

SOUTH WINDSOR EFFLUENT REUSE SCHEME

Introduction

The South Windsor Effluent Reuse Scheme Project was an initiative of Hawkesbury City Council. The project involved constructing a recycled water treatment facility at the existing South Windsor sewage treatment plant and installing a distribution system to supply recycled water to council reserves, schools and other sites for irrigation.

The Hawkesbury City Council South Windsor sewage treatment plant formerly had only minimal on-site reuse of treated effluent, with the majority of treated effluent being discharged to South Creek which flows to the Hawkesbury–Nepean river system.

The project was funded by the Australian Government under the *Water for the Future* initiative and received \$7.9 million of the total \$77.4 million allocated to the overarching Hawkesbury–Nepean River Recovery Program.



The South Windsor Effluent Reuse Scheme Project improved the quality of open space areas in South Windsor and Bligh Park

Objectives

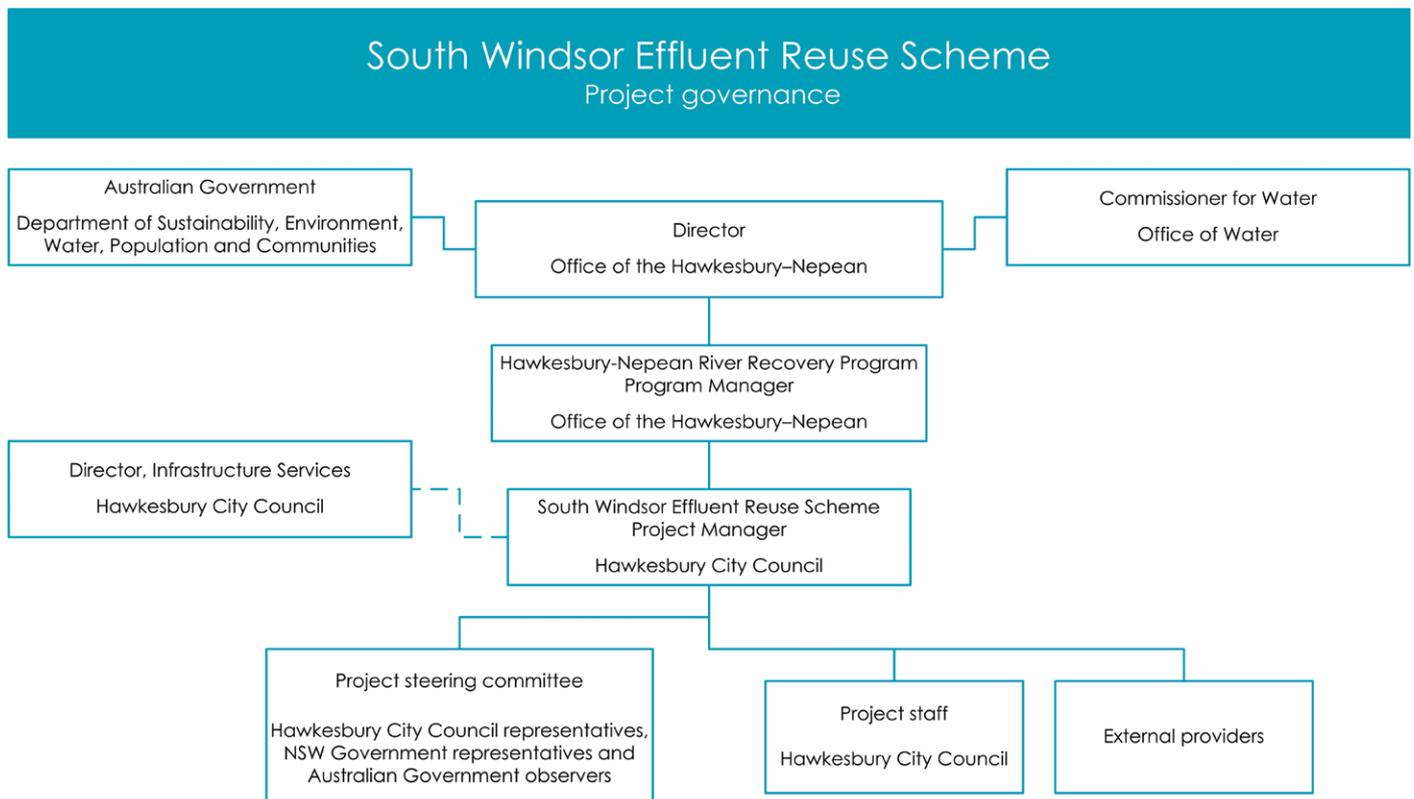
The objectives of the South Windsor Effluent Reuse Scheme Project were to:

- replace the 100 million litres per year of potable water used for open space irrigation with treated effluent from the South Windsor sewage treatment plant
- reduce total nitrogen loads discharged to the Hawkesbury–Nepean river system from the South Windsor sewage treatment plant by 0.44 tonnes per year
- increase social benefits realised through improved player surfaces and quality of open space areas in South Windsor and Bligh Park.

Methods

The South Windsor Effluent Reuse Scheme Project was managed by Hawkesbury City Council. Figure 36 illustrates the project governance.

Figure 36. South Windsor Effluent Reuse Scheme Project governance





A South Windsor Effluent Reuse Scheme Project Steering Committee was established and met at least every three months either directly or by conference call. The committee's function was to:

- coordinate and oversee the performance of the project including provision of quarterly progress reports to the Hawkesbury–Nepean River Recovery Program Steering Committee
- obtain information regarding the progress of the project and provide comment and guidance regarding project performance
- oversee preparation of reports, advice and information to be provided to the project steering committee.

The project was proposed as a design-and-construct project to treat and distribute recycled water from the South Windsor sewage treatment plant to council reserves and schools in Bligh Park and South Windsor. The recycled water would replace the use of potable water for irrigation and toilet flushing purposes.

The project stages comprised:

- concept design
- undertaking environmental impact assessments and obtaining planning approvals
- a risk assessment workshop
- preparing tender documents, public tendering, assessing tenders and awarding the design-and-construct contract
- undertaking detailed design of the scheme, constructing storage tanks, distributing pipelines, installing irrigation facilities in council open space and additional treatment processes at the South Windsor sewage treatment plant
- producing a recycled water management plan and validating the existing South Windsor sewage treatment plant processes
- preparing tender documents, public tendering, assessing tenders and awarding the contract for supplying and installing optic fibre
- commissioning the entire system.



Bligh Park Cricket Club is one of the sporting groups to benefit from the project

The recycled water from the South Windsor sewage treatment plant replaced the use of potable water for irrigation and toilet flushing purposes at council reserves and schools in Bligh Park and South Windsor

Concept design

At the commencement of the South Windsor Effluent Reuse Scheme Project, Hawkesbury City Council prepared a brief which outlined requirements for producing the project's concept design report. The brief was then given to selected consultants, requesting that they provide fee proposals for producing the report. The proposals were assessed and Sinclair Knight Merz was awarded the contract.

The scope of the concept design report included:

- data retrieval and assessment
- water demand forecast
- water quality assessment
- treatment plant concept design
- onsite storage verification
- distribution network concept design
- recycled water delivery pump station concept design
- desktop site soil assessment
- sub-surface irrigation system concept design
- cost estimation.



The purpose of the report was to form the basis for detailed design and allow a review of environmental factors to be undertaken to give recommendations for mitigating any negative impacts the project may have on the environment.

Review of environmental factors and obtaining planning approvals

The approach taken to facilitate the review of environmental factors was similar to that for the concept design report.

A review of environmental factors brief was prepared and given to three selected consultants, requesting that they provide a fee proposal for the specified scope of works. The fee proposals were assessed and the NSW Department of Finance and Services, Public Works was selected to carry out the scope of works as detailed in the brief.

The review of environmental factors assessed the following aspects of the project:

- impacts of the distribution network and sewage treatment plant unit construction on council-owned land
- operational impacts of any new infrastructure on council-owned land, including the sewage treatment plant and the on-site storage facilities, pumps and pipelines that comprise the distribution network
- impacts of the recycled water re-use, including irrigation, dual reticulation and industrial use, on all land (council and non-council owned).

The review of environmental factors, completed in November 2009, concluded that the proposed construction and operation of the South Windsor Effluent Reuse Scheme Project would result in only minor environmental impacts, which could be adequately addressed by adopting recommended mitigation measures. This outcome enabled the project to progress to the tendering stage.

Risk assessment workshop

During the review of environmental factors preparation, the NSW Department of Finance and Services, Public Works engaged Atom Consulting Pty Ltd to undertake a one-day risk assessment workshop. This assessment was necessary to achieve the requirements listed in elements 2 and 3 of the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) 2006. The workshop was attended by project team members, NSW Government representatives, industry members and sporting group representatives.

Central to implementing the Australian Guidelines for Water Recycling is understanding and managing risks to public health and the environment. The guidelines set out a holistic approach to managing health and environmental risks. This approach involves systematically assessing where and how contamination may arise, how it may find its way to the point of use and how to protect consumers and the environment from such contamination.

The objectives of the risk management workshop were to:

- understand the quality of the recycled water to ensure it was appropriate for its intended uses
- identify hazards associated with the scheme that may pose an environmental or health risk
- understand and prioritise the risks posed by each hazard
- identify the control measures in place (both existing or proposed) to minimise risk posed by hazards
- identify the additional controls (physical barriers or operational procedures) that may be required to manage and reduce risk to acceptable levels.

Tendering process

The process for preparing tender documents was similar to those followed in the previous stages of the project.

A brief was given to selected consultants who then submitted fee proposals for the process of preparing tender documentation, assessing tender submissions and recommending the most appropriate contractor to undertake the work. After assessing the fee proposals, Hawkesbury City Council appointed the NSW Department of Finance and Services, Public Works to undertake this process.

The tender submission period was from 27 July to 8 October 2010. After this period, the NSW Department of Finance and Services Technology, Public Works assessed the submissions and presented a report to Hawkesbury City Council recommending the preferred contractor.

The council resolved that the tender submitted by Murphy McCarthy & Associates Pty (MMA) for the design, construction, testing and commissioning of the South Windsor Effluent Reuse Scheme Project be accepted.

In accordance with the council's resolution, the contract was prepared and signed on 11 November 2010.



Design and construction

The contract commenced on 25 November 2010. In order to meet project deadlines, MMA were asked to design and construct the process treatment facility, the pipe distribution network and the irrigation systems concurrently. The design of the pipe distribution network through Bligh Park and South Windsor was completed on 4 March 2011 with works commencing immediately thereafter. The design of the irrigation systems at the council-owned reserves were completed and works commenced on 18 March 2011. The design of the additional process treatment facility at the South Windsor sewage treatment plant was completed and works commenced on 4 April 2011.

Construction of the project was supervised by the project manager who held fortnightly meetings with MMA to discuss progress, issues arising during the construction phase and the updated construction schedule. Through these regular meetings, potential issues were quickly and satisfactorily resolved, enabling the irrigation systems and pipe distribution network to be completed by mid August 2011.

The additional treatment processes at the South Windsor sewage treatment plant were successfully completed by 30 September, 2011.

Recycled water quality management plan and sewage treatment plant processes

In accordance with the Australian Guidelines for Water Recycling 2006, Atom Consulting Pty Ltd, facilitators of the risk assessment workshop, were engaged to develop a recycled water quality management plan for the project. The plan outlined the activities undertaken through the operation and maintenance of the South Windsor Effluent Reuse Scheme Project to meet the requirements of the guidelines.

In addition, the risk assessment workshop sought to validate the existing South Windsor sewage treatment plant processes (as required by the guidelines) to verify that bacteria, viruses and protozoa, which can affect human health, were being reduced.

To verify the reduction in pathogens through the existing processes, the ALS Group was engaged to sample and analyse the effluent twice a week for a period of 12 weeks.

The parameters required to be monitored were:

- *Clostridium perfringens*
- *Escherichia coli*

- somatic coliphages
- ultraviolet (UV) transmission.

Further validation may be required after commissioning the project to ensure the treated water is fit for toilet flushing purposes.

Optic fibre network tendering process

Hawkesbury City Council asked selected consultants to provide quotations for supplying and installing optic fibre at sites receiving recycled water for irrigation and toilet flushing as well as at selected sewage pumping stations. The quotations were assessed in accordance with the required criteria and IDC Solutions Pty Ltd was awarded the contract, which commenced in the first week of July 2011. IDC Solutions Pty Ltd worked directly with MMA and Hawkesbury City Council's information technology consultants to design and install the optic fibre network in council's administration building. This infrastructure allows remote monitoring of flows to sites receiving recycled water and remote monitoring and control of selected sewage pumping stations.

Commissioning

Commissioning the system was the primary responsibility of Hawkesbury City Council. As part of this process, MMA was required to verify their design process. MMA tested the project in three sections:

- The pipe distribution network was tested to 1000 pounds per square inch, the required pressure head to test for leakage.
- The irrigation system at each reserve was flushed and tested to verify optimal operation. The commissioning involved checking the pressure available from the irrigation pumps at each irrigated site as well as whether the irrigation heads provided the spray patterns required to achieve the required watering to each site.
- The treatment process was commissioned by validating the safety interlocks for the recycled water supply and the mechanism for stopping supply if recycled water quality dropped below required levels.

MMA's responsibility during commissioning was to verify the reuse process operation and ensure that 5 milligrams per litre of free chlorine was provided within the chlorine contact tank for a period of one hour. This provides enough chlorine contact time for disinfection as required by the NSW Department of Health.

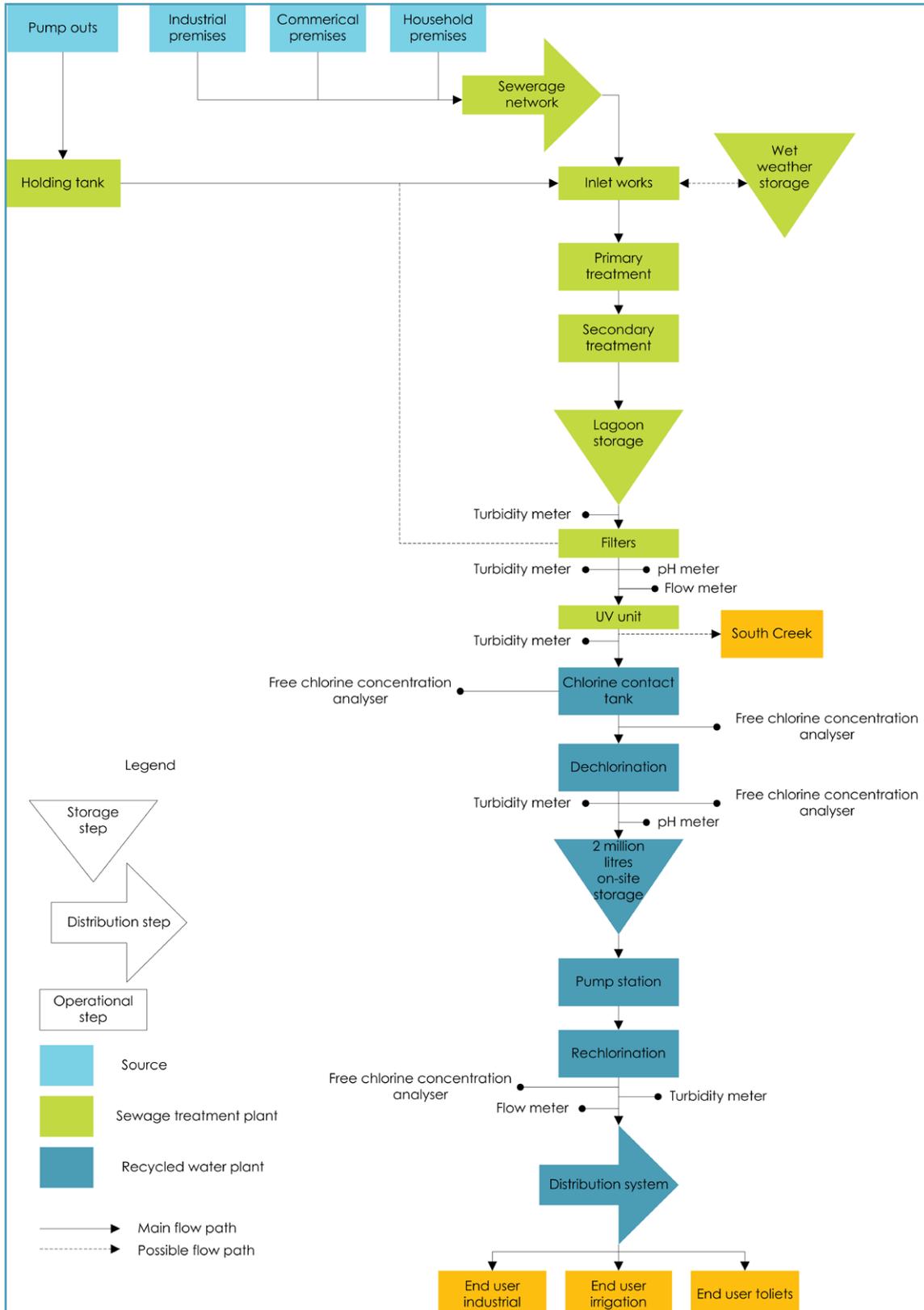
Once operational, the reuse process was tested to verify quality at the end point and ensure the treated water was fit for irrigation and toilet flushing.



Results

The construction and commissioning of the South Windsor Effluent Reuse Scheme Project has been successfully completed. With the scheme now operating, the project water savings, nutrient export reductions and social benefits are expected to be achieved. A diagram of the overall scheme and its key components is shown in Figure 37.

Figure 37. South Windsor Effluent Reuse Scheme Project





The basis for operation of the scheme is:

- Flow into the recycled water plant is achieved by gravity flow from the outlet of a newly constructed concrete diversion weir into a new chlorine contact tank. The recycled water is then transferred to a storage tank and pumped into the reticulation system.
- Flow into the chlorine contact tank is controlled by a valve with a magnetic flow meter for monitoring.
- The chlorine contact tank provides a hydraulic residence time (the amount of time the water is inside the chlorine contact tank) of one hour at design flow with 5 milligrams per litre of free chlorine residual at the discharge end of the chlorine contact tank. These requirements for disinfection via chlorination are specified in the NSW Recycled Water Co-ordination Committee Guidelines for Urban and Residential Use of Reclaimed Water.
- Pumping from the end of the chlorine contact tank into the storage tank is via a submersible pump station.
- If chlorine levels become too high and dechlorination is required, sodium metabisulfate will be dosed into the rising main leading to the recycled water storage tank with an inline mixer.
- A free discharge from the chlorine contact tank into the recycled water storage tank is required to consume excess sodium bisulphate.
- Re-chlorination to achieve the required chlorine residual occurs via a chlorine dosing point with an inline mixer in the pipe work downstream of the delivery pumps.
- Overflow to South Creek will only occur when the water from the UV unit flowing into the diversion weir exceeds the recycled water plant capacity, or when the recycled water storage tank is full.

The key hydraulic issue was to ensure the existing UV system is always submerged whilst preventing overtopping of the filtered water tank upstream of the UV unit. This has been achieved by constructing a UV weir chamber downstream of the UV unit but upstream of the new diversion weir.

UV weir chamber

The UV weir chamber is a concrete structure downstream of the UV disinfection unit, approximately 1 metre wide and 2 metres long. The chamber has been designed so that the UV unit will remain full, even when no flow is passing through the UV unit.

UV disinfection units require minimum flows to operate effectively. Therefore, the UV unit control system turns off when there is no, or low flow.

This means that effluent could potentially pass through the UV unit when it is off without being disinfected. To address this, a concrete structure with an overflow weir has been constructed so that the UV unit does not run dry. This ensures that all effluent is disinfected. This measure was required to ensure that the recycled water contains the pathogen levels specified in the Australian Guidelines for Water Recycling.

To enable the UV unit to be drained for maintenance purposes, a manual isolation valve has been installed in the UV weir chamber to allow liquid to gravitate under the weir.

Chlorination system

The chlorination system consists of a diversion structure, chlorine contact tank, recycled water storage pumping station and chemical dosing facilities.

To enable UV disinfected effluent to be fed to the chlorine contact tank, a diversion structure was required and was constructed downstream of the UV weir chamber. The diversion structure is connected to the chlorine contact tank via an off-take pipe. This enables the operator to take the chlorine contact tank offline for maintenance and allow flow from the UV unit to gravitate to the outlet control weir, as per the current operation.

The diversion structure has been equipped with an overflow weir. The diversion structure is a concrete structure, approximately 2 metres wide by 4 metres long. Flow enters the diversion structure then either overflows the weir to rejoin the pipe to the outlet control weir or passes to the chlorine contact tank.

Flow enters the chlorine contact tank from the diversion structure via a feed pipe. The feed pipe contains a magnetic flow meter and a modulating butterfly valve to control the flow. The open position of the butterfly valve modulates based on the liquid level in the recycled water storage tank. When the recycled water storage tank level is low, the valve opens to allow more flow to pass to the chlorine contact tank. As the storage tank fills, the valve closes. When the storage tank is full, the valve closes completely and the storage tank feed pumps stop. The modulating butterfly valve also limits the flow to the chlorine contact tank to ensure that the design capacity is not exceeded. Exceeding the design capacity could impact on the recycled water quality. If the valve fails, an alarm will be raised to alert the operator and the storage tank feed pumps will stop.



The chlorine contact tank requires an active volume of 126 cubic metres to give a residence time of 1 hour. The tank has an overflow weir that allows disinfected effluent to overflow into the storage tank feed pump station. At the feed end of the chlorine contact tank, a mechanical mixer and chlorine dosing point has been equipped to facilitate rapid mixing of sodium hypochlorite as it enters the tank. A baffle system is provided to contain the mixing zone.

There are two fixed-speed submersible pumps in the storage tank feed pump station; one duty pump and one standby pump. The duty pump operates based on the liquid level in the wet well and cuts out when the recycled water storage tank is at high level.



Sodium hypochlorite is dosed at a rate of 10 milligrams per litre (as chlorine) at the beginning of the chlorine contact tank. This ensures that there is at least 5 milligrams per litre of free chlorine at the end of the contact tank. A rapid flash mixer is required at the beginning of the contact tank to ensure that the dosed chlorine is dispersed adequately.

To control the chlorine residual level to an acceptable concentration of 3-5 milligrams per litre after the chlorination process, dechlorination can be required. To achieve this, bisulphite (sodium bisulfite $\text{Na}_2\text{S}_2\text{O}_5$) is dosed into the recycled water as it is being pumped to the storage tank through a controlled process.

A concrete recycled water storage tank at the sewage treatment plant was required to act as a buffer tank due to the difference between the potential recycled water flow profile produced by the recycled water plant at the sewage treatment plant and the demand flow profile which is governed by end users' demand patterns (which are influenced by the presence of onsite storage). The size of the recycled water storage tank at South Windsor sewage treatment plant has been determined accordingly at 2 million litres.

Distribution network

The 10.5-kilometre distribution network has been constructed using polyvinyl chloride (PVC) plastic pipes ranging in size from 100 millimetres to 300 millimetres in diameter to distribute flows to all proposed users. These include council reserves, parks and schools, Windsor Golf Club, Windsor Leagues Club, nominated commercial users and residential customers adjacent to the pipeline. The network has been broken down into nine sections based on required flow capacity. The design allows for future expansion and capacity for all users regardless of the servicing scenario selected. The network is shown in Figure 38.

A recycled water pumping station pumps recycled effluent from the sewage treatment plant recycled water storage tank to users through the distribution network. It is expected that the hourly recycled water consumption will vary significantly. For this reason it is necessary to use pumps with continuous variable speed control. Gradually re-filling on-site storage facilities every day using a constant flow acts to minimise this variation in demand.

The recycled water facility under construction (above) and completed (below)

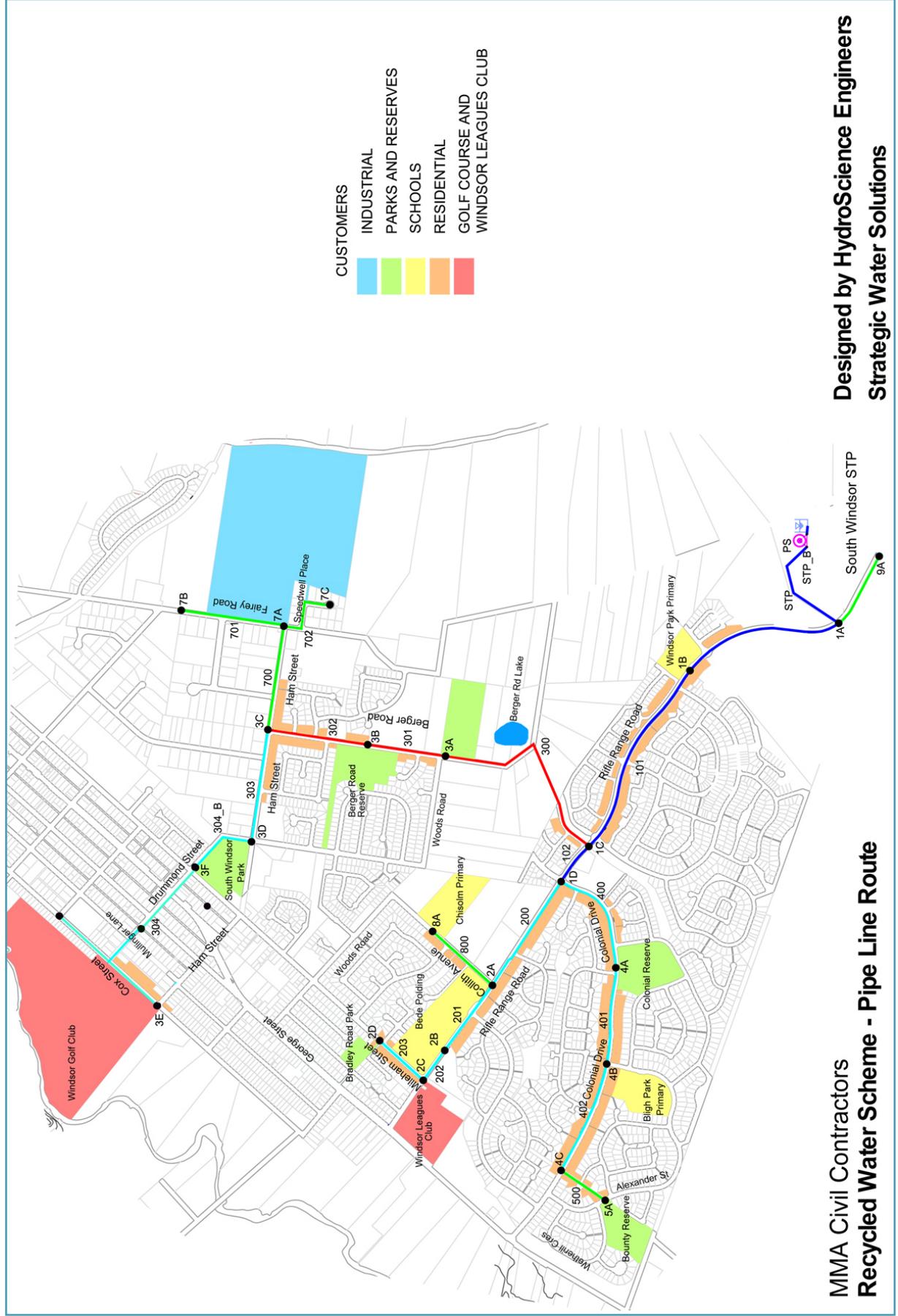


New onsite irrigation systems have been provided to four council-owned reserves - Colonial Reserve, Bradley Road Reserve, Berger Lake Reserve, and Mileham Street Reserve - for irrigation with recycled water. Two additional reserves - Bounty Reserve and Berger Road Reserve - which had existing irrigation systems, have also been connected to the distribution network to allow irrigation with recycled water. All irrigation systems on these

six sites comprise a flow meter to measure recycled water use, storage tanks, distribution lines with solenoid control valves, pop-up irrigation sprinklers, and connection to the toilet flushing system if a toilet block is on site.

To remotely monitor irrigation flow meter readings, an optic fibre network was installed from the Hawkesbury City Council administration office to all of the sites connected to the reuse system as well as the South Windsor sewage treatment plant. The network is shown in Figure 39.

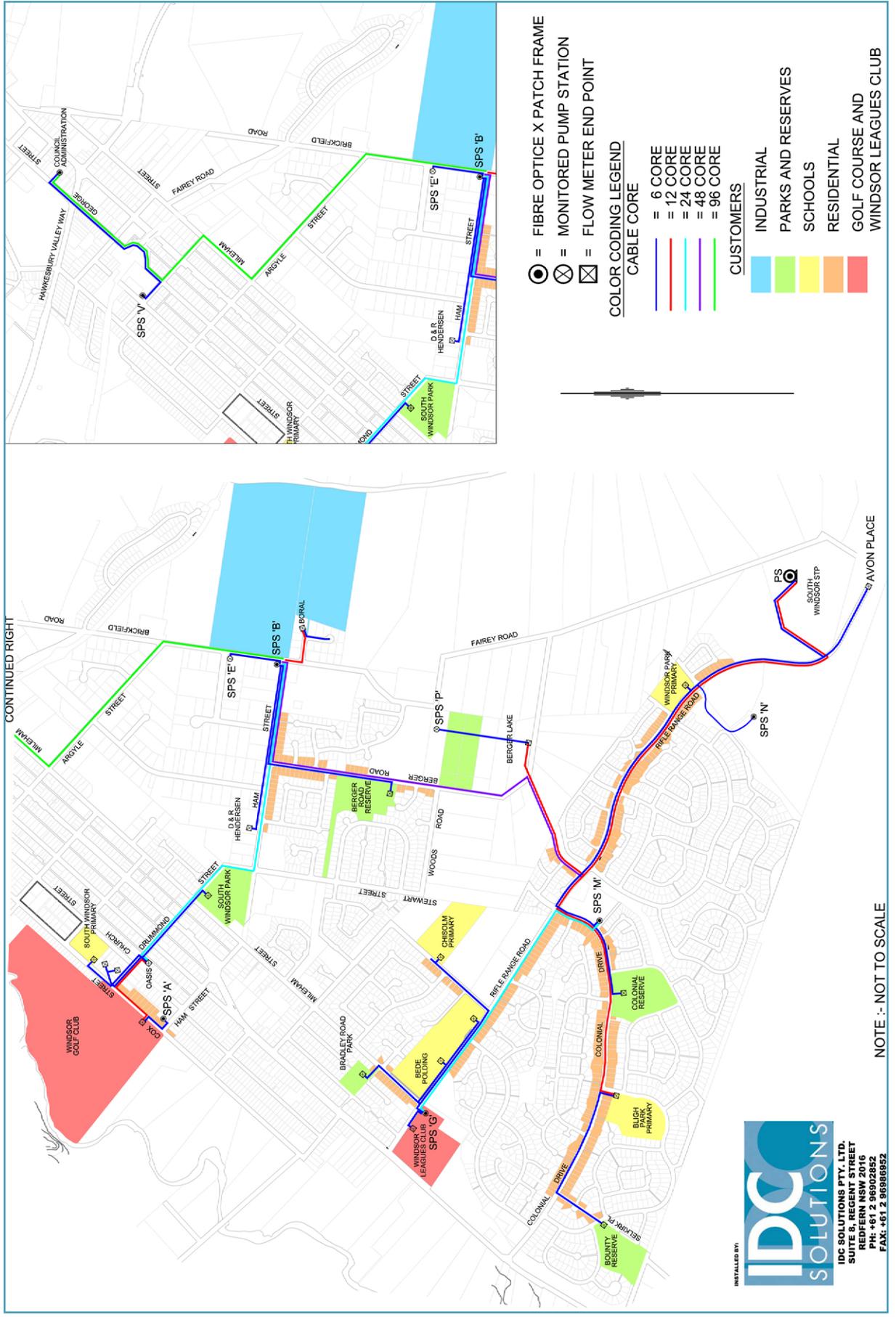
Figure 38. Plan of South Windsor's recycled water pipe distribution network



MMA Civil Contractors
Recycled Water Scheme - Pipe Line Route

Designed by HydroScience Engineers
Strategic Water Solutions

Figure 39. Plan of South Windsor's recycled water optic fibre network





Social benefits

As well as benefitting the Hawkesbury–Nepean river system, the South Windsor Effluent Reuse Scheme Project has created social benefits by improving sporting surfaces and the quality of open space areas in South Windsor and Bligh Park.

Colonial Reserve, Bradley Road Reserve, Berger Lake Reserve, Mileham Street Reserve, Bounty Reserve and Berger Road Reserve now have access to a continuous source of recycled water for irrigating playing fields and open space areas which improves surfaces and provides safer conditions for players and recreational users. Without continuous irrigation, surfaces can become hard and unforgiving to users, increasing the chance of injury.

Schools and sporting groups that directly benefit from the project are:

- Bligh Park Cricket Club
- Bligh Park Football Club
- Hawkesbury District Cricket Association
- Windsor Wolves Rugby League Club
- Bede Polding College
- Bligh Park Primary School
- Hawkesbury High School
- Windsor High School.

The recycled water will also reduce the amount of drinking water used for irrigation, providing cost savings to community groups and helping to increase Sydney's water supply security.

Community members took an active interest in the project's progress throughout the construction period. On 6 June 2011, members of the Bligh Park Football Club joined representatives from the Australian and NSW governments, councillors and project staff at Bounty Reserve to celebrate the connection of a distribution line from the new recycled water plant. The project was also celebrated on 8 November 2011 when dignitaries, staff and community members gathered for its official opening.



Members of the Bligh Park Football Club will benefit from the project



New South Wales Senator Doug Cameron and Hawkesbury City Council Mayor (former), Councillor Bart Bassett, accompanied by Bligh Park Football Club players, turn the first sod for the recycled water connection at Bligh Park, June 2011



New South Wales Senator Matt Thistlethwaite and Hawkesbury City Council Mayor, Councillor Kim Ford cut the official opening ribbon at the completion of the project, November 2011

Water savings and nutrient export reductions

The South Windsor Effluent Reuse Scheme Project aimed to:

- replace the 100 million litres per year of potable water used for open space irrigation with treated effluent from the South Windsor sewage treatment plant
- reduce total nitrogen loads discharged to the Hawkesbury–Nepean river system from the South Windsor sewage treatment plant by 0.44 tonnes per year.

The water savings objective will be validated by measuring the annual volume of recycled water used. This will be measured using flow meters at each participating site.

The nutrient export reduction objective was based on estimated nutrient savings achieved by stopping nutrient-rich water from being discharged directly into South Creek, instead treating the water and using it for surface irrigation. Actual nutrient export reductions achieved will be determined by:

- using flow meters to measure the annual volume of recycled water used (in millions of litres)
- measuring the concentration of nutrients (nitrogen and phosphorus) in the water (in milligrams per litre)
- multiplying the annual volume of recycled water by the concentration of nutrients which will provide the nutrient export reductions (in tonnes per year).

The effluent reuse plant was operational at the completion of the project. The project has been designed to meet the requirements of the Guidelines for Urban and Residential Use of Reclaimed Water and the Australian Guidelines for Water Recycling 2006 and operation and maintenance plans are in place to ensure ongoing compliance with these guidelines. Given the technical nature of this project, it can safely be assumed that with the successful completion of the project analysis, the objectives of 100 million litres of water savings and 0.44 tonnes of nutrient export reductions per year will be met.



The South Windsor Effluent Reuse Scheme Project will save 100 million litres of water per year and reduce nutrient exports to the river system by 0.44 tonnes per year

Learnings

Learnings resulting from the South Windsor Effluent Reuse Scheme Project are:

- Infrastructure projects require considerable investment in design and approval processes before the construction can commence. Investment must be made in the development of priority elements (design and approval) to ensure projects are sufficiently developed to allow for their completion during relatively short funding cycles.
- Using one contractor to carry out both the design and construction of recycled water facilities can significantly reduce costs and help to ensure deadlines are met. Extensive knowledge of both aspects allows the contractor to better plan for construction requirements in the design phase and more easily resolve any design issues in the construction phase.
- An optic fibre network is vital when monitoring the process and distribution of recycled water to recipient sites. The network provides real-time data which confirms whether the process is compliant, allows parameters to be changed from any remote site and provides access to information for streamlined accounting and reporting.

