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# OPPORTUNITIES AND IMPEDIMENTS TO WATER SENSITIVE URBAN DESIGN IN AUSTRALIA

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## ABSTRACT

Growing enthusiasm and support for a fundamental change in the way urban water resources are managed has occurred throughout the Australian water industry over the last decade. Water Sensitive Urban Design (WSUD) is being promoted as the new approach to sustainable urban development practices that aims to integrate the urban water cycle. This shift in the approach to urban water resource management presents various challenges including issues associated with the current regulatory framework, assessment and costing of management practices, technology and design, and marketing and acceptance of new approaches.

A recent national conference was held in Melbourne, Australia to highlight and explore the opportunities and impediments to the adoption of WSUD. Presentations by participants on their practical experience with WSUD projects provided valuable information which will help achieve a better understanding of the current status of WSUD in Australia and the challenges associated with its implementation. Key issues include the current culture and skills within local government, catchment management authorities, and the consulting and construction industry for the assessment, approval, construction and maintenance of WSUD management schemes. There is also a general lack of quantitative data on the long term viability and costs associated with water management schemes and market place acceptance.

This paper provides a review of information presented at the conference. The major issues related to the adoption of WSUD in Australia and potential strategies that may help to overcome some of the current obstacles are discussed.

## KEY WORDS

**Stormwater management, source control, urban planning and design, sustainable development**

## 1. INTRODUCTION

Urban growth and urban consolidation are placing increasing pressure on existing drainage infrastructure and their receiving waters. Emphasis now placed on the importance of protecting receiving water values is prompting a shift in what is considered appropriate land and water management practices in urban catchments. Consequently, growing enthusiasm and support for a fundamental change in the way urban water resources are managed is currently being voiced. Water Sensitive Urban Design (WSUD) is a philosophical approach to urban design which aims to integrate the management of the total urban water cycle into urban development. In many places, the initial driver for WSUD has been the need to reduce the impacts of urban development and redevelopment though improved environmental management of stormwater. However, in a number of projects, WSUD has been used to conserve water resources through reuse and recycling of stormwater and wastewater. WSUD provides the urban planning and water management framework required to achieve cost-effective solutions with enhanced human and environmental outcomes at all scales of the urban development process. Fundamental to achieving sustainable management of urban water resources is the integrated adoption of Best

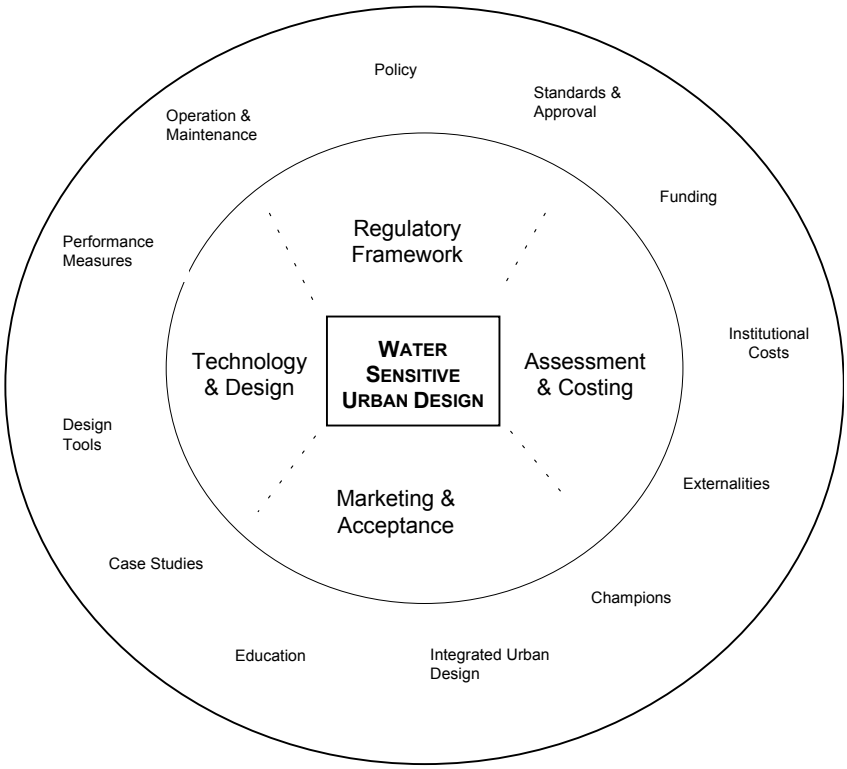
Planning Practices and Best Management Practices. These practices are discussed in a number of publications which should be referred to for further details (eg. Whelans *et al.*, 1994 and Stormwater Committee, 1999).

A national conference was held in Melbourne to highlight and explore the opportunities and perceived impediments to the widespread adoption of WSUD. This paper provides a summary of the outcomes of the conference. For further information and details of the conference presentations and discussions refer to Melbourne Water (2000) and Lloyd (2001).

# 2. EXPLORING THE ISSUES RELATED TO THE ADOPTION OF WSUD

Four major categories of issues were identified at the conference as being the most important to the advancement of WSUD practices. These categories are (i) regulatory framework, (ii) technology and design, (iii) assessment and costing, and (iv) marketing and acceptance. Key issues categorised into these four groupings are summarised in Figure 1.

*Figure1. Key Components to Successfully Integrating Water Sensitive Urban Design into Urban Development Projects*




## 2.1 REGULATORY FRAMEWORK

### 2.1.1 PERCEIVED IMPEDIMENTS

In most states of Australia, current institutional arrangements are such that the responsibility for water supply, stormwater, wastewater and groundwater management are separated within or between organizations. This fragmentation makes integrated water management more difficult. It was evident from discussion at the conference that integrated water resource management requires state and local governments to create an effective operating environment for WSUD practices.

At a strategic level, state and local government are responsible for release of land for development. Local government is generally responsible for approving development applications and usually specifies the development standards to be met. These standards are often based on rigid engineering conventions and do not

allow for an integrated approach water management. Often councils feel they lack the expertise to assess alternative designs and are reluctant to accept the inherent risk involved in approving alternative approaches.

At the conference there was a view that the skills of key stakeholders generally not being sufficient to properly assess or implement projects involving WSUD. Without established procedures, standards and approvals, councils and water authorities will struggle to assess concept designs submitted.

### 2.1.2 OPPORTUNITIES – PLANNING POLICIES AND LOCAL STANDARDS

There have been recent initiatives directed at amending the regulatory framework to facilitate the adoption of WSUD practices. Two such initiatives are changes to planning policies and local standards.

Brisbane City Council (BCC) has recently rewritten its planning policy to encourage the adoption of WSUD principles. BCC City Plan now specifies WSUD as the preferred option unless WSUD can be discounted on the grounds of safety, on-going maintenance or of being a nuisance. Implementation of this policy will require standards and approval procedures to be redrafted to include WSUD planning and treatment measures. A key issue will be the skills and capabilities of council planners and engineers for the approval of water sensitive concept designs. BCC plans to implement education and training programs for key stakeholders and to provide guidelines for assessment and approval standards to resolve these types of issues.

Attempts to control the effects of urban consolidation on catchment hydrology can be controlled by the use of local standards. One example of the use of standards is the control of the extent of effective site imperviousness by encouraging the de-coupling of impervious areas to the stormwater drainage infrastructure. This could include the use of on-site rainwater tanks, infiltration soakways, porous pavements, roof-top gardens etc. The use of standards is an effective method to control development in high risk or vulnerable areas.

Fundamental to an effective regulatory framework for WSUD is the linkage between the three levels of WSUD initiatives, ie. the local or on-site, precinct and regional levels. In Melbourne, as in most jurisdictions, there is generally not a good integration of planning between the regional and local scales. These activities are often undertaken by different authorities or agencies with quite different perspectives and approaches to urban water resource management.

Current efforts by many local councils in the majority of the States in Australia to develop and implement stormwater management plan are helping to build linkages between the strategic direction of the regional water authorities and local and precinct WSUD initiatives.

The final piece of the jigsaw in the regional/precinct/local WSUD framework is the use of local standards for development approvals. Their limitation is that such development standards usually apply to on-site or source control measures which may not necessarily be the most effective or strategic from a catchment management perspective. Often, stormwater quality measures and stormwater reuse schemes can be more effective when implemented at the precinct and regional scale. It would be preferable if developers (especially in-fill developers with limited treatment opportunities in built-up catchments) could contribute to regional and precinct WSUD schemes in-lieu of some (but not all) required on-site works. Investigation into the feasibility of a scheme for "trading" of credits or 'off-sets' for environmental management of urban stormwater is one of many efforts by Victorian local and state government departments to formulate more integrated regulatory framework for WSUD.

## 2.2 TECHNOLOGY AND DESIGN

### 2.2.1 PERCEIVED IMPEDIMENTS

There are a wide variety of stormwater management methods, which have been shown to work effectively when utilised as intended. Individual methods alone cannot be expected to meet all of the stormwater management objectives for a development and a treatment train approach is usually necessary. This approach involves the utilisation of a number of treatment methods in series or concurrently which will lead to an optimal overall performance of the treatment system facilitating a sustainable strategy which can overcome site factors that limit the effectiveness of a single measure. While the concept of a stormwater treatment train has been widely appreciated, this concept has not been implemented well in practice. Common problems have often arisen from the inappropriate utilisation of BMPs; their positioning within the treatment train; prioritisation in their implementation in a staged program and lack of maintenance.

Most technical research currently undertaken is directed at improving the hydrologic effectiveness or pollutant removal capability of stormwater treatment measures. Nevertheless there are a number of associated issues that raised concerns amongst participants at the conference and include the following:-

- Much of the information on treatment measures is scattered amongst different profession and not in forms readily accessible to specialised consultants, local council, water authorities and the general community.
- The linkage between concept and functional design of many of the BMPs and the detailed design and construction of these systems is not well established and often the intent of the functional design is poorly translated into the works on ground.
- A significant risk to the design performance of WSUD technology is poor construction practices, which can lead to high generation of sediment that can compromise the integrity of BMPs such as swales and infiltration systems.

### 2.2.2 OPPORTUNITIES

#### *Multi Disciplinary Design Teams*

In the past, many good WSUD design concepts have not been successfully translated from design intent to the final product. Harnessing the skills of a range of professions will ultimately provide cost effective and multi-objective solutions based on considerations of local site constraints. While managing stormwater using WSUD practices can provide equal levels of flood protection as conventional drainage practices, integrated stormwater management schemes offer multiple benefits including improved environmental outcomes and attractive streetscape and open space vista. The use of multi-disciplinary teams to develop concept designs promotes good integrated urban design. Figure 2 provides examples of landscaping variations in the design of swales and bio-filtration systems located within suburbs of Melbourne.

*Figure 2. Images of swale and bio-filtration systems integrated into local streetscape design around Melbourne*

### *Sediment Control to Ensure the Integrity of Best Management Practices*

The planning, adoption and enforcement of sound construction site practices for on-site control of runoff and sediment is important. A useful strategy adopted by some councils in Australia is the requirement for a construction site Environmental Management Plan (EMP) to be submitted with any development application. In the case of WSUD, the EMP will need to include consideration of construction sequencing of the various WSUD elements and strategies to protect these elements from extensive sediment loads. Controlling the construction sites is usually a local government responsibility. This applies whether an EMP is undertaken or not. Some examples of successful enforcement of planning and development controls to minimise the generation of sediment on construction sites are as follows.

In Melbourne, a local law passed by the City of Casey requires every builder to provide a rubbish container, portable toilet and adequate sediment controls on each allotment. Hydroseeding, sediment fences and hay bales were all used at the Lynbrook Estate to rapidly stabilise the construction site and protect Best Management Practices, in this case bio-filtration systems, from sediment laden runoff during the house construction phase. Failure to abide with the local laws will incur a penalty notice and fine for committing the offence. Re-offenders or those who fail to pay the fine can be prosecuted in the Magistrates Court for up to $2000. Figure 3 shows a range of these best management practices being used at Lynbrook Estate.

*Figure 3. Examples of runoff, sediment and rubbish control practice for construction sites.*


## 2.3 ASSESSMENT AND COSTING

### 2.3.1 PERCEIVED IMPEDIMENTS

Modelling tools for the selection and optimisation of potable water supply, stormwater and wastewater management are currently being addressed by research institutions such as the CSIRO, Cooperative Research Centre for Catchment Hydrology, University of Newcastle and others. Cost minimisation for the design of effective water management schemes is a major outcome of the modelling tools. Inclusion of externality costs was flagged as extremely important when assessing cost effectiveness. WSUD potentially provides a higher level of protection for the environment and quality of life for urban communities. However, externality costs are extremely difficult to calculate because no established methods exist as part of conventional infrastructure planning. While the capital cost of conventional infrastructure may be less than WSUD infrastructure the long

term environmental cost of the conventional approach are likely to be much greater.

### 2.3.2 OPPORTUNITY – SCENARIO MODELLING

The CSIRO Urban Water Program is investigating WSUD in its broadest context, integrating water supply, wastewater and stormwater management schemes to assess a range of urban design configurations that provide economic solutions based on specific site constraints and social acceptability. Scenarios such as pipe size optimisation, reduced water pressure management, peak water demand management and water harvesting and recycling options have shown enormous potential for improved cost and performance efficiency.

The Cooperative Research Centre for Catchment Hydrology is specifically working on developing a modelling toolkit that aims to optimise stormwater management schemes for quantity and quality control. The capability of these models will enable users to estimate stormwater pollutant loads from different landuses, define their impacts on the receiving waters and predict the effectiveness of stormwater Best Management Practices. These models will be integrated into a Decision Support System that will enable cost-effective solutions to stormwater management issues to be defined.

## 2.4 MARKETING AND ACCEPTANCE

### 2.4.1 PERCEIVED IMPEDIMENTS

There is undoubtedly widespread acceptance by developers that water features within urban developments help sell real estate and that 'softer' urban landscapes are key marketing advantage. Many design facets associated with WSUD promote retaining as much of the natural environment as possible and the promotion of vegetated treatment facilities (ie wetlands) with the incorporation of Best Management Practices in the streetscape and open space landscape. Additionally, many of the structural measures (ie, infiltration systems, water tanks) can also be located underground and out-of-sight. Consequently, the aesthetic values may not be realised without sufficient landscape design as well as engineering and scientific input to the design process.

Many of the water features in new urban developments may have long-term sustainability problems. For example, often there is little thought on how ponds and wetlands systems established as ornamental features in urban development can be utilised effectively to serve other beneficial functions associated with improvements to stormwater quality. As a result, some of these urban wetlands and ponds may become a long term liability to the community. Common problems encountered include:-

- accumulation of litter in some sections of water bodies;
- accumulation of oil and scum at "dead zones";
- infestation of weeds or dominance of certain species of vegetation;
- mosquito problems;
- algal blooms;
- scouring of sediment and banks.

Many of the above problems can be minimised or avoided by good engineering and scientific design principles. There are however stormwater management measures which have been designed from entirely an engineering perspective with only a cursory consideration and provision for incorporating these features into the urban landscape.

### 2.4.2 OPPORTUNITIES

#### *Integrated Urban Design*

Landscape architects through their influence on urban design, play a fundamental role in driving the changes required for WSUD in the urban landscape. Urban design is a key element in changing from conventional to a more water sensitive approach to development. Water sensitive urban landscapes can be designed to look more or less like conventional urban environments. While a more sustainable urban environment may not look the same as existing urban areas, it can and must be visually appealing and contribute positively to social amenity.

#### *Raising Community Awareness*

Conference participants indicated that the uses of water in WSUD developments influence the level of public acceptance. For example, the wider community generally accepts irrigation of open spaces using harvested

stormwater. However, there is likely to be more concern with use of recycled stormwater or wastewater at the allotment scale, especially if it involves any personal contact or consumption. The integration of stormwater Best Management Practices at the catchment and streetscape scale is likely to increase community confidence in alternative water management schemes involving stormwater or wastewater reuse.

*Figure 4. Education Boards to Raise Community Awareness*


## 3. CONCLUSION

Stormwater runoff and its environmental impact is a catchment-wide issue and requires a holistic approach to management. This holistic approach must incorporate considerations of landuse planning, social planning, urban design and landscape design in order to be sustainable and win community acceptance.

The following conclusions are made in relation to the opportunities and impediments to WSUD in Australia.

- State and local government planning authorities will need to make a firm commitment to take WSUD beyond just a policy or strategic intent and make it a condition of development through amendments to planning and regulatory instruments and relevant urban planning and design guidelines or standards.

- Communities will need to be empowered with a sense of ownership of the local stormwater assets. This will enable the assets to be cared for and managed in the hands of the community and thus not be fully reliant on recurrent funding from state or local government sources. This will only be achieved through designing urban stormwater systems to be features within the urban landscape and by promoting the inherent values of stormwater (ecological, aesthetic, recreation, education). The stormwater management systems of the 21st Century need to be understood and familiar to the local community, not "out of sight out of mind"

- There will need to be a greater embracing of the concept of "collaborative design teams" by the respective professions involved in the urban planning and design process. Breaking down traditional silos that have historically restricted or prevented true multi-disciplinary design will be essential. There is no place for the attitude "stormwater management should be left to engineers, or wetland design should be left to landscape architects". History has clearly shown that employing a single-disciplined approach to design more often than not leads to failure of the design.

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