical of Australian urban catchments, was carried out over a 3-year period to define and measure individual runoff processes. This monitoring work led to a greater understanding of the processes driving the aggregation of local runoff from many sub-areas into the runoff observed at full catchment scale.

The results from the monitoring process prompted a number of approaches to potentially reduce standard errors of estimate from model-attributable errors based on improvements to definable catchment response mechanisms. The research isolated a

number of basic building blocks associated with typical residential allotments, that can be grouped into roof drainage, yard drainage and adjacent road drainage.

A proposed modelling approach was developed that allowed these building blocks at an allotment scale to be simply computed using storage routing techniques. This then aggregated via the total catchment's public drainage system isochronal characteristics utilising a "process tree" approach to provide full catchment scale runoff response.

The potential reduction in estimation errors utilising the developed procedure was assessed using a large number of recorded events from the Giralang catchment monitoring data.

The proposed numerical modelling approach was found to provide significant improvements over current methods and offered a scale-independent and storm-independent methodology to model catchments of any size without the need for changes to any of the runoff routing parameters. Additionally the approach permits the flexible sequencing and inclusion of a wide range of different urban drainage structures within a catchment that are representative of the local characteristics.

The developed procedure also includes a spatially varied water balance approach to infiltration estimation that is more suited to future continuous simulation models.

The developed "flexible process tree" approach provides an important step forward in the numerical modelling of complex urban drainage systems. This can reduce errors of estimate by improving intra-catchment process representation.