

CANBERRA INTEGRATED URBAN WATERWAYS PROJECT

FINAL REPORT

wetlands for our suburbs





For More Information please contact:

Jennie Gilles

Manager

Urban Waterways Program

Environment and Sustainable Development Directorate

ACT Government

Email: jennie.gilles@act.gov.au

Phone: 02 6207 2141

Website: www.environment.act.gov.au

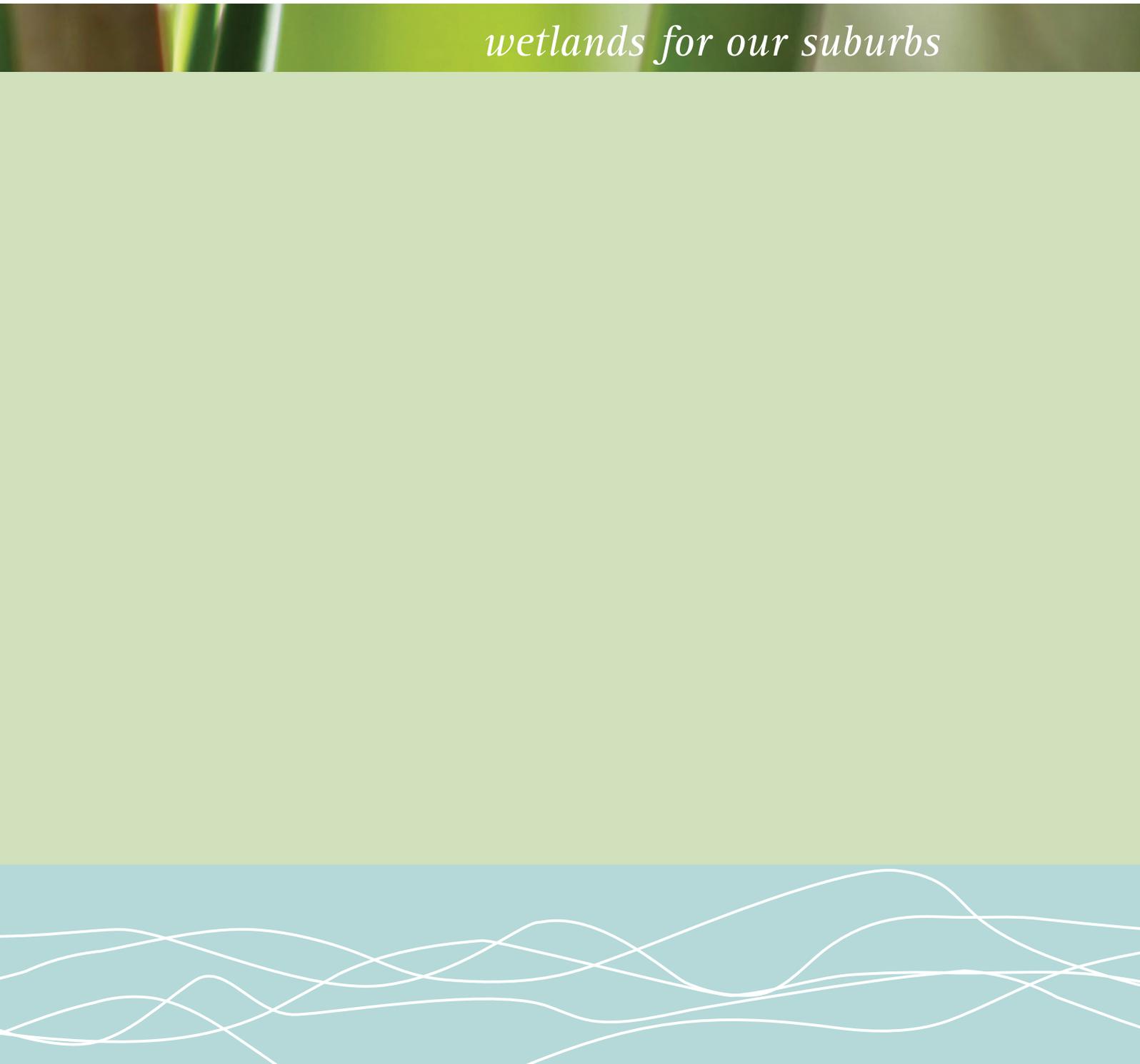
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CANBERRA INTEGRATED URBAN WATERWAYS PROJECT

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wetlands for our suburbs





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EXECUTIVE SUMMARY

The Canberra Integrated Urban Waterways Project (CIUWP) was jointly funded by the Australian and ACT governments in 2007 under the Australian Government's Water Smart Australia Program. The Water Smart Australia Program aimed to accelerate the development and uptake of smart technologies and practice in water use across Australia.

The funding agreement saw the joint commitment of \$17 million by both governments (\$10.2 million in Australian Government funding and \$6.8 million from the ACT Government) to deliver a range of stormwater harvesting options in urban Canberra to provide a reliable source of non potable water to irrigators. Beyond the substitution of potable water, CIUWP aimed to develop and implement integrated waterway management plans for Sullivans, Yarralumla, Weston and Ginninderra creek catchment areas. Overall, the CIUWP established the goal of saving up to 1.5 gigalitres (GL) by 2011 and up to 3 GL by 2015 of drinking water by substituting potable water with stormwater for irrigating parks and gardens.



GL (Gigalitre) = one billion litres

The CIUWP formed part of a larger ACT Government project to extend stormwater capture and reuse and enhance urban waterways across Canberra. Key outcomes from the project include:

- an urban waterways management master plan for ongoing implementation
- demonstrated techniques for achieving Water Sensitive Urban Design in established urban areas
- improved health of urban lakes and the Molonglo and Murrumbidgee rivers by reducing solids, nitrogen and phosphorus entering the system
- construction of the Flemington Ponds as a component of the stormwater management system for North Canberra
- construction of the Inner North Reticulation Network
- design of the Weston Creek and Tuggeranong stormwater reticulation networks
- strong levels of community interest, involvement and ownership in the landscaping and ongoing maintenance of stormwater ponds
- the use of the stormwater ponds as community education and recreation facilities
- the review of the regulatory framework to enable larger-scale stormwater harvesting.

The delivery of potable water substitution targets will be an ongoing program; however, significant environmental and social benefits to the ACT are beginning to be seen from the construction of wetlands within the Sullivans Creek Catchment. Trapping nutrients in urban stormwater and slowing the creek's flow into waterways will contribute to managing the cause of algal blooms in Lake Burley Griffin and provide wider catchment and waterway benefits. The ponds and wetlands have increased urban aquatic and terrestrial habitat and, importantly, are providing enhanced recreational, educational and volunteering experiences for the community. The wetlands have proved highly popular with local residents, schools and visiting educational groups, with strong levels of community participation in their landscaping and maintenance.

The success of the program has been proven with a Keep Australia Beautiful Award to the ACT Government in 2010 for its work with the community in landscaping the Banksia Street Wetland in O'Connor. The inner north wetlands and stormwater harvesting system won the 2012 Australian Institute of Landscape Architect's Land Management Award.

PROJECT CONTEXT

The management and protection of the ACT's water resources is one of the most important priorities for the ACT Government, recognising that Canberra's continued health and prosperity depends on the sustainable management of its water resources. The ACT Government has implemented its *Think water, act water* strategy, which aims to improve water use efficiency, reduce water quality impacts, enhance ecological values in urban waterways, enhance recreational and amenity value, and reduce water supply and management costs. A number of *Think water, act water* outcomes complement and support the CIUWP including:

- reducing mains water usage per capita through water efficiency, sustainable water recycling and use of stormwater and rainwater
- minimising the level of nutrients and sediments entering ACT waterways
- reducing the peak flow and volume of urban stormwater flows to manage the impacts of urban development.

Two supporting strategies complement *Think water, act water*:

- *Where will we play* commits the ACT Government to developing and implementing a sportsground master plan focused on reducing sole reliance on potable water to assist in drought-proofing sporting operations across the city.
- *The Urban Waterways Code* is a regulation under the Territory Plan that sets water quality targets for catchments in the ACT by reducing reliance on the potable water supply system, optimising opportunities for stormwater use and wastewater (treated effluent and greywater) reuse, and reducing the export of stormwater runoff and associated pollutants to pre-development levels.

In 2008, the ACT Government entered into a Parliamentary Agreement with the ACT Greens that established joint goals for delivering a sustainable city. Water sustainability initiatives are a key element of the agreement, including acceleration of a program for replacing stormwater drains within urban creek and wetland systems.

PROJECT AIMS

CIUWP was announced by the Australian and ACT governments in November 2006, with a funding deed signed in March 2007.

CIUWP had a number of aims:

- identifying least-cost stormwater harvesting options that would provide a reliable source of non-potable water to irrigators in urban Canberra
- saving of up to 1.5 GL of drinking water by 2011 and up to 3 GL by 2015 by substituting potable water with stormwater for irrigating parks and gardens
- improving water quality for the Molonglo and Murrumbidgee rivers and the ACT's lakes and urban waterways through the development of integrated waterway management master plans for stormwater capture and reuse, treated effluent recycling and distribution, aquifer storage potential, water quality management and drainage and flood management
- contributing to improving stormwater retardation and flood protection
- rehabilitating wetland habitats and recreational areas, including the construction of the Flemington Ponds
- enhancing urban biodiversity and landscape amenity.



PROJECT ACHIEVEMENTS

The project has delivered a number of key outputs that will work to meet the overall target of substituting up to 3 GL of potable water by 2015:

- Feasibility Study Phase 1 – *Canberra Integrated Urban Waterways – Feasibility Final Report*
- Feasibility Study Phase 2 – Design of three pilot stormwater harvesting projects located in the Inner North, Weston Creek and Tuggeranong
- design and construction of the Flemington Ponds, Mitchell
- construction of the Inner North Reticulation Network
- construction of the Banksia Street Wetland, O'Connor.

FEASIBILITY STUDY PHASE 1

In April 2007, CSIRO was commissioned to undertake a feasibility study that would examine a range of stormwater harvesting and irrigation options from existing lakes and ponds, new ponds, and new ponds where stormwater was combined with water stored in aquifers or reclaimed water.

The study's overall objective was to assess the feasibility of achieving up to 3 GL per year water saving target by 2015. The final report provided detailed analysis of key underpinning data such as:

- the location and volumes of stormwater available for harvesting, with consideration of the various harvesting options (new ponds, existing ponds and lakes, and managed aquifer recharge or MAR) and possible mixing of stormwater with locally treated wastewater obtained through sewer mining
- alternative sources of available water such as roof water (i.e. rainwater tanks) and grey water (i.e. laundry and bathroom water from residential developments) and recycled water and mixing these water streams with stormwater
- identification of potential end users of stormwater
- an evaluation of stormwater harvesting options that have the potential to achieve up to 3 GL per year of potable water savings within a triple bottom line framework
- an economic analysis of the costs and benefits of a portfolio of options
- integrated physical water system modelling to understand water and contaminant balance aspects of supply/demand options
- a portfolio of supply/demand using the analysis of potential harvesting options and stormwater users

- an evaluation of social acceptance of water reuse options
- an evaluation of the detailed engineering study of Sullivans Creek Catchment to identify options for immediate action to trap, store, harvest and reuse stormwater.

Consistent with the ACT Government's broader water policy context, the study area covered the entire urban area of the ACT rather than just the four sub-catchments (Sullivans Creek, Yarralumla Creek, Weston Creek and Ginninderra Creek) identified in the funding deed.

The study resulted in master plans that identified sites for stormwater harvesting that adopted least-cost planning principles and took into account social and environmental considerations. In particular, two master plans (B and C) are the key results of the study. The master plans identify the project sites for ponds in the ACT that could accommodate least cost stormwater harvesting.

The feasibility study can be found at:

<http://www.csiro.au/Portals/Publications/Research--Reports/Canberra-Integrated-Waterways-Final.aspx>

FEASIBILITY STUDY PHASE 2 – DEVELOPMENT OF PILOT PROJECTS

The completion of the first phase of the CSIRO study formed the basis of phase 2 of the feasibility study, which resulted in the identification of three pilot stormwater harvesting capital works projects that would move towards meeting the potable water substitution targets. Capital works were to be designed to meet other key objectives such as enhanced water quality protection and ecological resilience for ACT rivers and receiving water bodies.

Three pilot stormwater harvesting and reticulation projects were identified for feasibility, detailed design and construction – Inner North Canberra, Weston Creek and Tuggeranong.

Key factors that were considered in the selection of these pilot projects included:

- the preliminary feasibility and design work undertaken
- avoiding areas close to possible future connections for recycled water pumped from the treatment plant at Lower Molonglo (such as Belconnen)
- value-adding to existing lakes and ponds, for example reticulating from Lake Tuggeranong
- value-adding to the land release program, for example the construction of the North Weston Pond
- the location of priority end users such as highly used sportsgrounds
- cost estimates (levelised cost of water per kilolitre)
- any environmental impacts of drawdown.

The three projects were funded by the ACT Government beyond its commitments under the funding agreement and were intended to supply up to 1.5 GL of non-potable water per year by 2011. The water collected in these ponds, wetlands and associated structures would contribute significantly to supplying up to 3 GL per year of substituted water by 2015. The design and implementation of each reticulation project included an evaluation of its operation after five years to assess costs, volumetric reliability and other management and operational issues to support consideration of further expansion of the network.

Construction stages were identified for the networks based on funding availability and prioritisation of end-user sites. The networks have been designed to enable all irrigators to access water if available, and the systems can be readily retrofitted to include additional lines to future end users.

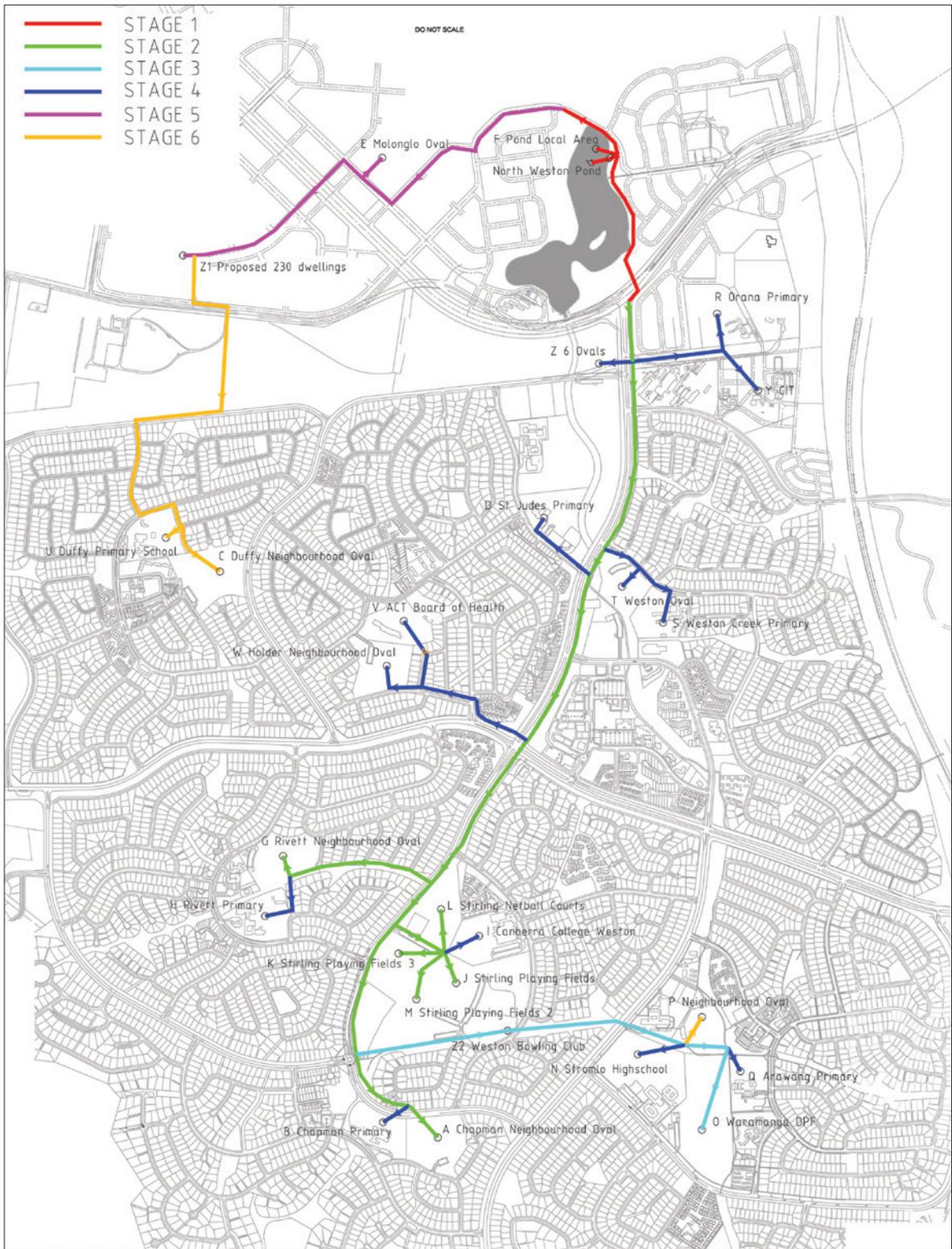
INNER NORTH STORMWATER RETICULATION NETWORK

The Inner North Stormwater Reticulation Network was designed as part of the CIUWP with construction expected to be completed by mid-2013. Once the network is commissioned, its efficacy will be tested and used to determine whether the Tuggeranong and Weston Creek networks should proceed.

WESTON CREEK STORMWATER RETICULATION NETWORK

The Weston Creek pilot project was identified to add value to the construction of the North Weston stormwater retention pond being constructed as part of the release of land in Molonglo, south of the City. The North Weston Pond will perform an important pollution control function in protecting the Molonglo River from urban stormwater flows. In the 2009–10 Budget, the ACT Government separately funded reticulation from the North Weston Pond to high priority sportsgrounds; a move that would contribute to delivering on the overall potable water substitution target.

Preliminary design is completed and the final design is underway. The preliminary design of the reticulation networks identifies several stages for construction including approximately 45 hectares of irrigated assets, equivalent to substituting 225 megalitres (ML) of potable water.



Schematic of the Weston Creek Stormwater Reticulation Network

TUGGERANONG STORMWATER RETICULATION NETWORK

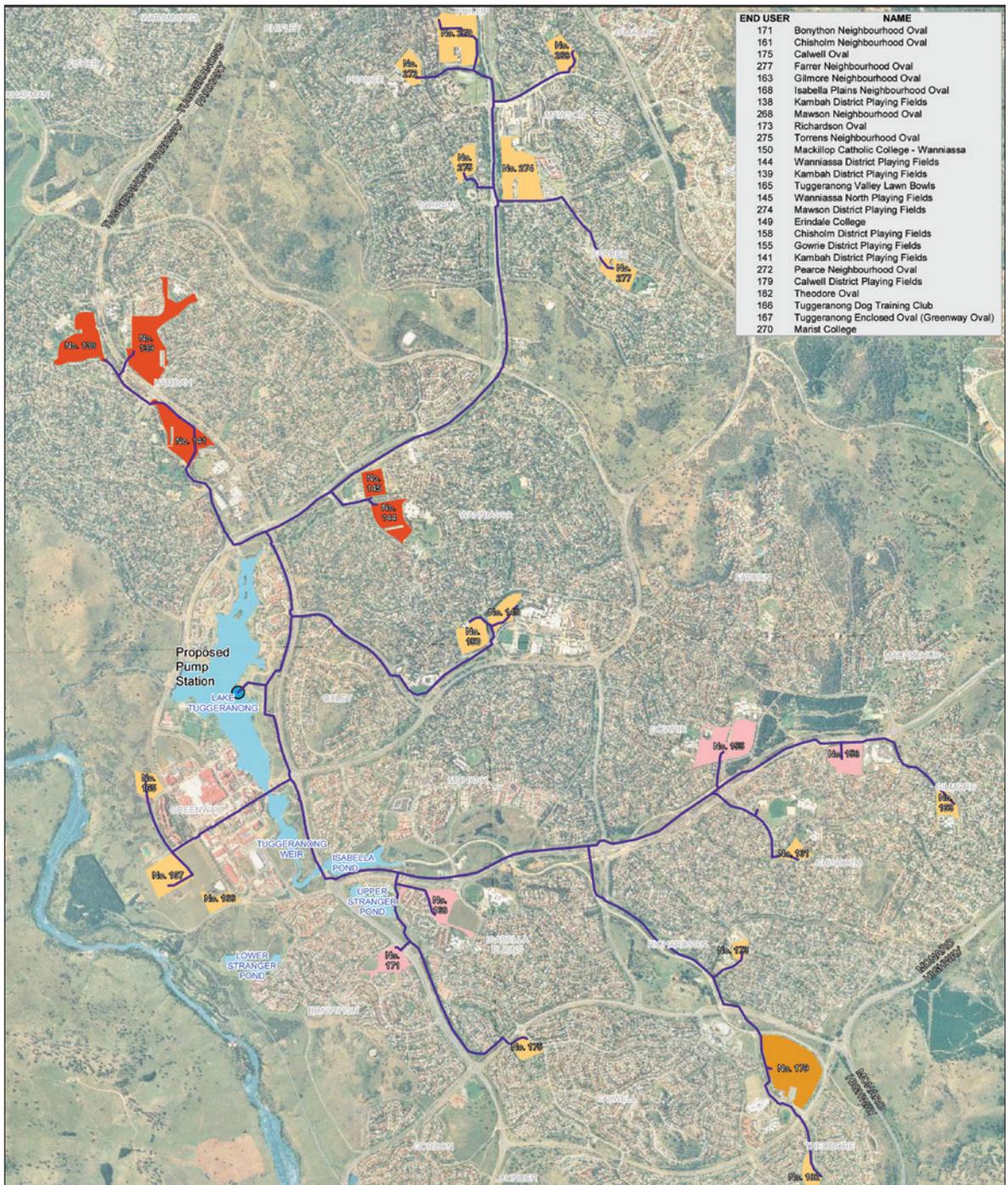
The Tuggeranong Stormwater Reticulation Network was identified by the Economic Development Directorate (Sport and Recreation Services) as an opportunity to replace potable water with non-potable stormwater from Lake Tuggeranong for high priority sportsgrounds. Tuggeranong's distance from the Lower Molonglo treatment plant makes the reticulation of recycled water to the area costly. Stormwater reuse was considered a more cost-effective alternative source of substitutable water given the existing lake infrastructure would not require further pond construction to capture water. The ACT Government funded reticulation from the pond to high priority sportsgrounds in the 2008–09 Budget; a move that would contribute to meeting the potable water substitution target.

The preliminary design of the Tuggeranong network identified several stages for construction, including approximately 90 hectares of irrigated assets which would substitute around 450 ML of water.

FLEMINGTON PONDS, MITCHELL

The Water Smart Australia Program directly funded the design and construction of the Flemington Road Ponds. The first pond was constructed in 2008 on the corner of Morrisett and Flemington Roads, Mitchell, and the second pond was constructed in 2009 on the corner of Randwick and Flemington Roads, Mitchell. These ponds provided stormwater quality improvements in the Sullivans Creek Catchment and play a major storage role in the Inner North Stormwater Reticulation Network.





Schematic of Tuggeranong Stormwater Retention Network



Drilling at Flemington Road Pond

INNER NORTH STORMWATER RETICULATION NETWORK

Development/construction of the Inner North Stormwater Reticulation Network was specified in the 2007 funding deed. It was selected because significant studies had identified a high value opportunity for ponds and stormwater harvesting in the Sullivans Creek Catchment.

The network was developed following a 2003 feasibility study of the Sullivans Creek Catchment that identified 25 potential pond sites in the catchment. The study found that construction of four key ponds would improve the water quality of Sullivans Creek by 70% of the total possible improvement that all 25 ponds could achieve. Those four ponds were:

- Flemington Road Ponds, Mitchell
- Dickson Pond at Hawdon Street,
- Lyneham Ponds at Goodwin Street (two ponds).

As mentioned above, the first and second Mitchell ponds were constructed in 2008 and 2009 respectively. The design and construction of the Dickson and Lyneham ponds was funded by the ACT Government in its 2009–10 Budget and were completed over 2011–12. The construction of these ponds enabled significantly larger volumes of stormwater to be captured for the network, ensuring irrigation demand for the area could be met. The inclusion of these ponds in the stormwater harvesting network has increased the cost-effectiveness of the overall network.

The network includes a transfer main from Lyneham Pond to Flemington Pond. Stormwater from Lyneham Pond will be transferred to Flemington Pond for storage, treatment and distribution to end users. The project will also trial managed aquifer recharge. This involves injecting stormwater into a bore at Exhibition Park in Canberra (EPIC), storing the water and retrieving it when required in the peak irrigation season.

With stage 1 of the network scheduled for completion by mid-2013, up to 0.5 GL (500 ML) of non-potable water will be available to high priority end users that include both public and private organisations with irrigation needs; for example, a golf course, cemetery, crematorium, winery, school playing fields, public sportsgrounds, sporting facilities, EPIC and Thoroughbred Park.



Schematic of the Inner North Stormwater Reticulation Network



Dickson Pond – May 2011



Dickson Pond – May 2011 members of the Design and Construction Team

Dickson Pond – Community Planting Day June 2011



PROJECT FUNDING

CIUWP was jointly funded by the Australian and ACT governments under a 2007 deed of agreement to a total of \$17 million; \$6.8m in ACT Government funding and \$10.2m contributed by the Australian Government.

The dovetailing of this project with broader ACT Government policies and programs (see 'Project context' above) saw a broader funding commitment and investment by the ACT Government in water use minimisation, potable water substitution (fit-for-purpose water use) and improving water quality to a total of \$38.87 million on top of the Australian Government's \$10.2m contribution.

Over the five years of CIUWP from 2007, the additional ACT Government funding has provided for:

- the design and construction of The Valley Ponds in Gungahlin. These wetlands will improve the quality of urban stormwater entering the Ginninderra Creek Catchment with stormwater to be delivered to tanks on the adjacent enclosed oval and to top up the Gungahlin College pond. Stormwater from the school pond is used to irrigate the school grounds and the town park
- the design and construction of urban ponds in Hawdon Street, Dickson and Goodwin Street, Lyneham (supplying stormwater to the Inner North Reticulation Network). These wetlands: improve the stormwater discharged via the Dickson channel and help reduce nutrients and sediment entering Lake Burley Griffin; provide urban habitat and enhanced urban amenity; and deliver stormwater for irrigation
- the design of the Weston Creek Reticulation Network
- the design of the Tuggeranong Reticulation Network (funded under the '*Where Will We Play?*' initiative).

PROJECT BUDGET

A total of \$51.37 million (including in-kind contributions) has been spent on CIUWP under both the Australian Government/ACT Government funding agreement and in additional allocations by the ACT Government.

Expenditure is outlined in the following tables

EXPENDITURE UNDER THE DEED OF AGREEMENT

EXPENDITURE ITEM	AUSTRALIAN GOVERNMENT FUNDING \$M	ACT CONTRIBUTIONS \$M	IN-KIND ACT CONTRIBUTION \$M	TOTAL \$M
Project Management Team	0.9	0.5	1.4	2.8
Feasibility Study – Phase 1 CSIRO	0.4	0	0.2	0.6
Feasibility Study – Phase 2 Design	1.5	3.68	0.2	5.38
Design/Construction	7.4	34.69	0.5	42.59
TOTAL	10.2	38.87	2.3	51.37

BREAKDOWN OF ACT BUDGET APPROPRIATIONS 2007–2011

PROJECT	ACTIVITIES FUNDED	AGENCY FUNDED ¹	YEAR	FUNDING APPROPRIATED \$M	REVISED FUNDING \$M
Where Will We Play?	Tuggeranong Stormwater Harvesting Reticulation Network	Economic Development	2008–09	16	9
Dickson and Lyneham Ponds	Pond design and construction	Environment and Sustainable Development	2009–10	13.87	13.87
Feasibility – Reticulation from existing lakes and ponds	Design	Environment and Sustainable Development	2008–09	1	1
Weston Creek Reticulation Network	Design and construction	Environment and Sustainable Development	2009–10	5	1
Valley Ponds, Gungahlin	Design and construction	Environment and Sustainable Development	2009–10	6.5	6.5
Inner North Stormwater Reticulation Network	Construction	Environment and Sustainable Development	2011–12	7.5	7.5
TOTAL				49.87	38.87

¹ ACT Machinery of Government changes in 2011 saw the Department of Climate Change, Energy and Water and the Planning and Land Authority merge to become the Environment and Sustainable Development Directorate and the CIUWP functions of Territory and Municipal Services move to the new Economic Development Directorate

PROJECT PROCEEDING WITHIN BUDGET

The project was proceeding within budget. However, the design process indicated the costs of the Inner North Reticulation Network would be higher than initially anticipated. A transfer main from Lyneham Pond to Flemington Pond to store captured water was an added cost. Part of the required funding was sourced from the ACT Government appropriating \$13.87 million to the Dickson and Lyneham pond developments, including reticulation infrastructure and networking with the Flemington Road Pond reticulation system. When detailed design was finalised, the cost of the relevant projects was determined and an additional \$7.5 million was appropriated to complete the project in the 2011–12 budget.

INCOME GENERATED TO DATE AND ANTICIPATED INCOME

From project commencement to October 2009, \$232,000 in interest was generated. These funds were allocated to the construction of Banksia Street Wetland, O'Connor in the Sullivans Creek Catchment. From October 2009 to June 2011, \$200,000 in interest was generated. These funds were allocated to the construction of the Inner North Stormwater Reticulation Network, committed on contract signing for the construction of the pipeline.

Income generated from water sales, once infrastructure becomes operational, will be directed into operation and maintenance costs and to recover capital costs over the life of the infrastructure.



PROJECT MILESTONES – SUMMARY

MILESTONE SUMMARY	
1	<p>Completion of a tender brief for Phase 1 feasibility study.</p> <p>Completion of a work plan for high value opportunities in Sullivans Creek Catchment.</p>
2	<p>Completion of detailed design for a high value opportunity in Sullivans Creek Catchment.</p>
3	<p>Completion of Phase 1 feasibility study (Part 1 i.e. Tasks 1–5).</p> <p>Construction of a high value opportunity in Sullivans Creek Catchment.</p> <p>Provision of the first progress report.</p>
4	<p>Completion of Phase 1 feasibility study (Part 2 i.e. Tasks 6–8).</p> <p>Completion of the second progress report.</p>
5	<p>Completion of Phase 2 feasibility study.</p> <p>Completion of high value opportunities in Sullivans Creek Catchment.</p> <p>Completion of the third progress report.</p>
6	<p>ACT Cabinet and Steering Committee decision to proceed.</p> <p>Completion of the work plan for all remaining construction projects.</p>
7	<p>Completion of detailed design and ACT Government approvals processes.</p> <p>Completion of the fourth progress report.</p>
8	<p>Written confirmation from the Project Manager that 75% of the capital works identified in the work plan have been completed.</p> <p>Completion of the fifth progress report.</p>
9	<p>Completion of all capital works identified in the work plan.</p> <p>Completion of the project and provision of the final project report.</p>

EVALUATION OF CIUWP

It is intended the Inner North Reticulation Network be evaluated after five years of operation to assess the costs and benefits of broad scale stormwater harvesting in the ACT. If the pilot evaluation concludes the project has been successful, the Weston Creek and Tuggeranong stormwater reticulation networks may be implemented to meet the longer-term 3 GL target of substituted potable water by 2015.

HOW WERE THE OBJECTIVES OF THE PROJECT MET?

Adopt a holistic approach to the project, incorporating a range of options and taking account of environmental, social and economic outcomes.

The project commenced with a feasibility study undertaken by CSIRO. The project aimed to assess the potential for broad scale stormwater harvesting in the ACT while adopting a least cost approach and taking into account environmental, social and economic outcomes. The study confirmed that the target of 3 GL per annum was technically feasible and determined broad costs associated with achieving such a target. Environmental benefits were determined indicating the drawdown of the water level of existing and proposed ponds would impact positively on the ecological integrity of the water bodies. Focus groups were held with the community to canvas the various water sensitive urban design options and seek input regarding attitudes and preferences for various infrastructure options. The community was generally very supportive of stormwater harvesting and fit-for-purpose use of non-potable water to substitute potable water uses where feasible.

Development of four integrated waterway management master plans for the Sullivans Creek Catchment, Yarralumla Creek Catchment, Weston Creek Catchment and Ginninderra Creek Catchment.

The ACT sub-catchments of focus for the project were identified as Sullivans Creek, Weston Creek, Ginninderra Creek and Yarralumla Creek (Woden). The feasibility study looked at the entire ACT urban catchment and prioritised infrastructure investment in Sullivans Creek (Inner North Canberra), Weston Creek and Tuggeranong sub-catchments.

Application of waterway values and objectives as a means for metropolitan integration of WSUD based measures.

The project aimed to protect waterways values including recreational opportunities, habitat protection and enhancement, landscape amenity, flood protection and the creation of capacity for non-potable water use.

The project aimed to meet these multiple objectives as follows:

Application of an integrated urban waterway management approach

The selection of infrastructure for the project was designed:

- improve water quality entering new ponds by 60%, reducing phosphorous, nitrogen and suspended solids
- attenuate/regulate flows entering waterways and rivers, thereby enhancing the ecological values of the water body
- enable stormwater harvesting for irrigation of sportsgrounds and other recreational and sporting facilities, substituting existing potable water requirements
- investigate and pilot the feasibility of storing surface water in recharged underground aquifers (aquifer storage and recovery) to increase the volumetric reliability of the stormwater resource used for irrigation
- support the sporting industry by enabling irrigated sportsgrounds and local ovals with a fit-for-purpose, less expensive and sustainable source of water
- support the sporting industry to negate obesity and other related health epidemics by providing adequate sites for formal sporting activities and recreational exercise
- enhance active and passive recreational opportunities and amenity for local communities
- create a source of revenue for government to be directed to operation and maintenance of the infrastructure through sale of fit-for-purpose water that recovers capital and operating costs of pilot stormwater harvesting networks
- assess the ecological impact of drawing down the ACT's existing lakes and ponds
- conduct a pilot of broad scale stormwater harvesting and evaluate pilot outcomes by analysing: levelised costs of the resource; take-up of the resource for irrigation; volumetric reliability; operation and maintenance issues and costs associated with the stormwater harvesting, and end user and community response to pricing of the non-potable water.

Development and refinement of relevant policies, guidelines and procedures

The project has involved reviewing existing legislation and regulatory frameworks for their suitability to accommodate broad scale stormwater harvesting.

- Pricing policy in the ACT was developed. The pricing policy is in accordance with the National Water Initiative's Pricing Guidelines. The price range adopted by Government was recommended by the Independent Competition and Regulatory Commission
- A technical code for stormwater reuse and recycled water has been drafted.
- Various supply models have been investigated and an option selected, considering the ACT's regulatory framework for reticulation infrastructure.
- Policy to enable managed aquifer recharge to occur in the ACT has been developed and the Territory Plan and National Capital Plan have been varied to allow the injection of surface water into bores.

Options for developer contributions to off-site flow detention facilities

Options for developer contributions were investigated. The scheme was not implemented due to the estimated administration costs. The ACT's cash contribution to the project was secured through formal budget appropriations, and significantly exceeded the agreed contribution.



Reduce potable supply by reusing up to 1.5 GL of collected stormwater for urban irrigation

The table below shows project sites where infrastructure was planned to be retrofitted to enable the substitution of potable water with stormwater for irrigation. The table also shows estimated water savings when implementation occurs. Water savings will be metered and monitored in accordance with the Water Resources Act 2007.

PROJECT SITE	ESTIMATED POTABLE WATER SUBSTITUTED MEGALITRES
Inner North Stormwater Reticulation Network	500
Weston Creek Stormwater Reticulation Network	225
Tuggeranong Stormwater Reticulation Network	450
Valley Ponds Stormwater Reticulation Network	30
Murrumbidgee Country Club	93
Yowani Country Club	60
Federal Golf Course	120
Point Hut Pond	35
Bonner District Playing Fields	12
Crace Neighbourhood Oval	5
TOTAL	1530

Development and evaluation of urban water management approaches including detention ponds

Numerous detention ponds have been constructed in the ACT and their design and management are being monitored for impact on waterways in terms of water quality, ecological impacts, stormwater reuse, flood management, peak flow reduction, environmental flows and community response.

Development and evaluation of urban water management approaches including infiltration basins

Infiltration basins are being investigated in both a local and regional context. The Flemington Road Pond is located over a shallow aquifer (gravel lens) and relationships between surface water and ground water system are being monitored.

Development and evaluation of urban water management approaches including aquifer storage and recovery

An aquifer storage and recovery scheme has been investigated in association with the Inner North Stormwater Reticulation Network. A trial of the injection of surface water into aquifers is being trialled as a component of the network.

Development and evaluation of urban water management approaches including wetland landscaping

PLANT DIVERSITY

The urban wetlands of Sullivans Creek Catchment are constructed within open space that had limited ecological value and mainly consisted of an even-aged stand of trees such as Eucalyptus and exotic deciduous trees, and dryland exotic grass. These open spaces lack a shrub or grassy understorey and as a result provide limited wildlife habitat.

For each wetland, landscape plans were developed closely with landscape architects and in consultation with Territory and Municipal Services and the Molonglo and Ginninderra catchment groups.

The majority of plants chosen for the wetlands are local provenance species, sourced from ACT wholesale growers licensed to collect local plant material. Using local species from a range of structural categories provides habitat for local fauna. Plants include:

- macrophytes (reeds) – which have a vital role in nutrient uptake
- ephemerals – species that can cope with wetting and drying, like Juncus
- perennials – non-woody species like native daisies
- native grasses and groundcovers – Poa, Themeda and Hardenbergia
- shrubs – tea-tree, Banksia, Callistemon
- trees – local Eucalyptus such as snow gums, kurrajongs, Casuarina

Planted wetlands like Banksia Street, O'Connor boast a diverse assemblage of plants and habitat. In the early stages of landscape development, macrophytes and grassy species grow rapidly, forming a dense understorey. As time passes, depending upon their density, trees may out-shade the understorey. This has occurred after ten years at the David Street Wetland in O'Connor. In the future, landscape management at David Street may include tree thinning and additional understorey planting, including more shade tolerant species.

WILDLIFE

Birds associated with the constructed wetlands include wood ducks, black ducks, grebes, dotterels, plovers, little pied cormorants, herons, reed warblers and welcome swallows. Pelicans and black swans have been recorded at David Street Wetland. Frog species quickly move in once a water body forms, as do macro-invertebrates like dragonfly nymphs, freshwater snails and yabbies. Ponds attract eastern long-necked tortoises which often bask on tree perches in the water. Small native fish like western carp gudgeon have been introduced into the Banksia Street wetland and their success will be monitored by ESDD.

Opportunities exist to link the wetlands with fingers of vegetation to hills and ridges to provide corridors for terrestrial fauna. One species that could be planted at the wetlands on higher ground is *Allocasuarina verticillata*, an important food source for the uncommon glossy black cockatoo.

PERCHES AND LOGS

Tree perches are installed in the deeper water sections of the wetlands. Perches provide refuge for water birds and tortoises from marauding dogs, cats and foxes. Wherever possible, large logs are incorporated into the banks. These logs provide habitat for insects, which in turn encourages insectivorous birds. Logs also provide a microclimate for frost sensitive plants.

At the Lyneham and Dickson ponds, islands have been incorporated into the wetland design. Like the perches, the islands provide protection from predators and opportunities for safe nesting sites.

LANDSCAPE CONNECTIVITY

Prior to the the Urban Waterways Program, the Sullivans Creek Catchment was a highly modified catchment, comprised mostly of concrete drains with little habitat value. The development of a series of wetlands along Sullivans Creek has greatly enhanced aquatic and terrestrial habitat within the catchment. Along the main branch of Sullivans Creek the wetlands commence near the top of the catchment at Flemington Road Ponds, via Yowani Ponds, adjacent to the Lyneham Pond and through the ponds of the ANU. The Dickson, Banksia Street and David Street wetlands have been built on catchment tributaries. Together these wetlands improve the quality of water entering Lake Burley Griffin and provide enhanced aquatic wildlife corridors.

CLIMATE CHANGE

Converting open spaces to water and a dense array of plants reduces urban land temperatures and helps mitigate the effects of a warming climate. During times of prolonged drought the wetlands will provide places of refuge for fauna.

AMENITY

Care has been taken to provide landscape amenity while protecting the habitat values of the wetlands at Banksia Street, Dickson and Lyneham. Paths and seats provide opportunities for viewing water, wildlife and plants. Viewing platforms at Dickson and Lyneham provide opportunities for visitors to get close to the water.

Stormwater management and flood mitigation

The construction of the Flemington Road Ponds has improved stormwater management in preparation for the development of Kenny and Throsby, yet to be developed in the Sullivans Creek Catchment. The larger of the ponds has been designed as a retardation basin to detain floods in extreme storm events and will contribute to the protection of downstream properties. The construction of Dickson and Lyneham ponds marginally improves flood protection within the Sullivans Creek Catchment.

Evaluation of catchment runoff and water quality

The impact of constructed urban wetlands is being monitored in terms of peak flow reduction and water quality improvements, indicated by reduction in suspended solids and nutrients. Regular water quality testing occurs in the ACT in all major ponds to determine the overall water quality improvement to the ACT's two major rivers, the Molonglo and the Murrumbidgee.

Capacity building within the community

Everyone can be a wetlands steward, as an individual, or in partnership with others.

The Urban Waterways Program developed a comprehensive community engagement program to promote the wetlands. The program aimed to inform participants about the proposed developments and encourage them to participate in caring for wetlands. The program included community fairs, a letterbox drop of a coloured brochure, on-site meetings, bike tours, school site tours, talks and planting days, art activities, website and facebook pages.

For ACT schools, the community engagement program is underpinned by *Understanding Canberra's wetlands: a school curriculum program for the study of constructed urban wetlands*. As well as enhancing student's knowledge of natural and constructed wetlands, the curriculum is underpinned by the notion that 'Everyone can be a wetlands steward, as an individual, or in partnership with others'.

Opportunities for community involvement include becoming a member of a supported wetland carer group, participating in school or community planting days and monitoring the wetlands through the Waterwatch and

Frogwatch programs. The program has facilitated the development of carer groups at the Banksia Street and Dickson wetlands. Supported by staff, the Banksia Street Wetland Carer Group has planted the entire wetland during a series of community planting days, spent time weeding and installed plant guards to protect species from marauding cockatoos. Planting days are regarded as an enjoyable social activity and are usually concluded with a barbecue. The success of the collaboration between the ACT Government and the community was recognised by a Keep Australia Beautiful Award in 2010.

Students from Turner Primary School, Girl Guides and a school for indigenous students participated in planting at the Banksia Street Wetland.

Following the success of the Banksia Street group, a similar group is being established for the Dickson Wetland. The first planting day was held in June 2011 and attracted over 200 participants. It is envisaged a core group of residents will continue to help maintain the wetland over the coming years.



Wetland Display at the Inner North Community Fair in Dickson – May 2010

PROJECT COMPLEXITIES

Several design and policy complexities were encountered by the project, causing delays for some of the project components.

- The project timeframe for the program of three years (later extended to four years) was difficult to achieve while undertaking a comprehensive feasibility study.
- Significant design complexities were uncovered through the design process. Investigation of pressures and a three day cycle required for direct irrigation from ponds required larger pipe sizes and resulted in a prohibitive capital cost, required redesign of the networks to include tanks at end user sites to enable pipe size reduction.
- Alternative solutions were investigated, including smaller pipe sizes and tanks enabling storage of water for 1.5–2 days watering, resulting in an acceptable capital cost.
- Assessment of telemetry options for automated operation and ease of monthly reporting required extensive investigation.
- Coordination between several different consultants, resulting in inconsistencies regarding modelling of yields and approach to design of various elements of the infrastructure, were a challenge.
- Reaching agreement with stakeholders on the appropriate supply model for non-potable stormwater associated with infrastructure ownership, operation, maintenance and administration and management was a challenge.
- Reaching agreement with stakeholders on the price of non-potable stormwater and management of funds was difficult.
- The review of existing policies and the regulatory framework to enable a suitable supply model to proceed was complex and took time and resources.



APPENDIX 1

KEY REPORTS RESULTING FROM THE PROJECT AND DIRECTLY RELEVANT TO THE PROJECT

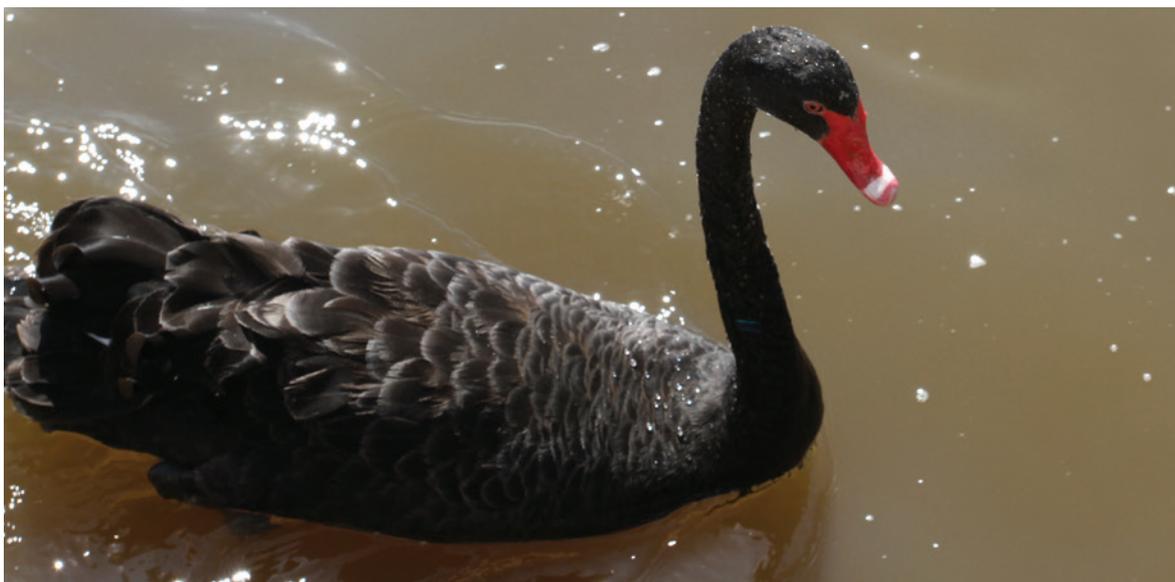
- A. Bill Guy and Partners, Review of Infrastructure Planning for Sullivans Creek Catchment, July 2003
- B. Bill Guy and Partners, Lyneham and Dickson Ponds Feasibility Study, March 2005
- C. ACTEW, Recycled Water Strategy for Canberra, June 2008
- D. CSIRO, Canberra Integrated Waterways – Feasibility Study, April 2009
- E. Parsons and Brinckerhoff, Water Management Plan for ACT Sportsgrounds, May 2009
- F. Cardno Young, Flemington Road Aquifer Recharge Investigation, June 2009
- G. Cardno Young, Weston Creek Non-potable water Reticulation Feasibility Study, June 2009
- H. Cardno Young, Inner North Non-potable water Reticulation Preliminary Sketch Plan Report, March 2010
- I. Independent Competition and Regulatory Commission, Pricing Recommendation for Pilot Stormwater Reuse Projects in the ACT, December 2009
- J. Cardno Young, Weston Creek Non-potable water Reticulation Preliminary Sketch Plan Report, April 2010
- K. URS, Dickson and Lyneham Ponds, Final Sketch Plan Report, April 2010
- L. GHD, Existing Lakes and Ponds Non-potable Water Reticulation and Aquifer Storage and Recovery Report, May 2010
- M. GHD, Existing Lakes and Ponds Non-potable Reticulation Water Environmental Impacts Report, May 2010
- N. GHD, Existing Lakes and Ponds Non-potable Reticulation Water Quality Report, May 2010
- O. ACTEW Canberra Sewerage Strategy 201–2060, March 2011
- P. ACT Planning and Land Authority, Non Drinking Water Technical Code, February 2011
- Q. URS, Managed Aquifer Recharge Investigation at Mitchell and Flemington Road, ACT Maximal Risk Assessment, January 2011
- R. GHD, Canberra Integrated Urban Waterways Project, Preliminary Sketch Plan Part B, stage 1, March 2011
- S. URS, Canberra Urban Waterways: Flemington Road Pond Reticulation Network, March 2011
- T. MY Global Solutions, Control System Requirements SCADA, April 2011
- U. ACTEW, Suburban Water Consumption 1994–2006

APPENDIX 3

PROJECT MILESTONES AND HOW THEY WERE MET

The milestones for the project and evidence of their completion are set out in the following tables.

	MILESTONE	EVIDENCE OF COMPLETION
1	<p>Completion of a tender brief for Phase 1 of the feasibility study.</p> <p>Completion of a work plan for high value opportunities in Sullivans Creek Catchment.</p>	<p>Milestone 1 was completed on 13 April 2007 as demonstrated by the provision to the Water Smart Australia Program of the final study design brief for Phase 1 of the Feasibility Study. The study brief was approved by the Steering Committee at its 12 April 2007 meeting. A work plan was provided for high value opportunities in Sullivans Creek Catchment. A gantt chart was produced for Flemington Road Ponds.</p>
2	<p>Completion of detailed design for a high value opportunity in Sullivans Creek Catchment.</p>	<p>Milestone 2 was completed on 27 June 2007 as demonstrated by the provision to the Water Smart Australia Program of a copy of the Flemington Road Ponds development application and design documentation.</p>
3	<p>Completion of Phase 1 of the feasibility study (Part 1 Tasks 1-5).</p> <p>Completion of construction of a high value opportunity in Sullivans Creek Catchment.</p> <p>Provision of the first progress report.</p>	<p>Milestone 3 was completed on 21 January 2008, with the submission of the first progress report for the project and completion of the first of two ponds adjacent to Flemington Road, Mitchell.</p>



	MILESTONE	EVIDENCE OF COMPLETION
4	<p>Completion of Phase 1 feasibility study (Part 2 Tasks 6-8).</p> <p>Completion of the second progress report.</p>	<p>Milestone 4 experienced some delays. The funding deed was varied to accommodate meeting the milestone. Tasks 5-8 of the feasibility study were delayed due to:</p> <ul style="list-style-type: none"> • Trials of various methodologies were initiated to determine the most appropriate process for site selection. The process required a comprehensive level of integration between aquifer, sewer mining and stormwater options to ensure that adequate integration between sources of water and options were identified. The options then needed to be cost-scaled in a matrix format to enable comparability when assessing cost of water delivered per kilolitre. • Additional investigations on costs of aquifer storage and recovery options were required to include in the analysis of optimum stormwater harvesting sites. The investigations necessitated specialist consultants, involving additional work and time to produce results that were provided to CSIRO as input to the study. • Extended period and diversity of comments from the technical advisory committee required modification of key assumptions for the scope of analysis. This required re-analysis of hydrologic modelling, storage behaviour analysis and life cycle costing of options, which CSIRO were unable to complete by the end of April 2008. • A thorough and detailed technical report as part of stage 1 of the study was completed, based on sound technical assumptions and the best available data. The outcomes of stage 1 analysis indicated that it is feasible to achieve 3 GL/year potable water saving target using stormwater as a source of supply for irrigation purposes. CSIRO identified the cheapest cost stormwater harvesting/ managed aquifer recharge options in infrastructure life cycle cost terms. Identified options have volumetric supply reliability of 95% and 85%. • The delay on Phase 1 analysis impacted on the time frame to deliver Stage 2 analyses. Without a short-list of options, Stage 2 analyses could not be completed. Much of Stage 2 analysis was undertaken in parallel with Stage 1 analysis, for example social analysis and sorting out criteria for Triple Bottom Line (TBL) assessment. • An integrated model of Canberra for assessing total water cycle implications of stormwater harvesting was also to be delivered as part of Phase 2.
5	<p>Completion of Phase 2 of the feasibility study.</p> <p>Completion of high value opportunities in Sullivans Creek Catchment.</p> <p>Completion of the third progress report.</p>	<ul style="list-style-type: none"> • Feasibility Study (Phase 1) was undertaken by CSIRO. CSIRO produced a comprehensive report that may be used as a key planning resource for the ACT's urban waterways into the future.

	MILESTONE	EVIDENCE OF COMPLETION
6	<p>ACT Cabinet and steering committee decision to proceed.</p> <p>Completion of a work plan for all remaining construction projects.</p>	<p>Variations to the funding deed were previously agreed in principle with Water Smart Australia officers.</p> <p>The second pond at Flemington Road was completed in 2009 and certificate of practical completion provided.</p> <p>Preliminary design of the reticulation infrastructure subsequently commenced.</p>
7	<p>Completion of detailed design and ACT Government approvals processes.</p> <p>Completion of the fourth progress report.</p>	<p>A letter of request for variation was prepared in October 2009 and signed in April 2010 to change the due date of Milestone 7. Milestone 7 was partially met within the timeframe. The ACT proposed that a part payment be made based on the quantum of work that was produced within the reporting period.</p> <p>The supply model and pricing options were prepared for consideration by government in 2010 and later in 2012.</p> <p>Phase 2 of the feasibility study was well progressed across all projects, however there were a number of design complexities that resulted in unforeseen delays. The design complexities required attention to ensure the infrastructure design would meet the needs of the non-potable water users. These design issues have been resolved and resulted in a better outcome as demand management issues were addressed.</p> <p>Design of the Inner North Stormwater Reticulation Network was completed, development application approved and tender advertised in April 2011. Construction commenced in 2011.</p> <p>Two new ponds located in Dickson and Lyneham were funded by the ACT Government (\$13.87 million). These ponds are networked with the Flemington Road Ponds to form the Inner North Stormwater Reticulation Network.</p> <p>The Tuggeranong Stormwater Reticulation Network was identified as a key project and funded by the ACT Government (\$14 million) in 2008-09. The design of the network was completed, development application approved and construction tendered.</p> <p>The Weston Creek Reticulation Network was also identified as a key pilot project. The design was completed and the project funded by the ACT Government (\$5 million) in 2009-10.</p> <p>Comprehensive feasibility study reports have been completed on water quality, managed aquifer recharge and environmental impacts, enabling designs to progress further. Significant design work has focused on adopting the most cost effective infrastructure option that also delivers the volumes of water required.</p> <p>Banksia Street Wetland was completed in early 2010 costing \$360,000, of which \$232,000 was funded from the interest generated from the project up to October 2009.</p> <p>The Independent Competition and Regulatory Commission prepared a report on the appropriate price for non-potable stormwater, whilst applying National Water Initiative pricing principles.</p>

	MILESTONE	EVIDENCE OF COMPLETION
8	<p>Written confirmation from the project manager that 75% of the capital works identified in the work plan have been completed.</p> <p>Completion of the fifth progress report.</p>	<p>The delays experienced meeting Milestone 7 impacted on meeting Milestone 8 by the required timeframe.</p> <p>The detailed design for the Inner North Stormwater Reticulation Network was tendered 15 May 2010. One tender was received and signed off by the tender evaluation team on 29 June 2010. The tender evaluation report was not signed off until 9 November 2010 resulting in the need to renegotiate the contract, which was signed on 23 December 2010. The delay was related to concerns to proceed with the final design without confirmation that the required construction funds would be available. The consultant submitted the final sketch plan in March 2011, followed by the submission of a development application in late March, with the expectation of planning approval in June 2011. Construction tenders were called in April 2011 enabling a construction contract to be in place by late June/ early July 2011. The construction contract committed all unspent Water Smart Australia Program funds, and enabled the project to proceed to meet objectives.</p>
9	<p>Completion of all capital works identified in the work plan.</p> <p>Completion of the project and provision of the final project report.</p>	<p>A final report on the project (this document) was initially submitted in December 2012 providing an overview of each of the project components and how the objectives have been met.</p>



Waterwatch with Girl Guides at Banksia Street Wetland

APPENDIX 4

POSTSCRIPT – FEBRUARY 2014

This is a report of the CIUWP until June 2011. Since June 2011 there were some adjustments to the work program for the project that have impacted on the ACT Government's ability to meet the potable water substitution target as specified in the funding deed.

Over 2009–2012 ACT Government financial commitments significantly increased for the implementation of the ACT's water security program, including; the enlargement of the Cotter Dam, the Murrumbidgee to Googong Transfer and purchase of water access entitlements from NSW. This additional financial commitment dovetailed with the easing of the drought.

In September 2011, the ACT Treasurer asked the Independent Competition Regulatory Commission to undertake an inquiry into the use of secondary water in the ACT. Secondary water includes greywater, stormwater, treated effluent and rainwater. The draft report was released in May 2012 and recommended:

'completing the Inner North component of the Canberra Integrated Urban Waterways Project pilot, while postponing the Weston and Tuggeranong elements'.

The final report titled 'Secondary water use in the ACT: Report 6 of 2012, June 2012' can found at:

http://www.icrc.act.gov.au/wp-content/uploads/2013/02/Report_6_of_2012_July_2012.pdf

The release of the draft report in May 2012 resulted in the withdrawal of the tender for the construction of the Tuggeranong Stormwater Reticulation Network (pipeline and pump station). The tanks for the first stage of the Tuggeranong Network were constructed in 2011–2012 and are now used for potable water storage. Sport and Recreation Services was appropriated \$16 million for source substitution, of which a small proportion of was expended on providing grants to golf courses for potable water substitution.

Government made a decision in April 2012 to withdraw construction funds for the Weston Creek Reticulation Network. \$4 million of the \$5 million appropriation was withdrawn, leaving \$1 million to complete the design of the Weston Creek network and deliver the telemetry component of the stormwater harvesting trial in the inner north.

Consequently, the targets set in the original funding deed between the Australian Government and the ACT Government will not be met.

The ACT Government committed funding to ensure the delivery of the Inner North Stormwater Reticulation Network. Construction of the network will be completed in 2013 and a five year trial will commence on the efficacy of supplying non-potable water. It is estimated that when fully constructed, this network will deliver up to 0.5 GL of harvested stormwater to end users per annum.

Adjusted ACT funding contributions and estimated potable water substitution targets are shown below.

CHANGES TO BREAKDOWN OF ACT BUDGET APPROPRIATIONS 2007–2011

PROJECT APPROPRIATED	AGENCY FUNDED	ORIGINAL APPROPRIATED \$M	REVISED FUNDING \$M
Where Will We Play?	Territory and Municipal Services (now Economic Development Directorate)	16	7
Dickson and Lyneham ponds	Environment, Climate Change, Energy and Water (now Environment and Sustainable Development Directorate)	13.87	13.87
Feasibility – Reticulation from Existing Lakes and Ponds	ACT Planning and Land Authority (now Environment and Sustainable Development Directorate)	1	1
Weston Creek Reticulation Network	Environment, Climate Change, Energy and Water (now Environment and Sustainable Development Directorate)	5	1
Valley Ponds, Gungahlin	Environment, Climate Change, Energy and Water (now Environment and Sustainable Development Directorate)	6.5	6.5
Inner North Stormwater Reticulation Network	Environment, Climate Change, Energy and Water (now Environment and Sustainable Development Directorate)	7.5	7.5
TOTAL		49.87	36.87

REVISED ESTIMATED POTABLE WATER SUBSTITUTED

PROJECT SITE	ORIGINAL ESTIMATED POTABLE WATER SUBSTITUTED MEGALITRES	REVISED ESTIMATED POTABLE WATER SUBSTITUTED MEGALITRES
Inner North Stormwater Reticulation Network	500	500
Weston Creek Stormwater Reticulation Network	225	0
Tuggeranong Stormwater Reticulation Network	450	0
Valley Ponds Stormwater Reticulation Network	30	30
Murrumbidgee Country Club	93	93
Yowani Country Club	60	60
Federal Golf Course	120	120
Point Hut Pond	35	35
Bonner District Playing Fields	12	12
Crace Neighbourhood Oval	5	5
TOTAL	1530	855

