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Editorial
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Editorial

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The papers in this issue of *Water Management* offer an insight into new developments related to the management of water supply and quality in urban and rural catchments. They cover the design of rainfall monitoring networks, water distribution systems and storm run-off barriers. New modelling approaches are introduced that integrate the uncertainty within data sets and complex interrelationships between system components in decision-making. Improvements in the design performance and operation of infrastructure for irrigation systems are illustrated, and the application of a novel low-technology concept for urban storm-water management is described.

The first paper describes a methodology that uses entropy theory coupled with sequential algorithms (SA) and genetic algorithms (GA) to determine the location of new rainfall stations for collection of rainfall data (Karimi-Hosseini *et al.*, 2011). This has a variety of relevant applications in water projects. The study considers the desire to optimise the distribution of the network stations and increase the quality of data obtained by them through growth of the network. The value of entropy theory is that it is an efficient method of uncertainty analysis in water resource systems and can be used as a measure of information transfer and available information in monitoring networks. The methodology is evaluated with a case study in Iran.

Transinformation entropy–distance relationships are generated to capture the spatial variability of transinformation entropy across the study area, as an aid to identifying the optimum locations for new rainfall stations. The algorithms are used in two ways. The SA uses a step-by-step selection procedure which does not consider the effect of other new stations on the transinformation entropy of the network. In contrast, the GA considers the effect of all stations on the transinformation entropy of the network simultaneously. The performance of four models is compared in the analysis, in which the SA and GA are employed to maximise transinformation entropy in defining new network locations for rain gauges. A key observation is that the performance of the two algorithms in determining the priority of rain gauge site installation was different and this difference increased with an increase in the number of new stations added. Overall, the study concludes that the GA is superior in developing the rain gauge network for the design criteria used. These include economic, efficiency and precision-based parameters, which can be extended to consider other goals in the management of a watershed. The implications with respect to using rainfall data in relevant management decisions and predictions (e.g. estimating precipitation, flood forecasting, integrated water resource management, river basin water balances or future network development) are discussed.

Optimising the design of water distribution networks in urban areas, industrial plants or irrigation systems requires that both performance and cost-criteria be considered. Statistical methods and modelling tools are increasingly being developed and applied to balance the constraints imposed by such design challenges. Genetic algorithms are among the most popular algorithms used in water distribution network design problems, due to their high performance in multi-objective analysis problems with complex objective functions. However, addressing the uncertainty in such complex systems, while considering the imprecision in the analysis, also requires the use of fuzzy decision systems.

In the paper by Amirabdollahian *et al.* (2011) a fuzzy genetic algorithm is used to obtain the least-cost design of looped water distribution networks. In this approach fitness evaluation is carried out using a fuzzy decision system. A novel feature is that it allows experts to have a direct influence on the optimisation process based on their experiences, the economical and social conditions at the time of using the algorithm and the uncertainty in introducing network characteristics. The study highlights improvements made to previous fuzzy water network optimisation techniques, through the use of a fuzzy decision system which simulates the tolerance in constraint deviation in network elements. The method is evaluated for two water distribution networks in the literature, where a fuzzy decision system is introduced by determining fuzzy parameters, membership functions and the rule set, considering the network layout and optimisation constraints. The results show the improved capability of the method in finding optimum cost solutions as well as providing a dynamic algorithm that gives engineers more practical insight into easily applying system uncertainty in the optimisation algorithm.

The third paper presents an experimental study of lateral intakes commonly used to control flow and sediment dynamics in irrigation diversion works (Esmaeili Varaki *et al.*, 2011). These are important components in diversion dams that maintain channel water levels in such networks, with the function of stabilising or minimising sediment transport through the system. Excessive sedimentation of these intakes decreases their operational performance and it is therefore important that they are designed to minimise the amount of sediment in diverted water entering them. Using a realistic lateral intake design constructed within a laboratory flume, the authors explore the effect of diversion angle on the structure of the approaching flow to the intake and amount of sediment entering it. By measuring the velocity fields upstream and in front of the intake, and sediment transport under various discharge combinations of the river,

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intake and sluice gate using in the design, they identify the diversion angles required for optimum performance.

The research demonstrates that the performance of lateral intakes is a complex function of a range of factors that control the way the flow is diverted from the main channel. An interesting observation is the role of eddies near the intake sill in collecting sediment from the bed and transporting it into the intake channel. This mechanism must be taken into account when considering any remediation works, such as installing an exclusion tunnel to minimise sediment transfer to the intake channel. The study is valuable in identifying the origin and relative significance of different design features of lateral intakes that influence the hydrodynamics of flow and sediment transport within them. It has practical application as the experimental design mimics the configuration of full-scale systems. The authors conclude by providing guidelines for the engineering design and operation of lateral intakes with improved performance characteristics.

Managing stormwater flow and quality in urban catchments is becoming more important, as the desire to deliver sustainable water resources must balance demands from increasing population growth against potential environmental impacts. There is now greater impetus to develop novel management solutions to address these issues, and to ensure these are compatible with the infrastructure and function of the urban environment. Green roof technology is one example. In the paper by Myers *et al.* (2011) permeable pavements are evaluated as an alternative approach, based on the principle that harvesting, storage and reuse of stormwater from these reservoirs provides an opportunity to alleviate water shortages in urban areas, moderate stormwater volume and manage pollutant loads in urban run-off. The study compares the influence of two types of base course aggregate (dolomite and quartzite), used as structural support for permeable pavements, on the quality of synthetic stormwater passed through a model pavement.

The research convincingly shows the net benefit provided by these materials for the attenuation of organic and inorganic pollutants and water quality parameters in urban stormwater, over a residence time of 144 hours, which is considered typical for practical implementation. It is clear from this work that permeable pavements using the materials examined can provide a significant attenuation barrier to suspended solids and many pollutants typically found in stormwater, with over 90% removal of heavy metals for example. Problems with specific groups of pollutants (e.g. nutrients or electrical conductivity) or applications (e.g. irrigation) are highlighted. The implications of the results for fit-for-purpose reuse are discussed with respect to irrigation of lawns and garden beds in domestic, commercial and industrial areas, based on Australian guidelines for irrigation and stormwater reuse.

REFERENCES

Amirabdollahian M, Chamani MR and Asghari K (2011) Optimal design of water networks using fuzzy genetic algorithm. *Proceedings of the Institution of Civil Engineers, Water Management* **164(7)**: 335–346, **doi**: 10.1680/wama.2011.164.7.335.

Esmaeili Varaki M, Farhoudi J and Walker D (2011) Study of flow structure and sediment entry to a lateral intake. *Proceedings of the Institution of Civil Engineers, Water Management* **164(7)**: 347–360, **doi**: 10.1680/wama.2011.164.7.347.

Karimi-Hosseini A, Bozorg Haddad O and Mariño MA (2011) Site selection of raingauges using entropy methodologies. *Proceedings of the Institution of Civil Engineers, Water Management* **164(7)**: 321–333, **doi**: 10.1680/wama.2011.164.7.321.

Myers B, Beecham S and van Leeuwen JA (2011) Water quality with storage in permeable pavement basecourse. *Proceedings of the Institution of Civil Engineers, Water Management* **164(7)**: 361–372, **doi**: 10.1680/wama.2011.164.7.361.

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