

# THE EVOLUTION OF STORMWATER MANAGEMENT IN NEW SOUTH WALES, AUSTRALIA

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## ABSTRACT

Stormwater management in New South Wales (NSW) has undergone a significant evolution in the past five years to reduce the environmental impacts of stormwater discharges on receiving waters. Significantly, the NSW State Government injected \$A60 million to “improve urban stormwater quality”, which has been driven by the increasing community awareness of the environmental impact of stormwater discharges on receiving waters. This paper describes the evolution of local councils stormwater management practices through an analysis of the implementation of a stormwater grants program, which has resulted in a significant growth in the application of education and other non-structural controls in stormwater management, increased management abilities for improved stormwater outcomes, and improved capabilities of the Australian stormwater industry.

**KEYWORDS:** Education, source control, stormwater management, technologies.

## INTRODUCTION

Throughout North America, Europe and Australia there have been significant developments in the management of water resources to meet community health, legal, and environmental outcomes. In the case of stormwater there have been significant paradigm shifts focused on firstly removing the stormwater from the streets in the 1800s, through to removing stormwater from urban areas in concrete channels throughout the early to mid 1900s, to the control of flooding in the 1970s.

More recently during the 1980s and 1990s, there has been a rise of environmental concern to manage stormwater impacts on receiving waters. Within this new environmental paradigm there have been changing focuses on water quality, stream health and catchment management.

Stormwater management in Sydney, the largest city in the state of New South Wales and Australia, has undergone similar paradigm shifts. In Sydney, the stormwater infrastructure has developed over the past one hundred years, with large sections of the system built during public works programs in the 1930s. Under such a regime stormwater drains were constructed as conveyance systems to reduce flooding and threats to life with concrete channels and pipes replacing natural streams. As a result, much of the stormwater infrastructure that has developed has been built to limited capacity, and there is limited knowledge of the infrastructure.

At present, control of the stormwater system is primarily the responsibility of local councils (the third tier of government in Australia), with Sydney Water (the water supply and sewerage manager for the greater metropolitan area) responsible for maintaining a significant number of larger trunk drains. There are over 20,000 kilometers of stormwater drains in the city, with most of the Sydney Harbour infrastructure managed by 27 local councils around the Harbour (98% - primarily street and feeder drains).

### **Drivers for Change**

It is only since 1990 that attention has been given to the effect of stormwater discharges on the water quality or ecology of receiving environments. The change in focus to water quality outcomes has been driven by general community concern over pollution of streams, rivers, the ocean beaches and the Harbour (O'Loughlin 1994). In 1993-94, Sydney Water through its Clean Waterways Program, undertook stormwater quality monitoring to ascertain the impacts of stormwater entering receiving waters (Sydney Water 1995).

The increased knowledge of the environmental impacts of urban stormwater led to a greater understanding of the main sources of pollution to waterways around the State. In Sydney Harbour water quality is adversely influenced by both sewer overflows and stormwater, with approximately equal quantities of the nutrients, nitrogen and phosphorus, originating from sewer overflows and stormwater runoff. Effectively all litter and most of the sediment load is discharged from the stormwater drains, while most bacterial pollution is sourced from sewer overflows.

### **IMPROVING THE ENVIRONMENTAL IMPACTS OF STORMWATER**

In October 1997, in response to the need for a concerted and integrated effort to manage urban stormwater, the NSW State Government committed \$A60 million to a three-year Urban Stormwater Program to encourage and support better urban stormwater quality management practices (see <http://www.epa.nsw.gov.au/stormwater>). The Program was established to use a combination of public education, urban stormwater management planning, piloting innovation and undertaking remedial actions, with the main components of the Program including:

- ❑ Stormwater Grants Program – a three-year, three-stage program that has funded \$A51million towards 252 grants to improve the stormwater quality throughout NSW.
- ❑ Urban Stormwater Education Program - \$A5million on mass media, public relations and community, industry and school education.
- ❑ Stormwater Management Plans – funding all urban stormwater managers to prepare catchment-based stormwater management plans outlining issues and implementation strategies (\$A4million), as discussed by Brown et., al., (2001) in these proceedings.

While all components of the Program have been complementary, they have had significant outcomes in their own right. This following discussion will focus on the Grants Program which has seen the highest levels of expenditure and resulted in the most marked evolution in stormwater management.


The Stormwater Grants are a competitive grants scheme, awarded to local councils to undertake on the ground works to improve urban stormwater quality. The grants are administered by the NSW State Government Environment Protection Authority. Over the three stages of the grants, 252 grants were awarded, including 58 Stage 1 projects in 1998

(\$A13million), 86 Stage 2 projects through 1999 (\$A19million) and 108 Stage 3 projects awarded in 2000 (\$A19million).

## OVERVIEW OF THE STORMWATER GRANT PROJECTS

The grant projects have encouraged the use of a variety of approaches to address local stormwater pollution issues including community education, vocational training, construction of sediment and litter traps and wetlands for nutrient removal. Table 1 outlines a stormwater management hierarchy, with the stormwater management principles ranked in order according to a preferred stormwater management response. The first stage of the Grants focused on end-of-pipe solutions with protection and restoration, however, through the stages of the grants there has been the uptake of a ‘treatment train’ approach to more comprehensively address stormwater issues.

Table 1 – Stormwater Management Hierarchy

Stormwater Management Principles		Stormwater Response	Grant Stage		
			1	2	3
	Protection & Restoration	Management & Rehabilitation	*	*	*
	Prevention	Planning & Regulation			*
	Source Control	Education & Local Controls		*	*
	End-of-Pipe	Pollutant Traps & Wetlands	*	*	*

An overview of the grants is discussed below in terms of the stormwater management hierarchy: protection, source control and end-of-pipe stormwater treatment techniques.

### **Protection – Streambank and Environmental Rehabilitation / Restoration**

Restoration and rehabilitation projects on degraded streams improve the aesthetics of project sites and increase their amenity by returning an enhanced natural asset back to the community. The significant impact of grant projects on preventing pollution reaching waterways is enhanced by rehabilitation and restoration of streambank vegetation in 7 Stage 1, 12 Stage 2 and 35 Stage 3 projects. In the past, the replacement of natural stream systems with concrete channels and pipes to rapidly remove stormwater has come at a significant environmental cost, removing the ability of the environment to assimilate pollutants, with weed species dominating native vegetation and erosion common place.

### **Source Control – Catchment Wide Education and Cleaner Industry Auditing**

Stormwater education encompasses a range of activities including broader community education of stormwater issues through to specific industry auditing and improvements in local council activities. Education has been promoted by the NSW Government as it “increases our capacity to make informed decisions and to act effectively in addressing environmental and developmental issues” (NSW Government 1996).

Education has become the most widely adopted stormwater treatment technique funded by the Grants Scheme, being used in 15% of Stage 1, 50% of Stage 2 and 83% of Stage 3 grants. The increased emphasis on education through the grants has been in response to a greater understanding by stormwater managers of the wide range of activities which impact on

stormwater, and of the inadequacy of structural devices to influence these activities and behaviours.

### **End-of-Pipe, Pollution Prevented from Reaching Urban Waterways**

*Gross Pollution Traps.* Through the three grant rounds, 171 projects have installed 854 pollutant traps to prevent sediment, litter and organic material from entering urban waterways. These pollutant traps include 471 larger gross pollutant traps on drainage lines and 383 stormwater pits traps to remove pollutants from the stormwater system. The devices prevent over 3600 tonnes of pollutants entering waterways each year.

*Constructed Wetlands.* Constructed wetlands combine natural biological, chemical and physical treatment mechanisms for water quality improvement. The grants have constructed 14 wetlands in Stage 1, 34 in Stage 2 and 25 constructed wetlands in Stage 3 projects, complementing the removal of gross pollutants thereby addressing the spectrum of stormwater-borne pollutants entering waterways.

## **EVOLUTION OF STORMWATER MANAGEMENT THROUGHOUT THE URBAN STORMWATER PROGRAM**

Figure 1 shows the number and type of projects undertaken in each grant stage, and highlights that while the number of projects undertaking environmental rehabilitation and installing gross pollutant traps has remained at similar numbers relative to the number of grants awarded, projects employing education either as a sole treatment technique or as a component of an integrated stormwater management project have increased significantly.

Through the stages of the Grants, projects have increasingly employed more than one stormwater management technique to comprehensively address stormwater pollutants impacting on the receiving water. The first stage of stormwater grants focused on piloting innovation in the application of treatment devices. In Stage 1 only 6 of the 56 funded projects (10%) employed a second stormwater management technique to enhance the outcomes of the project.

The two subsequent grant stages have focused on stormwater management closer to source and the integration of structural and non-structural solutions for effective stormwater management. In Stage 3, 89 of the 108 funded projects (82%) employed more than one stormwater management technique.

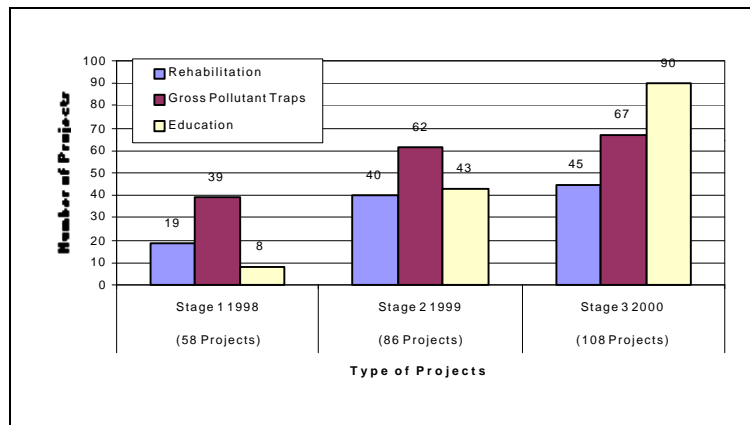


Figure 1 Type of Grants Funded through the Grants Program

By increasing the integration of stormwater techniques the Stormwater Grants are more comprehensively addressing stormwater pollution issues on a catchment basis, a practice in line with the Stormwater Management Plans, Total Catchment Management and Ecologically Sustainable Development principles.

Of particular note on the evolution of stormwater management through the grants stages, there has been a significant growth in the application of education and other non-structural controls for stormwater management, increased management abilities for improved stormwater outcomes and improved capabilities of the stormwater industry, which will be discussed in turn.

### The Evolution of Education and Other Non-structural Controls

As outlined above and shown in Figure 1, there has been a significant increase and endorsement of education as a stormwater treatment measure as an alternative to the traditional engineering base of stormwater, from 15% of projects in Stage 1 to 85% of projects in Stage 3.

The eight Stage 1 education projects adopted a variety of stormwater management techniques including auditing and community education. Beyond this most projects included some form of signage (90%), and most attracted media attention. However, activities such as these often raise people's awareness of stormwater but have limited evidence to effectively indicate a change in behaviour in relation to stormwater pollution.

The Stage 2 projects encouraged councils to address local stormwater issues close to source. As a result education featured in half of grants, with all grants having a targeted campaign of awareness raising. The outcomes of these grants have been improved through workshops on education and evaluation, and a part-time education officer to support grant recipients.

The broader adoption of education within the Stage 3 projects has led to Program's identification of the need for support for improved design and evaluation of local stormwater education activities.

The evolution of stormwater management techniques through the grants process reflected the growing understanding of and confidence in the role of education by all stormwater stakeholders, and in response to an understanding that stormwater management requires an integrated range of solutions. Specifically there was an:

- ❑ Increased understanding and acceptance in councils of the role of education in stormwater management;
- ❑ Increased understanding of the complexity of education approaches; this includes a shift towards better planned, more targeted, more complex initiatives;
- ❑ Improved skills and confidence amongst council officers managing projects;
- ❑ Increased understanding by councils of their communities (behaviours, needs, attitudes, and perceptions);
- ❑ Increased understanding by industry of the role of education and training for environmental protection and economic benefits.
- ❑ Readiness of local councils to consider a broader range of management tools. This readiness was nurtured by the Program managers that provided training, resources, media and support for stormwater protection using a diversity of approaches with industry, local council and the community; and
- ❑ A recognition by stormwater managers of the strengths and limitations of end-of-pipe devices to improve the quality of stormwater, coupled by a realisation by councils of the increasing costs of maintaining these devices.

This evolution is now leading towards a more sophisticated range of source control approaches being adopted and the subsequent evaluation of the effectiveness of each of these methods.

### **Increased Management Abilities for Improved Stormwater Outcomes**

Funding from the grants has been a catalyst for stormwater managers in raising their understanding of stormwater issues. The traditional focus on flood control is evolving to more effectively address water quality and, in some cases, ecosystem health issues, necessitating a more inter-disciplinary approach to urban stormwater management.

The survey of stormwater managers (Brown and Ryan 2000) has shown that the majority (64%) believe that the grants have improved their stormwater management skills and awareness. The grants have also shown the need for stormwater managers to address pollution comprehensively through the introduction of source control measures. The grants have introduced cooperation and sharing of data between councils at the catchment level, which is the most effective way to manage stormwater.

The stormwater grants have also increased communication within councils as a more multi-disciplinary approach has been encouraged in the implementation of their projects and their management of stormwater. The increased awareness of stormwater issues within councils has led to a growing realisation of stormwater problems by elected councillors, and has presented opportunities for councillors and State Members of NSW Parliament to raise awareness of stormwater quality issues through project launches and press releases. This has in turn lead to an increased willingness of the councils to spend money on stormwater quality improvement and remediation projects.

Table 2 has been developed as a summary of council capabilities before and during the Stormwater Program. The Table outlines a qualitative assessment of the evolution of

stormwater management ability in NSW, which shows that there has been an improvement in the capabilities of councils in the implementation of stormwater management techniques as a result of the grants.

Table 2 – Assessment of Council Capabilities Before and During the Stormwater Program

	Pre Stormwater Grants	Stage 1 1998	Stage 2 1999	Stage 3 2000
Focus	Flooding	Devices	At source	Integration
<b>Assessment of Capabilities</b>				
Drainage - conveyance	Good	Good	Good	Good
Gross Pollutant Traps	Poor	Average	Average	Good
In line Pits	Poor	Poor	Average	Average
Wetlands	Average	Average	Average	Average
Rehabilitation	Average	Average	Average	Good
Education	Poor	Poor	Poor	Average
Auditing	Poor	Average	Average	Good
Integration of Techniques	Poor	Poor	Average	Good
Evaluation	Poor	Poor	Poor	Average

### Improved Capabilities of the Stormwater Industry

The Stormwater Program has been a major catalyst for improving the capabilities of the NSW stormwater industry. The stormwater industry was benchmarked in November 1997 and it was found that most companies offered technologies with only a “broad brush” understanding of the capabilities of each device and their efficiencies in removing pollutants. Since that time there has been significant investment and a greater understanding of the appropriateness of stormwater devices to provide a more sophisticated response to specific pollutants and needs of stormwater managers.

Competition resulting from the Stormwater Program has increased the need for companies to continually improve their products in order to remain competitive. This is evidenced by major companies either introducing new devices or changing their design practices in the past three years. Further there has been a maturing of the stormwater industry with companies now providing both the equipment and follow-up maintenance required to ensure the ongoing performance of their devices. One company has doubled the number of units it offers in three years in response “to the demand from Councils for more flexibility in treating stormwater”. As a result of the Program stormwater suppliers and manufacturers now offer a range of stormwater solutions to target specific pollutants derived from differing catchment conditions.

NSW has become a showcase for stormwater companies that are offering devices on the international market, with Sydney being cited as an example of “how it should be done”. Other States in Australia are also now adopting the components of the NSW Urban Stormwater Program. One stormwater company has recently opened its sixth office in North America, breaking into the market based on the growth in Australia spearheaded by the Olympics and the Stormwater Program.

### CONCLUSION

The NSW Government provided \$51 million of funding to the three stages of the Stormwater Grant Scheme. The first round of stormwater grants focused on piloting innovation in the application of treatment devices; the two subsequent grant rounds have focused on the integration of structural and non-structural solutions for effective stormwater management. This has grown from the realisation that structural solutions alone have had limited success in addressing stormwater issues, and are typically focused on the problem and not a solution.

The projects demonstrate that the complex problem of urban stormwater quality can be tackled using a mix of innovative, integrated cost-effective solutions. The key outcomes from the projects has been the significant growth in the application of education and other non-structural controls for stormwater management, increased management abilities for improved stormwater outcomes and improved capabilities of the stormwater industry.

Future stormwater management in NSW will build on this Program, incorporating the lessons learnt and empowering local councils to integrate stormwater management throughout all their activities.

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