Alternative Water Strategies in Public Domains: Innovative Strategies in Progress along North Terrace, Adelaide

Dr David Jones
School of Architecture, Landscape Architecture & Urban Design
The University of Adelaide
Adelaide 5005
AUSTRALIA
E-mail: david.jones@adelaide.edu.au

Abstract

Water sensitive design on our urban threshold is increasingly becoming topical. In Adelaide it is being driven by stormwater management strategies and economic efficiencies in a city that is beginning to embrace its Mediterranean environment, low water sustainability, and whether our showpiece public domains in Adelaide can afford large expanses of manicured lawns.

This paper reviews four projects in progress along the North Terrace in Adelaide. The first involves a major redesign of First Creek as it traverses Adelaide Botanic Garden to address stormwater management issues. The redesign includes strategies to control flash flooding, to cleanse stream water from pollutants, and to carefully incorporate a wetland system as an integral botanical and horticultural feature of a botanic garden. Further down North Terrace, the University of Adelaide is evaluating a scenario that will totally redesign Goodman Crescent, its picture-postcard promenade lawn. The scenario is to host an integrated water retention and water purification and cleansing system that will service independently of mains water an irrigation system and a waterfall. The proposal draws upon a similar strategy recently adopted by the South Australian Museum to capture and cleanse surface and roof water but place the installation and process on display as part of its overall biodiversity museum display that will unfold over the next five years under director Tim Flannery. The fourth example, in process at present, is to devise an integrated water system that may enable the Government House grounds to remove itself from dependence upon costly mains water to totally sustain its extensive gardens and lawns.

Importantly each project has similar threads: creative water maximization and purification use, and a desire to place these 'installations' on display as public statements of their commitment to water sustainability in Adelaide. But radically, here are four prominent cultural institutions readily willing to redefine the notion and traditional visual imagery of a 'wetland' on what is the main cultural boulevard of a capital city.

1. INTRODUCTION

Increasingly the role and value of water is being recognized as a finite commodity. It contains renewable properties, can be valued in terms of its tap price to the consumer, and measured in terms of its quality, use and frequency of availability. Water is a finite resource that is treasured in the rural landscape because of its role in enabling and sustaining agricultural production. But it is a relatively unappreciated commodity in our urban areas where it is directed away from our properties down drains and watercourses engulfed in pollutants like it is a waste. The significance in Adelaide, in the last 25 years, is that it has readily been accepted as a commodity that can be purified, can enhance our park lands and can be harnessed to better improve our physical environmental systems and landscapes, but that it is a commodity that can be stored, creatively used in lieu of mains water, and can re-charge our aquifer systems. The simple policy by the City of Burnside five years ago to permit water tank storage of rain-water, and to enable internal water storage within residential allotments, has displayed a forthright ethical pronouncement of a direction for our urbanity.

Over the last 25 years Adelaide has been through two waves of exploring water creatively in urban contexts. From the early 1970s to the mid 1980s it sought, in a fragmented fashion around the metropolis, to harness and delimit flood and flash flood implications of water, and to craft park lands and linear parks to retard, store, recharge, and re-irrigate park lands. From the 1980s-2000s we have

watched the advent of urban catchment authorities to comprehensively manage water at a sub-metropolitan or regional level, and to plan the overall urban design integration of water control, retention and recharge measures. The next 'adventure' appears to be shifting to the micro-level where individual institutions and corporations are now approaching the topic in a manner that seeks to achieve all of the above aims but also reduce their operational reliance and financial dependence upon mains water while at the same time publicly displaying a green ethic to the community.

This paper reviews several of these micro-level initiatives as they relate to a suite of projects along North Terrace, Adelaide's 'Cultural Boulevard'.

1.1. The North Terrace Setting & Adelaide

North Terrace of Adelaide may seem like a most unlikely venue to explore and test creative stormwater management and harvesting strategies. It would not be considered in the public's view as being a venue capable for accommodating such functions and realising creative ways of capturing the educational values of this increasing science.

Strategically within stormwater management and harvesting approaches in Adelaide is the recognition that water retarding basins and wetlands are integral to conserving water as well as delimiting the damage caused by flash flooding that occurs at more frequent intervals given upstream suburbanisation and decrease of pervious surfaces and watercourse meanderings. A second facet has been that it is not simply an answer to 'design' a wetlands or retarding basin but that the 'design' needs to address biodiversity, aesthetic, health and safety, and educational outcomes. The first designed wetlands in Adelaide, The Paddocks complex at Para Hills, in 1971 points to the possibilities and efficiencies of wetlands being more than simply a venue to store excess water during flash floods and a home to mosquitoes.

Integral to this shift of approach has been the role of landscape architects working with environmental and hydraulic engineers in re-appraising the latter's approaches and conclusions and wrapping them into landscape designs. The Paddocks is an example of this work, as also numerous benchmarks around Adelaide including the Barkers Creek Inlet, Urrbrae Wetlands, Patawalonga retarding basins, River Torrens Linear Park, amongst others. But these examples are substantially suburban if not urban examples which can afford expanses of land and a wider landscape and design setting to integrate and craft water retarding basins into a larger park or subdivision system. Where are we going with inner city if not 'deep' city stormwater management and harvesting strategies?

In the last 5 years much of the political debate and discourse about North Terrace in Adelaide has rotated around the need to design and implement an urban renovation to this 'cultural boulevard'. The political diversions have centred upon the classic debate about Plane Trees (*Platanus orientalis*) versus Spotted Gums (*Corymbia maculata*) or Eucalypts in general. Behind this debate is several innovative unfolding tales. Synergistically, most of the cultural institutions along the 'boulevard' have been going through a self-renewal process of recharting their servicing roles, their position and relationship to science, the arts, knowledge and the community. Paramount has been need to be seen relevant and challenging, but also to 'tear down conventional barriers' to make such venues more accessible and thereby more respected and in demand by the wider community. The Adelaide Botanic Gardens, the Royal Adelaide Hospital, the University of Adelaide, the Art Gallery of South Australia, the State Library of South Australia, Government House, and Parliament House are all participating in this renewal consciously or unconsciously led by their endorsement of the North Terrace Urban Design Scheme, and an acceptance of their position in greater Adelaide, while at the same time the City of Adelaide Council has been recharting the meaning and significance of the Adelaide Park Lands.

One of these innovative unfolding tales is water; stormwater management and harvesting. In an increasingly water sensitive environment, perpetuated by the epithet the 'driest city in the driest state on the driest inhabited continent', each institution has embarked upon a questioning of its water use, and in particular how to capture water, harvest it, store it, recycle it, rechart its role educationally, and to tangibly portray an ethical concern to the sustainability of the resource while at the same time trying to reduce their dependence upon mains water which in a increasingly user pays system is a expensive overhead for their operations.

2. NORTH TERRACE PROJECTS

2.1. Adelaide Botanic Garden

The Board of the Botanic Gardens of Adelaide is presently preparing a Master Plan for its Adelaide and Mt Lofty Botanic Gardens. The former Garden was established in 1854 Under superintendent George Francis. In the following years Francis, and prominent Garden directors Schomburgk and Lothian have all struggled with harnessing and delimiting the possibilities and damage that First Creek and Botanic Creek have upon the Gardens. While the Garden appears as a Victorian gardenesque delight, underneath it harbours a network of creeks, ponds and underground channels that have erratically been designed and constructed to delimit water damage to the plant collections rather than provide aesthetic features.

The Garden is susceptible to flash flood damage from both Creeks and has historically never been able to resolve the flooding risk to its living collections. As part of the Master Plan process the Board commissioned a Conservation Study (Aitken *et al* 2004), a review of water systems (Byrne 2003; Ecological Engineering 2004a), *inter alia*, to inform and guide the development of a master plan (Taylor Cullity Lethlean 2004).

The Conservation Study qualified the historical dilemma that has faced the Garden in terms of its siting on the two water corridors. The dilemma possesses historical, engineering, living collection, social and cultural implications as also values. But also clear was the understanding that irregular flooding was a way of life in the Garden and that the consequent problem was silt and sedimentation transferral and contaminant and pollutant transferral and dispersal that resulted in the real damage to living collections and the Garden's infrastructure rather than simply the water.

The water systems study (Ecological Engineering 2003a) sought to research peak flow management of water, to consider stormwater capture and reuse options, and to propose creative options that may enhance the Garden aesthetically, visually and botanically in terms of its living collections. First Creek and Botanic Creek have catchments of 19 km² and 3 km² respectively. The former has an estimated culvert capacity to the 20 year average recurrence interval (ARI) with an estimated peak discharge of 22.3 m³/s , and a diversion capacity of 3 m³/s for the latter, before either overflow and disperse water over surfaces and into overflow channels and underground pipes.

Flash floods and excessive water flows naturally force flooding situations and flooding can occur haphazardly in both winter and summer seasons. Such flows result in multiple overflows and associated property flooding, deposition of litter and debris, scouring of banks and deposition of sediments, and public risk to water velocity along watercourses and edges.

The water systems study has proposed two scenarios to address these problems.

In First Creek, it was perceived that the construction of a water-retarding basin could reduce peak flows and their impacts in excess of 1.5 year ARI discharges given the physical constraints of the available land. This scenario proposed a coarse sediment vegetated basin with a capacity of 80,000 m³ required between 2-3 ha, in addition to gross pollutant traps, a wetland treatment system and a small shallow open water body. The creative design scenario proposed that it become a perennial water plant and tree display venue and ecosystem, representative of the Adelaide Plains but to afford a closer appreciation of the Plain's biological systems.

In Botanic Creek, a highly urbanised catchment, it was noted that road embankments upstream through the eastern Adelaide Park Lands constrained true projections and modelling assessments prolonging continual high water movement into the Gardens rather enabling slow release of excessive water mass. One key answer was therefore rethinking the upstream water retarding basins and watercourse through the Park Lands upstream of Wakefield (7,000 m³) and Rundle Roads (8,000 m³). A second was in enabling efficient water flow through the Garden and Main Lake but in a manner that minimizes disturbance to living collections and infrastructure in the Garden and damage to adjacent properties. The latter included a 16 m wide grassed trapezoidal channel and embankment on the western flank of the Garden enabling the Main Lake to overflow into this channel and for it to

accommodate meandering low flows. A third answer lay in renovating the Main Lake outlet configuration including outlet pits and trash racks.

On average the Garden uses approximately 120 ML of water per year and it is almost exclusively distributed as irrigation. Scenarios for water harvesting included harvesting stormwater, use of reclaimed water captured elsewhere, extracting groundwater, or continuing to use mains water. Modelling has demonstrated that a storage of approximately 17 ML would be required to enable a 80-90% reliability service

The study proposed the adoption of a multi-action strategy on both Creek corridors with the renovation of First Creek and the creation of a water-retarding basin and the creation of a water channel through the proposed 'Western Entrance' to the Garden as priorities. Both recommendations, together with minor recommendations are being woven into the Master Plan without compromising the conclusions and recommendations of the Landscape Conservation Study.

2.2. University of Adelaide – Goodman Crescent

The University of Adelaide has a significant historical and visual presence on North Terrace. Barricaded behind its stone Victoriana fencing, its hosts the key features of a Chancellery, Elder Conservatorium, and Bonython Hall set within an expansive lawned open space – called Goodman Crescent – in dispersed with statues and a prominent Moreton Bay Fig (*Ficus macrophylla*).

Historically the Crescent hosted a crushed gravel surface before progressively an open lawn planted extensively with palms, cycads, and Victorian architectural-plants was established together with an informal car circulation system. In the late 1920s this character was reinvented into a northern Italian lawn piazza with statues, lawn, a bituminised circular roadway, and strong plantings of typical 1930s semi-Mediterranean Adelaide trees comprising Italian Poplars (*Populus nigra* 'Italica') and Sweet Pittosporum (*Pittosporum undulatum*).

As part of the North Terrace Urban Design scheme the University recognised the need to renovate and integrate its front lawns as part of the overall project and commissioned Taylor, Cullity, Lethlean to prepare a design for the Goodman Crescent Lawns precinct.

The proposal, adopted by the Chancellery recently, proposes the creation of two garden spaces within the existing Goodman Crescent footprint. The main space, symmetrically aligned to the front door of Elder Conservatory, will reinforce the sense of formality and strength of the University, and will be re-designed as a formal *allée* space encompassed by Jacaranda (*Jacaranda mimisofolia*) trees and a re-positioned Thomas Elder statue that will better frame this newly crafted space. Underneath this space will be positioned two large water storage tanks similar to the design proposed in the South Australian Museum project, that will be used to store water gained from the surface catchment of Goodman Crescent as well as the majority of roof catchments of the adjacent Mitchell, Elder and Bonython buildings. The water, pre-filtered and cleansed, will be used to irrigate the lawns of Goodman Crescent as well as the major waterfall feature in the Wills Court immediately down-hill of Goodman Crescent.

On the western flank will be created a new rectangular garden space that is intensive in its spatial configuration, rich in the lower storey plants being used, and will include a water filtration wetlands. It will enable ready movement by people, will be in the shade in excess of 40% of the day, will preserve an aging English Elm (*Ulmus procera*) and the original well for Mitchell Building, and will enable smaller semi-formal seating areas within the larger Goodman Crescent.

The University is moving on implementing this project over the 2004-2006 financial years.

2.3. South Australian Museum

The forecourt of the South Australian Museum provides a major nondescript entrance to the Museum from North Terrace. It presently possesses no cultural relevance to the Museum's role less hosting an

expansive undulating heavily watered and used lawn, several elderly Date Palms (*Phoenix dactyifera*), a fossilled tree feature, and the Bonython Fountain.

Historically the forecourt has been generally an open expanse dotted with palms and cycads in a gravelled undulating space. In the 1920s the space was renovated into its present form with the transferral of Date Palms (*Phoenix dactyifera*) from Marree, the installation of the features, and the creation of the undulating lawn.

In 2003 Ecological Engineering (2003b) were commissioned by Taylor Cullity Lethlean in consultation with the Museum to consider options for stormwater capture, treatment and cleansing, but more importantly to display in a strong interpretive sense the biodiversity and educational possibilities of stormwater collection and harvesting. Thus water science being brought to the front of a Museum environment in an interactive three-dimensional display.

The study identified the potential to harvest stormwater from the roofs, roads and pavements within and adjacent to the Museum buildings, on North Terrace, and proposed a designed stormwater reuse system to be topped up with potable mains water during long dry periods.

The intention being to maximise stormwater use, while providing a 70-90% reliable supply to the bio-retention structures. Re-use of the water was proposed for lawn areas, perimeter trees, seedling nurseries, and for display planting beds. An estimated demand of 590,000 litres per year assuming 0.5 ML/year monthly water demand for lawn areas and 0.2 ML/year monthly demand for display and seedling plants.

Source areas were assessed as 2,500 m² for roads and footpaths, and 1,800 m² for surrounding roofs assuming 75% and 100% impermeability respectively.

The study applied a Model for Urban Stormwater Improvement Conceptualisation (MUSIC) to estimate storage volumes required, computing irrigation demands, catchment areas and Adelaide seasonal rainfall patterns for the 1970-80 period. This model concluded that a storage facility of 150KL m³ was necessary to enable irrigation functions at approximately 65% reliability with an expected mean annual replacement of 460,000 litres of mains water.

The study thereupon proposed the installation of an integrated stormwater harvesting system that including a formally-structured bio-retention wetlands on approximately 25 m² of the forecourt with undergrounds storage tank. The bio-retention wetlands, or filtration trenches, would enable sifting of fine particles and pollutants, extended detention and some biological uptake of contaminants. A fine media layer of 500 mm sandy loam over a 200 mm coarse sand layer covered by an average 300 mm of water would facilitate the runoff filtration, and vegetation would grow in the media to enable soil disintegration, promoting growth of biofilms on plant roots, and minimising erosion of the filter system. But instead of the bio-retention system being organic in shape and design, or linear as in road medians and planter boxes, the system was proposed to be shaped in linear parallel swales to heighten design attractiveness and the educational creativity that may be derived from the facility. In contrast, MUSIC used realised a scenario that an overall 35-40 m² was necessary to accommodate a vegetated wetlands, 5 m² for the inlet pond with the need for a 300 mm deep permanent water source, in contrast to a bio-retention system. Both systems were feasible but the bio-retention system costed less.

2.4. Government House Domain

The Government House Domain comprises 5.6ha of gardenesque landscape hosting the state's Government House together with associated cottages and infrastructure. The House has a long cultural and symbolic association with North Terrace, and provides an important visual feature along the 'cultural boulevard'.

Historically the House has been managed by the state Governor through the Premier's Department, with the care and management of the Grounds being the prerogative of the respective state Governor and family often with the guidance of the director of the Adelaide Botanic Gardens. Since 1997 the Grounds have been managed by SA Parks & Gardens, an independent contractor. With this change it

increasing became evident that no management plan or co-ordinated strategy had been formulated for the Grounds and that its care, watering, and long-term character was being compromised. This is despite various interventions and recommendations by directors and staff of the Adelaide Botanic Gardens, the *Government House Adelaide Conservation Study* (1986) that addressed the House and not the Grounds and its outbuildings, and that that the Grounds hosted over 20,000 visitors a year associated with public and ceremonial activities at the House.

As part of this recognition the House and Grounds Committee commissioned a *Landscape Conservation Study* (Jones 2004), to qualify the cultural significance of the place, and a *Landscape Master Plan* (Fifth Creek Studio 2004), to guide the future planting design and management of the Grounds. In both reports, water, senescent vegetation, jumbled planting agendas, and progressive excisions raised key implications for the Grounds. The *Landscape Conservation Study* quantified a strong extant 1920s-1940s Mediterranean upper storey that characterised the Grounds, was complementary to the geology and soils of the location, and needed low water supply levels, as being a significant layer within the historical structure of the Grounds.

Additionally, the House recognised that it needed to rationalise its management costs associated with the Grounds; that the House was now increasingly accountable for the costs of maintenance and infrastructure and utility services. A key element within this was water. While watering the gardens and Grounds of the Domain was seen as essential as ensuring the green atmosphere and character of the Domain, and ensuring continued healthy growth of its plants and trees, the increasing costs of mains water supply that the House now had to pay was seen as a hindrance.

The Landscape Master Plan grappled with these key aspects and has recommended the adoption of a planting renovation strategy that maintains the Victorian accent-planting pattern but increasingly enables the transferral of the gardens towards a 1920s-1940s Adelaide Mediterranean planting style. This style is reflected in the extant Dragons Blood Trees (*Dracena draco*), Jacaranda (*Jacaranda mimosifolia*), Kurrajongs (*Brachychiton populneus*) and Illawarra Flame Trees (*B acerifolius*), Claret (*Fraxinus oxcarpa* 'Raywoodii') and European Ash (*Fraxinus excelsior*) specimens and mass plantings of low water user ground covers. Secondly, it also proposed an integrated stormwater harvesting system to enable the surface water within the Domain to be harvested, cleansed, and to be recycled back onto the gardens and lawns thereby reducing the dependence of the Grounds upon mains water supply.

The former strategy applies a smart low watering planting design strategy that reinforces part of the previously unrecognised historical character of the Grounds, and the latter seeks to position the Domain within an environmental ethic that seeks to achieve environmental sustainable outcomes in water management and garden management.

The environmental sustainability policies seek to address water harvesting, irrigation and organic waste in a creative manner. Water is proposed to be harvested from the roof catchment of the House for reuse. The stormwater catchment of the Grounds and roadways will be shifted into bio-retention systems and then to an underground storage facility for reuse, and also seeks to address polluted surface water from the North Terrace footpath / plaza catchment for reuse within this system. The irrigation strategy seeks the use of subsoil irrigation instead of above ground sprinklers thereby saving a projected 38% of water use, and a rationalisation of the irrigation network within the Grounds. The organic waste strategy seeks to provision of space for chipping storage ready for composting, composting on site including mulching. Currently stormwater exits directly into the local stormwater system and thence into the River Torrens untreated and unharvested, the Domain uses mains water and odes not store water on site, and the all garden waste is carted from the site and new mulch and compost transported onto the Domain.

The House and Grounds Committee has considered and adopted the findings and recommendations of the *Landscape Conservation Study* (Jones 2004) and *Landscape Master Plan* (Fifth Creek Studio 2004) and is currently seeking Treasury and Catchment Board funding support to implement, in addition to the normal gardening and planting activities, the stormwater harvesting strategy.

3. DIRECTIONS

These series of examples relate state-of-art examples about to be constructed in Adelaide and all are positioned within the inner city environment.

The key points to recognise from these examples are that:

- it is possible to creatively cleanse, store and recycle water within individual urban allotments whether the owner is institutional or private;
- wetlands, or the way we interpret a conventional 'wetland', should not be constrained by conventional designs that are organic and expansive in configuration, and that rectilinear and 'post-modernist' stylistic forms are possible if not conducive to the architectural or urban design setting they are being located within;
- water can be stored on site in urban contexts and should not be constrained by conventional thought about above ground water-tanks when underground and on-roof options also exist;
- initiatives in urban areas are often now being driven by economic imperatives to reduce operating costs, and that we should use this imperative to advance the furtherance of even more creative ways of designing micro-integrated stormwater and harvesting systems.

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