Integrated Water Supply Solutions

Recycled, desalinated, storm, ground and reservoir water

IWA Study Tour 2010

Institute of Water Administration

Melbourne, Adelaide, Perth, Darwin, Singapore

15th – 26th June, 2010

Table of Contents

This study tour was developed by Atura Pty Ltd for the IWA.

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Disclaimer

i. About Atura

Atura is a consulting firm providing risk assessment and risk management services to ensure the protection and safety of the terrestrial (soil based) environment. Atura specialises in the management of risks posed to soils in both urban and agricultural landscapes and protection of the biota and resources found on land. This includes agronomic and amenity horticulture, with strong ties to the use of recycled water in the terrestrial environment.

Atura has considerable experience in conducting study tours for industry leaders in Australia and internationally.

ii. About the IWA

The Institute of Water Administration (IWA) is a Victorian not-for-profit training and development organisation with members coming from the state's water corporations and suppliers. The primary objective of the IWA is to advance the standards of management and administration within the water sector, making an active contribution to the future directions of the industry by providing effective networking, training and development opportunities.

IWA has commissioned this Study Tour to explore the challenges, opportunities and solutions available to water corporations in Victoria. *'Integrated Water Supply Solutions'* will look at all aspects of managing the integration of a variety of water sources, including desalination, from operations to administration, customer communication to technology, recruitment to risk management; as well as legal and financial considerations.

iii. Acknowledgements

Tour participants provided notes for specific days on tour and these notes have been incorporated when summarising the major points from each site visited on the tour.

IWA Study Tour 2010: Adelaide, Perth, Darwin and Singapore.

Overview

The Institute of Water Administration (IWA) is a Victorian not-for-profit water industry organisation with a member base of individuals, water corporations and other contractors and consultants servicing the state's water corporations. The primary objectives of the IWA are to advance the standards of management and administration within the Victorian water industry. These objectives are achieved through shared networking, training and development opportunities that make active contributions to the future directions of the industry. IWA members contribute and share learnings in the form of conferences, Special Interest Groups, networking functions, development and other awards and study tours . IWA commissioned Atura Pty Ltd to organise and lead a study tour exploring the variety of approaches to integrated water supply management; with the aim of ensuring IWA members are aware of opportunities and the most innovative solutions to these complex challenges.

Ten delegates recently stepped outside of their state to discover how similar challenges are being faced by their counterparts in South Australia, Western Australia, Northern Territory and Singapore. All aspects of managing the integration of a variety of water sources, including desalination, stormwater, groundwater, surface water and recycled water were studied. Innovation and integration of diverse water resources were explored in both large and small scale projects. Topics ranged from strategy to action planning, operations to administration, corporate culture to customer communication, technology to risk management; as well as legal and financial considerations.

Challenges for tomorrow explored

As a nation we are facing one of the biggest challenges of our time; to maintain and sustain water supplies for tomorrow's Australia. Urban water resources are becoming scarce and will not meet future demands, especially if the quality of life expected by the increasing population is to be met. Forecast population growth and the expansion of current metropolitan areas are compounding the impacts of climate change. To combat and manage these changes and ensure our quality of life will be improved and maintained by easy access to fresh water supplies in the future, the study tour explored several emerging challenges:

- The variety of water supply modes available and their impact on communities, catchment management and infrastructure planning (including managed aquifer recharge, stormwater harvesting, desalination, greywater, rainwater, recycled water).
- Strategies for the provision of water security in the face of climate change and uncertainty; cost effectiveness and sustainable management.
- Seawater desalination – is it an insurance policy only? If so, what is the premium for this insurance?

- Incorporation of water sensitive urban design principles, addressing the environmental impacts of integrating water supplies and developing appropriate alternative energy solutions.
- Understanding urbanised landscapes as water catchment areas, and harnessing the diversity of water supplies in light of competing demands for water of varying quality and volumes.
- Managing impacts of modified water signatures (a consequence of desalinated water) in a water grid on infrastructure and water quality.
- Water quality challenges associated with capacity management and the blending of a variety of scarce water sources
- Communication and customer service challenges, issues and opportunities relating to public relations, community engagement, customer perceptions, education and uptake.

MELBOURNE HIGHLIGHTS

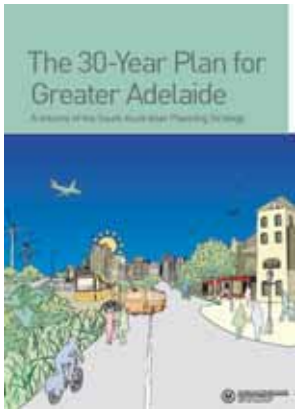
The tour started with a welcome dinner which set the scene for the journey to follow. Delegates had the opportunity to gain an Australian perspective on integrated water supply and use over dinner and a round table discussion with special guest, CEO of WSAA, Ross Young. Ross shared some of his views on future water trading opportunities and limitations, the connected Water-Energy challenges, and potential industry impacts of any future emissions trading scheme.

ADELAIDE HIGHLIGHTS

SA Water and the State Government has placed significant focus on planning and the development of infrastructure, systems and schemes to support the significant population growth projections and the associated demand for quality water supplies anticipated.

Delegates learnt about and spoke frankly with people in charge of programs such as the:

- Network Water Security Program which provides infrastructure planning for the next 20 years to address limited connectivity issues and on optimising the use of existing infrastructure. The development of the North South Interconnection System Project is a significant part of this program and aims to connect Adelaide's northern and southern water supply networks to allow:
    - Enhanced security of supply
    - Optimal use of assets
    - Flexible long term management of current and future water resources
- Water for Good is a comprehensive, robust plan for South Australian water security to 2050. Released in June 2009, the plan incorporates:
    - future supply demand scenarios
    - diversity of supply
    - adaptability in planning
    - legislative, regulatory, and pricing reform
    - education and community awareness
    - innovation and increasing opportunities for competition.



- 30 year plan for Greater Adelaide – This vision for Adelaide's development for the next three decades is the biggest project of its type undertaken since the 1962 metropolitan plan. The plan looks at a wide range of initiatives including mandating water sensitive urban design and sustainability.

Delegates visited a number of sites where they could see the results and implications of this extensive planning including:

- The construction site of the Adelaide Desalination plant which will serve over 1.5 million South Australians with a capacity to provide up to 50% of Adelaide's drinking water in future.
- Aldinga Managed Aquifer Recharge Scheme – storing recycled water for use by irrigators in summer months. A leading technology and research site which may enable this technology to be used in other remote SA locations in future.
- SA Water house – New 6 star Green Building. Utilising the opportunity to align with sustainability values and address cultural and operational issues. Achieved significant cultural change goals along with water, energy and operational efficiencies; if you are ever in Adelaide you have to go and see this building!
- Lochiel Park – leading example of water sensitive urban design integrating stormwater, water sensitive urban design and water recycling.
- Mawsons Lakes –understanding use of recycled water and stormwater for public open space irrigation and third pipe supply to houses for toilet flushing and garden watering.
- City of Salisbury – stormwater reuse using wetland treatment and aquifer storage and recovery (ASR) storage.
- Glenelg to Adelaide Parkland Scheme – recycled water used from Glenelg STP to provide water for Adelaide Parklands and other CBD water recycling initiatives replacing water from the Murray, Hills and River Torrens catchments and groundwater.
- Bolivar STP & Virginia Pipeline – Bolivar STP provides high quality 'Class A' recycled water (Fit for irrigation of fresh vegetables) for use in The Virginia Pipeline for irrigation. The water from Bolivar is also used at Mawsons Lake and Parafield Wetland. The Virginia Pipeline Scheme is the first and largest recycled water scheme of its type in Australia and now has more than 240 contracts using more than 15,000 mega litres of reclaimed water for irrigation each year.

PERTH & ROTTNEST ISLAND HIGHLIGHTS

Tour delegates took a boat trip to Rottnest Island, where they experienced first-hand the challenges of managing water and energy supplies in a small reasonably inaccessible community. Ingenuity, a focus on sustainability and a direct relationship between wind power and seawater desalination resulted in 40% efficiency due to the reliable nature of the wind on Rottnest (power is supplemented with diesel generators).

Delegates also visited Perth's operational seawater desalination plant – the first of its kind to provide desalinated water for large scale public consumption and also the nearby Kwinana Water Reclamation plant which provides recycled water for industry use, saving 6 GL per year of potable water supply.

Gaining insight into strategies used by the Water Corporation to provide water security in the face of climate uncertainty the delegates were provided with a number of presentations:

- Water Forever – 50 yr plan aiming to make Perth and surrounding areas more climate resilient to ensure sufficient and sustainable water supplies for Western Australia. It incorporates 3 key strategies. By 2030, they plan to:
    - Reduce water use by 15%
    - Recycle 30% of all water
    - Develop 70 – 100 GL of new water sources
- The Integrated Water Supply System (IWSS)
    - Delivering water to 1.6 million people across Perth, the South West, Kalgoorlie-Boulder and the Wheatbelt and Goldfields Agricultural regions.
- Groundwater replenishment
    - A future water source for WA where water from a wastewater treatment plant undergoes further treatment and is then recharged to groundwater.
- Land applications of biosolids
    - insight into the success and challenges associated with one of the most successful schemes in Australia

DARWIN AND BATHURST ISLAND HIGHLIGHTS

Significantly different issues are faced in NT. Delegates had the opportunity to explore issues associated with wet vs. dry seasons and the impact on wastewater treatment and reuse as evidenced by the Alice Springs Recycled Water Scheme. They were also faced with the issues and complexities associated with culture, water quality, management and supply options to outstations and remote communities when they visited the community of Nguiu, Bathurst Island.

The tour also joined the NT AWA Branch for a seminar on the supply of water to remote communities in NT meeting many representative of the Water industry in NT, and sharing with the NT Branch some Victorian perspectives on recycled water pricing.

SINGAPORE HIGHLIGHTS

The delegates explored world leading water resource management in Singapore with visits to:

- PUB (Public Utilities Board) which has 1.2million customers and manages their 4 national taps which include: local catchment, imported water (from Malaysia), 'NEWater' and desalinated water. NEWater is treated used water that has undergone stringent purification and treatment process using advanced dual-membrane (microfiltration and reverse osmosis) and ultraviolet technologies. NEWater could be mixed and blended with reservoir water and then undergo conventional water treatment to produce drinking water (a procedure known as Planned Indirect Potable Use or Planned IPU). There are currently 4 NEWater plants in Singapore and significant education and public relations campaigns are conducted within the community to ensure support for this 'tap'. Delegates visited their impressive visitor centre.
- The Marina Barrage (Singapore's 15th reservoir and the first in the heart of the city) has a catchment area of 10,000 hectares it offers 3 benefits, water supply, flood control and a lifestyle amenity.
- ABC Waters Program (Active Beautiful Clean Waters). These sites are transforming Singapore's drains, canals and reservoirs into vibrant, clean and aesthetically-pleasing streams, rivers and lakes. This is part of PUB's strategic objective to bring Singaporeans closer to water so that they can better appreciate and cherish this precious resource and help improve their quality of life.
- Chestnut Avenue Water Works is a protected jungle catchment - the last remaining jungle catchment in Singapore. It is one of the largest immersed membrane plants in the world producing drinking water. Fish bio-monitoring is undertaken here to enable quick response to pollution or contamination.

After the study tour several participants stayed on to attend Singapore's International Water Week, 'Exploring Sustainable Water Solutions for Cities'.

By the end of the 11 days on tour delegates were exhausted from the pace of the tour, yet amazed by the variety of methods utilised to manage integrated water supply systems and the enormous amount of innovative solutions they had studied. Appreciation for the time, enthusiasm and willingness to share information with the delegates is extended to all representatives at each of the sites and companies visited. Their openness, question answering and time given to help educate and share their experiences with delegates was astounding! A number of the delegates agreed that what was learnt on tour, along with the contacts and friendships made will provide a solid foundation for improving how work is done in the future. The benefits to the water industry will be experienced for years to come.

KEY MESSAGES

Some key take home messages in relation to integrating water source management from participants were:

Community and Culture

- Respect the environment, culture , community and history
- Seek to understand social considerations when investing in water projects - Community consultation is critical; collaboration between water corporations and the local community is crucial
- SA Building of Life is a Conduit of Culture (enhancing cultural change within an organisation) illustrating that improved productivity and cultural benefits can co-exist
- Education for all ages is the key
- The right work culture is critical - You must embrace a **can do** attitude

Industry Collaboration

- A collaborative approach is required enabling water projects to be developed that support a coordinated 50 year plan
- The need to communicate and share industry knowledge is paramount
- Encouragement of Innovation is required We need to “Go for it”,

Future Drivers

- Stormwater integration is part of the solution
- Optimisation of system quality, quantity and energy use
- Need to diversify water supply risk re:
- Climate change impacts
- Opportunities to manage stormwater
- With money and the right drivers anything is possible, however, you need to bring the community along
- Appropriate Water pricing is essential to encourage investment and innovation in water projects
- Energy is “the next big thing” and there needs to be a cooperative industry effort
- Strong project management

1 ST DAY: OUTLINE OF TOUR - INTEGRATED WATER USE IN AUSTRALIA (TUE 15/6 EVENING)

This introductory evening provided an opportunity for tour delegates to meet one another after checking in at Mantra Tullamarine.

Peter Quinn, IWA President welcomed the group and Daryl Stevens (tour leader) provided delegates with an overview of the study tour destinations. This was followed by a round table of who's who and each delegate stated what they hoped to learn from the tour.

See the final day for a summary of the major learnings from the tour and site visits (Section 11.4)

Special guest for the evening was Ross Young, Executive Director of Water Services Association of Australia (WSAA).

1.1 ROSS YOUNG, WSAA - AN AUSTRALIAN PERSPECTIVE ON ALTERNATIVE INTEGRATED WATER SUPPLY AND USE.

1.1.1 CONTACT DETAILS

Ross Young- Executive DIrector,
Water Services Association of Australia
(03) 9606 0678
www.wsaa.asn.au

1.1.2 ON TOUR NOTES

Presentation and general discussion with Ross Young. Key points from notes:

- Seawater desalination is the insurance policy for the water industry.
- Currently as an industry we are in a state of transition – changes are coming but structure will be similar.
- Institutionalise water planning – currently urban planning is dominated by transport – like to see water considerations feature more in urban planning.
- Green-fields are opportunities for demonstrating innovation; Brown-fields are much more challenging.
- Need to be clear about the 'water versus energy nexus' that is the next big industry challenge that is coming.
- Regulators haven't been good at looking at energy impacts – this will come – potentially in the form of energy penalties.
- The ongoing benefits of scale versus regional diversification is a big unknown at present.

Future benefits may be declining, for example, we can't keep hooking up customers to Melbourne's Werribee Treatment Plant as they get further and further away

- Diversification of water sources is critical to manage the risk of water shortages. Desalination alone is not the answer. The water industry also needs to consider recycling, managed aquifer recharge (MAR), dams, and other sources as part of the solution.
- Population growth will see Australia reach 31.5 million people by 2036; hence a lot more water will be required in future.
- Local councils in many states look after stormwater which is a resource to Melbourne Water
- Water trading will not get down to residential level – 'too hard'
- Water energy nexus is the 'next big thing'. An Emissions Trading Scheme will eventually happen – the community will demand it!

Electronic Media and Useful Links

Disc contains:

- Infrastructure Australia: Review of Urban Water Security Strategies report, May 2010.

2 ND DAY: MELBOURNE - ADELAIDE (WED 16/6)

2.1 ADELAIDE DESALINATION PROJECT

Focus: Integration of desalinated sea water supply into surface water catchments - Adelaide Hills and Murray River

FIGURE 1: **ADELAIDE DESALINATION PLANT MAJOR PROJECT DECLARATION AREA**

2.1.1 CONTACT DETAILS:

Jan Pederson
0408 471 083
Presentation by:
Milind Kumar- ADP Project Director
Adelaide Desalination Plant (ADP),
+61 8 7424 3645, milind.kumar@sawater.com.au
Location: 16 Chrysler Road, Lonsdale

2.1.2 BACKGROUND INFORMATION

The South Australian Government's $1.83 billion Adelaide Desalination Project will provide reliable drinking water supplies for the future – up to 100 billion litres of water each year, or about half of Adelaide's annual water supply.

Construction is well under way at the Lonsdale site, south of Adelaide. AdelaideAqua – a consortium of four companies with extensive world-wide desalination experience and strong environmental credentials – have been contracted to design, build, operate and maintain the plant for 20 years. The project is being managed by SA Water.

First water will be delivered by the end December 2010 (approximately 15 ML a day), progressing to 50 GL capacity by the end August 2011 and full 100 GL capacity by the end of December 2012.

A temporary visitor centre on the site hosts regular information sessions. IWA members can look forward to an overview of the project, models and display materials to explain the desalination process, and a tour of the construction works so far.

Transfer pipeline

An important part of the Adelaide Desalination Project is the transfer pipeline system to deliver water from Port Stanvac to the Happy Valley water treatment supply. Desalinated water will be pumped through the pipeline to Happy Valley, where it will be combined with water from the water treatment plant before entering the existing water supply network. The water will not enter the reservoir but will be mixed with already treated water from the plant.

The pipeline has been constructed by respected construction companies McConnell Dowell Constructors Pty Ltd and Built Environs Pty Ltd (a joint venture).

2.1.3 On Tour Notes

Overview

SA Water:

- Serves 1.5 Million (M) people in SA
- Operates 30 Wastewater Treatment Plants (WTP) and 24 Water Recycling Plants (WRP)
- Manages a $9 billion (B) asset base
- Employs 1500 people
- Typically has an annual budget for approximately $400 M capital expenditure (Capex) and uses different delivery models for Capex compared with Victoria.

Adelaide Desalination Project (ADP) is currently under construction and involves:

- 1,200 people on site for construction.
- $1.83 B Capex
- Reverse Osmosis
- Power Supply
- Transfer Pipe
- Site Preliminary works
- Renewable energy – 100% Green power secured, 20 year fixed price black energy contract secured
- Future provision of 50% of Adelaide's drinking water (100 GL/a)
- 20 year maintenance and operating period, 150 ML/day – first stage 15 ML/d

Concept Development

Started project concept development in December 2007

- Contracts awarded:
  - Feb 2009 (50 GL/a)
  - June 2009 (100 GL/a – update)
- Completion due
  - Dec 2010 (15 GL/a)
  - Aug 2011 (50 GL/a)
  - Dec 2012 (100 GL/a)

The Financial Delegation negotiated with government to enable fast track due to the amount of money being spent on the site (Spend is $60 M / week at the site).

- Financial delegations 4 major projects
- Recovery rate of 48%
- Independent reviewer appointed, also charged with finding solutions, not review of payments.
- Contractor regular monthly assurance statement, no issues, no claims, etc.

The environmental impact statement (EIS) was noted as very good and detailed and can be used as benchmark for other projects.

SA Water is funding all of the project in close relationship with the SA Government in terms of milestone requirements and approvals. The ADP is a Design, Build, Operate and Maintain (DBOM) project with a 20 year life.

During the design and build process they have learnt that critical aspects of the project include:

- Durability
- Quality
- Environmental aspects

Bids for the DBOM were requested on various capacity plants – 100 GL/yr was agreed based on reasonable price submitted originally and government funding availability.

Critical path for performance on the DBOM was that there was no float available on time or cost. Contingency includes multiple shifts, wet weather engineering contingency, air freight of equipment, lay down and assembly areas, early equipment order, overseas inspections by SA Water people, and human resources development.

Design, Build, Operate and Maintain Factors

Some of the factors considered important for the DBOM are:

OH&S

- New personnel on a large site, working long hours pose a challenge

Durability

- Some issues re: concrete minimum requirements for long life and proximity to sea

Community

- Open visible project – engaging the community is a big component in guaranteeing acceptance of the project
- Communication support is high as this creates jobs and provides water to overcome restrictions

Contractors

- Selected on whole of life cost – not lowest capital
- Lowest annual cost for operation and membrane design
- Adelaide Aqua – Abbey Group, McConnel Dowell, Acciona is desalination contractor

Governance involves

- ADP steering committee and SAW Board
- CEOs meetings
- Monthly project contractor meetings
- ADP leadership team – weekly meetings
- SA Water Projects Group
- Independent verifier – SA Water and contractor engaged
- Commonwealth project reviews
- Independent project estimates and progress reviews
- Dispute resolution board
- Each month a contractor statement made so durability / cost / time issues are known at this point in time.

Project risks:

- Milestone compliance
- Tunnel / marine works
- OH&S
- Stakeholder Management
- Overseas supply items
- M and E Capability of local resources Design Completion
- Commission resources

Major contracts:

- DBOM – desal / marine works
- Design and construct (D and C) for pipeline from Port Stanvac to Happy Valley
- Power upgrade to site
- Renewable energy

Notable points:

- Fast track project
- Collaborative approach with SA Water, contractors and Government critical to achieving project milestones and costs
- SA Water funding a critical elements
- Governance allowing SA Water to remain in control – critical
- Durability specification is critical up front (quality) – tricky when a fast track project.

ADP Site Tour:

- Inlet / outlet pipes – 1 km long 2.8m diameter 20 m depth of water

Process:

- RO -> storage -> pump station -> pipeline (8 km) -> BOH tank at Happy Valley and Wastewater treatment plant.

Pump station:

- Sized for 100 GL/a (Approximately 300ML/d)
- 4MW motors (largest)
- Sound is an issue

Enterprise Bargaining Agreement (EBA):

- Separate EBAs for trades on site lead to some small issues needing to be addressed

Daily photographs are taken onsite to keep a record of progress.

Foster a "Can do attitude"

ELECTRONIC MEDIA AND USEFUL LINKS

http://www.waterforgood.sa.gov.au/desalination/the-adelaide-desalination-plant/

For more information about the project visit www.sawater.com.au.

Note: No photography was allowed while on site tour

2.2 ALDINGA WATER FARM

Focus: Managed Aquifer Recharge with a variety of water sources.

2.2.1 CONTACT DETAILS

Chris Marles (SA Water)
0417 886 369
Tony Lennon (SA Water)
Greg Ingleton (SA Water)
Tony Sims/Glenn Templeman (Willunga Basin Water Company)
www.wbwc.com.au
ph 08 8323 7633
fax 08 8323 7934
info@wbwc.com.au
Location: Colville Road, Willunga

FIGURE 2: TRIAL AQUIFER INJECTION SITE

2.2.2 BACKGROUND INFORMATION

ABOUT THE SCHEME

SA Water and the Willunga Basin Water Company are operating an Aquifer Storage and Recovery (ASR) Scheme at the Aldinga wastewater treatment plant. The scheme involves recycled water being stored in the aquifer (30-70m beneath the surface) in winter when irrigation demand is low. It is then retrieved and used by irrigators during the summer months.

The recycled water that is stored in the aquifer is sourced from the Christies Beach wastewater treatment plant at a quality suitable for the irrigation of vineyards. The Department of Health and the Environmental Protection Agency (EPA) have granted approval for this scheme, and set conditions for storing and supplying recycled water. It's important to note this is the same quality of recycled water currently being used by approximately 50% of the Willunga Basin vineyards, via the WBWC.

This project has enabled SA Water to increase the use of recycled water from the Christies Beach wastewater treatment plant, reducing the amount discharged to the Gulf St Vincent. The project also benefits the River Murray by replacing potable supplies currently being used for irrigation.

THE PROCESS

Water is to be injected through three bores into a confined aquifer to enable up to 400 ML of water to be stored per annum. Modelling indicates the injected water will form a bubble (or plume) in the aquifer which will only move a short distance from the injection point; this is due to slow movement of water in this aquifer (Figure 3).

Bores located within a few hundred metres of the injection points may be subject to increased water pressure as injected water displaces a portion of the natural groundwater. There are however, very few private bores within this range of the injection points.

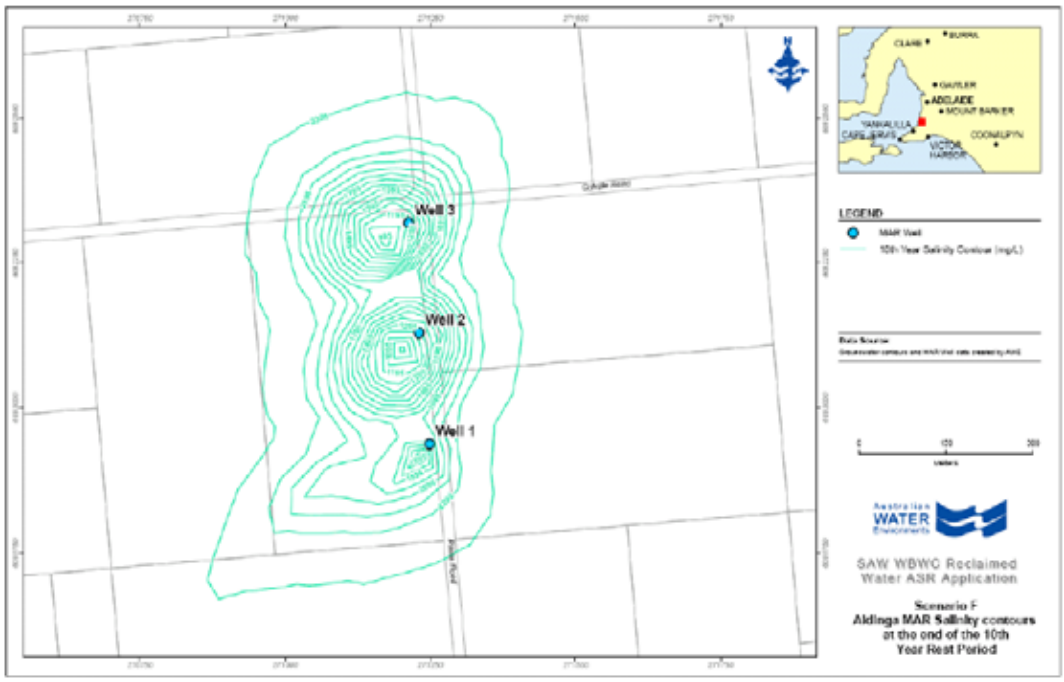


FIGURE 3 LOCATION OF THE BORES AND THE PREDICTED EXTENT OF THE BUBBLE AFTER 10 YEARS. THE AMOUNT OF RECYCLED WATER BETWEEN THE TWO OUTER-MOST CONTOURS IS ABOUT 4% OF THE TOTAL WATER, WITH NATIVE GROUNDWATER BEING THE OTHER 96%. INFORMATION COURTESY OF SA WATER

2.2.3 ON TOUR NOTES

Approximately 12 years ago groundwater availability in the Willunga basin had reduced. An alternative supply for agriculture (grapes, almonds, olives) was required so Willunga Basin Water (WBW) formed and partnered with SA Water to use recycled water from the Christies Beach WRP. The big driver for WBW was a 40% cut to ground water entitlement.

WBW obtains recycled water from SA Water which is transferred via pipeline infrastructure (that they own) and sold to customers (12 kms South and 8 km East). Some facts and figures:

- Use of recycled water favourable for wine labelling re 'organic' produce.
- 1000 mg/L TDS supplied on average (potable water TDS in SA Water Adelaide System 350 – 500 mg/L). Desalination plant coming online (with RO plant) may reduce salinity.
- Approximately 9GL recycled water available from Christies Beach (26 ML/d)
- Need more over summer than available so WBW need to store water discharge for use over summer (up to 45ML/d) in summer
- Pressurised system
- Need to be wary of potential 'salt in wine' issue which is related to exceeding the max chloride values allowed in Europe.

For connection and supply of water WBW are charging:

- Head works (one off charge of $6,600/ML)
- Tariff: 75c per KL – Take or pay. For Class A, recycled water price is 75% of tier 2 drinking water tariff ($1.86/kL) is the cost of recycled water.
- If more than 5ML / p.a. then $11,000 connection cost charged plus $6,600 /ML, plus tariff.
- Noted telemetry system – flow limit infrastructure
- Class B RW supplied

Note: WBW do not pay anything for the recycled water supplied by SA Water, however, WBW are perceived as taking excess Christies beach WRP recycled water (i.e. winter flows) thereby offsetting SA Waters need to upgrade irrigation etc to cater for these flows.

Aldinga Aquifer Storage and Recovery (ASR) Scheme

- 400 ML capacity stored over the winter for summer extraction.
- Sourced from Christies Beach WRP
- Groundwater: 2500 TDS; Recycled water: 800 TDS
- Agency management has been a challenge as new technology (e.g. escaping from aquifer concerns)
- Only chlorine @ Christies Beach WRP prior to injection
- If too salty on extraction will go back to Christies Beach WRP or Aldinga WRP.
- 40m – 80m aquifer storage depth or layer
- WBW require up to 45ML/d in summer
- Aquifer water movement towards coast is a concern of authorities
- Bore is a small pipe (80mm) injection in casing (no screen)
    - Inject 16L/s
    - Extract 5L/s
    - Run about 9m of backflush when required
- Charging area is on SA Water land
- EPA more accepting of stormwater recycled projects than recycled water projects
- Christies Beach recycled water SS 7mg/L, 7 NTU – OK for use in this ASR
- Bore is backwashed regularly when injector rates drop off (20KL/event => to WRP)
- ASR is energy intensive
- Pathogen reduction potential / studies in ASR could be important for future urban reuse treatment
- One month minimum between injection and extraction for pathogens
- Iron in ground noted as an issue (as introducing oxygenated water)

Southern Urban Reuse Scheme

- Class A required
- Ultra-filtration going in (10ML/d - $20M) at Aldinga (i.e.: Class B/C to A)
- Pump to Seaford. Didn't build plant at Seaford due to load constraints
- To be used as a Class A third pipe scheme (toilet flushing, garden use, recreational facility watering) not for laundry due to potential iron concentrations cause staining.
- Costings of ASR vs surface storage to be refined in due course, as study will allow a full scale comparison for this scenario (i.e. They are still to determine if ASR or surface storage has the best whole of life cost).

Why Have SA Water Gone to ASR?

- Costs are probably equivalent to above-ground storage
- To demonstrate to regulators and stakeholders that they could do it
- Leading technology / research opportunities
- If successful here, could transfer to other more remote SA Water sites
- There are no real stormwater options in the Aldinga area
- They can do this type of scheme because water price is higher in SA therefore allowing cheaper recycled water schemes to emerge. If lower potable water tariffs, probably wouldn't work.

700 ML Water Storage (Aldinga WRP)

- $5.5M for storage (no pipe work)
- Aldinga WRP = 1.6ML/d – approximately 400ML /p.a.
- 700 ML size based on use / availability equations for WBW and Christies Beach WRP supply etc.

FIGURE 4: RECYCLED WATER SUPPLY USED FOR VITICULTURE

3 RD DAY: ADELAIDE (THURS 17/6)

3.1 SA WATER HOUSE SUSTAINABILITY FEATURES

Delegates met in lobby for a tour of SA Water House and site visit of building followed by a series of presentations.

3.1.1 CONTACT DETAILS

Main contact: Trish Cannizzaro (08) 7424 1171
Richard Veale- Accommodation Project Change Manager, SA Water (Sustainability tour).
Andy Steere - Program Director of the Network Water Security Program
Robyn McLeod – SA Commissioner for Water Security
Anne Howe – Chief Executive SA Water
John Ringham – Chief Operating Officer SA Water
Location: 250 Victoria Square, Adelaide.

3.1.2 BACKGROUND INFORMATION

- SA Water House is a showcase of Sustainability. Water, energy and waste have all been targeted to create South Australia's first 6 Star Green Star building – in the heart of Adelaide.
- SA Water House has been designed with the public in mind and provides an opportunity for greater levels of community interaction
- A large Customer Service Centre on the ground floor will provide a range of information and face to face services, while a new SA Water Learning Centre will promote a wide variety of water and wastewater information to schools and the broader community
- SA Water is a building designed for the future and sustainability has been woven into every element – from the structural depths to the striking facade.

3.1.3 ON TOUR NOTES

Sustainability Tour of SA Water conducted by Richard Veale, Accommodation Project Change Manager, South Australia Water Corporation.

FOCUS ON CULTURAL CHANGE

The drivers were:

- Culture survey identified accommodation as an issue for morale and equity.
- Significant costs were previously incurred as a result of the geographical spread of the offices / labs etc. Time wasn't being used productively.
- SA Water took the opportunity to align with sustainability values and the chance to showcase these.

Opportunities like this occur only once in a career – culture, efficiency, address internal customer and community needs.

- The project had broad strategic intent – increased productivity and efficiency but wasn't a key driver (turned out to be a significant benefit though). They also wanted to:
    - become an employer of choice to attract the right workforce.
    - promote collaboration and teamwork between previously separate workforces.
- A strategic accommodation review was also requested at the beginning. The new SA Water workplace was always going to be more than a change of address – culture change was a key objective.

Key project principles were established before deciding on site and decisions. Work-shops with senior management were conducted to develop principles. Came up with approximately 12 which were then work-shopped with the 650 staff and are as follows:

- Flexibility – future proof!
- Open and transparent – no closed-in offices
- Ecologically sustainable – 5 star minimum rating
- Healthier environment and natural light
- Consider customer needs – plumbers, customers, etc
- Part of community
- Facilities provided on basis of need (e.g. offices) rather than hierarchy
- Encourage teamwork, collaboration and communication
- Staff input into their own workspaces
- Accessible leaders

All principles have been achieved!

The biggest cultural change was to have no offices. The SA Water CEO doesn't have an 'office' either; senior members reflect policies of the organisation.

3 Key processes

1. Planning a holistic process of change
2. Reinvention of how we work – extensive consultation
3. Reinvent how a building is procured

SA Water had 4 years to find a site, build and move in as lease on the current building was expiring.

They wanted a high performance culture, a new generation of leaders to lead in sustainability. They also wanted to bring laboratories and offices together.

Strategic intent – government policy, cultural and business (e.g. morale, punctuality, OH&S, sustainability).

PROCUREMENT

Six months was spent talking with staff to define what they wanted the building to do (not how it would look). This fed into a building performance brief. Workshops were conducted with developers responding to briefs as they were being developed. It was a 6 week design process – in hindsight this process could have been given an extra 2 weeks to firm up costs (were a bit rubbery with costing during the design process).

Twelve weeks were provided for evaluation and implementation. They had a scoring system for each parameter of what they wanted the building to do (-1, 0, +1) then totalled the score. Parameters with the highest scores were acted upon.

The land is owned by the Catholic Church and is rented at $\$420/m^2$. SA Water has also funded a cogeneration plant so the building produces some of its own energy.

CHANGE MANAGEMENT

Very detailed planning was undertaken, for example ensuring basics such as milk were stocked on day 1. The lab staff came on board when they realised they had the opportunity to build a state of the art laboratory. Prior to this, the lab staff didn't recognise themselves as SA Water staff.

950 people were to accommodate 8 levels. Approximately $13m^2$ per person is typical. Need to have $3m^2$ around work area of unencumbered space. Ultimately SA Water wanted to provide better facilities for all staff.

Richard spoke to managers about offices as they were meant to be removing half the number of offices. Offices were seen to be a status thing so to preserve everyone's status they removed all offices. While there was a lot of debate, senior management eventually decided to give it a go. As the MD was happy to go without an office, most of the others thought if she can do it so can I.

Project managers brought staff in before building was complete for reassurance that it would be OK and to show will be plenty of space.

BUILDING ELEMENTS

The SA Water building is regarded as one of the best in the country – still remains highest rated by the Green Building Council.

Note: the laboratories are not included in green rating as the Green Building Council doesn't have a rating system for those at this stage.

Energy:

- Air-conditioning / Heating through under floor ventilation.
- Air-conditioning – most of the time is 100% air however if <14˚C or >32˚C requires energy.
- High performance double glazing on all windows.
- During the 10 days of 40+˚C the building got to 26 to 28 degrees C.
- 95% of the time heater / air conditioning works well, however, the top floor seem to have some issues as becomes too hot.

Water efficiencies:

- Rainwater collection
- Class A water for toilet flushing and cooling tower
- Wanted to get higher points for water efficiency but had to renegotiate a bit for having cooling towers (as much lower energy use)
- Other new buildings in the CBD are also tapping into water source from Adelaide Parklands.

RESULTS

SA Water overall

- Willingness to engage and share pain and gain.
- High levels of trust
- Acceptable gross rent achieved (now comparatively cheap)

Post occupancy review

- Staff perceptions survey (Pre and Post)
- Workplace productivity
- Indoor environment quality and productivity
    - Noise / light levels, CO_2 levels, particulate matter, etc

Good response from post occupancy workshops and surveys.

- New building has increased staff pride in working for SA Water.
- Improved image of SA Water
- Not much bad press as kept the line of sustainability; and 'no-one knocks sustainability these days.'
- Building and organisation seen as moving into the future
- Education centre for school groups, etc around water conservation.

OTHER LEARNINGS FROM THE PROJECT:

- Increased speed of decision making – accessibility
    - People run into each other and discuss things (i.e. not relying as much on email)
- Increased knowledge sharing
- Increased access to managers
- Big education program for staff – half day induction covering OH&S, new technology, protocols of working in open spaces.

- Realised storage issues would be part of new building therefore developed a new records management system to reduce storage by 50 to 60% of previous buildings
- Increased offsite and electronic storage.

SA Water recognises that they are heading in the right direction, however, are not there yet. The new building has exposed older cultural issues that will still need to be addressed. A change in workplace would help change the organisation. SA Water couldn't compete on salaries.

Operational Considerations:

- Developed standards and guidelines for all SA Water facilities (for regions). To do facilities management (e.g. cleaning)
- Involved monitoring water, energy and waste.
- Printing doesn't print until you get there and swipe ID disk. If you don't go to the printer then it will be deleted after 24 hours – no pages at the printer uncollected and solved confidentiality issues and concerns.
- Open space area very quiet as people understand noise issues and acoustic 'baffling' is used.
- Clear roof to get natural light (in atrium)
- Staircase a feature to encourage use – staff use them all the time. This also increases the 'bump' factor. Furnishings and layout lead staff to stairs – not lift. 6 printers per level (172 staff). Each level has 3 meeting rooms
- All furnishings were considered with Environment Safety and Health guidelines in mind. Desk sizes designed for no MDF wastage from each sheet.
- Separate waste disposal at each 'hub' (kitchen meeting area). Staff have to walk from desk to dispose of rubbish here (only have recycling bin at desk).
- Additional (visible) cleaning undertaken during the day.
- 50% of areas are "social contact" areas
- Includes a Learning Centre for Community & School engagement
- No car parking for staff.
- Bike racks, change rooms and showers provided
- Clothes lines for wet clothes from riding / walking
- Bike riding has increased dramatically
- Public transport close by – started educating staff 2 – 3 years before moving. Didn't lose any staff due to move into CBD.
- Gym in school next door – staff can salary sacrifice membership
- Board fully backed it – e.g. have same chairs as staff
- Frittered veil on west side of the building helps control glare into the building.
- Had to do a lot of retrofitting air-conditioners for IT equipment. Need to make sure you know what they have. IT servers are now held off site as they produce too much heat.

Wanted to avoid refurbishing again and creating "Grandma's Axe" – ie, you can replace the handle 3 times, and the head once – but it is still the same Axe! The old Barton facility has been removed and will be turned into an urban forest (5.5 ha)

Learning Centre

Designed to be interesting and engaging – non corporate – want to promote fun and laughter of kids. Kung Fu the Poo – fun show for wastewater education.

Electronic Media and Useful Links

Richard Veale's presentation (PPT) from SA Unions:
www.utlc.org.au/campaigns_new/Climate%20Change/Richard%20Veale.ppt

Disc contains:

- Employee productivity in a sustainable building report by Price Waterhouse Coopers

3.2 PRESENTATION: NETWORK WATER SECURITY PROGRAM

3.2.1 BACKGROUND INFORMATION

Andrew Steere, Program Director of the Network Water Security Program (NWSP) presented on this program of new capital works that has been implemented to achieve a number of interrelated goals. These relate to optimising the use of existing infrastructure and management of the bulk supply of water and distribution of water through the network.

The North South Interconnection System Project is a significant part of the Network Water Security Program which aims to connect Adelaide's northern and southern water supply networks to allow:

- Enhanced security of supply
- Optimal use of assets
- Flexible long term management of current and future water resources

3.2.2 ON TOUR NOTES

The Network Security Program provides planning for the next 20 years. Limited connectivity is an issue; currently it isn't possible to do large volume intra-system transfers. The long term objective is to provide interconnection to allow transfer of bulk water systems between North and South.

One can look at redundancy with respect to desalination coming online but there still needs to be a connection between North and South in order to utilise the desalinated water in the North of SA. Currently water supply is gravity fed as storages are positioned in the Adelaide Hills but this is about to change with the overhaul of the system.

FIGURE 5: MAJOR PUMP STATION (PS) IN THE POTABLE WATER DISTRIBUTION SYSTEM OF ADELAIDE.

SA Water was looking at connecting 2 reservoirs to transfer untreated bulk water. This was not cost effective ($1B). As the size of the desalination plant was planned to double, SA Water decided they needed to be able to transfer treated water (at a cost of approximately $400M). A systems planning study confirmed efficacy of interconnectivity of treated water distribution network. This project is separate to ADP to ensure aims of the project are kept and not compromised.

Adelaide Desalination Plant (ADP) can do 300 ML/day but the southern region can't use that much water. It doesn't make sense to have an asset (ADP) that can't be fully utilised.

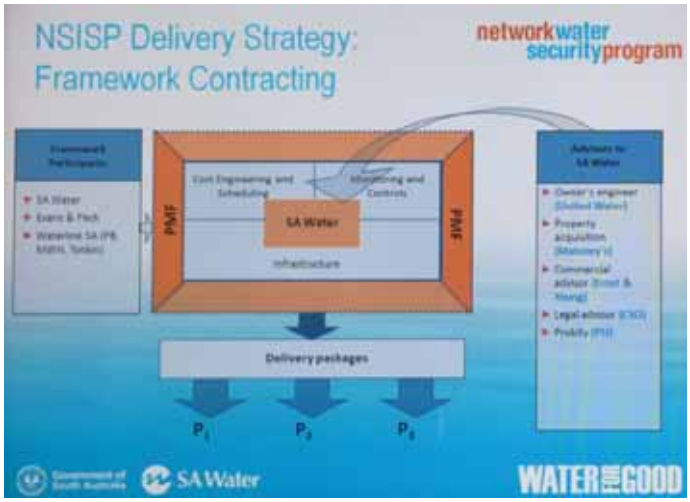
PROGRAM OBJECTIVES:

Interconnectivity of Adelaide Water Distribution Network allowing:

- Enhanced security of supply
- Optimized asset utilization (a major driver)
    - There is a potential to defer capital upgrades (e.g.: head works)
- Flexible long term management of current and future water resources
- Improved continuity of water supply following a loss of key infrastructure (e.g.: pipeline WWTP)
    - This was previously an emergency management exercise and now has capital.
- Water restrictions to 1 in 100 years
- Get the best volume out of the State's water resources
- Maintain current levels of water quality

Real-time operational management of the water network trim deployment of advanced monitoring models and decision making tools allowing:

- Long-term distribution network and bulk water planning
- Improved detection, response and integrated management of field events
- Ensure bulk water and network models are developed
- Can be used for long-term planning



The Network Water Security Program:

- Monitoring and controls include: SCADA, water quality (still to be developed) and PS local controls
- Infrastructure
- Decision Making Tools – Integrated Demand Management System Upgrade (IDMS)

MONITORING AND CONTROL

During the next 6 weeks SA Water will be developing and determining what is required. The Water Management Centre is to develop a 10 – 20 years forward plan looking at optimising water use (desalinated, river, reuse, etc) – The aim is to have infrastructure in place and operational to supply 100ML/day by March 2012.

They will be using Framework Contracting, which has also been used successfully in the UK:

- Commissioning of system will be an SA Water risk and done while the network is still live (40 km of pipeline)
- Allows separate packages to be delivered

Feasibility completed with optimisation and multi criteria analysis (MCA) utilised, then endorsed by desalination steering committee and SA Water.

Infrastructure:

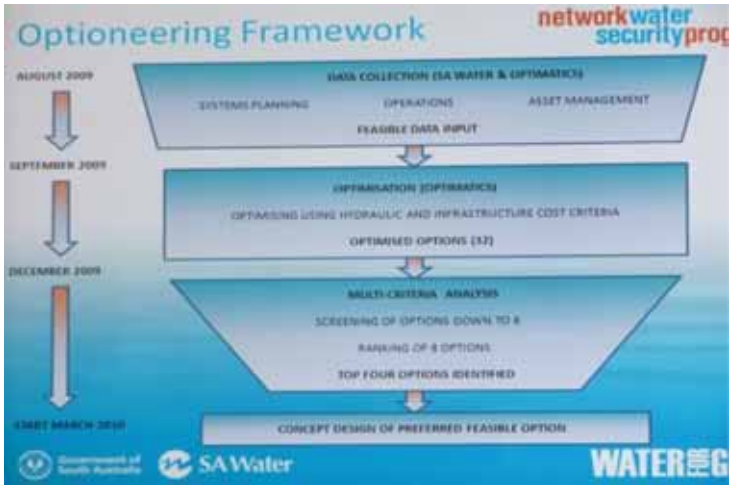
- Currently in final stages of concept design for infrastructure and management.
- Is being split into 10 packages for delivery
- Concept and detailed design done in parallel to enable meeting of timelines
- No land acquisition issues
- 12 months to construct pipes and Pumping Stations
- 1 m diameter pipe (20 – 30m laid per day)
- Used a genetic algorithm to determine where to put new infrastructure – to optimize – was then handed to engineers to do hydraulic design.

Frameworks:

- Data Collection – systems planning, ops, asset management.
- Optimisation – using hydraulic and infrastructure cost criteria
- MCA - screening options down to 8 ranked top 4 identified
- Concept design of preferred option

Optimisation Genetic Algorithm (OGA)

- Financial
- Supply
- Assets
- Political constraints
- Risk
- Operations
- Customer Service
- Environmental constraints



MCA removed the inferior alternatives. Screening criteria includes:

- Operations level of service
- Water quality
- Impact on assets
- Environmental impacts and planning
- Social Impacts – e.g. traffic disruption (working in with road workers)
- Infrastructure delivery

Did a technical assessment – Is best option value for money? Cost wasn't weighted in analysis. MCA categories were weighted by an internal advisory group.

Project is now divided into East, West and Central so will be 3 different paths of water transfer. This will enable them to spread the water uniformly over the district.

Didn't keep focused on original objectives during MCA process – was too easy to get into detail. Most stakeholders were happy with this option.

Pros: Opportunities for options

- Operations flexibility and resilience
- Potential for less bursts and lower leakage
- Potential for improved water quality
- Ease of commissioning – "can we commission it?" was a key driver during the process. Had to fit into timelines

Con: Risks

- Schedule
- Land acquisition
- Approvals
- Control complexity (a key driver)
- Power upgrades

A value for money assessment was undertaken on the top 4 options. Cost was not included in any of the original analysis & assessments until the value for money assessment.

Adelaide Distribution Regeneration will be run flat out for the first 2 years however it doesn't currently have infrastructure to be able to do this. ADP is an insurance policy - should it not rain then we can get it through the system. Customers will be getting a blend of desalinated or river water sources – not 100% of either.

- River Water: 350 – 500 TDS
- Desalinated water – approximately 200 TDS expected.

There will be an extensive mains cleaning program before commissions as flows will be reversed in some areas.

Desalinated water will be blended at the Happy Valley WTP. This has been reduced in capacity to 50 ML/day (was 150 ML/day) to enable control over blending.

Network Water Security Program has a team set up within the planning and infrastructure group. Operations staff are part of the team to ensure solutions developed are owned by ops (and that they are involved in development of these solutions).

Currently messages are being developing around having water available and no restrictions. Will continue to have permanent water saving measures in place and promote effective, efficient wise use of water. Changes have already been made that won't be reversed (e.g. gardens, tanks, washing machines, etc) so not expecting a huge bounce back of usage. SA Water is also looking at affordability for some sections of the community.

Electronic Media and Useful Links

SA Water Sector Agreement February 2010
http://www.climatechange.sa.gov.au/uploads/pdf/PCCC/SA_Water_Sector_Agreement_Feb10.pdf

3.3 PRESENTATION: SA WATER FOR GOOD

3.3.1 BACKGROUND INFORMATION

South Australia's Commissioner for Water Security, Robyn McLeod, will address the study tour with a presentation on Water for Good.

Water for Good is a comprehensive, robust plan for South Australian water security to 2050

The plan, released in June 2009, incorporates:

- future supply demand scenarios
- diversity of supply
- adaptability in planning
- legislative, regulatory, and pricing reform
- education and community awareness
- innovation and increasing opportunities for competition.

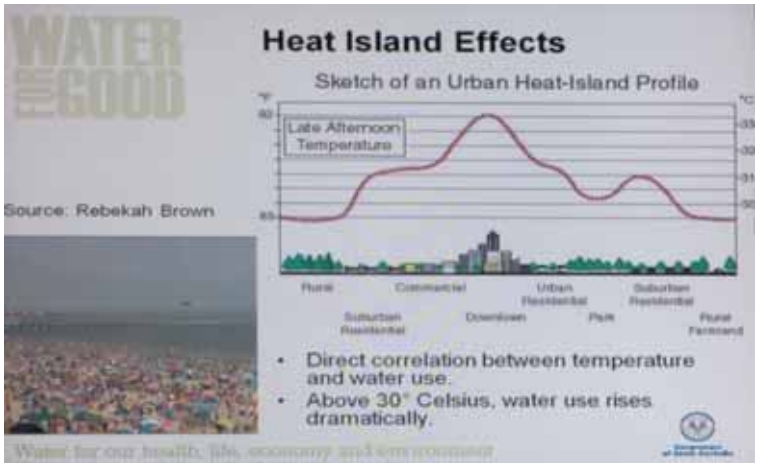
3.3.2 ON TOUR NOTES

The task was to develop a water security plan to take SA through until 2050. Adelaide is the source of 90% of drinking water demand. Currently ¾ of water used comes from the Murray River. By 2050 will be about 2/3.

- Currently 82% River, 18% recycled
- 2012 – Aim 50% desalination, 50% Murray & recycled water & other sources

Want to see cities as water catchments, not just users. So there will be step change reduction of flows in Murray and Mount Lofty. Direct correlation is seen between temperatures and water use. When temperatures are above 30˚C water use increases dramatically.

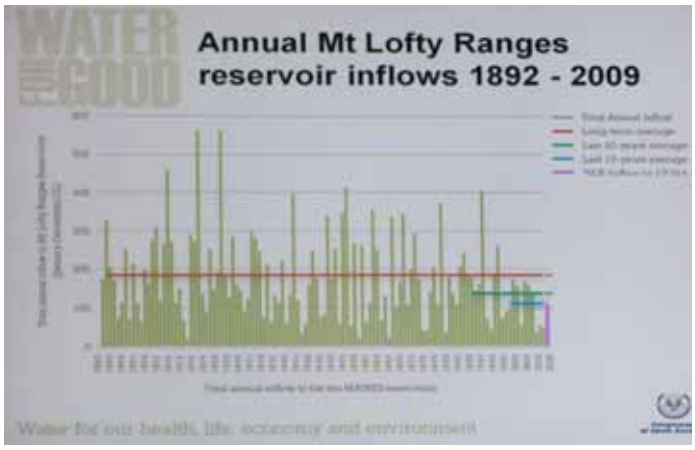
Big population growth is expected in Adelaide by 2050. Desalination alone would only provide water security until 2038.
Increased water harvesting and water recycling is required as well as pricing and regulatory reform. This should ensure secure water by 2050. The aim is 50% desalinated water for Adelaide as this will not be climate dependent.



Some of the factors and considerations changing future water management in SA are:

- Need a basin plan for the Murray. Last resort is to build a weir at Wellington.
- Need to protect catchments against fire.
- Have water allocation planning; need to be quicker.
- Looking at desal needs at Eyre Peninsula

- SA national leaders in stormwater recycling.
- Highest level of tank ownership.
- Stormwater infrastructure is getting ahead of policy (through innovative designs)
- Tripling stormwater harvest by 2050 (60 GL)
- Aim 60 GL stormwater capture and reuse by 2050.
- Stormwater is not to be used for drinking.



Water recycling:

- Victoria has the lowest recycled water use ramp up.
- 3-4˚C heat island effect of cities compared with rural/regional areas.
- Aim 75 GL recycled water use by 2050.

Future plans are:

- WSUD to be mandated by 2013; demand reduction required through uptake of tanks etc. Education is part of the program - the conservation message is a very strong component. There have been significant improvements in water use reduction, but not as low as in Melbourne, Sydney or Brisbane.
- Pool covers to be mandated by 2012 – rebate available.
- Washing machine and garden rebates.
- A lot of old buildings that need to be retro fitted (e.g. dual flush toilets)
- A large education campaign conducted (spent $2 million). Ads are available on the website (www.waterforgood.sa.gov.au/)

Adaptive planning – annual reports are provided to the Minister.

What is coming soon:

- Water Industry Act by end of 2010
- 3rd party access and independent pricing
- Safe drinking Water Act
- Independent regulator (ESCOSA – same as ESC)
- Water will be cost reflective next year
- Low income houses will be protected by concessions

A sustainability assessment was undertaken by Worley Parsons (Triple bottom line to determine the most cost effective options to get an extra 50GL). Options included:

- Expand desalination
- Purchase more water (temporary or permanent)
- Stormwater recycling
- Wastewater recycling
- Demand management

Environmental issues in Lower Murray:

- River bank slumping
- Acid sulphate soils (had to lime 2 creeks to neutralise – went to pH 3 overnight)
- Flooding in Queensland will deliver 400 – 500 GL to SA. This may help to save the struggling lower lakes.
- Desalination is 100% renewable – through purchase of RECS (Renewable Energy Certificates).
- Councils will be responsible for WSUD implementation
- Only rebates for 4 ½ star washing machines, etc to try to push industry to improve.

Water for Good wanted it to be government policy, had to get buy in from departments and go through cabinet. It's now Government policy (from June 2009). 90% of actions done by 2013. Robyn now monitors and evaluates implementation.

Summary notes:

- Water security for SA. Diversity of suppliers. Better water security planning.
- New water industry Act for industry compliance. State-wide pricing model.
- 3rd party access arrangements (e.g. WBWC etc) will be regulated.
- "Build it and they will come" Bigger is better, a monopoly is OK provided regulation is strong.

FIGURE 6 CURRENT AND POTENTIAL STORMWATER HARVESTING SITES

ELECTRONIC MEDIA AND USEFUL LINKS

Disc contains the following PDFs:

- Urban Stormwater Option Study
- Water for Good Community Publication
- Water for Good Plan in Brief
- Water for Good Plan in Brief – print ready version
- Water for Good Full Plan

Interesting info at:
www.infrastructureaustralia.gov.au/publications.aspx
www.waterforgood.sa.gov.au

Robyn McLeod's 2009 presentation on Water Security for Australia available at:
http://www.lga.sa.gov.au/webdata/resources/files/Robyn_McLeod.pdf

3.4 GLENELG TO ADELAIDE PARK (GAP) RECYCLED WATER PROJECT

Focus: Supply of recycled water to parks and buildings within Adelaide's CBD

3.4.1 CONTACT DETAILS

Chris Marles – Major Business Development, Ph: 08 7427 1375, 0417 886 369
chris.marles@sawater.com.au
Cliff Liston – Manager Treatment Water, Quality and Environment, Ph: 08 7427 1925 cliff.liston@sawater.com.au
Guest presenters: Joe Lazzaro - GAP Customer Development)
gapreuse@sawater.com.au
1800 812 362 and
Kent Williams from ACC
08 8203 7203
city@adelaidecitycouncil.com

3.4.2 BACKGROUND INFORMATION

This State and Federal Government funded project has the capacity to provide more than 3.8B litres of high quality recycled water annually. In addition to supplying existing customers, the project will provide a minimum of 1.3B litres each year to irrigate the Adelaide Parklands.

The project provides a sustainable long-term solution for watering the Parklands and can provide opportunities for the development of additional recycled water initiatives. It will reinforce Adelaide's position as a green city and a leader in water conservation. It will also contribute to a range of significant environmental benefits including:

- Reduced discharges of treated wastewater to the Gulf St Vincent;
- Increasing the annual reuse of treated wastewater from the Glenelg Wastewater Treatment Plant by more than three times; and
- Improved health of the River Torrens and quality of the water in Torrens Lake.

3.4.3 On Tour Notes

Cliff Liston – Manager of Treatment – technical support to Operations showed the group around.

Glenelg STP is the 2nd largest in Adelaide (1.6 GL/yr in 2008-09) – before Glenelg to Adelaide Parklands (GAP). Potential 3.8 GL/yr in short term and up to 5.5 GL/yr. GAP is part of Water for Good program and replaces water from the Murray, Hills and River Torrens catchments and groundwater.

It will decrease summer discharges from the Glenelg STP by 48% to Gulf of St Vincent.

The will also be new dual reticulation systems in CBD. This will be delivered by an Alliance (Figure 8) which is a first for SA Water – Design Build Operation Maintain (DBOM), 5 yrs OM and 35 ML/d design that will include:

- Advanced treatment by UF plus UV plus Chlorination (multiple barriers)
- Covered and lined storages
- Department of health approval in Feb 2010
- 10 km trunk main.
- 30 km ring to distribution mains

SA Water had to develop risk management plan – DOH requirement in accordance with Australian Water Recycling Guidelines 2006. DOH provided separate approvals for supplier (SA Water) and individual users.

FIGURE 7 CUSTOMER CONNECTION TO RECYCLED WATER IN GAP

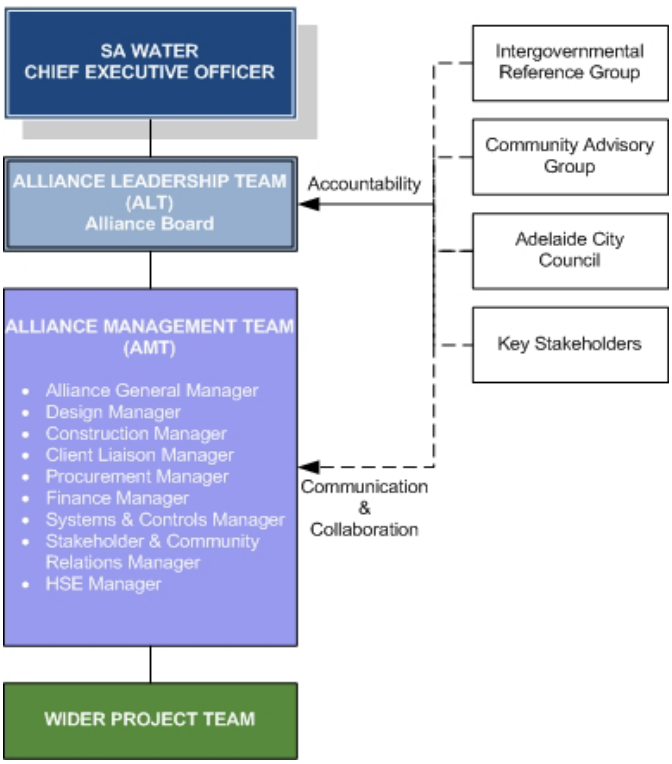


FIGURE 8 ALLIANCE STRUCTURE FOR GLENELG TO ADELAIDE PARKLANDS PROJECT (FROM CLIFF LISTON'S PRESENTATION)

GAP Customer Development (Joe Lazzaro)

Adelaide City Council (ACC) is foundation customer – MOU between ACC and SA Water – committed to 1.3 GL/yr.

Other customers are developed based on:

- Customer Liaison – info sessions with potential customers, requests from potential users, contacting potential customers in vicinity of route.
- Users enter into a supply agreement with SA Water
- Customer develops a business case to determine if reuse is appropriate / cost effective. Includes annual consumption, peak flow rate, connection costs and their own property plumbing works required to receive recycled water.

Customer challenges:

- DOH approval through Environmental Management Plan
- Retrofitting existing irrigation systems (plumbing audits, backflow prevention, PRV, risk assessment)

There are 17 customers so far (1.8 GL/yr) –with potentially a further 15 customers (200 ML/yr). Price per KL can be negotiated. Can be up to 75% of the drinking water tariff – Usually somewhere between 60 to 75% of 2 tier ($1.86 currently). A pricing review is in progress.

The connection fee is dependent on investment made by SA Water to connect them. Annual access fee $174.60 /p.a. plus volumetric charge.

Kent Williams – ACC

The ACC currently use recycled water in the Adelaide Parklands on:

- 760 ha open space around the city
- 175 ha currently irrigated

New editions in the future will be:

- 2 city squares
- New sports fields.

There are 82 recycled water meters – close to existing systems. To manage the chance of cross connections they held technical and management meetings every 2 weeks, with regular briefing to councillors. Stakeholder and community consultation was also a key factor.

At present there have been no direct complaints to Kent or ACC and this has been attributed to the public consultation and communication program undertaken.

FIGURE 9 ADELAIDE CITY COUNCIL IRRIGATION AREAS (FROM JOE LAZZARO'S PRESENTATION)

Key Issues identified during the project were:

- Trees – minimal impact due to piping – bore on shift alignment
- Plumbing audits – retrofitting to existing systems – uncovered a whole range of asset issues / connections
- Irrigation recycled water management plant – submit to Department of Health
- Development of soil and groundwater monitoring – salinity and nutrients
    - Monitoring 6 monthly for 1st 3 years
    - 1000 – 1300 mg/L TDS recycled water

Opportunities:

- Improved parkland amenity
- Reactivation of water features
- Upgrade existing irrigation systems

THE GLENELG STP AND RECYCLED WATER PLANT

Some facts and figures:

- Currently running around 5 ML/day – low winter use
- Plant is harder to run as have to rotate UV tubes
- 1 operator mans the plant each day
- 7000 hollow fibres in each tube treating water
- 100m long x 2 m diameter – chlorine contact pipe before storage
- 750mm diameter pipe to parklands 10 km away (city)

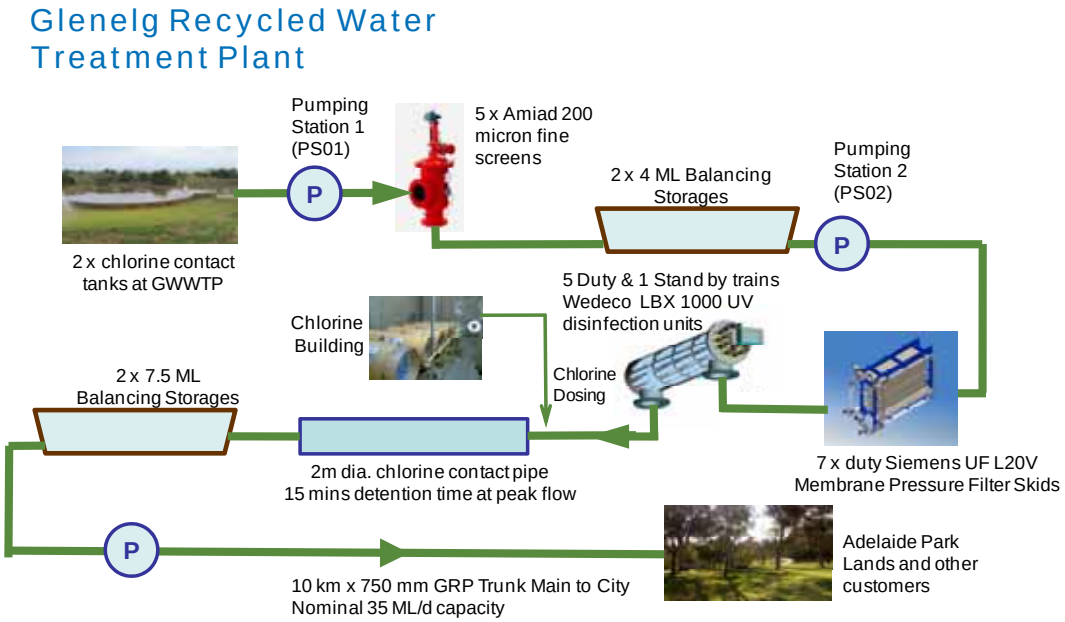


FIGURE 10 GLENELG RECYCLED WATER TREATMENT PLANT PROCESSES (FROM CLIFF LISTON PRESENTATION)

ELECTRONIC MEDIA AND USEFUL LINKS

www.gapreuse.com.au

Disc contains the following PowerPoint presentations:

- GAP – IWA Presentation – June 2010 CL Update
- Introducing Recycled Water to the Adelaide Parklands

3.5 Dinner Guest Speaker: Lois Boswell

Focus: 30 Year Plan for 'Greater Adelaide'

3.5.1 Contact Details

Lois Boswell - Director of Strategy and Sustainability.
Department of Planning
and Local Government, SA.
08 8204 8394
lois.boswell@sa.gov.au

3.5.2 Background Information

Lois Boswell presented on 'The 30-year Plan for Greater Adelaide' - This vision for Adelaide's development for the next three decades is the biggest project of its type undertaken by this department since the 1962 metropolitan plan.

FIGURE 11 MANDATING WATER SENSITIVE URBAN DESIGN IN ADELAIDE, SA.

3.5.3 On Tour Notes

Planning Challenges:

- Population growth
- Population change
- Housing affordability
- Climate change
- Oldest population in Australia needs to retain a working age population base

Economy is diversifying – and was strong during the global financial crisis of 2009. The plan has valued land environmentally – rated high, significant and lower. Can't touch high, can implement offset plan for significant – nothing for the rest.

They are trying to gain certainty for development whilst needing to protect heritage.

Targets:

- Concentrate new housing and jobs in existing areas and transit corridors
- Increase density around stations and transport interchanges
- Need to better coordinate with agencies and utility providers to coordinate services (e.g.: water, health, etc)
- 15% of new dwellings in new developments must be less than $215 K and only available to low income earners. They must look integrated into the community.

- Keep housing prices reasonable and keep population
- Improved energy efficiency of buildings and neighbourhoods
- Deliver 17% less in emissions by end of plan
- Protect 115,000 ha of significant environmental land
- Mandate WSUD by 2013 in new developments
- New Greenfield developments after 2011 to source outdoor water from non mains water sources

Urban heat island effect – putting in temperature / humidity monitoring to correlate with satellite imaging to see effects. (Increased heat in city / asphalt areas during extreme heat times.)

30 YEAR PLAN FOR ADELAIDE

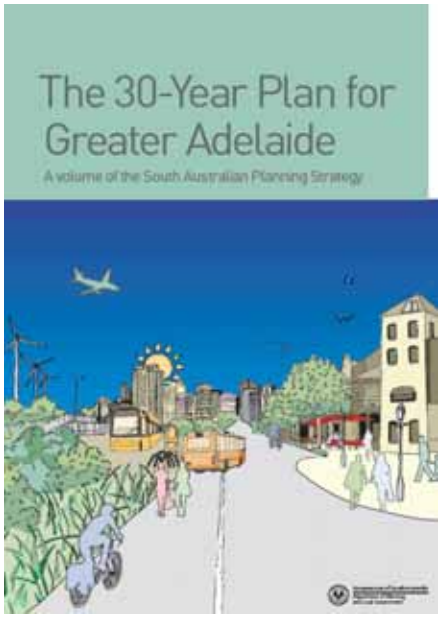
- Adelaide has the oldest average population of all capital cities in Australia.
- They have a desalination plant in the south but the major growth corridors are in the north!
- Must have 15% of all new developments accessible to low income earners.
- They are mandating water sensitive urban design (WSUD) – aim is for outdoor taps to be non-drinking water. Currently mandate rainwater tanks to be plumbed into houses for all new developments. Aim is for 15% minimum substitution of non-drinking sources per household.

FIGURE 12 A PLAN TO MAKE LIVEABLE CITIES ALONG GROWTH AND TRANSIT CORRIDORS.

ELECTRONIC MEDIA AND USEFUL LINKS

Adelaide's 30 year plan:
http://www.dplg.sa.gov.au/plan4adelaide/index.cfm
Disc contains:

- The 30 Year Plan for Greater Adelaide – A volume of the South Australian Planning Strategy (PDF)



3.6 DINNER GUEST SPEAKER – PETER NEWLAND – EPA SA

Focus: EPA involvement with Water Source Management

3.6.1 CONTACT DETAILS

Peter Newland - Manager Water & Catchments, Water Quality Branch,
Environment Protection Authority, South Australia
08 8204 1318
peter.newland@epa.sa.gov.au

3.6.2 ON TOUR NOTES

Recycled water related projects in SA that the EPA SA is involved with include:

- Stormwater ASR – 3 golf courses – Total 1 GL
- Water Proofing northern Adelaide – 29 wells – currently 18 GL/yr.; target is 80 GL of stormwater
- Waterproofing the south – McLaren Vale with ASR
- Bolivar recycled water ASR trial underway.

Some current work that the EPA SA is addressing includes:

- Recycled water quality Issues
- 2 cross connections to date – resulted in drinking recycled water, but no significant issues.
- ASR guidelines being produced based on AGWR.

Current ASR legalities:

- NRM Act 2004, AP Act
- ASR Cop (5 yrs old)
- Public and Environmental Health Act 1987 - Only have to have DOH approval for treated wastewater not stormwater – SA Water get approval for both.
- Development Act 1993

Currently in SA:

- There are 23 STPs (SA Water) – 170 community wastewater management systems
- 26% reuse systems state-wide – in the next 5 years will rise to 40%
- 100 GL waste water produced annually, currently this impacts the seagrass in St Vincent Gulf, confirmed by an the Adelaide coastal waters study
- $25M power bill p.a. that will increase to $65M pa when desalination plant fully operational.

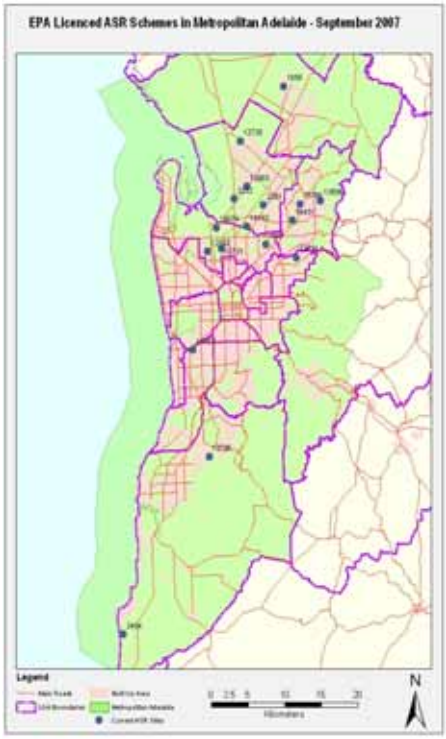


FIGURE 13 LICENSED AQUIFER STORAGE AND RECOVERY SCHEMES IN ADELAIDE (FROM PETER NEWLAND'S PRESENTATION).

ELECTRONIC MEDIA AND USEFUL LINKS

http://www.epa.sa.gov.au/

4 TH DAY ADELAIDE – PERTH (FRI 18/6)

4.1 RYMILL PARK, ADELAIDE PARKLANDS

Focus: Use of recycled water in high public access areas

4.1.1 CONTACT DETAILS

Cliff Liston and Chris Marles (Section 3.4.1)

4.1.2 ON TOUR NOTES

Rymill Park is part of the Adelaide City Council's use of recycled water from the Glenelg STP (visited the previous day). The park contains one of the first high public access parkland filled with recycled water lakes in Adelaide. A full risk assessment using the Australia Guidelines for Water Recycling[1] has been approved by the Department of Human Services.

[1] www.recycledwater.com.au/index.php?id=16

4.2 LOCHIEL PARK, ADELAIDE

Focus: Water sensitive urban design (WSUD)

Site visit to small housing development utilising stormwater and rainwater for water sensitive urban design

FIGURE 14: PLAN OF LOCHIEL PARK

4.2.1 CONTACT DETAILS

Cliff Liston and Chris Marles

4.2.1 BACKGROUND INFORMATION

WATER-SENSITIVE URBAN DESIGN

Stormwater from the homes and roads in Lochiel Park will collect in carefully designed bio-retention pits and a central swale in the main boulevard. Aquatic plants within these sites will treat the stormwater naturally before it flows into the Torrens River. They will be maintained by council and will also rely on the community to do the right thing by not allowing contaminants onto the roads or into drains from houses.

Stormwater from two large external catchments east of Lochiel Park drains into the Torrens River. This stormwater is cleared of rubbish by diverting it through gross pollutant traps and then into two wetlands located to the north and the south of the Lochiel Park residential village.

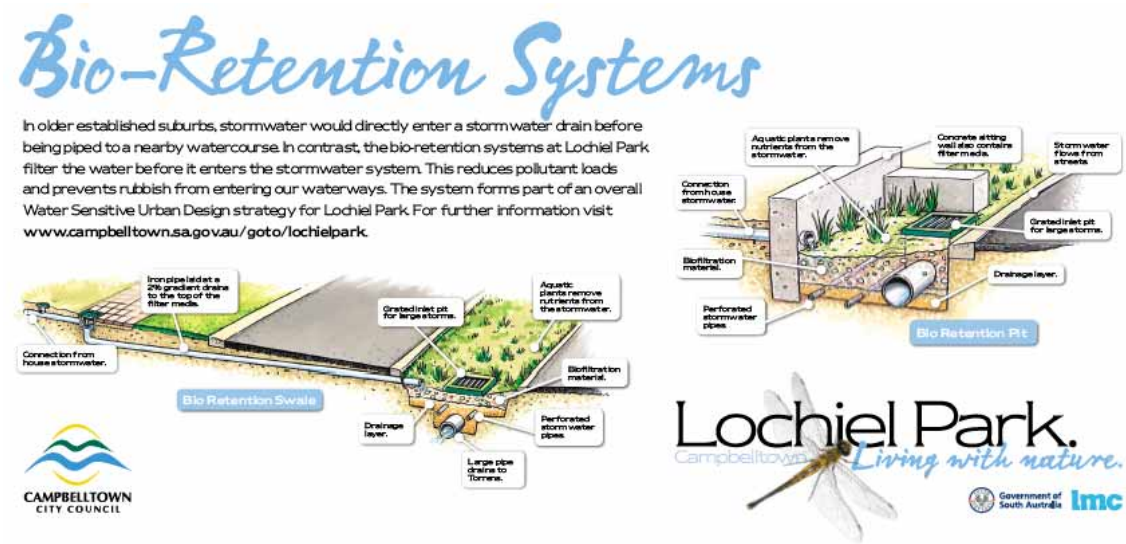


FIGURE 15: DIAGRAM OF BIO-RETENTION SYSTEM AT LOCHIEL PARK.

Rainwater Tanks

All homes in the development are required to have a minimum 1.5 kL rainwater tank connected to the hot water service. Although current legislation allows homes connected to recycled water an exemption, the Lochiel Park project has mandated the use of rainwater tanks to maximise the total water savings and demonstrate both systems.

Rainwater will be heated to a minimum temperature of 60 degrees in household hot water services to kill any bacteria. The water supply system from a rainwater tank must be clearly marked at intervals not exceeding 500 mm with contrasting coloured wording "RAINWATER". Water outlets shall be identified as "RAINWATER" with a label or a rainwater tap identified by a green coloured indicator with the letters "RW".

Recycled Stormwater

Stormwater collected in the southern wetland is treated through natural processes. When sufficient water is available it is pumped into an underground aquifer approximately 188m below the surface or into a buffer tank, depending on the demand for water. This water is then disinfected and reticulated around the subdivision for toilet flushing, washing machines and garden irrigation and for irrigation of the park lands. Recycled water is delivered via a distinctive lilac-coloured pipe network.

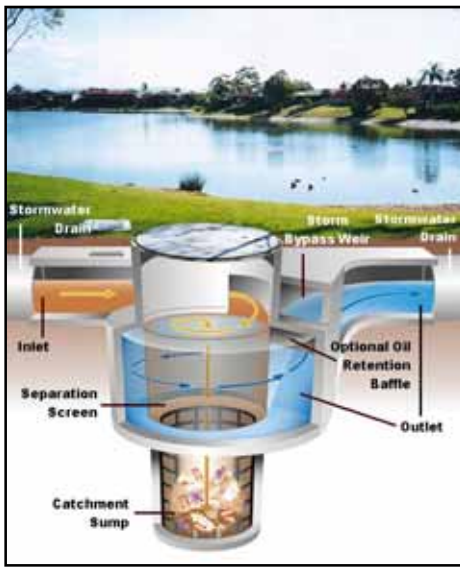


FIGURE 16 GROSS POLLUTANT TRAP DIAGRAM

Wetlands

Lochiel Park's wetlands are planted with aquatic plants to provide a natural filter system for the stormwater as well as a habitat for fish and other aquatic life. The wetlands are stocked with native fish including the Big-headed gudgeon, the Purple-headed gudgeon and the Rainbow fish. Each species occur naturally in the Adelaide plains waterways including the River Torrens but are under threat from pest fish invading their native habitat.

The wetlands will be home to at least four species of native frogs. Frogs are more commonly heard than seen and only male frogs have a voice. Just like birds, frogs have their own characteristic songs and they sing at particular times of the year. The sound of a frog chorus is a good indication that the aquatic environment is healthy.

Frog expert Mike Tyler says: "One frog species most likely to be seen is Ewing's Tree Frog because it may be an evening visitor to your home. It is attracted to light and walks up the glass on windows to feed on small moths."

The wetlands will be a major feature of the Lochiel Park environment. Native fish such as the Purple spotted gudgeon will be introduced to control any threat from mosquitoes. Stormwater collected in the southern wetlands – and will be ultimately used for irrigation, toilet flushing and cold tap washing machine connection - must meet specific minimum quality standards. This is controlled partly by treatment processes in the wetland prior to entering the aquifer and before pumping to houses. It is very important that the health of the wetland ecosystem and the quality of the water is maintained.

4.2.2 On Tour Notes

Purple pipe installation: At this site purple pipe is installed into houses: Lots of backflow audits are required – every 5 years at $60 ea. This is very onerous. Double non-return valves provide additional protection.

Smart metering system: This is to supply information on water and electricity to householders. Cycles are on each meter and feed into the home management system.

Energy and water saving initiatives add approximately $80k to price of houses. Takes a long time to pay back costs! Energy savings are around 75%.

Homes are valued at approximately $500k+ and rates are approximately $1600 per annum for an average house.

After wetland treatment water is put into an ASR after UV treated. Aquifer is fractured rock so no treatment via aquifer. Water is chlorinated on pumping to storage tank when reticulated.

It was also noticed by delegates on tour that the street lights were solar powered.

Summary of points from the 2000 lot subdivision

- SA Water undertake three construction audits (same on PIC) but also at every change of ownership and/or every 5 years. Customers self audit. No information from tenants is collected or recorded by SA Water. Above ground drinking water connection with recycled water until 3 audits completed.
- Stormwater – wetland filtration, chlorination and UV. Colour may be an issue, still being proven.
- Stormwater – wetland filtration, chlorination and UV. Then injected into ASR if not used by customer.
- 78% decrease in drinking water use compared to traditional. Left hand thread is no longer used for recycled water taps outdoors.
- Recycled water meters not able to be interchanged with drinking water meter. All new houses in Adelaide to be 6 star, with minimum 1500 L rainwater tanks for hot water services. Rainwater tank overflow directed to stormwater system. Approximately $80k per lot cost to develop above normal. Average house is valued at approximately $650k. $40k rebates available.

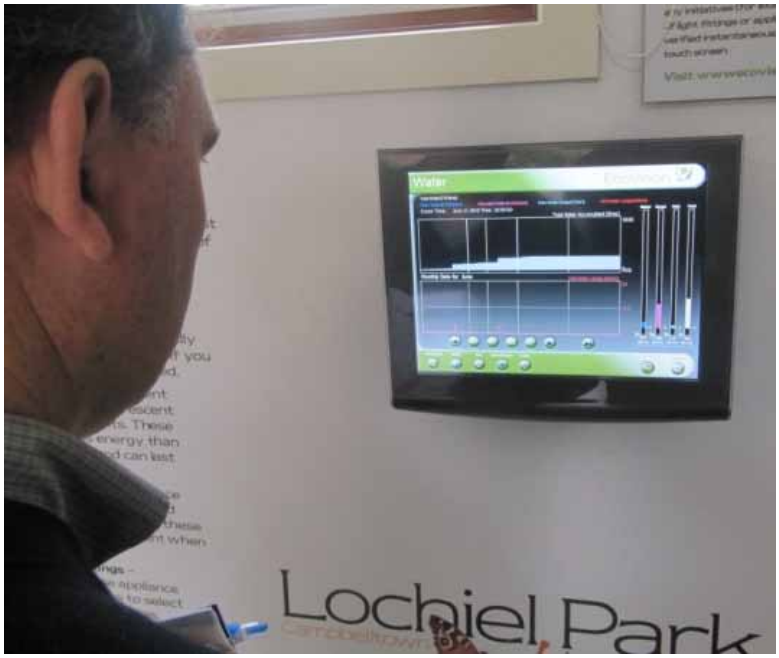
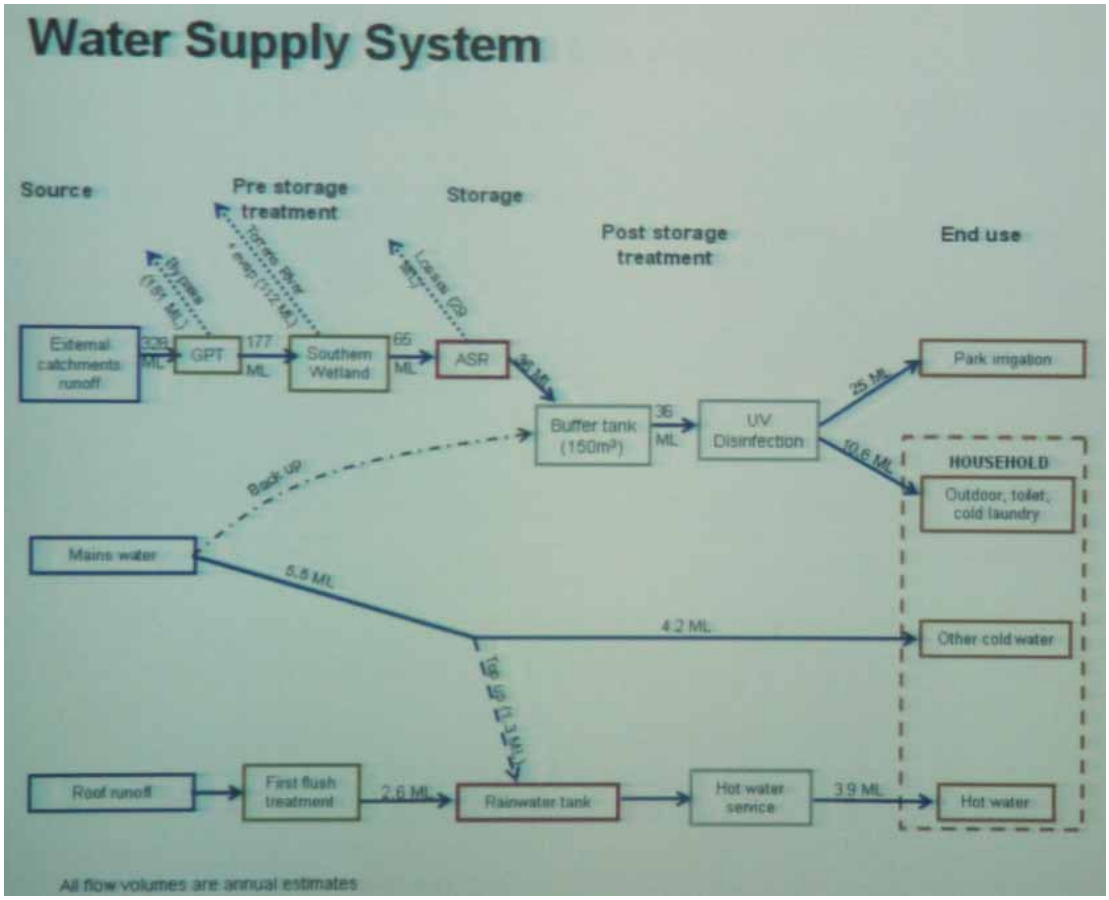


FIGURE 17 WATER SUPPLY SYSTEMS AT LOCHIEL PARK



ELECTRONIC MEDIA AND USEFUL LINKS

www.lochielpark.com.au/lochielpark/water.htm

4.3 BOLIVAR WWTP AND VIRGINIA PIPELINE SCHEME

Focus: Recycling water from effluent and stormwater for reuse in urban environments and for growing food crops

4.3.1 CONTACT DETAILS

Cliff Liston and Chris Marles (Section 3.4.1)

4.3.2 BACKGROUND INFORMATION

BOLIVAR WASTEWATER TREATMENT PLANT

Completed in December 2005, SA Water's $100 million Bolivar Environment Improvement Program (EIP) was one of the largest capital works projects in the State. It represented a significant investment in the environment for the future benefit of all South Australians.

FIGURE 19: BOLIVAR WASTE WATER TREATMENT PLANT

The first stage of the program involved the construction of a $30 million Dissolved Air Flotation Filtration (DAFF) plant to provide high quality "Class A" reclaimed wastewater for use in irrigation. The plant was completed in September 1999 and now provides treated wastewater suitable for direct irrigation of market gardens through the Virginia Pipeline Scheme.

Construction of the second stage of the plant - to control odour and reduce nutrient levels - was completed in July 2001 at a cost of approximately $68 million.

This involved replacing the existing biological filters, which were the major cause of odours from the plant, with a new activated sludge treatment process. The process has reduced nitrogen and odour levels significantly.

The final stage was the construction of a new high salinity wastewater treatment plant at Bolivar to replace the Port Adelaide Wastewater Treatment Plant (WWTP). A new pumping station and a 17-km pipeline were constructed to transfer wastewater from the Port Adelaide plant to the Bolivar high salinity plant via the Queensbury Diversion Pumping Main for treatment.

Environmental benefits from the Bolivar EIP have been achieved, including:

- Reduced nitrogen concentrations in the treated wastewater
- Reduced outflows of treated wastewater to the sea
- Reduced odours
- Reduced demand on the northern Adelaide Plains groundwater basin by providing an alternative source of water for irrigation

SA Water is also exploring options for using more renewable energy by making greater use of methane from biogas produced at Bolivar. Bolivar now processes almost 70% of metropolitan Adelaide's wastewater.

VIRGINIA PIPELINE SCHEME

Virginia is about half an hour's drive to the north of Adelaide - is home to highly productive market gardens and Australia's largest concentration of greenhouse production.

FIGURE 20: CUSTOMER CONNECTION TO RECYCLED WATER

Thanks to the Virginia Pipeline Scheme the future continues to look bright for the expanding horticultural industry in the region. The scheme is a co-operative undertaking of the Virginia Irrigation Association (representing market gardeners and other irrigators), SA Water and Water Reticulation Systems Virginia (a private sector subsidiary of Tyco International).

As part of its Environment Improvement Program, SA Water constructed a $30 million filtration/disinfection plant (DAFF) to treat lagoon effluent from the Bolivar wastewater treatment plant, producing Class A reclaimed water which can be used for irrigation of Virginia's crops (as mentioned above).

The quality of the water is closely monitored in accordance with procedures set down by the Department of Human Services to ensure public health standards are maintained.

The scheme provides an alternative source of water to the local underground water supplies which were overused and progressively deteriorating in quality. It also supports one of South Australia's most valuable produce markets.

Water Reticulation Systems Virginia, with financial assistance from SA Water and the Federal Government, constructed an extensive distribution system involving more than 100 kilometres of pipes at a cost of about $22 million.

The system was commissioned in 1999 and has a capacity of 110 mega litres/day. It commences at the Bolivar plant and fans out to provide water to irrigators as far north as the Gawler River.

The scheme now has more than 240 contracts using more than 15,000 mega litres of reclaimed water for irrigation each year.

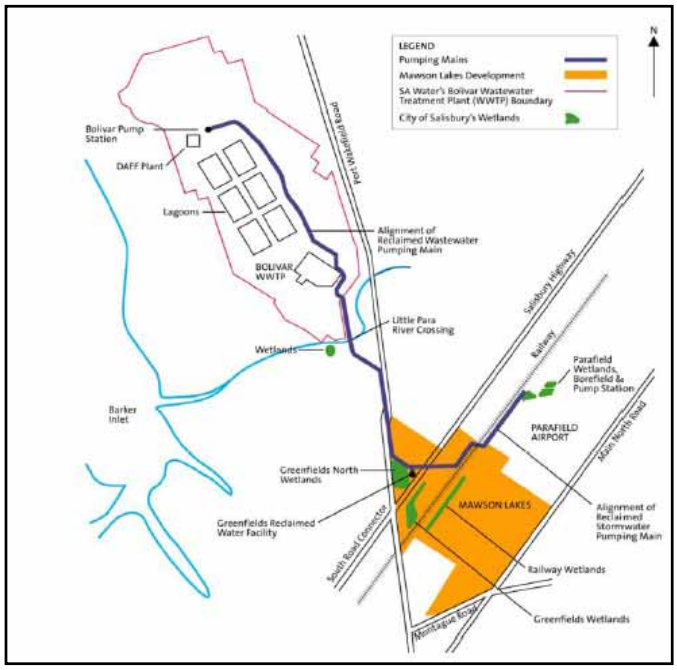


FIGURE 21: BOLIVAR RECYCLED WATER IS ALSO USED AT MAWSONS LAKE AND PARAFIELD WETLANDS

Use of reclaimed water is expected to increase as the horticultural industry continues to expand production, as groundwater substitution takes place, and as growers establish on-site infrastructure and refine their irrigation methods.

The diversion of wastewater from the Port Adelaide Treatment Plant will make even more recycled water available through the scheme.

It is expected that ultimately between 50% and 70% of the treated wastewater flow from the Bolivar plant could be used for irrigation on the northern Adelaide Plains.

The Virginia Pipeline Scheme is the first and largest reclaimed water scheme of its type in Australia. The water from Bolivar is also used and Mawsons Lake and Parafield Wetlands (See Section 4.4 and diagram above).

4.3.3 On Tour Notes

Normal effluent flow from Bolivar STP is 117 ML/day. STP used to use trickling filters and 350 ha lagoons added for natural removal of pathogens (help). A DAFF plant was added for Crypto/Giardia removal and production of recycled water. Alum and Poly used in DAFF 40/50 mg/L up to 200mg/L alum, and then required pH adjustment. Chlorine control channel on final effluent. Fish (Carp) were swimming in the DAFF tanks.

FIGURE 22: FISH IN DAFF TANKS

The recycled water treatment process was changed to address a midge fly problem and problems at the STP with odours, so a centrifuge was installed, as the lagoon was considered as a main odour source. Centrifuge was used to reduce load on lagoons. 25,000 Y dry sludge/day with 2,500t goes through centrifuge. 2 grades of sludge – A (3 yrs) B (1 yr)

Stabilisation from anaerobic digester. Farmers use dried sludge. SA Water pay for everything – including delivery up to 180km. Farmers can also come and pick up biosolids freely. 25 000 tonnes per annum produced. Sludge has high phosphorous so is valuable to farmers due to rising costs of phosphorous.

Bolivar is the largest WWTP in Adelaide with cogeneration power on site. 3.8 MW turbine from digester methane.

The recycled water pipeline to Virginia pipes approximately 105ML per day. Users of recycled water pay 7c/kL in winter to 17c/kL in summer to compete with bore water. Recycled water is also used to grow bamboo for the pandas at the Adelaide Zoo.

Electronic media and useful links

http://www.sawater.com.au/SAWater/Environment/SaveWater/EnvironmentImprovementProgram/Bolivar+EIP.htm

4.4 CITY OF SALISBURY

Focus: Understanding SA's approach to water source integration – stormwater reuse using wetland treatment and ASR storage

4.4.1 CONTACT DETAILS

Cliff Liston and Chris Marles (Section 3.4.1)

4.4.2 BACKGROUND INFORMATION

The City of Salisbury has a commitment to water conservation and management which has resulted in creative, environmentally sensitive projects which decrease reliance on water from the ailing Murray River. Over the past two decades, over 50 wetlands have been developed which detain and slow stormwater flows, divert water to ponds and lakes and allow time for natural processes to improve the water quality, thus helping protect the downstream ecosystems of streams and coastal areas.

Concerned with the environmental impacts and wastefulness of the traditional water management methods, not to mention the City's huge irrigation costs, Salisbury Council has developed a sustainable water management strategy to help the city to overcome its reliance on mains water.

Stormwater run-off from the highly developed urban catchment is detained and regulated in a series of flood control dams constructed in the upper reaches of the catchment. These dams, constructed to handle a one in 100 year flood, are used to regulate the flow of water into a series of pipes and open channels which deliver the water to a network of constructed wetlands. The reed beds of the wetlands filter and cleanse the water, removing sediment, suspended matter, nutrients and heavy metals.

The cleansed stormwater is 'harvested' and injected into underground sandy limestone aquifers to provide a buffer storage for the drier months. The cleansed water is recovered and pumped via a dedicated distribution network for irrigation of Council parks and reserves, school sports grounds and increasingly by industrial and commercial users with high water dependency. This process is known as Aquifer Storage and Recovery (ASR) and it was first trialled by the Department of Mines and Energy and Salisbury Council in 1994.

One of the key considerations in utilising aquifers for the storage and recovery of stormwater is that of environmental protection - both in terms of protecting the quality of groundwater, and ensuring that the naturally occurring aquifer is not depleted. The storage mechanism is highly regulated by State Authorities including the Environment Protection Authority (EPA) and the Department for Water, Land and Biodiversity Conservation (DWLBC). The EPA issue a license for each ASR site with a focus on ensuring the quality of the injection water meets quality criteria before injection in order to minimise potential pollution of the aquifer receiving environment. The DWLBC focus is on sustainable management of the overall groundwater resource. In short, the primary consideration for sustainable management and operation of the ASR system is that the amount of water being

injected into the Northern Adelaide Plains aquifer must be greater than the amount of water being extracted. This is achieved through the use of a water licensing system which is tied to the amount of water being harvested and injected.

4.4.3 On Tour Notes

Stormwater facts and figures:

- 7-10 days water movement through wetlands. Ownership of stormwater is an issue in licensing arrangements for stormwater into aquifers, only allowed to recover 80%; 20% is set aside to replenish aquifer. This is unlike RW in ASR where 100% must be extracted.
- Reed beds need to be cut periodically.
- Situated next to airport – shade-cloth used to protect aircraft from birds.
- 20% of stormwater is left in the ground to replenish the aquifer
- 1 GL – is capable of 3 GL
- SA Water buys stormwater from Salisbury Council then resells them the water when mixed with treated wastewater. Adds on transport cost. TDS – 200 – 900 with wastewater
- Recharge rate: 40 L/s (pressurize to inject)
- Pump rate 20L/s from bores 180m deep
- Uses aquifer as pipeline – inject and recover elsewhere
- Another large customer takes 30 GL from Aquifer.
- Cost of water in SA – approximately average of $470/ML per annum.
- SA buys treated stormwater from Council. Mix of RW (approx 75%) + stormwater (25%) to achieve maximum 850 mg/L TDS

Electronic media and useful links

http://cweb.salisbury.sa.gov.au/manifest/servlet/page?pg=16062andstypen=html

4.5 MAWSON LAKES

Focus: Urban Irrigation and dual pipe schemes. Visit to a housing development utilising recycled wastewater and stormwater for municipal irrigation and supply to houses for toilet flushing and garden watering.

4.5.1 CONTACT DETAILS

Cliff Liston and Chris Marles (Section 3.4.1)

4.5.2 BACKGROUND INFORMATION

The Mawson Lakes Reclaimed Water Scheme is a project established by the City of Salisbury, Land Management Corporation, Delfin Lend Lease and SA Water to provide reclaimed water to Mawson Lakes residential and mixed use development through a reclaimed water network, known as the 'lilac system'.

SA Water owns and is responsible for the operation of the recycled water system at Mawson Lakes.
Recycled water is delivered via a dual reticulation system. Our metropolitan contractor United Water undertakes operation of the system.

Each property is fitted with a lilac coloured reclaimed water meter. It is envisaged that the reclaimed water supply system will provide over 50% of household water (toilet flushing, garden watering and potentially car washing) and all public open space irrigation.

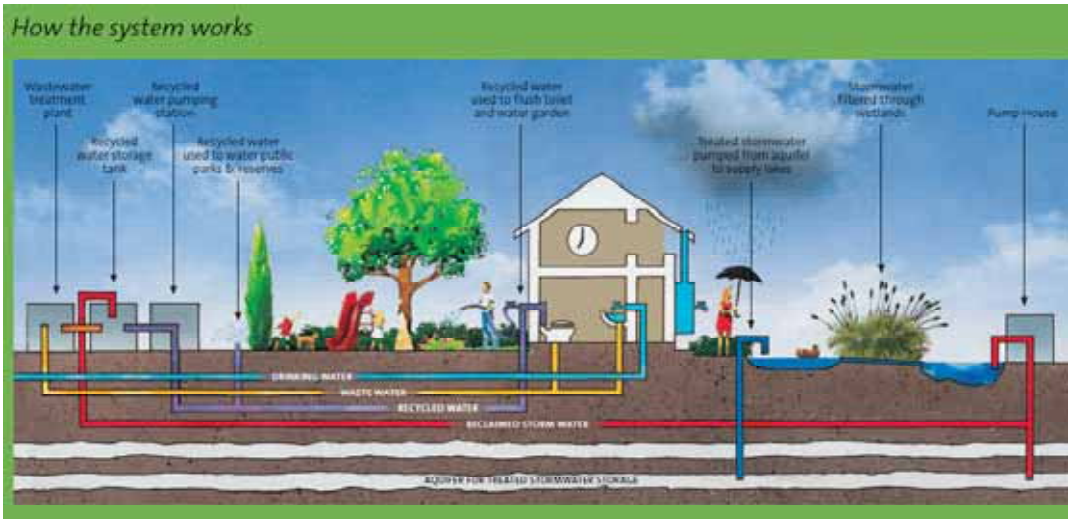
The supply of reclaimed water will be achieved by treating waste water from the Mawson Lakes community at the Bolivar Treatment Plant and returning the reclaimed waste water to mix with recycled stormwater from Parafield Wetlands in a mixing tank at Greenfields. The reclaimed water is then pumped back to the Mawson Lakes Development. This whole system is called the Mawson Lakes Reclaimed Water Scheme.

All recycled water use, including that delivered to Mawson Lakes residents, is subject to Permanent Water Conservation Measures while all mains water use is subject to current water restrictions.

Recycled water at Mawson Lakes is suitable for the following:

- Watering lawns, parks and gardens
- Flushing toilets
- Washing cars
- Filling ornamental ponds (with no fish) and water features
- Watering fruit, vegetables and flowers

This innovative scheme is expected to increase the water resource available for use. It will also reduce the environmental impact on the River Murray and on the Barker Inlet by reclaiming waste water from the Bolivar Treatment Plant and stormwater from the Dry Creek Catchment.



4.5.3 On Tour Notes

Almost 4,500 lots have been completed with dual pipe supplies. There is no need to have rainwater tanks. Fire fighting services connected to drinking water. The aim was for recycled water pressure to be 10m/head below drinking water, but this is not always achieved or a regulatory requirement. The system is to be handed over to SA Water in December 2010.

Electronic media and useful links

http://cweb.salisbury.sa.gov.au/manifest/servlet/page?pg=9434

5 TH DAY PERTH (SAT 19/6)

5.1 ROTTNEST ISLAND

Focus: Small scale integrated water + energy

5.1.1 CONTACT DETAILS

Genevieve Farrelly – Acting Coordinator of Education and Interpretation. Ph: 08 9372 9781
Louie Ranauro – Manager of Projects, Rottnest Island Authority
Ph: 08 9372 9740 louie@rottnestisland.com.au

5.1.2 BACKGROUND INFORMATION

SITE DETAILS

Rottnest Island's wind turbine produces around 35% of the Islands' power needs, at maximum capability the turbine will be able to produce around 37% of the Island's power!

The upgrading of the desalination plant and installation of a wind turbine generator has greatly reduced the reliance on rainfall dependant water supplies on Rottnest Island. These facilities will save approximately 430 000 litres of diesel per year and reduce greenhouse gases by around 1100 tons per year.

HISTORY

The Rottnest Island wind energy project has been evolving from as far back as 1979. Construction of several wind turbines on Rottnest Island was proposed as part of a plan to find the most effective and least costly electricity supply to remote locations. Two original wind turbines of different design were erected on Forbes Hill, however due to difficulties experienced these turbines were removed in the early 1990s.

Up until the installation of the new wind turbine generator in December 2004 at a cost of $2.1M, Rottnest Island has been totally reliant on liquid petroleum fuels for power generation.

In January 2001 the Rottnest Island Authority (RIA) reported that its underground water supply was being depleted and the salt levels in the normally fresh water were rising. This was attributed to the overall ongoing lack of rainfall on Rottnest Island over the previous 5-10 years. In response to

this, the RIA produced an Integrated Water and Power Development Plan. The philosophy behind the plan was to shift from a predominantly rainfall dependant water source to a majority of potable water being supplied through desalination. A single wind turbine would supplement diesel-generated power in order to make the shift economically and environmentally acceptable.

The Rottnest Island Authority launched a Community Consultation Plan in 2001 to test public opinion on the erection of a wind turbine, and the report from this consultation indicated public support of the project.

5.1.3 On Tour Notes

Rottnest Island

- $30 M/y revenue from accommodation (flat lease and % of income – costs approx $0.25 / kW), moorings /boating fees.
- Large volunteer contingent
- Government approves charges for year
- Tents on the island for accommodation – 3 ½ star
- Water production at $2.20 kL – pay for power cost and depreciation
- Permanent accommodation restricted to police, park managers and business owners.
- Everything is government owned – (no private ownership). Leases for 30 years for private operators.
- 20 km from main land
- Power and Water have direct relationship – wind power and seawater desalination – 40% efficiency due to reliable nature of wind
- Recently received a $3 million capital works grant from the state government.
- Facilities manager administers all utilities
- One issue is aboriginal heritage; island used to be a prison for aboriginals. Rottnest was a military Base during WW2 with 2,500 personnel based there.

Power Generation

- 6 diesel generators, 300 kW each – no longer used
- 2 low load generators 320 kW – with wind turbine meet demand – Diesel biggest load.
- 400 – 500 kW/day typical load, 1000 kW on Australia Day.
- Currently considering 2nd wind turbine. 58m tall, 23 m blades. 15 year life expectancy of wind turbine.
- Battery storage was tried but not economical
- Outsourced facilities recently to Hourigan Power (in 2010) including RWP's etc.

WATER

- Grey water system for garden watering is being expanded.
- Currently using a limited amount of Class B recycled water for oval, but looking into upgrading to Class A water for use in 'greening' the main part of Rottnest.
- There is a "real phobia with using and drinking RW".
- 120 ML total water use per annum. The aim is to discontinue use of all septic tanks. RW evaporated or recharged when it is not used on ovals etc into ground water.
- Storage of water - 21 days in reserve.
- 30 bores – old – 10 are still being used equivalent to approximately 20% of demand rainfall catchment area no longer used

- 120,000 kL/yr originally, now 25,000 kL/yr from old bores – before desalination.
- Desalination plant designed to operate when the wind turbines run, as plant is biggest electricity user on the island.
- Desalination brine discharge showing signs of effecting marine environment. Old desalination plant 20% Drinking water, 80% reject.

WASTEWATER TREATMENT

- Built in 1995 CASS system – Cyclonic Activated Sludge System
- Currently operating at 50% capacity
- Composting toilets in some areas
- Sludge compressed, binned and taken off the island – woodman point – 3 bins per week

- Liquid evaporated and infiltration.
- Water treatment – filtration and watering. Class A plant proposed in future.

ELECTRONIC MEDIA AND USEFUL LINKS

http://www.daws.com.au/projects/Rottnest_Island.html

http://www.rottnestisland.com/en/Travel_info/Conservation/Pages/Wind_turbine.aspx

6 TH DAY: PERTH (SUN 20/6) – REST DAY

7 TH DAY: PERTH (MON 21/6)

7.1 PERTH DESALINATION PLANT, KWINANA

Focus: Operational large scale desalination plant

7.1.1 CONTACT DETAILS

Amanda Hazell – Process Chemist, WC and President, AWA Young Water Professionals
ywp_president@awa.asn.au
Location: Baxter Road, Kwinana

FIGURE 23: PERTH SEAWATER DESALINATION PLANT

7.1.2 BACKGROUND

The Perth Seawater Desalination Plant was the first plant in Australia to provide desalinated water for large-scale public consumption. Located at Kwinana, 40 kilometres south of Perth, the plant started supplying water to the Integrated Water Supply Scheme (IWSS) in November 2006. In doing so, it became the first plant in Australia to provide desalinated water for large-scale public consumption.

It is the Water Corporation's biggest single water source feeding into the IWSS, providing some 17 per cent of Perth's water needs. On average, the plant produces up to 130 million litres of drinking water per day, or 45GL per year.

The Environmental Protection Authority has set stringent criteria for the plant, and the Water Corporation is implementing the most intensive ocean monitoring program of any desalination plant in the world. An independent report into the environmental impact of the plant has shown that oxygen levels in Cockburn Sound have not been affected by the discharge from the plant. The report was undertaken by the Centre for Water Research at the University of Western Australia in August 2007.

By harnessing water from the ocean, the State has acquired an abundant source that is not dependent on rainfall – an important factor in the face of a variable climate.

FIGURE 24: MODEL OF DESALINATION PLANT

7.1.3 On Tour Notes

An under seabed pipeline is used for intake and outflow. Low velocity water flow, therefore fish and other marine life can swim out. The pipeline in situated in a mussel growing area, hence there is a problem of mussel growth in the pipeline. Algal blooms can occur. Inlet structures must therefore be cleaned at least annually. There is approximately a 40% recovery of potable water from seawater.

Energy recovery devices are used, based on water flow and pressure. Some mixing of water does happen, 1 moving part only (ERI).

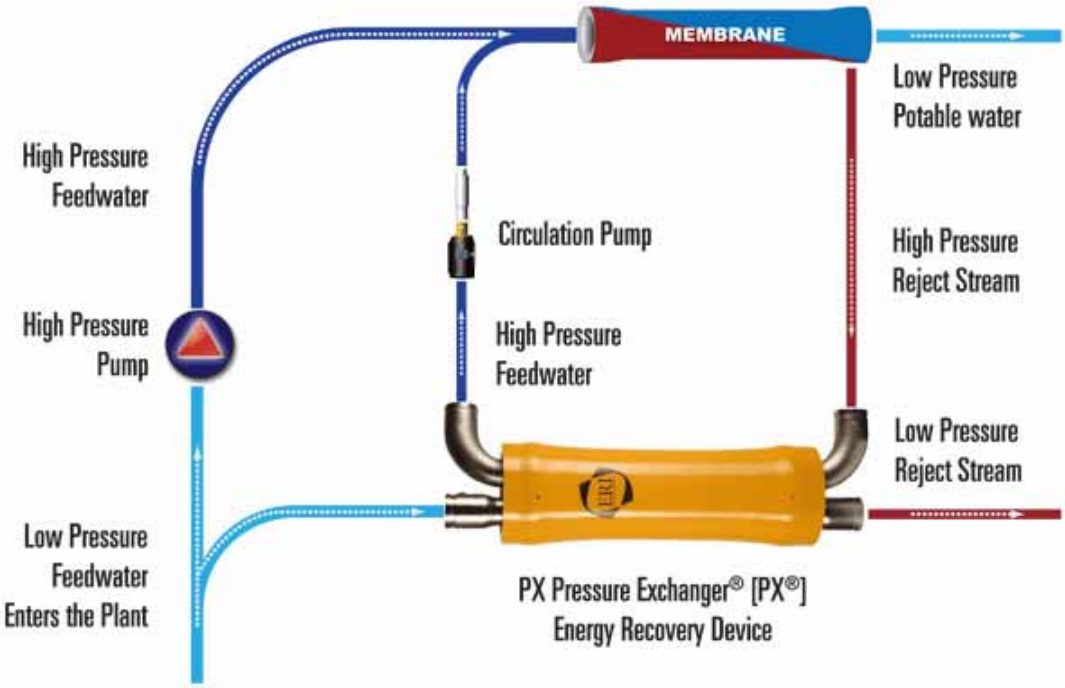


FIGURE 25 ENERGY RECOVER SYSTEM USED AT PERTH DESALINATION PLANT.

Bromide passing through the desalination plant increases as water temperature increases, therefore the second bypass plant is used when the water temperature is high. 16-26˚ C sea water seasonal temperature range. Base load plant therefore runs continually, around 140 ML/d. Desalinated water not used from base load is pumped into dams for storage.

Backwash water solids are sent to landfill after belt pass. Backwash water/brine is mixed and sent to 500m outfall pipe with diffusers at the 300-500m section. The desalination plant is located next to the power station. Indirect green energy is used - offset from wind farm 80 km away. Energy is purchased at a premium price to secure continuous electricity supply. Monitoring of seawater quality is continuously undertaken including DO, conductivity and temperature.

In the area there are multiple 'straws' in the bay all drawing seawater out (including for the power station and fertiliser company so brine discharge needs to be positioned appropriately. Cockburn Sound Management Council also monitors environmental impacts.

300 ML per day of seawater is pumped through fibreglass pipes to produce 140 ML/d of desalinated water. There are 25 full time equivalent staff on site to operate the plant. The project is a 25 year alliance.

Desalinated water goes direct to the distribution system. It uses spiral wound membrane.

ELECTRONIC MEDIA AND USEFUL LINKS

http://www.watercorporation.com.au/D/desalination.cfm?uid=6748-4571-0262-4525

7.2 KWINANA RECLAMATION PLANT

Focus: Secondary treated wastewater supplies for local industry

7.2.1 CONTACT DETAILS

Kevin Martin – Process Technical Officer
(08) 9420 2291
Location: Tiwest Private Road off Mason Rd, Kwinana

7.2.2 BACKGROUND INFORMATION

The Kwinana Water Reclamation Plant became operational in late 2004.

The reclamation plant reduces industry demand for scheme water by up to six GL a year, which is equivalent to about two per cent of Perth's total scheme water use.

It treats about 24 million litres a day of secondary treated wastewater from the Woodman Point wastewater treatment plant. The high quality industrial grade water stream produced (about 17 ML/day) is supplied to industry in place of scheme and bore water.

A major benefit of the plant is that it will reduce the amount of treated industrial wastewater discharged into Cockburn Sound by about six million litres a day.

The treated industrial wastewater from a number of Kwinana industries combines with the KWRP reject stream and, together with the Woodman Point treated wastewater, is discharged to the ocean through the Sepia Depression Ocean Outlet.

Ongoing monitoring and reporting of environmental effects will continue to ensure there is no harm to the marine and coastal environment around the outlet.

7.2.3 ON TOUR NOTES

The main purpose of this plant is to provide recycled water for industrial use. The plant was built by Veolia and achieves 16 ML/d potable replacement water. The ultimate capacity of the plant is 26 ML/d. Perth produces 300 ML/d wastewater. This WRP and has a 75% recovery efficiency. It is essentially a sewer mining plant, but can also accept some trade waste.

FIGURE 26: PRIMARY FILTERS SYSTEM

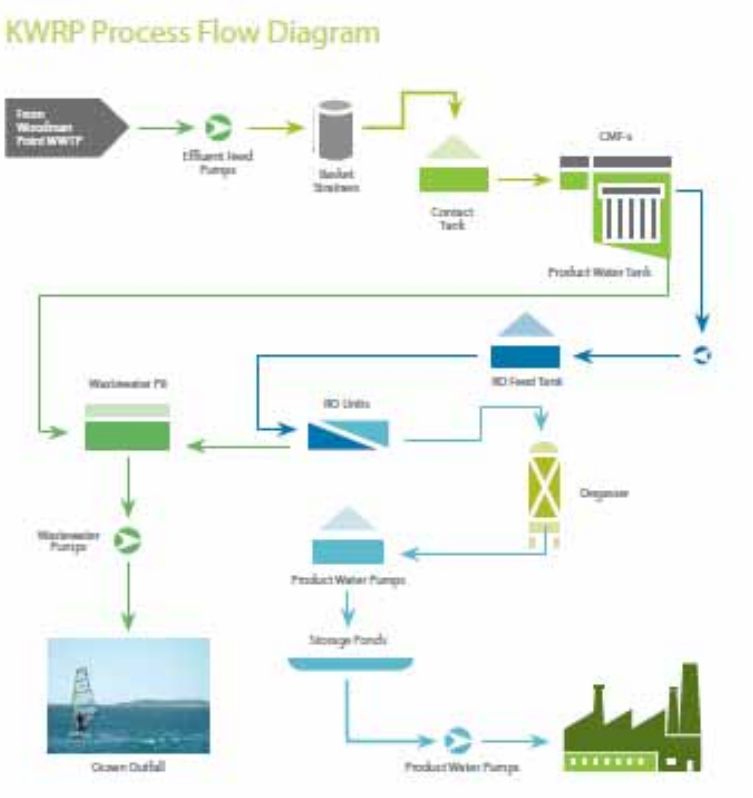
The nearby Cockburn Sound has an issue with wastewater when the weather is calm. The WRP has a 1 day balancing storage. The Water Corporation charges $1.17/kL. The water has a Low EC with no chlorine residual. It is mainly used for process water, boilers and cooling. The recovered water has a very low TDS (at approx 20 mg/L) and, can be quite corrosive.

Customers own their own pipeline and have individual contracts, take or pay. Customers can on-sell without Water Corporation intervention or approval.

All waste gets put back into discharge pipeline. The cost of the WRP was $24M. Plant water passes through RO membranes twice. Uses spiral wound membrane which has an expected life of 5+ years with $1M cost ($1k/membrane). Elements all 1m standard length, but can be made to suit width.

Water goes through a 'gas shower' to strip CO_2 from water with a 10c/kL energy cost.

No HACCP practiced due to RW being provided only to industrial customers. The WRP is not manned 24 hours a day.



Sample taps are in each RO cell. Currently new membranes are being trialled that can operate at lower pressure to save power.

Electronic Media and Useful Links

http://www.watercorporation.com.au/_files/PublicationsRegister/7/kwrp-brochure.pdf

FIGURE 27: GREEN LIGHTS ABOVE SHOWER FOR OHS

7.3 Presentation: Water Source strategy Including Ground Water Replenishment

7.3.1 Contact Details

Nick Turner - Principal Engineer, IWSS Source
Water Corporation Offices, Leederville
08 9420 2420

7.3.2 Background Information

Groundwater replenishment using recycled water is one of several options for future water sources for Western Australia. Groundwater replenishment is a process where water from a wastewater treatment plant undergoes further treatment, then recharged to groundwater.

7.3.3 On tour notes

No dams have filled to overflowing level for over 30 years. Perth's second desalination plant is located approx 150 km south of Perth, requiring $400 M in new pipelines and interface connections. Without groundwater replenishment, the region faces the risk of being 'desal forever'. Ring barking of noxious trees takes place in catchment areas to decrease water loss.

There is a Groundwater Replenishment Trial – UF/RO/UV bore injection (as per Singapore). 5 ML day trial, $20 M Federal government grant. Aiming to 'bank' water in aquifer. Regulators support is provided more easily for a deep confined aquifer versus shallow unconfined aquifer.

Electronic Media and Useful Links

See Water Corporations videos @:

http://www.youtube.com/Watercorpwa

http://www.youtube.com/watch?v=bE64YEA5wjo

http://www.youtube.com/watch?v=KP8CqjVxHq8

http://www.youtube.com/watch?v=bE64YEA5wjo

http://www.youtube.com/watch?v=H-Gv2OFoNUE

To find A PDF of the most recent GWRT Newsletter:
http://www.watercorporation.com.au/G/gwr.cfm

Perth leans towards recycled water
ABC Online - A researcher at the University of Western Australia has been surveying whether **recycled water** would be acceptable. PhD student Fiona Gibson says her research reveals changing attitudes**...**

7.4 Presentation: Integrated System Management

7.4.1 Contact Details

Peter McAllister - Scheme Operations Manager
Water Corporation Offices, Leederville
08 9420 2420

7.4.2 Background Information

The Integrated Water Supply System (IWSS) delivers water to 1.6 million people across Perth, the South West, Kalgoorlie-Boulder and the Wheatbelt, Goldfields and Agricultural regions. Water for the IWSS currently comes from three sources:

- Surface water from dams (approximately 25-45%)
- Groundwater (approximately 35-45%)
- Desalination (approximately 15-20%).

7.4.3 On Tour Notes

This project involves the management of very large water supply schemes, e.g. Perth water to Kalgoorlie approx 600 km away.

Perth consumption is around 300 GL p.a. with approximately 120 000 private bores in Perth city.

The operating strategy is to use all groundwater; annual quota first (quota dependent on levels in surface water dam), take out all desalinated water; then determine water available from dams.

Postage stamp pricing plus water quality throughout state (i.e. Perth subsidies all others).

Energy contract is 'take or pay' with penalty rates above that. $50M power budget.

One area of Perth gets 4 sources of water – desalination, surface + 2 different bores. The aim is to supply water at around 25˚C, but can supply up to 32˚C. Water quality complaints go straight to operations centre. Had a lot of complaints initially; "use of customers as biotesters!"

Some samples can take up to 2 months to get results. There are 104 Recycled Water Plants across WA.

The Integrated Water Supply Scheme. This Scheme is supplied from multiple groundwater and surface (dam) water sources and, from October 2006, the Perth Seawater Desalination Plant.

Operations centre is staffed 24 hours a day, covering the whole state (except Bunbury and others such as Rottnest). Water Corporation run a fatigue assessment prior to sending out employees and contractors after hours. Wages for staff are 45% above award for shift work (2 nights + 2 day week, 12 hour shifts). Operators earn approx $90 k p.a.

Electronic Media and Useful Links

http://www.watercorporation.com.au/_files/publicationsregister/22/SourcePlan_2005_Summary.pdf

7.5 Presentation: Water Source Planning and the Role of Water Efficiency

7.5.1 Contact Details

Ben Jarvis - Water Efficiency Branch Manager
Water Corporation
Ben.jarvis@watercorporation.com.au
(08) 9420 2420

7.5.2 Background Information

Water Forever is a 50-year plan developed through extensive consultation with stakeholders and community, to make Perth and surrounding areas more climate resilient to ensure sufficient and sustainable water supplies for Western Australia. It incorporates 3 key strategies. By 2030, we plan to:

- reduce water use by 15%
- recycle 30% of wastewater
- develop 70-100 GL of new water sources.

7.5.3 On Tour Notes

The Water Forever Program has been developed in response to a 75% decrease in inflows to reservoirs.

Perth's consumption of water is above all of Australia with the exception of Darwin.

- Residential use – 268KL potable water per house per year (average – but excludes private bore use)
- Mining town use – 400 KL potable water per house per year (average)
- 72% or potable water is used by households

FIGURE 28: WATER FOR EVER PLAN, FROM BEN JARVIS' PRESENTATION

We are now headed towards climate resilience; 1 year in 50 climate reliability.

2 days per week permanent sprinkler roster from 6pm to 9am leading to a 21% reduction in use.

A water efficiency program can defer significant CAPEX, for example options being considered include:

- $1.20 kL use indoor – hurdle rate for investments
- $1.72 kL outdoor use – hurdle rate for investments
- Winter sprinkler ban in place. Average Perth 270 kL/kh/yr excluding private unmetered bore use.
- Significant real increase in tariffs (17% increase + CPI).
- Investing in pressure reduction.

Water Smart Margaret River campaign reducing consumption by 12% with monthly phone calls to advise customers of their monthly water use. Smarter metering first step was to move to a quarterly meter reading cycle.

FIGURE 29: WHAT'S NEXT IN THE WATER FOR EVER PLAN, FROM BEN JARVIS' PRESENTATION

ELECTRONIC MEDIA AND USEFUL LINKS

http://www.thinking50.com.au/
http://watercorporation.com.au/W/water_sources_new.cfm?uid=9809-4354-6198-5978

7.6 Dinner Guest Speaker – Vanessa Moscovis

Focus: Land Application of Biosolids

7.6.1 Contact Details

Vanessa Moscovis (Nancy Penny could not make it)
Water Source Strategic Planner
Water Corporation
T: (08) 9420 3163 F: (08) 9420 3179
629 Newcastle Street, Leederville, WA 6007
PO Box 100, Leederville, WA 6902

7.6.2 Background Information

Vanessa spoke on the Water Corporation's program for land application of biosolids (one of the most successful in Australia).

7.6.3 On Tour Notes:

Facts and figures for biosolids:

- 99% reuse – broadacre agribusiness/landfill/tree plantations. Class B biosolids. Metals pose bigger risk than pathogens. Applying 3-5 tonnes/Ha.
- Water Corporation takes soil samples, delivery, spreading up to 250-300 km (!)
- More than 100 000 t/yr produced more than 17% solid. 15000 t/yr goes to forestry. Budget approx $10M/yr.
- Flies pose significant issue with storage. Built enclosed storage – on farmers paddock! Tent like structure. $120/t costs to send to landfill. Pelletiser plant stopped due to high power costs.
- Phosphorus is most valued by farmers.
- Demand > Supply but have not thought about charging/cost recovery.

Electronic Media and Useful Links

http://www.watercorporation.com.au/G/gwr.cfm
Disc contains:

- Groundwater Replenishment Update Newsletter June 2010 (PDF)

8 TH DAY PERTH – DARWIN (TUES 22/6)

8.1 DARWIN – AWA SEMINAR / EVENT

Focus: Integrated Water Supplies in NT

8.1.1 CONTACT DETAILS

Joanne Noske - Assistant to the General Manager Remote Operations
Power and Water Corporation
Ph: (08) 8924 5601
Fax: (08) 8924 5360
joanne.noske@powerwater.com.au
Darryl Day - General Manager Remote Operations, PWC
darryl.day@powerwater.com.au
www.powerwater.com.au
Alison Bowman - AWA
(08) 8362 7576
ntbranch@awa.asn.au

8.1.2 BACKGROUND INFORMATION

The event provides the opportunity for discussion on the issues and complexities associated with NT water management (water quality and water resources) along with the chance to meet with a number of representatives from the Northern Territory water industry first hand.

The itinerary included:

- Water Management for large Indigenous Communities (Darryl Day)
- Outstation Water Quality (Nadine Riethmuller)
- Recycled Water Pricing at Western Water (Les McLean)
- DNRETAS – NT Water Resource Management (Ian Lancaster)
- Alice Springs Reuse Project (David George)

8.1.3 ON TOUR NOTES

ALICE SPRINGS RECYCLED WATER SCHEME

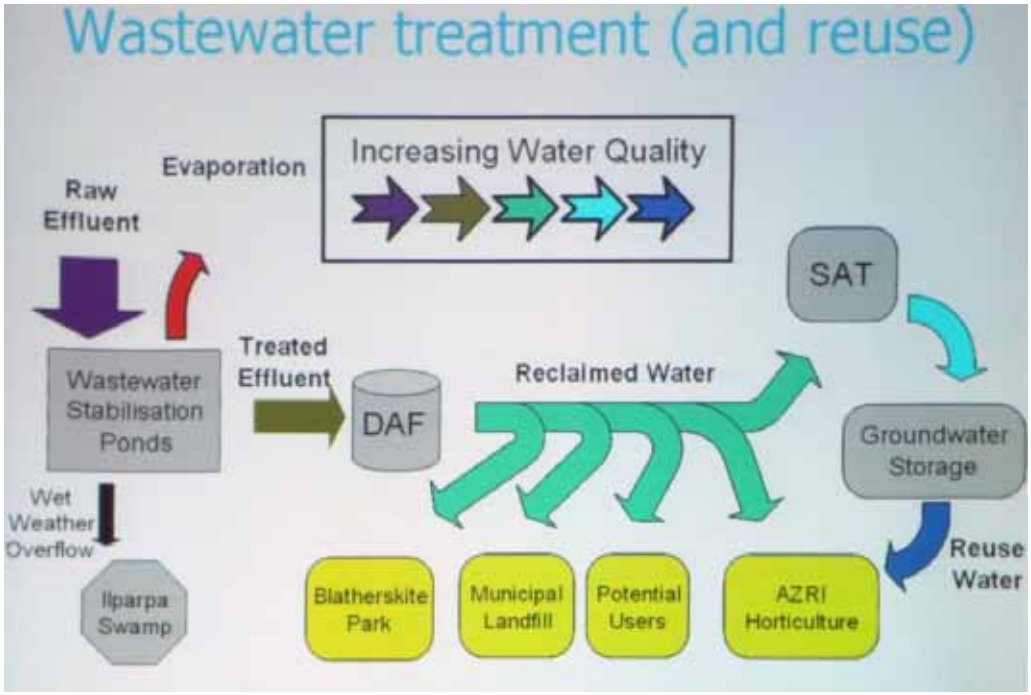
The community didn't want sewage ponds increased, primarily due to mosquitoes.

It costs $13.5M to recycle up to 1800 ML/year, currently recycling 600 ML/year. This is the first project of its type in the Northern Territory using Infiltration, storage and reuse. Recycled water is used for recreational area irrigation, horticulture and Council amenities. Principle of water treatment (filtration) is via percolation and further treatment whilst in aquifer.

5 basins cover approx 1 Ha. The aim is for continuous RW quality monitoring. Basins are filled quickly where possible to create hydraulic pressure. There is a 5 day cyclic wet/dry period. The basins must dry out for 5 days to avoid algal build up. There is a 300mm water depth when basin is full. Project is used by CSIRO to develop ASR guidelines. Customers previously received green coloured RW!

Recharge rates are lower than anticipated (more clay in soil than expected) only 400ML/year at present. There is less need for chemical/physical treatment at recycled water plant as it uses natural soil processes. Also need 4 pipelines for customers with access to aquifer. Alice Springs drinking water aquifer is non-renewable. Groundwater is owned by State Government, therefore lost control which is a key future issue for pricing and trading.

Class B water goes into basins at an approximate cost of 50c/kL. Scarify top of dry basin. Around 2 years travel time to extraction point roughly 2km, away. Total water available is approximately 6 GL. Basin construction is simple bank created by clearing a drain area. Drinking water supply comes from adjacent aquifers.

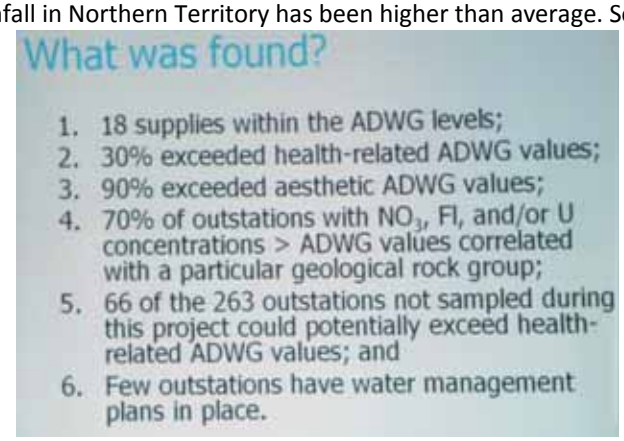


Outstation Water Supply

There are approximately 500 indigenous outstations in NT, and around 10,000 people are supplied with drinking water at outstations in addition to 40,000 other people who are mobile. Most water is sourced from groundwater bores. 90% exceed ADWG for aesthetics and 30% exceed ADWG for DWQ.

Most outstations have no water management plans. Approx 90% of all water use in NT is sourced from ground water. There is no water trading in Northern Territory.

The rule of 20% extraction of groundwater inflow is the cap. 80% of river flows is to be allocated to the environment. NT has vast amount of groundwater in aquifers. Likely cap for whole of NT is approximately 300 GL. Since 1974 rainfall in Northern Territory has been higher than average. Some bores (for example in Katherine) have filled and spilled with strong recharge. If this happens, bores must be capped.



Darwin dam 265 GL, licensed to take only 50 GL of that. No water treatment of drinking water. Drinking water use > 500 L per person per day. Drinking water price 90c/kL.

9 TH DAY DARWIN – SINGAPORE (WED 23/6)

9.1 NGUIU, BATHURST ISLAND

Focus: Water management on a remote island

9.1.1 CONTACT DETAILS

Craig Cawood - Community Liaison Officer, Power Water Corporation
(08) 8924 5357

9.1.2 BACKGROUND INFORMATION

The community of Nguiu is on the south-east corner of Bathurst Island, part of the Tiwi Islands 70 kilometres north-north east of Darwin. Water production was struggling to meet demand from the growing community due to limited infrastructure capacity. A drilling program was undertaken and resulted in six production bores capable of augmenting the water supply by 30 litres per second. At this stage, two bores have been equipped and commissioned. An additional three litres per second was also secured by improving conveyance through upgrading the rising main by replacing 3490 metres of 150 millimetre PVC pipe with 250 millimetre PVC pipe. Nguiu has also been approached to participate in developing a Community Water Plan.

Nguiu has a population of around 1500 that relies entirely on groundwater as its drinking water source. The borefield consists of seven bores with a combined capacity of 32 litres per second. The borefield intersects the aquifer in the Van Diemen Sandstone. The aquifer has developed in a predominantly fine silty/sandy unit of the formation, which causes difficulty during drilling and bore construction because of the fine nature of the aquifer material, leading to bore sanding (Moretti and Yin Foo, 1992). The sustainable yield from the aquifer near the current borefield has been estimated at two million cubic metres per annum (this equates to a continuous instantaneous yield of 60 litres per second) (Moretti and Yin Foo, 1992). The aquifer sustaining the current borefield is capable of an increase in the volume of water sustainably harvested in order to meet the growing demand of the community.

Water consumption is also of concern at Nguiu, with peak averaged per capita daily usage at almost 1,100 litres per person per day.

FIGURE 30: DEISEL SUPPLY FOR POWER STATION

FIGURE 31: WASTE WATER TREATMENT LAGOON

The Community Water Plan program was introduced to Nguiu in mid 2008. Discussions have centred on community elders requesting a water conservation program and support was displayed for local bands to participate in a public education campaign.

The Tiwi people have lived on Bathurst and Melville Islands for more than 10,000 years and their separation from the mainland has created a unique culture, music and artworks.

This leg of the tour provides a unique opportunity to see firsthand the challenges and solutions provided in relation to water source and supply in remote indigenous communities.

FIGURE 32: WATER BORE SITE

Key Facts (2008)

- Population Approx 1,582
- Bulk water consumption (ML p/yr) 632,
- Avg. water consumption (L/p/d) 1,094

9.1.3 On Tour Notes

Approximately 2,000 people are supplied with bore water with chlorination. Water samples collected and analysed daily. Reticulated sewage, macerator cuts rags/solids into a slurry (although cannot handle pig carcases!), pressurised sewer system, all houses are reticulated. Only power capacity in the event of outages is to use pump well storage. Pre-paid power rates, water and sewerage tariffs are free to indigenous community, but rates are paid by Europeans. Moving to remote meter reads.

FIGURE 33: VISITORS CENTRE/MUSEUM

There are 3 sewerage ponds, no further treatment, and ocean discharge. No reuse “too much water”. No marine discharge monitoring. There is free transport to Melville Island for residents. Diesel generated power, solar hot water on each house, 15-20 people house.

FIGURE 34: DIESEL POWER GENERATORS

Main learnings from site visit – respect – for land, for culture, for environment, for self and one another, for family, for life and the past.

Electronic Media and Useful Links

http://www.powerwater.com.au/__data/assets/pdf_file/0004/13477/Indigenous_Essential_Services_Sustainable_Water_Management_Annual_Report_2008.pdf

9.2 Travel to Singapore

Tour returned from Nguiu to Darwin airport, departing for Singapore at 4pm.

10 TH DAY: SINGAPORE (THUR 24/6)

10.1 MARINA BARRAGE

Focus: 1st Reservoir in the heart of the city

10.1.1 CONTACT DETAILS

Mr Rajiv Dixit – General Manager,
Industry Development Department
PUB
Rajiv_dixit@pub.gov.sg
8 Marina Gardens Drive,
Singapore 018976
Ph: 65 6731 3193

10.1.2 BACKGROUND INFORMATION

Briefing and guided tour of Marina Barrage which is built across the mouth of the Marina Channel. The Marina Barrage creates Singapore's 15th reservoir, and the first in the heart of the city. With a catchment area of 10,000 hectares it offers 3 benefits, water supply, flood control and a lifestyle amenity.

Think you've experienced all there is to reservoirs? Think again. Singapore's very first reservoir in the city takes a different spin on the conventional nature-themed reservoir. Interweaving greenery with city chic, the Marina Barrage gives you the height of technological sophistication in the throes of urban vibrancy.

Situated at the heart of the up and coming Marina South district, this colossal architectural masterpiece is a must-visit. Take a stroll through the barrage's vast compounds and come face to face with stunning engineering equipment. Visit the intriguing gallery and discover how the barrage ingeniously prevents flooding to the city's low-lying areas. Or simply stand atop the green roof to take in the sweeping Singapore city skyline.

10.1.3 ON TOUR NOTES

PUB has 1.2M customers, and Singapore a population of 5 million. Singapore has an annual rainfall of 2,400 mm and land area of 710 km^2. Singapore has no ground water. The island state also has little agriculture, so use is roughly 50:50 domestic to industrial usage.

WATER SOURCES

PUB tagline is …*Water for all: Conserve, Value, Enjoy*.

Aim to ensure an efficient and adequate supply.

They talk about 'Used' water- not "waste water" which they believe has a negative and misleading connotation, and also use 'NEWater' to describe water made fit for many uses.

There are 4 national 'taps' – local catchment, imported water, NEWater and desalinated water.

FIGURE 35: PARKLANDS ON TOP OF MARINA BARRAGE INFORMATION CENTRE

1. Singapore imports water from Malaysia under two agreements: 1961 – 2011 (this one will not be renewed next year) and 1962-2061.
2. The Marina Barrage serves 3 functions: water storage from local catchments, flood control and lifestyle attraction. The Marina Barrage opened 31/10/2008 and has had over 1 million visitors to date. Huge pumps 280m^3/s to move water. NEWater has capacity to meet 30% of Singapore's water needs by 2011 (1% Drinking Water and 99% commercial). 5 plants produce 122 ML/d. There are 500m buffer zones around STPs. Singapore's rapidly growing population (within a limited land area) has lead to deep tunnel sewerage systems (DTSS) being developed.
3. Desal plant opened in 2005, 136 ML/d, Design, Build, Operate Own (DBOO). Use DICL pipes which assist in low recharge rates.

Water Losses are less than 5%. DICL pipes used which assists in low leakage rates. Illegal water tappings can result in up to 5 years jail..!

Consumption Fees and Charges

Currently domestic water consumption is at 155 L per person per day. The aim is for a long term rate of 140 L.

Their approach is to promote ownership of water conservation. Pricing aims to reflect the strategic importance and scarcity value of water. PUB has a 24 hour manned call centre, with calls answered within 10 seconds. Singapore is 100% sewered and sewer is separate from drainage.

Usage tariffs:

- Non-domestic same as domestic 1st tier. 1st tier 0-40 ML/month $1.52/ML + $0.30
- WBF= water borne fee for used water ($0.60 for commercial) 2nd tier >40 ML/month + $0.30 WBF.
- Tariffs include a Water Conservation Tax. Fixed sanitary appliance fee = $3 month.

Control imposed on commercial discharge to sewers in relation to trade waste quality. Commercial customers must implement onsite treatment if required to meet discharge standards.

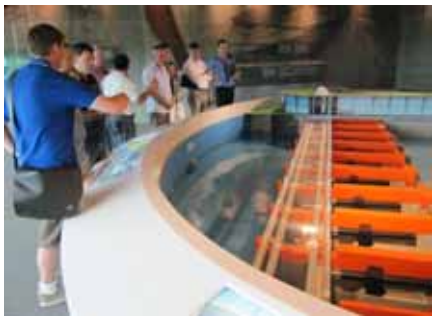


FIGURE 36: INSIDE THE MARINA BARRAGE INFORMATION CENTRE

General Information

PUB uses technology as a tool to solve water solutions. Power is produced from gas supplied by Malaysia. 1% of NEW water into drinking water is a deliberate strategy to gradually introduce recycled water into drinking water supplies. Aim for a generational change, so start educating next generation (school kids).

The Marina Barrage aims to supply 10% of Singapore's water consumption. The water is still brackish so not yet used. Within next 2 years expected to commence using Marine Barrage water, but will be further tested before use. Two weeks without rain in Singapore is unusual, so no rain in February 2010 was a big issue. High rise apartments and units are

separately metered. Meter reading is still done manually on a bimonthly basis and shared with reading of power meters.

Grass roof is to control temperature. Solar Park provides 50% of energy requirements. For non-compliant trade waste discharge users have one chance; upon 2nd breach, supply is shut off. Marina Barrage is slowly de-salting as stormwater flushes replace salt water.

The stormwater captured will be pumped directly to Chestnut Ave WTP or into Upper Pierce Reservoir. They expressed some concerns about algae in water from Marina Reservoir. Stage 1 upgrading to 90 million gallons per day to cope with additional water from marina membranes.

Security of the potable water supply is very important. Sometimes monkeys produce nuisance trips of security systems. Canals have video monitoring and computer monitoring of fish health using tiger barb fish in tanks (biosensors).

Total 54 employees on site; Shift staff 20 with each shift having 4 staff

To mitigate flooding downstream of Pierce Reservoir during storm event Singapore will reduce imported treated water from Malaysia and increase operation of Chestnut Ave WTP.

Electronic Media and Useful Links

http://en.wikipedia.org/wiki/Marina_Barrage

www.pub.gov.sg/Pages/default.aspx

10.2 HYFLUX SINGSPRING DESALINATION PLANT, TUAS SINGAPORE

Focus: Desalination, water recycling, wastewater treatment and potable water treatment

10.2.1 CONTACT DETAILS

Felicia Yoo - Corporate Communications, Hyflux Ltd
T: 65 6214 0777
Michael Siew - GM Operations & Maintenance
michael_siew@hyflux.com
Alan Toh - GM Business Development
allan_toh@hyflux.com
Location: Hyflux Building 202 Kallang Bahru

FIGURE 37: AERIAL VIEW OF PLANT – IT CAN SUPPLY 10% OF THE COUNTRY'S NEEDS

10.2.2 BACKGROUND INFORMATION

Hyflux is a leading technology company that is fully committed to developing new technology applications and intellectual property as its long-term competitive advantage. It maintains its leadership position in its core business by engaging in a sustained, market-driven program of research and development.

In 2004, Hyflux launched its membrane and materials technology centre - the largest in Asia, outside Japan, to spearhead its development in cutting-edge membrane technology and environmental engineering solutions. It maintains more than 10 research laboratories in Singapore, including a knowledge centre, an innovative process development centre, a materials and membrane products development centre as well as advanced machining, prototyping and industrial design functions to support the Hyflux Group's status as a leading environmental solutions company.

HYFLUX SINGSPRING DESALINATION PLANT, TUAS Singapore's first desalination plant – the largest of its kind in Asia – ranks among the most energy efficient ever constructed, enabling it to achieve the lowest desalinated seawater price in the world. Opened in September 2005, within its first year of operation the plant has won a distinction in the 2006 Global Water Awards and two of the companies involved have gained industry honours for their work on the project.

HYFLUX - MORE THAN JUST WATER

Today, Hyflux is more than just a water treatment company. It is an integrated solutions provider, offering services that cover the whole spectrum of research and development, process design and development, manufacturing and systems assembly, engineering, procurement and construction (EPC), and operation and maintenance of a wide range of water treatment and liquid separation projects. Hyflux's strength as a membrane technology company has enabled it to identify niche applications in several sectors other than water – moving into the field of clean energy in environmental applications such as the recycling of used oil, processing of bio-ethanol as well as in the production of bio-based materials such as lactic acid.

The Plant

Completed some three months ahead of schedule, Singapore's first desalination plant – the largest of its kind in Asia – ranks among the most energy efficient ever constructed, enabling it to achieve the lowest desalinated seawater price in the world. Opened in September 2005, within its first year of operation the plant has won a distinction in the 2006 Global Water Awards and two of the companies involved have gained industry honours for their work on the project.

At 110,000m^3/day, the Tuas seawater reverse osmosis (SWRO) plant has sufficient capacity to meet around 10% of the national demand - and at a price which challenges the notion that desalination is a high-cost option. Based on a pre-defined formula, the water sale price varies monthly with prevailing fuel cost and annually with inflation. The initial tender figure was $0.78/m3 for 2005; in practice the plant's efficiency has meant that the actual first year selling price approaches half that.

The project cost was SD $200m and project finance came from a SD $165m loan facility, together with a S$35m equity investment from Hyflux. A syndicate of international banks was involved in funding the plant. The arrangement comprised a senior debt facility of up to S$158.5m to fund 80% of the project budget, with an associated contingency facility of up to S$6.5m which had been put in place to cover 70% of the costs in the event of an overrun. The balance was made up from the original Hyflux equity contributions into SingSpring.

10.2.3 On Tour Notes

This plant cost SD $180M. Hyflux is currently looking for its first project in Australia and is seeking partnerships with strong Australian companies.

SingSpring produces 136 ML/d. Hyflux has built own and operate this project that will meet 10% of Singapore's water needs. The plant used a two pass RO membrane system, with 45% recovery in 1st pass and 90% recovery in second pass, therefore approx 35% total recovery. Minerals are added post treatment, plus pH balancing. It is an energy efficient process.

3 of 4 taps (except NEWater) are mixed in one reservoir and supplied to reticulation. NEWater is not supplied to customers due to cultural sensitivity issues.

Two thirds of Singapore is used for stormwater collection. In areas of commerce and industry it is not collected/used. Imported water from Malaysia contributes around 50% of drinking water supplies. Malaysia has increased cost of imported water price, which is high for raw water and on some days demand for water cannot be met. Singapore is growing at a rate of 1-3% p.a. and is starting to tighten its immigration policy.

Monitoring is undertaken of the sea water receiving environment, mixing brine with sludge before discharge.

PUB pays 78c/kL for water produced from desalination plant. Water temperature is a constant 28˚C. 4.3 kWh per ML energy consumption. Cold water requires smaller membrane pore sizes and is not ideal. All water must be sold to PUB.

There is a 120 m offshore pipeline. There are up to 20 operators onsite (minimum of 10 at any one time). Top of skids provide for extra capacity. The membranes have a lifespan of approximately 7 years. TDS after first pass is approximately 20 mg/L.

PUB undertakes daily samplings and online monitoring is continuous. There are 2,500 metres between the inlet and outlet pipes.

12 month construction period with 6 months testing and commissioning. All built on reclaimed land. Maintenance contract also includes significant landscaping requirements. Next desalination plant due to be tendered for in 2011.

10.3 ABC WATERS PROGRAM

Focus: Active, Beautiful, Clean Waters – An introduction

10.3.1 CONTACT DETAILS

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FIGURE 38: VISOTORS HAVING FUN EXPERIMENTING WITH THE ARCHIMEDES SCREW AT KOLAM AYER ABC WATERFRONT

10.3.2 BACKGROUND INFORMATION

Introduction to the ABC Waters Program, introduced in 2006: the Active, Beautiful, Clean Waters (ABC Waters) Program aims to transform Singapore's drains, canals and reservoirs into vibrant, clean and aesthetically-pleasing streams, rivers and lakes. Part of PUB's strategic objective to bring Singaporeans closer to water so that they can better appreciate and cherish this precious resource, it creates new community focal points and recreational spaces for people to enjoy.

Under the ABC Waters Masterplan, more than 100 locations have been identified island-wide for projects to be developed in phases over the next 20 years. Under the first phase, more than 20 projects will be carried out island wide by 2012. They include Kolam Ayer ABC Waterfront, Balam Estate Rain Garden, MacRitchie Reservoir Phase 1 and ABC Waters@Kallang River-Bishan Park.

FIGURE 39: VIEWING TRIAL DRAINAGE BANKS

10.3.3 On Tour Notes:

Industrial stormwater is all discharged to sea without further treatment. Drains with a depth of more than 1 metre must have railings for safety. November/December months have the highest rainfall months in Singapore. Tides range from 1 to 3-4 metres.

PUB spent $2B to widen and deepen drains and canals. To prevent flood events, they use 3 strategies:

1. Drainage master planning and development control. Proper drainage for new land developments. PUB pays for drainage and stormwater expenditure. Allow for 0.5m tide increase for climate change impacts. 1m elevated buffer for important facilities to protect against flooding.
2. Drainage improvement projects, including rehabilitate old rains, covering old canals and creating park land above them.
3. Maintenance and enforcement program with approx $23 M spent annually on de-silting, rubbish removal and closely monitoring construction sites. If colour and turbidity are too high, an alarm will be triggered and an inspection will take place. Minimum design standards are in place for major rivers, drains and minor rivers.

Active, Beautiful, Clean Waters program launched in April 2006. The program aims to integrate the publics' use and enjoyment of water assets as it is important to get community involvement. They work closely with National Parks who manage the parks.
Drains include safety nodes which have water level sensors to measure flood waters if they rise above safe levels. Additional maintenance costs exist within drainage reserve areas for landscaping. Drains often 'double up' as footpaths as well. They are planning to launch a regulation scheme via "ABC Waters Certification".

Proposals are exhibited for public consultation and feedback.

Stormwater quality is regularly sampled.

Electronic Media and Useful Links

http://www.pub.gov.sg/abcwaters/Pages/default.aspx

Disc contains:

- ABC Design Guidelines (PDF)
- Code of Practice on Surface Water Drainage (PDF)

11 TH DAY SINGAPORE (FRI 25/6)

11.1 CHESTNUT AVENUE WATERWORKS

Focus: Recycled Water for Drinking

11.1.1 CONTACT DETAILS

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11.1.2 BACKGROUND INFORMATION

Chestnut Avenue Waterworks, was designed by Black and Veatch and constructed to a fast track schedule between September 2001 and Christmas Eve 2003.

At 273 ML/d at the end of 2003 when it was commissioned, Chestnut Avenue Waterworks was the largest immersed membrane plant in the world producing drinking water. Thinking creatively, we eliminated permeate pumps, which are normally used on each membrane train to draw water through the membranes and we replaced this with a simple siphon system taking advantage of the lie of the land. This is illustrated in the attached image. This solution eliminated 24 large pumps and associated variable frequency drives and reduced capital and operating cost, reduced plant footprint and resulted in a very simple system to maintain.

11.1.3 ON TOUR NOTES

Raw water from Malaysia can be pumped to Pierce reservoir which provides 7 GL storage. Most water is from local 'protected' catchment. From June 2011, water from Marina Barrage will begin to be pumped to Pierce Reservoir as well. Pierce Reservoir at 134 m above sea level. 5% is membrane reject resulting in 95% efficiency. Sludge is then pressed via belt press and solids sent to land fill.

Fish monitoring is regularly undertaken to enable quick response to pollution/contamination. They monitor gill movements of fish electronically.

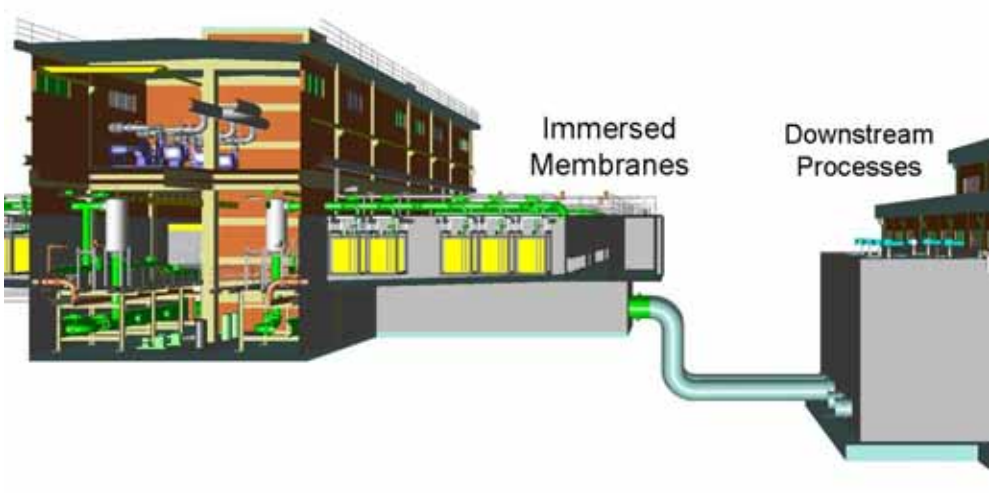
Chestnut Avenue Waterworks is not only supplying water but supplying amenity as well as addressing some of the social issues. They have covered a clean water tank with turf to control temperature and for amenity / landscaping value. Continuation of high technology and use of natural processes e.g. fish varieties that are sensitive to toxicity ensure high water quality standards.

Chestnut Avenue Waterworks is a protected jungle catchment - the last remaining jungle catchment in Singapore. It can also pump rain water from Joher into Upper Pierce Res. - Stage1: 270ML/d 1975, Stage 2: 270ML/d 2003

MEMBRANE PLANT & TREATMENT

1. Stage 1: sand filtration
2. Stage 2: immersed UF membranes. Membrane backwash 45s every 15 min

Most water still comes from Malaysia, with the biggest storage in Singapore. Singapore has its own treatment plant in Malaysia. Malaysia water is cheaper than Singapore treated water. Most treatment water from Malaysia goes direct to the Singapore distribution system.



ELECTRONIC MEDIA AND USEFUL LINKS

www.pub.gov.sg/general/Pages/WaterTreatment.aspx

11.2 NEWATER

Focus: Indirect Potable Reuse – one of the first in the world

11.2.1 CONTACT DETAILS

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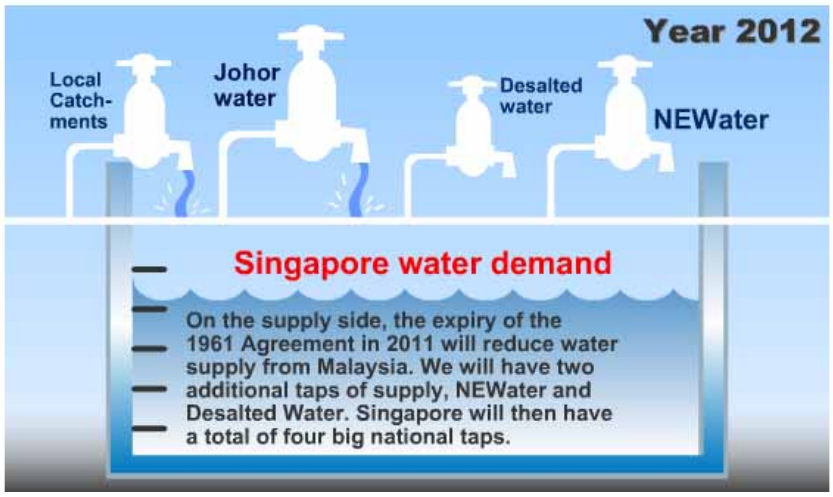
11.2.2 BACKGROUND INFORMATION

NEWater may sound like an overnight success for Singapore. But its evolution is a journey that has spanned three decades.



Singapore's first water master plan was drawn up in 1972. In 1974, PUB, the national water agency, built a pilot plant to turn used water into potable water. This was the precursor of today's NEWater factories. But it was ahead of its time. The costs were astronomical and the membranes were unreliable, so the idea was shelved to await further technological advancement.

In 1998, the necessary technology had matured and driven production costs down. In May 2000, the first NEWater plant was completed.

Currently, there are four NEWater plants in Singapore. The fifth NEWater plant at Changi will be Singapore's largest NEWater plant. NEWater will meet about 30 percent of Singapore's total water demand by 2010.

The NEWater Visitor Centre, which was opened in February 2003, is the focal point of PUB's public education on NEWater. The centre highlights the importance of water and how Singapore leverages on advances in technology to reclaim water. Visitors are able to view firsthand the operation of the advanced dual membrane and ultraviolet technologies used to produce NEWater.

The Singapore Water Reclamation Study (NEWater Study) was initiated in 1998 as a joint initiative between the Public Utilities Board (PUB) and the Ministry of the Environment and Water Resources (MEWR). The primary objective of the joint initiative was to determine the suitability of using NEWater as a source of raw water to supplement Singapore's water supply. NEWater is treated used water that has undergone stringent purification and treatment process using advanced dual-membrane (microfiltration and reverse osmosis) and ultraviolet technologies. NEWater could be mixed and blended with reservoir water and then undergo conventional water treatment to produce drinking water (a procedure known as Planned Indirect Potable Use or Planned IPU).

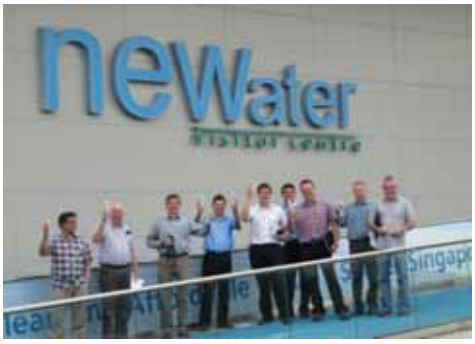
Participate in a comprehensive tour of NEWater facilities and treatment plant. Gain understanding of water resource management for Singapore (4 taps (sources), closing the loop, technology development). Understanding the proposed uses of NEWater (IPR (1-2.5% in Bedok Reservoir), Industrial, cooling, etc. how these have been developed and users secured.

Their public relations and communication program for NEWater works through their educational facility.

11.2.3 On Tour Notes

NEWater Centre

- Demonstrates use of UF-RO-UV-pH correction
- Most of this water goes to industry e.g. semiconductor plants
- IPU = Industrial potable use
- Motto is 'Water for all: conserve, value, enjoy'
- They produce 300 Mega Gallons per Day: 600 Olympic pools per day
- Singapore has 14 reservoirs plus Marina Barrage; 2/3 of Singapore's water supply is from catchments
- 4 NEWater facilities, approximately 1% of Singapore's potable water consumption is from NW
- Typically 200-300 students visit per day with up to 700 on peak days. Advanced WRPs.
- Bedok plant was opened in 2000
- NW has been certified safe 2002 by Prime Minister
- 1-2% of water from taps is NEWater as it is gradually introduced into drinking water supplies
- Examples of similar projects are shown from around the world: Orange County, Scottsdale and Europe
- 1970s – 1st experiments with reclaimed water
- 1990s: affordable membrane technology
- VOX pop testimonials supporting NEWater: Clean enough to drink



KEE WEE'S PRESENTATION

- NEWater demo plant was opened and 2 year study commenced in 1999. Renovate exhibits every 3 years.
- Current facility opened in 2003 and has had 750 000 visitors.
- NEWater produced 3-4% of supply in February 'drought'.
- August 2002 – National Day 6,000 bottles of NEWater given out, with a public survey showing 98% support.
- Water recycling plant next to NEWater plant has been decommissioned when deep sewer tunnel commissioned. Plant now gets water from Changi WRP 5-8 km away (site is not suitable for primary school visits).
- Water industry needs water with <1 ppb TOC. Public was initially resistant but now accepts NEWater.
- Conductivity out of RO <60-70 EC but 100-150mg/L TDS after chemical addition.
- Next NEWater plant will be at Changi.

ELECTRONIC MEDIA AND USEFUL LINKS

http://www.pub.gov.sg/newater/nationaltaps/Pages/default.aspx

11.3 SEMBCORP, JURONG ISLAND SINGAPORE

Focus: Expertise in desalination (hybrid plant) recycled Effluent and Industrial wastewater

11.3.1 CONTACT DETAILS

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Location: SembCorp Industries Ltd
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Singapore 179360
Presentations by Olarikarit Kamolwan, Daniel Goh and Senior Vice President Business Development, Dr Lieu.

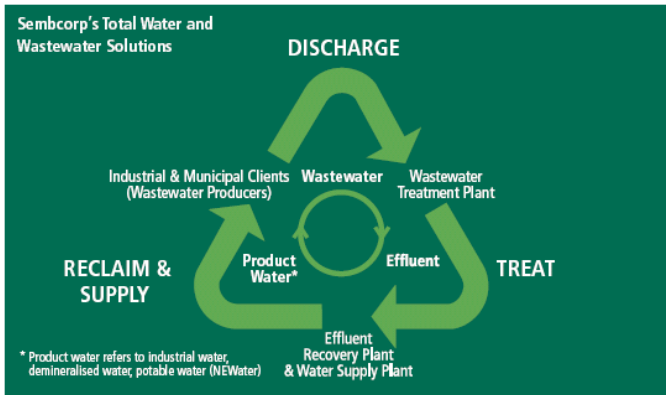


FIGURE 40: SEMBCORP'S TOTAL WATER AND WASTEWATER MODEL,

11.3.2 BACKGROUND INFORMATION

Core to SembCorp's service offerings are competitive and technologically advanced water solutions. As Singapore's leading water management company, SembCorp has expertise in wastewater treatment, high-concentration wastewater management, water recycling and desalination. SembCorp's water capabilities have been successfully exported to China, the UK and the UAE, bringing its overall water resources capacity to over 4 million cubic metres per day.

The high grade Industrial Water Recycling plant on Jurong Island, is Singapore's largest recycling plant; produces high purity de-mineralised water from industrial effluent.

SembCorp is Singapore's largest water management company. On Singapore's Jurong Island, SembCorp Changi NEWater Plant and in China's Zhangjiagang Free Trade Port Zone, SembCorp treats and recycles wastewater in a closed loop, making water a sustainable resource.

Using a combination of Micro-filtration, Reverse Osmosis and Ion Exchange technology, we are able to reclaim secondary effluents from complex industrial wastewater. The process cuts the conductivity of effluents from as high as 10,000 µS/ cm to 0.1 µS/cm and total organic carbon to under 0.1 mg/L.

Areas of focus for SembCorp include:

- High rate and high efficiency biological treatment of complex industrial wastewater
- Low fouling, high flux membranes to increase water recovery
- Energy-efficient seawater
- desalination technology

THE GREEN FACTOR

As a leader in the environmental sector, we take pride in our environmentally sound processes. For example, SembCorp was among the first users of anaerobic biogranulation technology (e.g. EGSB) to treat wastewater. This method not only consumes less energy, it produces energy in the form of biogas, with minimal production of biosludge. The biogas is recovered for the production of steam. Our water reclamation facilities recover water from wastewater effluent for industrial use. This diverts more precious water resources for drinking purposes.

We also utilise advanced fluid composting technology to treat industrial wastewater at our latest wastewater treatment facility on Jurong Island. This technology eliminates the production of biosludge which would normally have to be disposed of in a landfill. These initiatives have resulted in reduced greenhouse gases and a smaller carbon footprint.

FIGURE 41 SEMBCORP WATER TREATMENT FACILITIES, SINGAPORE.

11.3.3 ON TOUR NOTES

- Sembcorp partners with Sita in Australia.
- Sembcorp sell NEWater treated water to Public Utilities Board, Singapore.
- Combined heat and power (co-generational power) plants provide water for process industries.
- Jurong Island 3200 hectares
- Chemical hub in NW Singapore. Used to be 7 islands but now joined up with reclaimed land.
- Sembcorp facilities on Island (Sakrol) commenced operations in 1977.
- Sembcorp contracts directly with industrial customers, with PUB not involved. High strength treatment 1200M^3/d (1.2ML/d) up to 10416 COD
- High Grade Industrial water plant at 35ML/d, 1st NEWater plant, and effluent recovery plant 5ML/day.
- 1st Singapore facility to reclaim industrial wastewater.
- NEWater Plant: 228ML/day
- Longest NEWater plant in Singapore
- Sembcorp sells water back to PUB under a 25 year contract.

END OF TOUR REFLECTION

Some participants chose to stay on in Singapore for Water Week while others returned to Melbourne

11.4 KEY LEARNINGS EXPRESSED BY TOUR PARTICIPANTS

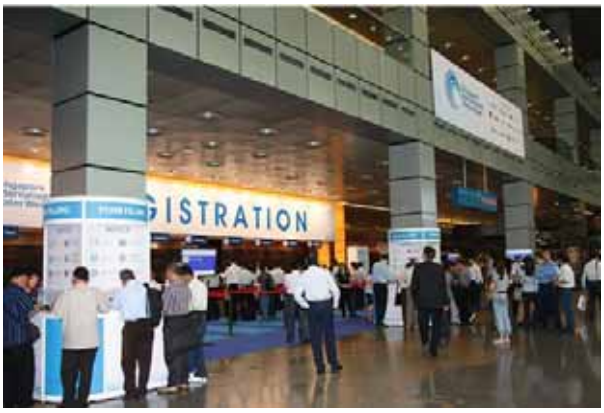
1. Respect for:
    a. Environment, culture , community and history
    b. Understand others
2. Can do attitude:
    a. High performance culture
    b. Behaviour, symbols and systems
3. Stormwater integration part of the solution:
    a. See opportunities not problems
    b. Financing and storage are the key issues
    c. Consider water and energy nexus
    d. No 'one-size" fits all
    e. Need for consistency in regulation
    f. Bring community along with you
4. Knowledge on recycled water pricing structures, and closing gap between drinking and recycled water prices
5. Productivity and cultural benefits can be gained
6. Look at optimising systems quality, quantity and energy use
7. Water is still too cheap in Victoria. Driver should be investment not price!
8. Education is the key – at all ages
9. Social consideration of investing in water projects
10. Catchment management. Currently we don't encourage recreation due to potential risk, the water industry is risk adverse – this can be improved
11. Victoria is very risk adverse. We need to "Go for it"
12. Need to manage groundwater in an integrated manner
13. Need to diversify risk re:
    a. Climate change impacts
    b. Opportunities to manage stormwater
14. Regulators appetite for risk needs to be improved, regulatory lag still an issue
15. Impact of regulators – need to learn from existing trials in other states to educate regulator so not so risk adverse
16. Follow up with urban design issues with SA Water
17. With money and the right drivers anything is possible. But need to bring the community along
18. Victoria needs a coordinated state 50 year plan
19. Water pricing that is real is essential to encourage investment and innovation in water projects
20. Need for standardised regulation in Australia
21. Culture is critical
22. Energy is the next big thing and needs to be a cooperative industry effort on energy recovery, and low energy solutions
23. Need business focus in recycled water projects
24. Respect is important. Out of sight should not be out of mind
25. Learnt about desalination and aquifer storage and recovery systems
26. Demand management is the cheapest and at least as important as supply solutions
27. Passion for work - culture is very important and productivity is still an issue

28. Sustainable solutions can fit with Eco- Tourism
29. There is a need for strong project management skills
30. Community consultation is critical, collaboration between water corporations and the local community is the key
31. Victorian water corporations need to communicate and share knowledge better.
32. SA Building of Life is a Conduit of Culture (enhancing cultural change within an organization)

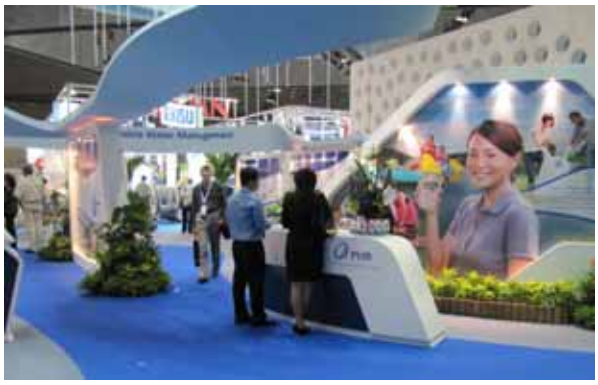
WATER WEEK – OPTIONAL EXTRA

SIWW = Singapore International Water Week.

Water Week was promoted as providing the forum to help countries adopt a 'glo-cal' (global-local) approach in their own countries; leverage global best practices and make them relevant to the unique water needs of the local market (Michael Toh, MD of SIWW).



The China Business forum at SIWW will discuss opportunities in the $200 billion China water sector, where accelerated water demand from a population and rapid urbanization program have pushed the demand for food and sustainable water projects. Australia was also in focus as one of the top 5 spenders on desalination and water reuse.



AWA said,

> Singapore International Water Week 2010 takes place 28 June - 2 July. Themed Sustainable Cities: Clean and Affordable Water, the Week will focus on the need for efficiency and cost effective solutions to address water problems amidst a constantly changing environment.

The recently concluded Singapore International Water Week 2010 (28 June to 2 July 2010) ended on a high note, where the total value of announcements for projects awarded, tenders, investments into Singapore and R&D MOUs exceeded SD 2.8 billion, up by 27% from last year's SD 2.2 billion. The event, which was held together with the 2nd World Cities Summit, saw a record number of over 14,000 trade attendees from 85 countries.

379 top industry leaders attended the 2010 Water Leaders Summit, an increase of 22% compared to last year, while over 1,000 experts, academics and practitioners came together at the Water Convention to discuss the advancements and challenges in water technologies - representing an increase in attendance by almost 20% over the preceding year.

The Water Expo saw a record turnout with a total of eight country pavilions, boosted by the presence of more than 500 participating companies from nearly 40 countries/regions. In all, 26 new products and technologies also made their regional and international debut at the Water Expo's Innovation Corner.

The increase in delegates number coupled with an ever-growing Water Expo was a strong endorsement of the Water Week as a global platform for water solutions. 80 eminent speakers and distinguished industry experts from both the public and private sectors graced each of the eight Business Forums to present insights and share business opportunities while the number of co-located events increased by nearly 60% to 120 events.

Electronic Media and Useful Links

www.siww.com.sg/