Integrated Water Services Technologies Review

Presentation to the CRC Board April 2007

Sustainable sub-divisions:1 – Energy and Water Efficient Design

Steven Kenway, Clare Diaper and Grace Tjandraatmadja – CSIRO

Julie McClellan, Michelle Hennessey and Scott Prenzler – BCC

Ron Apelt, Del Jones and Stewart Crook – DPW

Susan Crozier – Qld Housing

Brookwater and DEM

Overview

Project Methodology

SEQ water use - review of data and issues

Literature and project review

- Water technologies and systems
- Greywater, rainwater, stormwater, wastewater capture, treatment, use

Case studies

- New build and retrofit, single house to sub-division
- Both residential and commercial

Recommendations, findings and completion

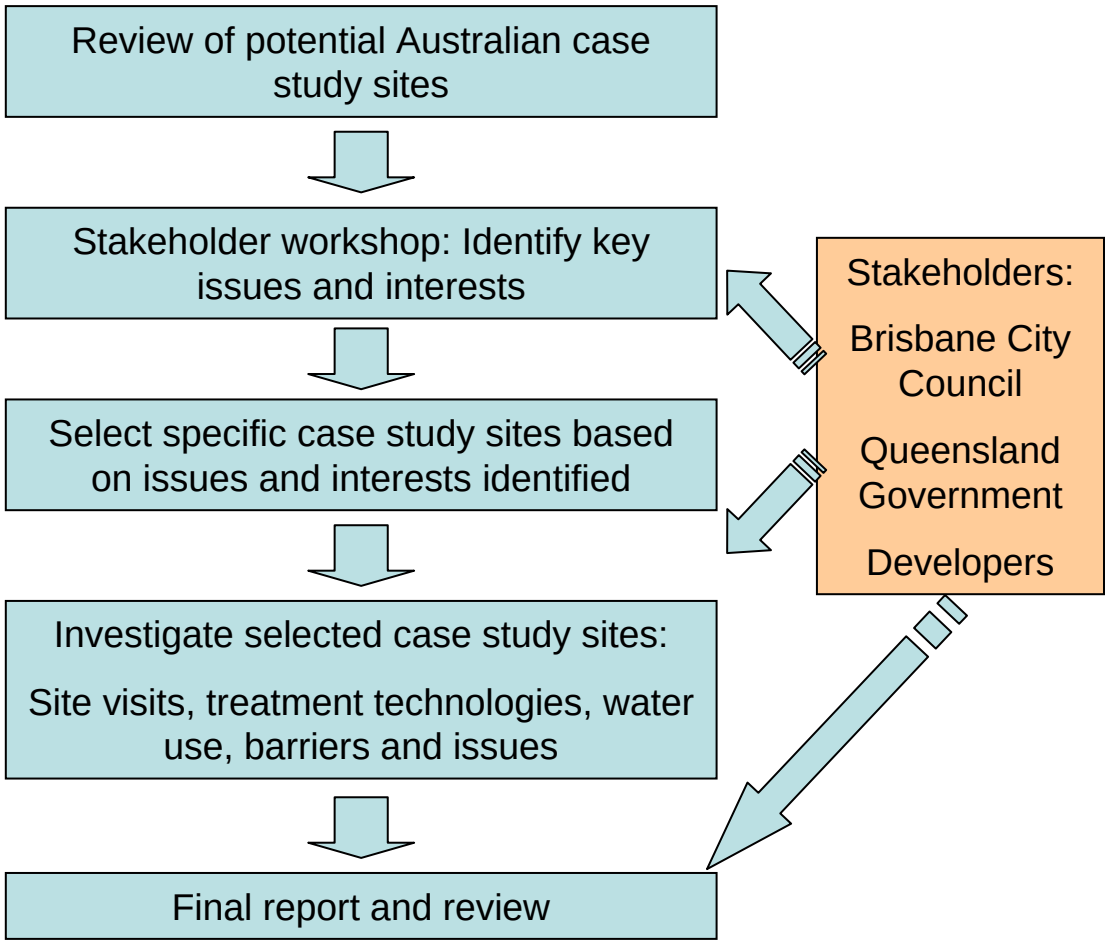
Methodology

Research Report

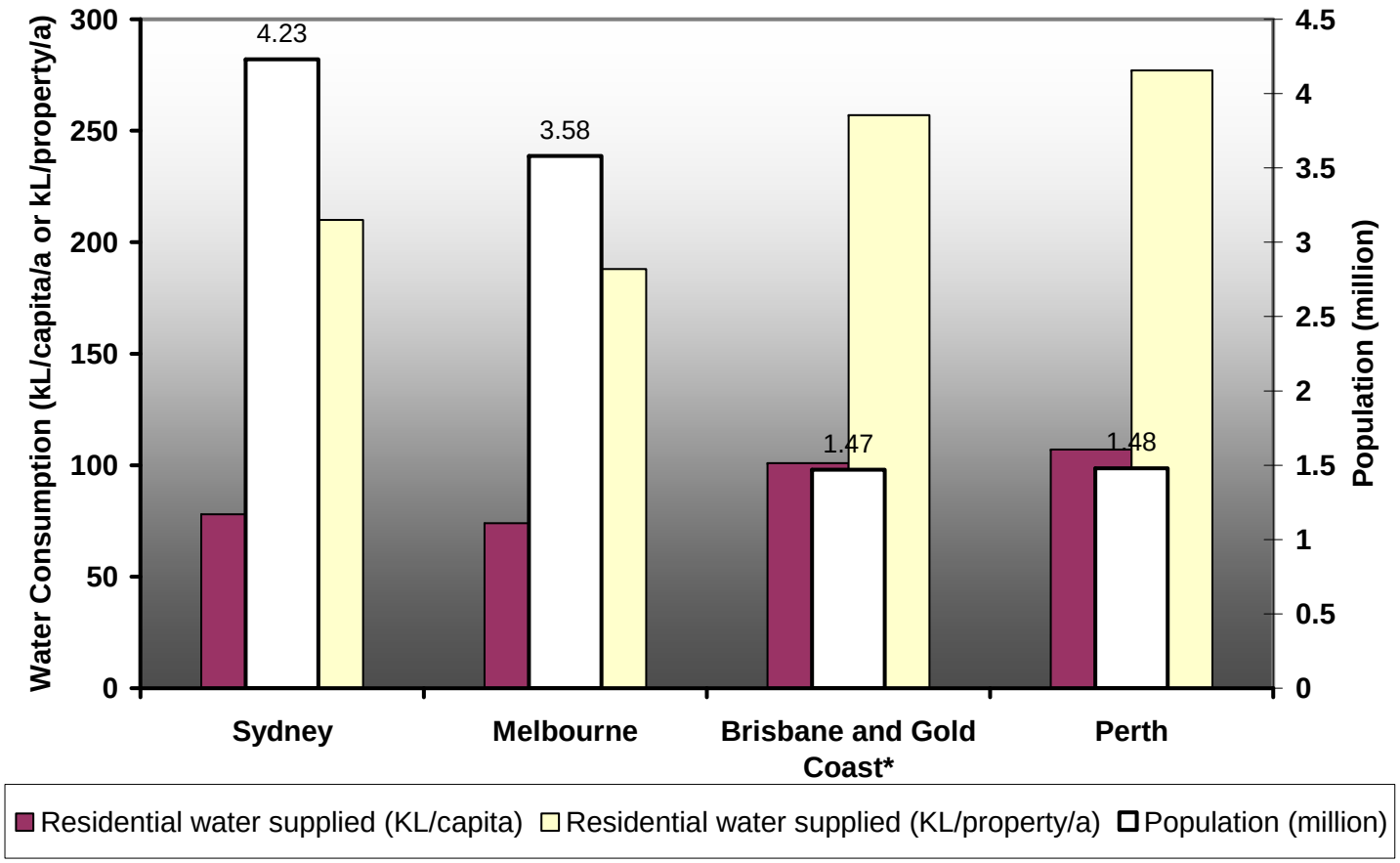
- Background (SEQ), Literature Review, Case Studies, Conclusions, Implications and Recommendations for further research

Industry Brochure

- Summary of Research report. Implications for SEQ

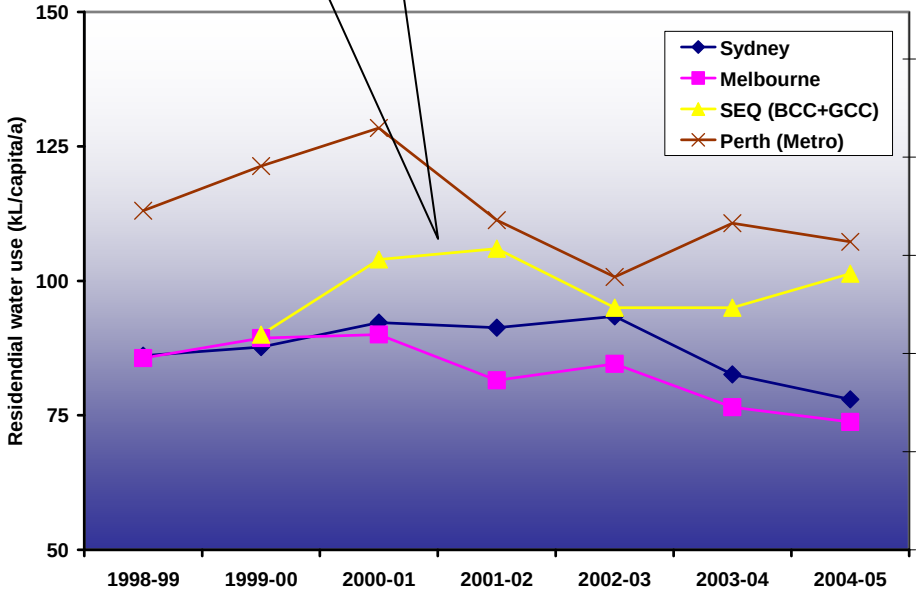


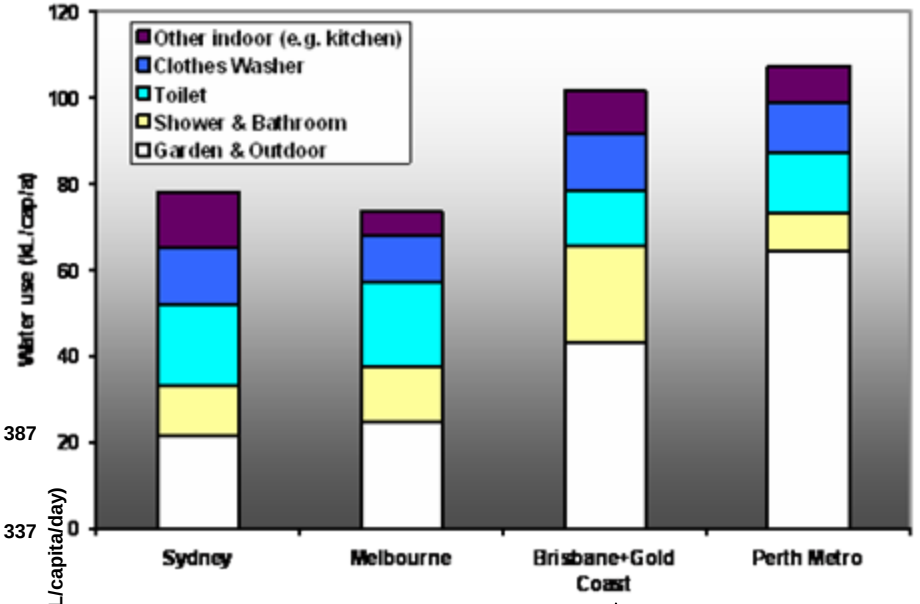
Water use in SEQ



SEQ water use in context

Apparent trend for water usage from mains supplies is upward however further data necessary to validate





Relatively high overall water use in SEQ – particularly outdoor water use but also shower and bathroom

Technologies review

Rainwater

- Traditional water supply option in rural areas (17% of homes, ABS 2004)
- Different requirements for urban tanks – aesthetic and size or footprint
- Collection
  - Wet, dry and siphonic
  - Gutter guards, first flush systems
- Storage
  - Flexible tanks
  - Level monitoring
- Treatment
  - Depends on intended end use
  - Filtration, thermal disinfection and UV
- Distribution
  - Usually pumped
  - Potable water back up

Technologies review

Greywater

- Water from bathrooms and laundries
- Direct diversion or treatment
- End use dependent on treatment
- Wide range of contaminants
- Continuous supply
- Increased householder awareness
- No studies on the perception of large scale use
- Retrofit difficult in slab built properties
- Many technologies of with varying costs, performance and maintenance requirements

Technologies review

Stormwater

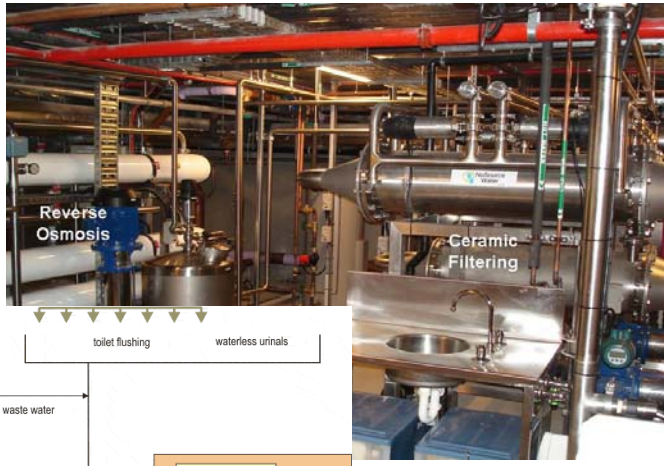
- Household scale – permeable paving
- Stormwater sensitive urban design – for reduction of flows and contaminants. Environmental protection
- Larger scale collection in subsurface tanks
- New storage systems
- Techniques/technology performance requirements not clear

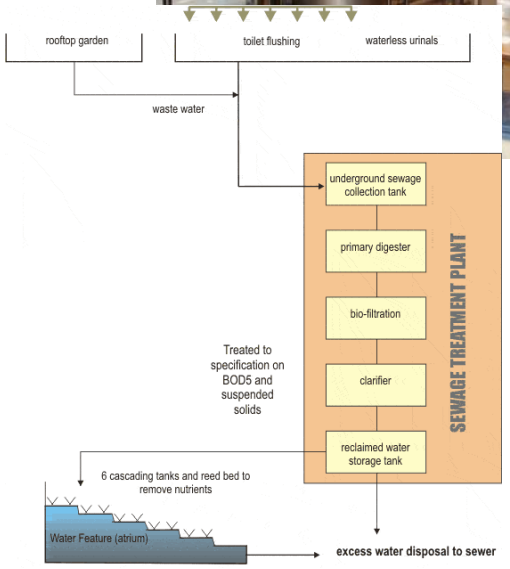
Image from Payne Road Project DNRMW
http://www.payneroad.com.au/mainpages/home.htm

Technologies review

Wastewater

- On site management in unsewered areas
  - Water use reduction and/or on-site treatment
- Additional challenges
  - Higher pathogen concentrations
  - Sludge removal or treatment
- Cluster collection and treatment
  - Vacuum, low pressure, smart pipes
  - Large range of technologies
  - Mix of on site and cluster scale





Case Studies

Sustainable House – single dwelling, Sydney

Currumbin Ecovillage – new sub-division, SEQ

Payne Road - new sub-division, SEQ

60L – retrofit office building, Melbourne

CH2 – new office building, Melbourne

Atherton Gardens – high density, existing residential, Melbourne

Pimpama Coomera – new sub division, SEQ

City of Bayside – existing suburb, Melbourne

Technology issues

- Treatment technologies must be designed to treat the higher concentration waste streams produced by lower water using developments
- Consider biosolids production and management in the initial design of systems
- Consider chemical and energy use of system
- For rain tank systems where potable backup is used, apply technologies that avoid repumping mains water
- Consider the impact of hygiene product use on the treatment technology
- Many existing technologies are not easily applied to existing household as the correct infrastructure is not available

Other issues

Integration of demand management, water management and landscape design both in the project assessment and implementation and in the institutional frameworks governing the project is necessary.

Education and information dissemination and propagation for all stakeholders including householders, councils, developers, water companies, regulatory bodies and other parties.

Clear guidelines for the assessment and selection of appropriate technologies are needed.

Simplification of complex regulatory requirements.

Understand and address non-technical barriers to adoption (costs, home ownership, performance perceptions).

Implementation of infrastructure to allow flexibility in water servicing approaches in the future.

Recommendations and Research Needs

- **Detailed life cycle analysis and monitoring of alternative systems;**
- **Understanding the impact of greywater reuse;**
- **Improved garden irrigation technologies including:**
  - understanding outdoor usage, use of improved sensors (climate, soil and water use) – climate stations, wireless networks, irrigation system automation;
- **Guidelines (e.g. for roofwater harvesting for all residential use and residential water efficiency);**
- **Impacts of alternative water servicing on existing infrastructure and transitioning strategies;**
- **Investigate alternative funding sources and economic incentives or disincentives for implementation of alternative water sources;**
- **Review of the impact that legislative and planning processes have on adoption of integrated water services (e.g. the BASIX program in NSW).**
- **Social or behavioural research including values that lead people to consume water in different ways;**
- **Economic analysis of alternative and traditional technologies**
- **Regional scale and development scale collaboration**

Impact and Adoption

- **RAIA e-learning module has been developed including a targeted presentation;**
- **BCC indicate that the report will be useful with relation to information requests;**
- **The report identifies suggested research contributers to various issues including AGO, Environment agencies, local and state government universities, technology developers, CRC's, water utilities and the development industry.**

Completion

Industry report

- **Has been reviewed by:**
  - project partners and CSIRO processes
  - CRC editor (returned to CSIRO yesterday)
- **Now in the process of addressing editors comments**

Research Report

- **Has been reviewed by:**
  - Project partners and CSIRO processes
  - To CRC and editor this week

Detailed slides on case studies if they are desired

Sustainable house

Overview

- Rainwater collection used for hot and cold water and bathroom
- Mini wetland for tank overflow
- Grey, blackwater, food scraps collected into sand and peat treatment system effluent reused for toilet flushing, washing and garden irrigation

Technology

- Concrete tank with sand and peat filter beds packed with worms and bugs,
- UV disinfection run by solar power
- Rainwater collection via roof, 1st flow diversion into the garden, storage in 8.5kL underground concrete tank.

The Currumbin Ecovillage

Summary

- 110 ha, 144 residential allotments and Village Centre, commercial and recreational facilities to be developed in 3 stages
- Wastewater - A combination of centralised and on-site systems
- Rainwater - Collection at household level with 22.5 to 44-45kL tanks. These capacity includes a 5kL firefighting requirement.
- Other WSUD features have been designed into the subdivision. Some mandated by the body corporate and include rainwater tanks, solar water system, 3A or 4A rated appliances and the use of recycled water

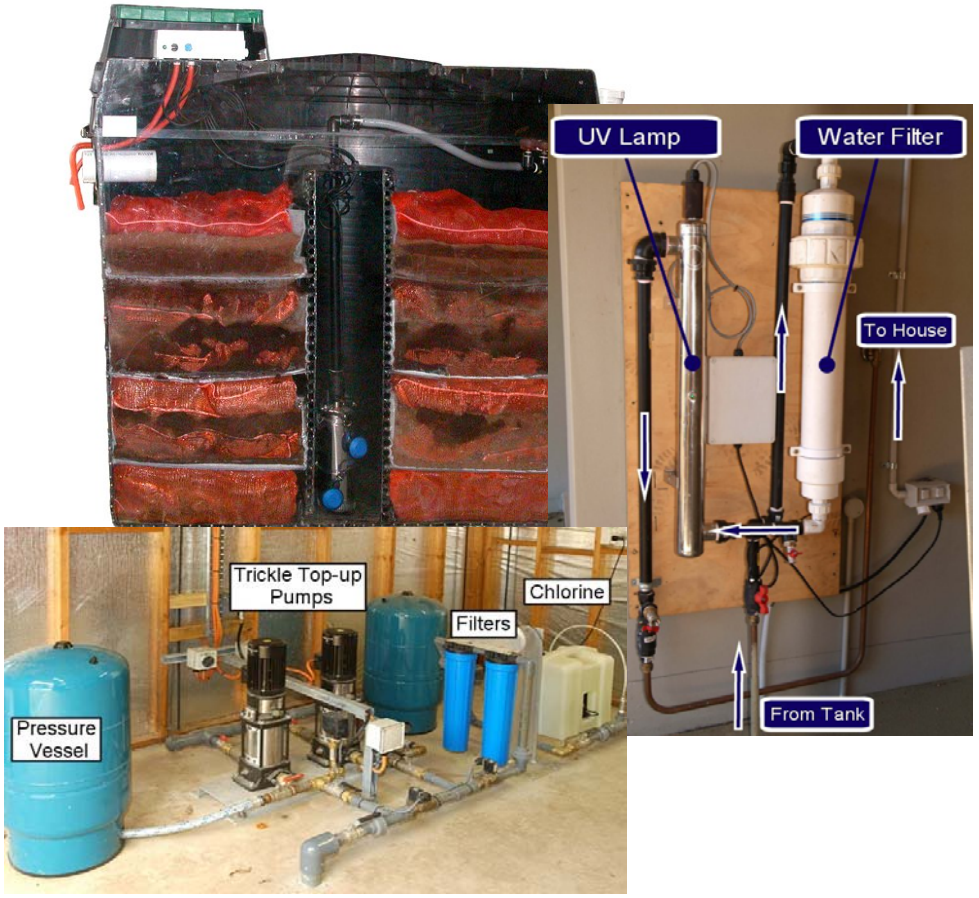
Other tools

- Extensive resource and performance monitoring systems for each household mandated by the body corporate
- An Interpretive Centre has been built to provide continuing education in sustainable practices
- Landscaping at the site designates 80% of the site as open-space
- Provision of a list of potential suppliers of technologies and services supplied to all householders and a schematic of a proposed homeowner build method

Payne Road

Summary

- 18kL to 22kL rain water tank for each household. Treatment by activated carbon filters (1mm) and UV for all household applications. Excess rainwater is diverted to communal tanks located at the bottom of the development.
- Two 75kL communal rainwater tanks (6.7m diameter) for storage of household rainwater excess, provision of fire fighting and future supply of households at bottom of subdivision.
- Greywater and kitchen waste treatment via ‘Biolytix’ aerobic vermiculture system for each household. Treated water reused for sub-surface garden irrigation with moisture sensor.
- Bioretention basin and filter for stormwater.
- Data logging of rainwater tanks, pumps and treatment systems to allow monitoring of water and energy use.
- Sewer collection tank/sump for discharge to sewerage at non-peak hours.



Images from Payne Road Project DNRMW
http://www.payneroad.com.au/mainpages/home.htm

Payne Road

Issues

- Water use is similar to average Gap house. Low awareness of water supply and energy use.
- Water saving comes at an extra energy cost.
  - High energy use for rainwater pumping (linked to pump start up) and UV disinfection
  - Potable water top up to rainwater tank
  - Greywater and sewerage systems used more energy per ML than conventional sewage pumping and treatment
  - Assessment of alternative systems requires detailed analysis i.e LCA
- Pressure sensor for rainwater pumping too sensitive
- Requirement for wet collection system for rainwater for aesthetic purposes may impact water quality and produce odours
- Housing market slow down has meant development of vacant lots is slow. Costs of extensive initial infrastructure not yet recouped

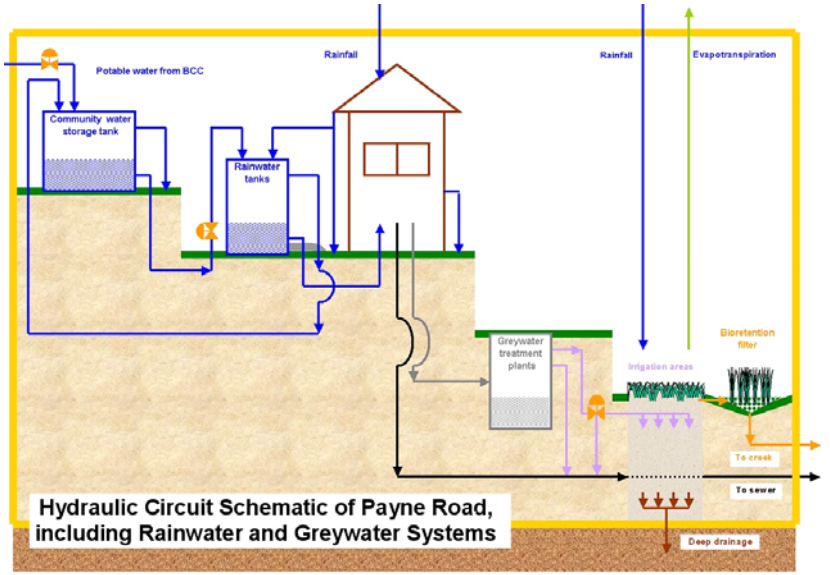


Figure 1: Hydraulic circuit of Payne Road development

Images from Payne Road Project DNRMW
http://www.payneroad.com.au/mainpages/home.htm

60L Green Building

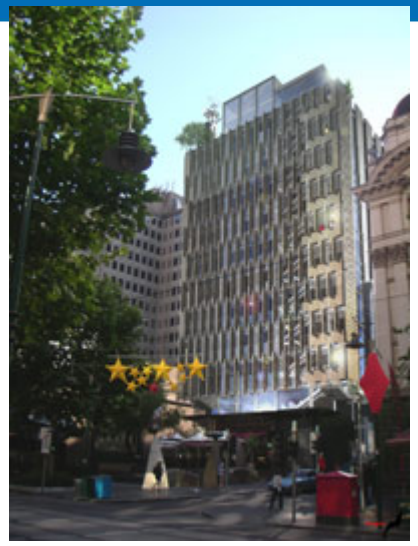
Summary

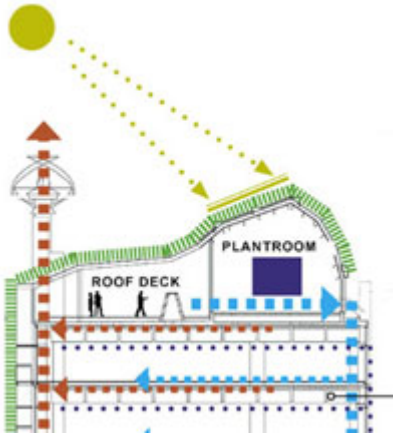
- Commercial high rise >225pe
- Water efficient fixtures & fittings, including water-less urinals and low flush volume toilets
- Roof collected rainwater replaces mains water consumption whenever possible. Rainwater is stored in 2x 10 kL tanks, filtered and disinfected prior to use in taps and showers.
- Wastewater collected and treated via a modified package treatment plant with aerobic and anaerobic processes and a membrane filter. Used toilet flushing and irrigation of rooftop garden. Excess to a water feature in the building atrium
- Water and wastewater automated control, including conductivity monitoring.
- Firefighting supplied by water mains

60L Green Building

- Set clear environmental objectives at project initiation
- Consider existing building form when selecting design options for retrofit
- Design of the wastewater treatment plant needs to allow for higher concentrations of wastewater due to reduced water usage on site
- Guidelines for water/wastewater provision for commercial buildings would be useful for future developers and the industry. These were not available at the time of design and development.
- Consider noise and odour issues when citing sewage treatment plant inside building envelope
- Ensure adequate training and understanding of alternative water features by all building users
- Install all services in common trenches to reduce costs and soil disturbance
- Additional time is often needed to source recycled items

Council House 2





Scale

10 storey office building for 450 pe, Melbourne CBD

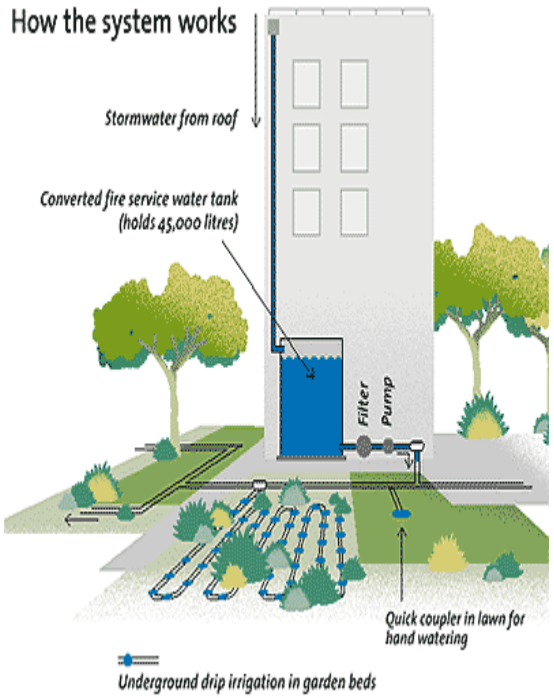
IUWCM

- AAAA fittings
- Sewer mining 100kL blackwater from public sewer (class A)
- Supply of non-drinking uses (plant irrigation, cooling, toilet flush and street washing and open spaces) with rainwater + treated blackwater
- 25% Potable water from reuse of water from fire sprinkler testing

Technology

- Multiwater treatment plant MF

Atherton Gardens & King Estate



Scale

4 High rise housing estates

IUWCM

- Stormwater collection via roof and greywater supplement for garden irrigation
- Swales in carpark
- Savings 6 million L drinking water
- Reuse 17kL greywater/day

Technology

- Storage tank 6kL in basement
- Treatment by filter
- Distribution to garden by sub-surface drip irrigation lines