Water Efficiency Research

2002 – 2016

Project Summaries

August, 2016

Smart Water Fund Water Efficiency Research

This document summarises the water efficiency and efficiency-related research initiated by the Smart Water Fund during its 15 years of operation since its establishment in 2002. Water efficiency is here taken to refer to practices that maximise the benefits gained from every unit of water consumed.

Smart Water Fund is a joint venture between the Victorian Government, Melbourne Water, City West Water, Yarra Valley Water and South East Water. The Fund invests in research that addresses the shared challenges and risks of the Victorian water industry. This research is for the benefit of the entire Victorian water industry.

With this in mind, the purpose of this document is to highlight the full suite of water efficiency research the Fund has instigated. This summary provides opportunities to utilise existing efficiency research for the benefit of the water industry and its customers. It is hoped that documenting these projects can help the water industry achieve immediate water efficiency goals, avoid duplication of effort, and identify new opportunities to build on existing knowledge and datasets of the future.

The research projects in this document are grouped into three categories. The first category (pages 3 to 8) is the full list of water-efficiency-specific projects the Fund has instigated. Two categories of research projects that are complementary to water efficiency follow. These are grouped under 'augmenting supply' (pages 9 to 12) and 'planning and water resource management' (pages 13 to 15).

Each project summarised below is hyperlinked to the relevant Smart Water Fund resource library web page. Full project case studies, final reports and related content can be accessed via these pages. One or more sub-themes are listed for each project in this document to make it easier to sort through the research. These sub-themes are:

- Efficient technologies
- Irrigation
- Residential insights
- Commercial insights
- Best practice
- Integrated water management (IWM)
- Water Sensitive Urban Design (WSUD)

- Planning
- Rainwater
- Stormwater
- Wastewater
- Water recycling
- Customer behaviour
- Asset management
- Conservation

Water Efficiency Research Projects

Project	Sub-themes	Description
Optimising Open Space Management (11SW4)	Irrigation Best practice Efficient technologies	This project developed the *Best Practice Guidelines for Functional Open Space*. These take the form of a toolkit designed to assist open space managers and field staff achieve functional and sustainable green space by using water very efficiently. The Guidelines cover: • The most water efficient technologies and how to apply • Social and environmental benefits of improved open spaces • Developing business cases for the application of open spaces
National Business Water Efficiency Benchmark (9TR2-014)	Commercial insights	The National Business Water Efficiency Benchmarking project (NBweb) allows business customers & the water suppliers to benchmark business customer water usage. The tool can: • Enable businesses to compare their water use to industry averages • Identify their own ways to use water in the most efficient manner and save costs • Enable water suppliers to share their experience and pool resources
Improving Water Efficiency in Evaporative Coolers (72M-7091)	Residential insights Commercial insights Best practice	Two field trials were conducted for this project that used 50 residential and 50 non-res evaporative coolers to establish the water efficiencies of these units in operation. The results of the trials were combined with knowledge of the state wide installed base and current installation practices to produce total estimates of water use and to identify potential savings. Findings were then used to develop best practice guidance for residential and non-residential customers on the operation and maintenance of evaporative coolers.

Project	Sub-themes	Description
Water Efficient Bed Pan Sanitizer Units within Hospitals (72R-7006)	Efficient technologies Best practice	This project promoted water efficiency through best practice for bed pan sanitisation. After use, bed pans are washed and sterilised by sanitiser units that previously used 45 litres per cycle. The new sanitiser units developed in this project clean bed pans in a much more efficient manner.
Recycling Greywater in Continuous Batch Washers (72R-7072)	Commercial insights Greywater	In this project, modifications were made to two large commercial washers, Continuous Batch Washers, to recycle greywater. There was a significant reduction in water usage immediately following the commissioning of these machines.
Sustainable Water Use at Tamil Temple (72R-7030)	Rainwater harvesting WSUD Greywater	The final outcome was the completed upgrade of a Tamil Temple with clever design that adopts environmentally sustainable principles to provide a practical demonstration to its members and the broader community of how to embed the efficient use of water in community assets.
Assessment of Clean in Places in Food Businesses in Melbourne (62M-2039)	Best practice Commercial insights Efficient technologies	This project developed the *Clean in Place Best Practice Guidelines*. These Guidelines are a support tool for medium to large sized food businesses. The Guidelines look to optimise the Clean in Place systems to enable commercial cleaning practices to be as water efficient as possible.
Innovative Water Conservation and Irrigation Systems for Grass Bowling Greens (52M-2080)	Irrigation Water conservation Stormwater harvesting Water recycling	This project demonstrated a number of water saving and recycling technologies that utilised stormwater capture and reuse and incorporated innovative sub-surface irrigation systems rarely used in the bowls sector. The final fully integrated water conservation plan for the Blackburn Bowls Club eliminated the need for potable water for all non-drinking water applications and was expected to save the club 1.2 million litres of water a year.

Project	Sub-themes	Description
Construction of a Waterless Equine Racing Track (52R-2018)	Efficient technologies	This project trialled the use of alternative harness racing track surface materials to determine their effectiveness at reducing water demand while remaining acceptable for horse training and racing purposes.
Net Zero Water Use Project at Cadbury's Ringwood Plant (52M-2086)	Commercial insights Efficient technologies	A water recycling system was designed and installed at Cadbury Schweppes in Ringwood. The system reduced the volume of water consumed by the vacuum pumps at the plant. Water savings are around 5.5 million litres of water per year. Return on investment for the $25,000 project cost has been delivered through reduced water costs and reduced trade waste charges.
Replacing Cooling Towers to Conserve Water (52M-2108)	Water conservation Commercial insights	This project designed and trialled a new waste heat rejection system to replace cooling towers in power stations and large air-conditioning systems. This project demonstrated that compact polymer heat exchangers can be used to replace cooling towers in power stations and large air-conditioning systems. The findings from the project open the path to major water savings.
Best Practice Water Use Guidelines for the Health Spa Industry (42R-2018)	Commercial insights Water recycling Efficient technologies	The project consisted of an audit of the Victorian Spa Industry to understand current water usage across the industry and allow for the development of water efficiency guidelines. Potential water saving measures were identified, including installing water efficient equipment, recycling and reusing water, and adopting more water efficient practices.
Beckley Park Conservation Project (42R-2021)	Efficient technologies	The project implemented and trialled a variety of initiatives in order to make the Beckley Park racing track facility less reliant on mains potable water, including upgrading to water efficient appliances, installation of a wastewater re-use system and installation of a 110 kL rainwater tank.

Project	Sub-themes	Description
Water Conservation in the Bendigo Bank Head Office (42R-2031)	Greywater Water recycling Efficient technologies	The purpose of this project was to incorporate water saving measures into the building design of Bendigo Bank's head office to reduce demand on potable supplies in highly stressed catchments. The project will conserve an estimated 4.5 million litres of potable water and a considerable quantity of landscape irrigation water each year.
Drought Proofing Tennis in Victoria (42M-2023)	Efficient technologies	This project trialled two new technologies unique to the Australian tennis industry that have the potential to reduce water use on red porous courts by at least 50 per cent. These water saving technologies were demonstrated to have the potential to save between 300-450 litres, per court, per day, which is approximately 300-600 million litres of water per year.
Rainwater and Water Recycling Options for the Home (42M-2033)	Residential insights Rainwater harvesting Efficient technologies	The project has involved the production of a book that is focused on the practical methods of using rainwater and recycled water onsite. Through the application of the methods and technologies described in the book, householders will be able to minimise their reliance on centralised mains water supplies.
A Toolkit to Minimise Water Use in Small Scale Food Processing (42M-2047)	Commercial insights Best practice Efficient technologies	This project developed a 'toolkit' to provide useful information for small to medium scale food manufacturing businesses on how to plan and implement water efficiency and conservation initiatives.
Water Smart Tourism – Saving Water in Regional Motels (42R-2035)	Efficient technologies Commercial insights	This project demonstrated the benefits of regional motel businesses implementing water saving technologies in accommodation premises through the water audit, retrofitting water efficienct appliances, monitoring and assessment of water and cost savings for 8 motels in different regions across Victoria. The project achieved approximately 3.75 million litres per year of potable water from the 8 case study motels.

Project	Sub-themes	Description
Collection, Treatment and Reuse of Nursery Runoff Water (42R-2036)	Irrigation Water recycling Efficient technologies	This project saw the installation of a unique recycling system that collects, treats, stores and reuses rainwater and irrigation run-off water for irrigation purposes at a large scale seedling production nursery which is one of the largest uses of water in Hamilton.
Market Garden Fully Automated Watering System (32R-3000)	Irrigation Efficient technologies	The aim of this project was to install a new fully automatic watering system in a 28 acre market garden near Horsham, exclusively using surface and sub surface dripper tape.
How to Achieve Water Savings of 80% in Residential Buildings (32R-3001)	Residential insights Efficient technologies Greywater Rainwater harvesting	The aim of this project was to encourage adoption of water efficiency measures in the residential sector. Deakin University was funded to study water use and conservation in a sustainable designed house in Geelong. The design incorporated rainwater harvesting and treated greywater systems and achieved a 64% reduction in the use of potable water.
Innovative Water Optimisation in Hospital Laundry Operations (32R-3003)	Commercial insights Efficient technologies	The project retrofitted the main batch washing system in a large commercial laundry to conserve water. The project achieved a total annual water consumption reduction of 43% and a reduction in trade waste of 54%.
Development and Testing of a Smart Shower Meter (1021)	Efficient technologies Residential insights	A prototype smart shower meter was developed and tested to determine whether users, when given real-time feedback, would make significant reductions in their water usage. A six-month trial in Melbourne demonstrated an average of 14.8 per cent reduction in shower water consumption among households who trialled the device.

Project	Sub-themes	Description
Replacing Courts with Classic Clay for Water Savings (1027)	Efficient technologies	Smart Water Fund allocated funds towards the construction of a waterless tennis court demonstration site. The project demonstrated that with a 35% conversion of existing porous red courts to 'classic clay' around 500 million litres of potable water could be saved each year in Victoria.
Installation of Waterless Conveyer Technology (1132)	Commercial insights Efficient technologies	This project helped Cadbury Schweppes replace a water based lubricant system of conveyor belts with a belt system that eliminated the use of water in its operation. . The project has saved up to 21.6 million litres of water and wastewater.
Evaluation of Saline Tolerant Grasses and Reclaimed Water Use for Golf Courses (1133)	Irrigation	This project evaluated new turf grasses to identify those that would be suitable for irrigation with reclaimed water. This was achieved by undertaking trials at sites subject to different climatic conditions, soils and water qualities. The results indicated that C_4 grasses (couch, kikuyu, Paspalum, Zoysia) use on average 25-30 percent less water than other types of grasses.

Complementary research: Augmenting supply

Project	Themes	Description
Stormwater Treatment Requirements for Dual Pipe Use (10TR12-001)	WSUD Stormwater	The overarching objective of this project is to improve the planning and design of future stormwater harvesting systems by better understanding stormwater hazards and determining the roles passive treatment systems can play in mitigating these hazards. The project is using the Troups Creek wetland (Narre Warren) as a case study. Research from the monitoring program at the wetland is focusing on: • Characterisation and quantification of human health hazards • Understanding key sources of these hazards • Understanding the potential of wetland processes to reduce sediment and pathogen levels
Survey of Condition and Savings from Rainwater Tanks (10TR4-001)	Rainwater harvesting Residential insights Stormwater	This project examined the condition of residential rain water tanks across Melbourne and the estimated water savings and related stormwater benefits these private assets provided. A condition survey of 417 household rainwater tanks was conducted, along with a metering study of 21 systems. Important results from the research include: • nine per cent of all sites had faulty electronic diverters • 57 per cent of water samples had some level of discoloration • 12 per cent of sites had mosquito larvae or mosquitoes present in the tank and water. • rainwater use at different sites varied considerably depending on the setup.
Trial of Cross Connections Sensor (8OS-8014)	Recycled water Asset Management	This project was run in two parts. The first part developed a miniaturised low cost high accuracy electrical conductivity (EC) sensor with software to detect cross connections. Results from the trials confirm the EC devices are capable of accurately and quickly detecting cross-connections and small variations in source water quality.

Project	Themes	Description
Trial of Cross Connections Sensor (8OS-8014a)	Recycled water Asset Management	The second part of this project developed a small scale, low cost sensor using UV fluorescence as an alternative indicator. The final UV fluorescence prototype was able to detect cross-connections of less than 1% recycled water in the potable water supply and was demonstrated to work effectively in two field trials.
Hospital Operations save H2O for Fire Fighting Operations (62R-2007)	Wastewater Water conservation	This project demonstrated an innovative reuse of wastewater from the Bacchus Marsh and Melton Hospital steam sterilisation units for CFA fire-fighting activities and training. Water recovery rates from the hospital exceed 5,000 litres per day.
Reducing Water Consumption for Fire Fighting Training by Recycling Water (52M-2027)	Water conservation Water recycling	This project was a trial of a water recycling system to reduce non-metered water usage for fire-fighting training. The recycling system has the potential to save up to 60 million litres of water a year.
Surplus Water Collection for Community Sporting Facilities (52R-2011)	Stormwater harvesting	This demonstration project captured water runoff from the Graincorp Berriwillock silo site and directed it to a holding dam for reuse at various sporting and recreational facilities within Berriwillock. This reuse supplies 3.0 – 3.5 million litres of water annually, meeting the 2.1 million litre supply requirements of water for the sporting facilities
Water Recycling and Reuse within Car Wash Facilities (42R-2015)	Water recycling Greywater Commercial insights	This project developed and installed a recycled water processing system at a car wash facility in Traralgon. Concentrations of all water quality parameters measured at the facility were lower than the average value measured of other car wash facilities.

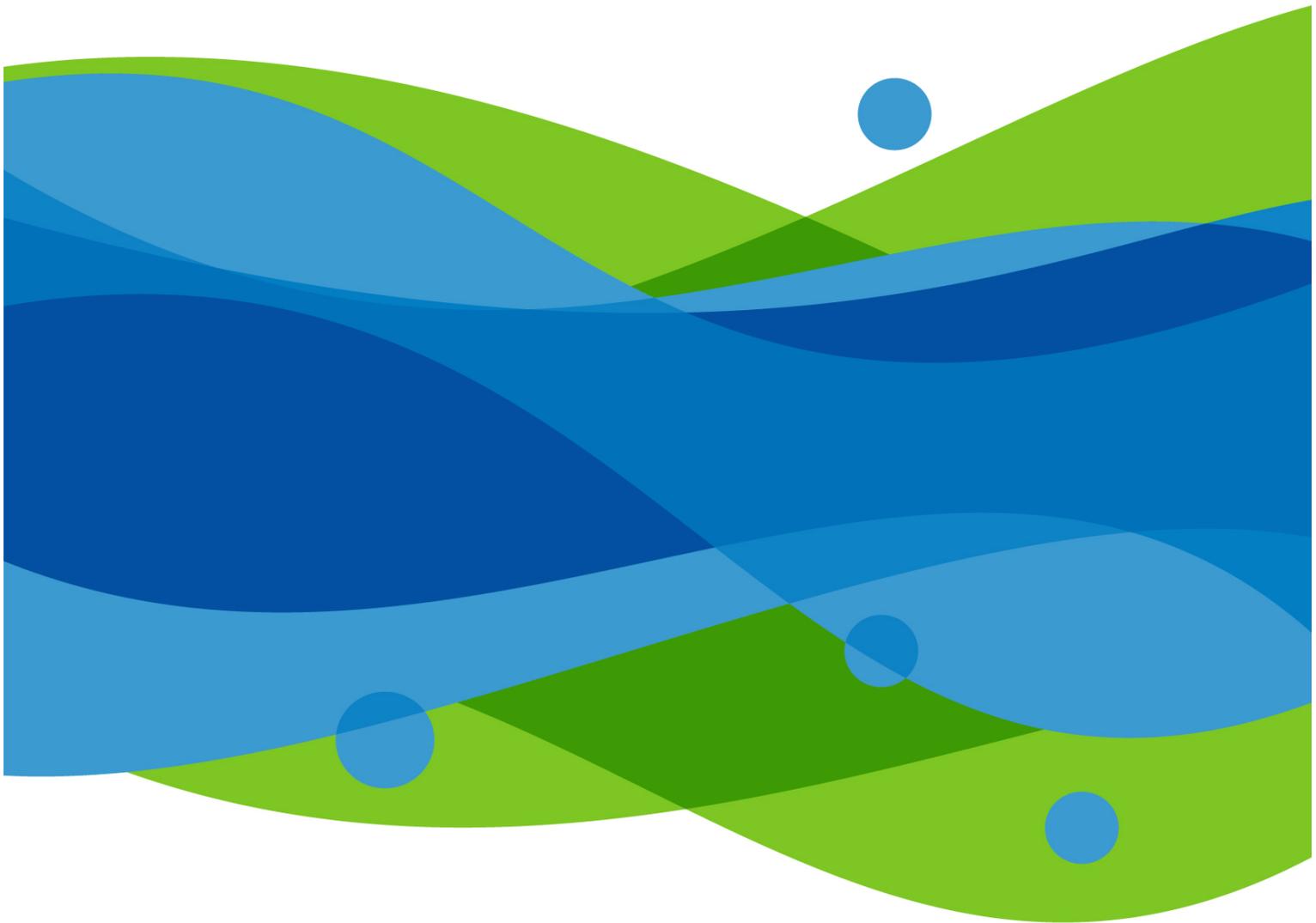| Project	Themes	Description
Knox Leisure Works Pool Backwash Recycling and Reuse (32M-2046)	Water recycling	Funding from this project saw the design, development and trial of a system to reuse pool backwash water for irrigation of sports grounds to save up to 18 million litres of water a year and effectively drought-proof one of Knox's top sporting grounds. This has potential benefit for other aquatic centres and sports grounds considering similar applications.
Smart Water not Mains Water for Urban Communities (32M-2076)	Rainwater harvesting Wastewater	Development of practical approaches that will result in significant reductions in mains water reliance for the gardens at CERES. The project demonstrated the safe and effective reuse of treated wastewater and harvested rainwater in garden irrigation utilising large scale harvesting of rainwater from sub-surface storage.
Urban Wastewater Reuse and Integrated Aquatic Production (32R-3007)	Commercial insights Recycled water	This project investigated the commercial viability and social acceptance of utilising Class C recycled water for the production of fish using aquaculture technologies. It was found that the system rested on a number of variables including the price of Class C recycled water, fish harvest yields and tapping into existing commercial supply chains.
Smart Water Schools in Bendigo (32R-3029)	Rainwater harvesting	Funding was provided for 3 schools in the Bendigo region to develop a range of effective water saving strategies including the development of water-wise gardens. The project also informed curriculum units of study and community awareness programs focused on water savings.
Steriliser Water Conservation (1008)	Greywater Water conservation	This project looked at reusing wastewater from steriliser machines at 3 metropolitan hospitals. The machines were connected to the water supply line of the reticulated air conditioning systems at the hospitals. This solution has saved over 20 million litres of water a year and reduced the hospitals' water bill and sewerage costs by approximately $24,000 per year.

Project	Themes	Description
Water Harvesting and Reuse System for Victoria's State Netball Hockey Centre (1181)	Rainwater harvesting Greywater	This project implemented a rainwater harvesting and greywater reuse system at Victoria's State Netball Hockey Centre in Parkville. Rainwater collected from pitch areas and roofing is stored in four 45 kilolitre underground tanks for use on two synthetic wet hockey pitches. This intervention has saved around 24 million litres of drinking water every year.
Waste Not Want Not: a New Design to Reduce Water Consumption (123)	Wastewater	Installation of a new wastewater treatment facility for a 33-story office building in the Melbourne CBD. Sewage is directed to a blackwater treatment plant, treated, and then pumped to a holding tank on the roof for reuse as toilet-flushing water. The savings can exceed 97,000 litres per day.
Lessons for Car Washes (147)	Water recycling Greywater Commercial insights	This project designed and implemented wash water recycle equipment at a high volume commercial car wash complex in Melbourne. The research demonstrated that the benchmark standard for key water quality requirements for recycled water can be met or exceeded.
Testing Household Greywater Treatment Systems (193)	Greywater Residential insights	This project tested the usability and associated risks of six greywater systems for homeowners. The project consisted of onsite trials of the 6 systems that reduced household water consumption by approximately one third, and a market survey of 120 members of the Alternative Technology Association that found 88 per cent of respondents were motivated to adopt greywater systems.

Complementary research: Water resource planning and management

Project	Themes	Description
Urban Water Cycle Planning Guide (10TR2-001)	IWM WSUD Stormwater harvesting	This project developed the *IWCM Developer Guide*: a step-by-step support tool for developers, consultants and planners to ensure they are incorporating whole-of-water-cycle management into the design of new urban developments. The Guide aims to maximise the efficient use of water on site and at a local scale, taking into consideration water harvesting and recycled water opportunities as part of the servicing strategy of the local area
Melbourne Residential Water Use Reports (10TR5-001)	Residential insights Planning	This project provided a detailed and comprehensive picture of Melbourne's residential water use fro, 2010 - 2012. It tested two different methods to understand Melbourne's residential water use to test existing calculation methodologies. The research included a stock survey of all major water-using appliances and the associated pattern of use through home visits and a questionnaire. The final reports from the project provide a unified understanding of water use in Melbourne households that can be used for metro-wide planning purposes.
Water-Energy-Carbon Links in Households and Cities (9TR1-001)	Residential insights Efficient technologies	This research addresses knowledge gaps around water-related energy use in households and the interrelationship between water, energy, greenhouse gas emissions, and related costs. The results assist in understanding how changes in technology uptake or behaviour influences water use, energy use, carbon emission and costs to households. The research: • Quantified and modelled water-energy-carbon links at the household level • Calibrated these against metered energy and water consumption • Identified implementation pathways for improved management of the energy-water nexus

Project	Themes	Description
Assessment of Potential Impacts on the Sewage System by Advanced Water Efficiency Measures (8TR4-006)	Asset management	This research aimed to better understand the practical limits that the conventional sewerage system in Melbourne places on water efficiency investment. It is important as it tested assumptions regarding the impact of advanced water efficiency measures on the sewerage system and whether there was a limit to water efficiency investment. Some of the specific conclusions were: • There has been an overall decrease in wastewater flows since 1995 • Frequency of blockage will increase as uptake of water efficiency initiatives increases • A number of emerging technologies could potentially assist in mitigating the impacts
Alternative Water Atlas for Melbourne (8TR1-002)	Planning Alternative water IWM	The primary objectives of this project were to explore, quantify and cost the opportunities for alternative water sources across Melbourne. The analysis provided an insight into the potential opportunity for alternative water sources across Melbourne. It produced a spatial planning tool (the Atlas) that can match the needs of users with these alternative water sources users.
Options Assessment Framework (8TR5-003)	Planning IWM	The Options Assessment Framework was developed to assist the Melbourne metropolitan water industry in planning for the future. It draws together three key streams of thinking: • Characterising uncertainties as trends or shocks for better response to their impacts • Identifying scenario paths that consider balancing supply and demand • Developing investment strategies that set a hierarchy for the measures
Water Usage and Savings for Aquatic Systems (52M-2110)	Best practice	Research and analysis of water use in aquatic facilities was conducted to develop industry wide strategies and benchmarks for the most efficient use of water. The research was an important component in the development of the *Indoor Aquatic and Recreation Development Guidelines*.

Project	Themes	Description
Recycled Water Handbook for the Amenity Horticulture Industry (42M-2026)	Recycled water Best practice Irrigation	This project assessed the barriers to adoption of recycled water use in the horticulture industry and determined its specific needs regarding water reuse and recycled water irrigation schemes. It culminated in a handbook that provides designers and managers of amenity horticulture with information to implement recycled water projects.
Pricing for Water Conservation in the Non-Residential Sector (313-002)	Non-residential Customer behaviour	The purpose of this research project was to further advance collective knowledge of the non-residential sector in Melbourne. It produced alternative pricing frameworks and suggested structures designed to improve water conservation in various segments of non-residential sectors.
Savings in the City – Green Hotels (32M-2007)	Best practice Commercial insights	Research from this project produced the *Savings in the City* toolkit that provides support and tools to help hotels make water, waste and energy savings. It would be particularly useful for water industry practitioners designing programs for this target audience.
Best Practice Program for the Laundry Industry (1072)	Best practice Commercial insights	To help the laundry industry improve its water efficiency a *Best Practice Manual for Laundries* was developed to demonstrate to the industry that significant reductions in water use are viable and achievable.
Victoria Bakeries Water Use Best Practice (1170)	Best practice Commercial insights	This project developed the *Smart Water Practice Guide* that provides practical advice on actions bakers can take to save water and money through simple changes in bakery practices, which involve little or no capital investment.