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**Integrated Urban Water Management and Water Recycling in
SE Queensland – RECENT developments**

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INTEGRATED URBAN WATER MANAGEMENT AND WATER RECYCLING IN SE QUEENSLAND –RECENT DEVELOPMENTS

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Abstract

There is much interest in urban reuse of recycled water in SE Queensland, particularly in areas where water supplies are affected by drought. While there are a number of significant proposals for reuse, real progress towards increasing the total volumes used tends to be hindered by a number of uncertainties and constraints, including uncertainties regarding water quality, the cost of supplying major agricultural areas and the inability of farmers to pay, the high costs for residential reuse, the lack of urban non-residential demand and community/stakeholder attitudes to be overcome.

This paper reviews a number of recent / on-going projects in South East Queensland, including technical, environmental and community drivers for the projects and the role of stakeholder consultation in the Projects.

Key Words: Reuse, recycled water, beneficial reuse, integrated water management.

Introduction

The water management agenda in SE Queensland is dominated by the overlapping issues of rapid population growth, drought, shortage of new water sources and increasingly more stringent licensing/discharge requirements. Given the increasing urgency of these issues, it would seem essential that water recycling be incorporated into the regional water equation. The only alternative 'new' water source is seawater desalination, and this is still expensive and energy intensive.

While progress is being made in some areas, significant reuse is constrained by the lack of readily accessible agricultural uses, concerns regarding the costs of urban non-potable recycling, and political/ community reluctance to seriously consider any form of potable reuse.

There is a real need to decide what the future role for treated wastewater will be:

- EITHER, an urban water resource;
- an agricultural water supply; OR
- environmental flow.

The last 10 years have seen major changes in what is possible with reuse, yet we still

have real uncertainty regarding the future. It is to be expected that the next 10 years will see even greater advances, hopefully bringing with it greater certainty for how recycled water will be put to best use.

What are the key issues for reuse

The major drivers for reuse include:

- substitution for potable water supplies;
- reduction/elimination of environmental discharges;
- desire to make use of the water as a resource;
- opportunities for aesthetic benefits;
- changing community attitudes.

Substitution is of major importance in growing urban areas where existing water sources are limited and future sources will be either difficult or expensive to provide. Substitution has the potential to reduce per capita potable water demand and defer the need for major water source and water treatment augmentations. Because substitution is only real when reuse actually replaces potable water uses, it is restricted to urban uses such as residential garden watering and toilet flushing, and perhaps to some extent irrigation of public open space and industrial reuse.

In many urban areas there is increasing pressure to reduce environmental discharges. In SEQ this has been largely driven by the Brisbane River and Moreton Bay Water Quality Management Strategy (now the Healthy Waterways Partnership) that has placed a general limit of 5mgN/L on nitrogen. Local nitrogen load limits may also apply depending on environmental sensitivity. Phosphorus limits do not currently apply but are likely to follow in time. Reuse is inevitably an essential consideration as a way to limit effluent and therefore nutrient discharge to the environment.

While the aesthetic and community benefits that can arise from reuse are worthwhile, this is not a major driver for increasing reuse because, in most areas, the community sees no need for alternative sources of water when potable water is amply available and relatively inexpensive. This is not true in all areas.

The other community issue relates to water quality, and lingering concerns regarding the safety of the water. While the water industry tends to have confidence that the technology exists to ensure the quality of the water, the community remains concerned about 'basic' issues, such as will their children be exposed to infection, and 'fear of the unknown' issues such as the risk of exposure to endocrine disruptors.

Most of the uses mentioned above are 'non-potable' uses. At this point in time, potable reuse tends to be off the serious agenda, partly because the State Government does not currently support direct potable reuse, but largely because of the concerns regarding obtaining community and regulatory approval. Indirect potable reuse would provide very high levels of reuse at a relatively low cost. There are no formal indirect potable reuse schemes in Australia.

Integrated urban water management, while not necessarily new, offers the potential to improve environmental outcomes without increasing the cost of infrastructure.

The SEQ Recycled Water Project

The South East Queensland Recycled Water Project was conceived as a way of addressing two significant water-related issues for the region, the environmental impact of effluent discharge to the Brisbane River and Moreton Bay, and current water shortages for agricultural irrigation in the Lockyer Valley and eastern Darling Downs. The project would deliver effluent from local authorities in South East Queensland, treating it to a high standard and delivering it to irrigators in the Warrill, Bremer, Lockyer Valleys and the Darling Downs.

Demand for Recycled Water

A market assessment completed as part of the project identified potential demand for recycled water for irrigation in the Warrill, Bremer and Lockyer Valleys and the eastern Darling Downs of the order of 127,000 ML per year at a cost of \$150 per ML.

Figures 1 and 2 illustrate potential demand and income from water at different prices.

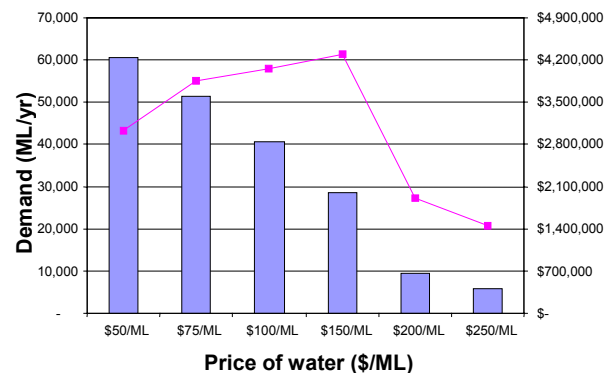


Figure 1 Lockyer/Warrill/Bremer Demands and Income

A full scheme supplying all potential users would cost around \$790M to construct and \$20.5M per year to operate, i.e. a total cost of around \$894 per ML, or an O&M cost of \$167 per ML delivered. Capital costs are dominated by the cost of pipelines (60-70% of the total). Operating costs are dominated by pumping energy costs (50% of the total). A scheme supplying the Darling Downs would require over 300km of trunk pipeline and pumping stations with a total of 39MW of installed capacity, including a 15MW pumping station at the Toowoomba Range.

Providing a smaller supply to the Lockyer Valley only would reduce the cost to around \$124M, equivalent to \$920 per ML or \$144 per ML O&M only.

The Role of Community Consultation

Extensive consultation with the key stakeholder groups, namely irrigators and representatives from SEQ Councils and Government, is essential to the execution and progress of the project. The recent user survey accurately quantified recycled water demand and potential income, as well as determining a range of other cropping, operational and design data necessary to develop the scheme.

Discussion

The problem for the SEQ Recycled Water project is that, while there is proven demand and the scheme is technically feasible, the amount that farmers have indicated they are prepared to pay for the water is barely enough to cover operating costs, and therefore, substantial external funding would be required for the scheme to proceed. This could come from the private sector, and Federal, State and Local Government. At the moment the project lacks the funding support that it needs to proceed.

The Wetalla Wastewater Project

The Wetalla WWTP serves the City of Toowoomba, one of the largest cities in the Murray Darling Basin with a population of around 100,000 people. Design flows from Wetalla are 9,500ML/yr in 2000 increasing to 11,000ML/yr in 2010.

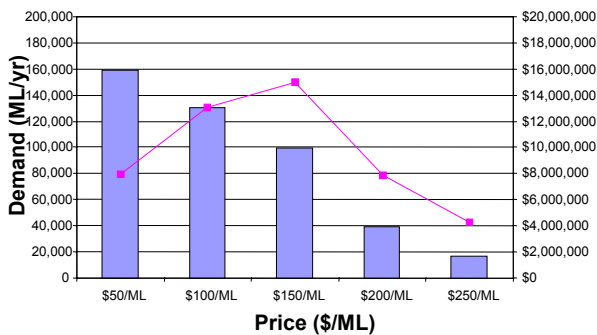


Figure 2 Darling Downs Demands and Income

Water Available to the Project

The volume of water available in 2005 from the Ipswich, Brisbane and Logan STPs is currently 112,700 ML per year increasing to 155,300 ML per year in 2025. Figure 3 illustrates the annual supply of recycled water potentially available to the scheme and demands from the reuse areas.

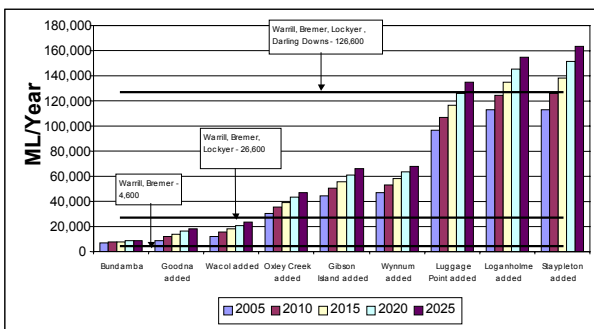


Figure 3 Supply of Recycled Water

A survey of irrigation demand indicated that a total demand of 7,000ML/yr is available within 50km of Wetalla increasing to 11,000ML/yr within 70km. Anticipated demand data from a pipeline are summarised in the Figure 4 below.

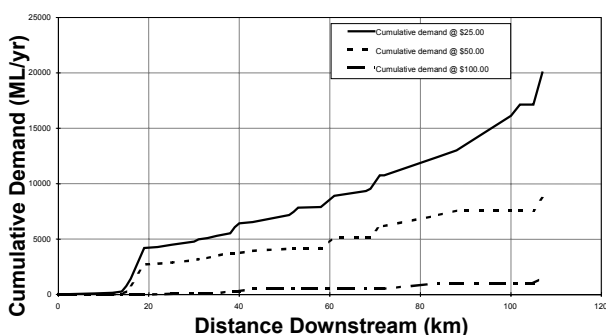


Figure 4 Wetalla Cumulative Effluent Demand

The survey results indicated that farmers did not want to pay more than about \$25-50/ML for piped effluent. There was no interest expressed in purchasing water at more than \$100/ML.

Financial Analysis

Financial analysis indicated capital costs of around \$25-30M. The unit cost of water ranges from \$45/ML to cover operating costs only, up to \$450/ML without external contribution.

The Role of Community Consultation

Again, extensive consultation with the irrigators through their representative group, and with local and state government, including participation on the Technical Advisory Group is essential to the success of this project. Broader focussed consultation was also important to ensure a wider community understanding of the project and why it was being done.

Discussion

At present, farmers on Gowrie and Oakey Creeks irrigate with effluent from the creek essentially at no direct cost apart from nominal licence fees. The proposed pipeline will deny them access to this 'free' creek water and provide an alternative piped supply that they must pay for. So why would they want the piped water? Firstly, competition for the water from other non-agriculture consumers, and EPA concerns about effluent discharge to the creek, could see them lose access to the water altogether. Secondly, a piped supply is of greater value to the irrigator because it provides improved supply reliability and therefore improved certainty in the production cycle.

This scheme will also require significant contributions from local, state and federal governments if it is to proceed. In 2001, Toowoomba City Council put the scheme to the private sector for development. While the technical issues have been substantially resolved, the project is still seeking the required funds.

Urban Reuse Generally

Most councils in the SEQ Region are pursuing reuse to some extent. The main driver for this is the realisation that future restrictions to treated water discharge to the environment will increase.

Logan City

Logan City is designing for a future wastewater flow of around 24,000 ML/year and has a load-based licence (nitrogen) that will necessitate discharge reduction in the future.

Opportunities available to the City within its boundaries may include urban and commercial open space irrigation (about 10% of the design flow). There may be some agriculture and industrial reuse potential south of the Logan River within Gold Coast City, however, it is likely that the Gold Coast will also be looking to these opportunities to meet their own disposal needs.

Indicative reuse costs for urban open space are around \$800/ML all up, or \$190/ML for O&M only.

Gold Coast City

The Gold Coast recycles approximately 10% of its effluent through golf course irrigation and uses such as dust suppression. In addition, a major activity is the Reclaimed Water Strategy (RWS) being implemented as part of the Northern Wastewater Strategy. The RWS is based around the Beenleigh WWTP and will provide water for open space irrigation, sugar cane irrigation and for cooling of the co-generation plant at Rocky Point Mill. At this time, up to 3.7ML/day of recycled water is being supplied to Rocky Point and the sugar cane supply system is being developed. Initially, 350ha of sugar cane is expected to use 1,000ML/yr of water.

Redland Shire

There is very little reuse in Redland Shire at the present time, though there is pressure for this to increase. Reuse is made difficult by the trend towards redevelopment of the shire from agricultural uses to urban development.

Like Logan City, load based licensing on plants like the proposed augmented Victoria Point WWTP will eventually necessitate capping effluent discharge. In addition, the island communities present particular challenges with respect to effluent management. Development of sewerage systems and effluent management for the Southern Bay Islands of Macleay, Karragarra, Lamb and Russell Islands are presenting significant challenges.

Brisbane City

Brisbane City is tackling water recycling on a number of fronts. The 10 ML/day industrial reuse project at Luggage Point is an important demonstration of what can be achieved where industry exists. Elsewhere, the focus is on open space irrigation and commercial/industrial uses from plants such as Oxley Creek, Wacol and Sandgate. The potential for urban residential recycling is being investigated as part of integrated water

management schemes for areas such as the Forest Lake area and Rochedale.

Redcliffe City

Redcliffe is in a quite unique situation in that it is essentially fully developed, with no opportunity for expansion and no agriculture within its boundaries. The only opportunities for reuse within the City are urban open space irrigation and, possibly, residential reuse in a dual reticulation system.

Redcliffe is undertaking investigations to determine the best way to reuse up to 6,200 ML/yr of recycled water. If all irrigation opportunities and a full dual water supply system were developed, up to 50% of the available supply could be reused. Realistically, this may not be able to exceed 20%.

Total scheme cost estimates range from \$800/ML for irrigation-based schemes up to 2,500/ML when residential reuse is included. The equivalent O&M costs are between \$250 to \$450/ML.

Pimpama Coomera Water Future

The Gold Coast Region of South East Queensland is one of the fastest growing urban centres in Australia. Its population of 400,000 people is expected to increase to around 1.1M by 2050. The city relies on one major reservoir for its water supply, the Hinze Dam. The recent drought has been effective at focusing the community's attention on the need to reduce rates of water consumption and to develop alternative sources of water to substitute for conventional surface water supplies.

Traditionally, the various components of the water cycle have been considered independently. It is becoming increasingly apparent that this is not sustainable, and that the interdependences between the elements of the water cycle need to be recognised and harnessed. Integrated urban water management involves a more holistic approach to the way water, wastewater and stormwater infrastructure is provided for urban communities. Adopting an integrated approach creates opportunities to deliver

services more economically yet with a smaller ecological footprint.

The Pimpama Coomera area is a major new growth precinct for the Gold Coast, covering an area of 5,500ha with an expected population of around 130,000 people. The Pimpama Coomera Water Future project has provided an opportunity to develop and prove the effectiveness of water efficiency initiatives to reduce the ecological footprint of urban development.

Water Efficiency Strategies

A broad range of possible initiatives was defined covering the water supply, wastewater, recycled water and stormwater systems. This is illustrated in Figure 9 at the end of the Paper. The initiatives can be defined as ‘primary initiatives’ that define the major differences between strategy options, ‘secondary initiatives’ which are optional extras to the strategies, ‘common elements’, which are best practice systems and practices that should be incorporated into all project strategies, and ‘special application’ initiatives that may be appropriate in specific areas but not across the board.

An integrated approach to water infrastructure requires a departure from traditional design criteria. New criteria must be based on reliable data and recognise the interdependencies of the key components of the water infrastructure. In this case, measured water consumption data was used to define expected total per capita water consumption. Analysis of this data generated the typical demand distribution between specific uses, and hence the potential demand from different water sources.

By way of example, potential potable water use substitution achievable with different strategies is given in Table 1.

Table 1 Potential Reduction in Residential Potable Water Demand

Potable Water Use (L/ET/day)	Initiative
1,030	Current Gold Coast standard of service
815	Mandatory use of water efficient devices (dual flushing toilets, shower roses, front loading washing machines); ‘no planning factor’
550	Rainwater tanks only
440	Dual water reticulation with storage
170	Dual water reticulation with storage and rainwater tanks

The Water Future strategy options combined groups of complementary initiatives to meet agreed targets. In overview, the options considered are outlined below:

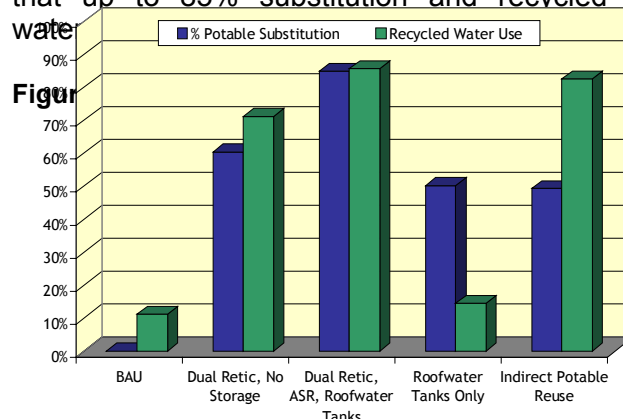
- the ‘business as usual’ base case;
- a reticulated recycled water supply for non-potable reuse, with low cost reduced infiltration ‘smart’ sewerage;
- recycled water supply, roofwater collection and ‘smart’ sewerage;
- roofwater tanks only, with ‘smart’ sewerage;
- indirect potable reuse.

These are illustrated in the Figures 10, 11 and 12 at the end of this Paper.

Strategy Evaluation

A multi-criteria analysis (MCA) approach was used to evaluate and compare the strategy options. The process included a range of expected outcomes, expressed as minimum requirements to be met by all options (desired sustainability outcomes), and comparative criteria used to score the various options. Numerical targets were developed where possible.

The potential for the various options to achieve two key outcomes, ie potable water substitution and recycled water use, is illustrated in Figure 5 below. This data shows that up to 85% substitution and recycled



The results of the financial analysis of options are illustrated in Figures 6, 7 and 8, which compare the options costs to business as usual.

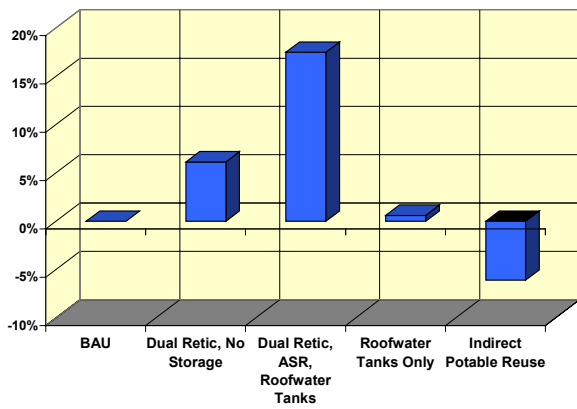


Figure 6 Total Costs of BAU

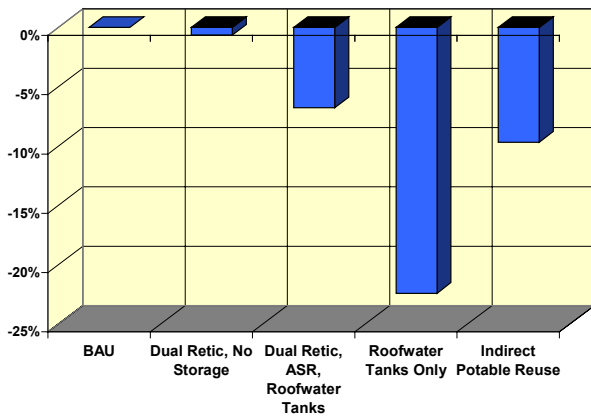


Figure 7 Headworks and Reticulation Costs of BAU

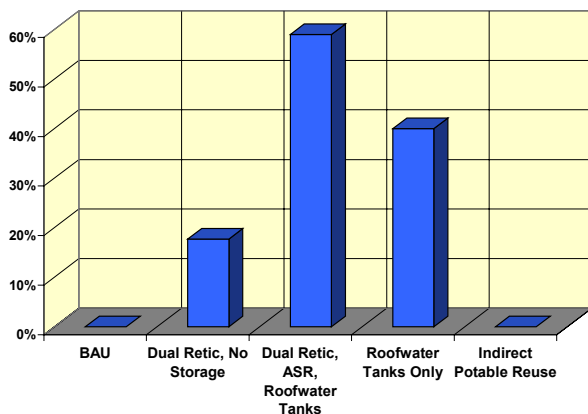


Figure 8 Household Coasts cf BAU

The financial analysis shows that, contrary to common perception, it is possible to achieve significant changes to the way water infrastructure is provided without necessarily incurring major additional costs across the board. For options with recycled water only, plus 'smart' sewers, the system cost is very close to BAU (+5%). Additional costs for recycled water are offset by savings in water supply headworks and sewerage infrastructure costs. The result is similar for the roofwater tank options. The highest costs occur when recycled water and roofwater are included. Indirect potable reuse has the lowest cost (BAU -7%).

What is perhaps most interesting is the extent to which costs are transferred between

the developer and the householder. The data shows that substantial savings in the cost of headworks and reticulation to developers is offset by increases in household costs for additional plumbing and related systems.

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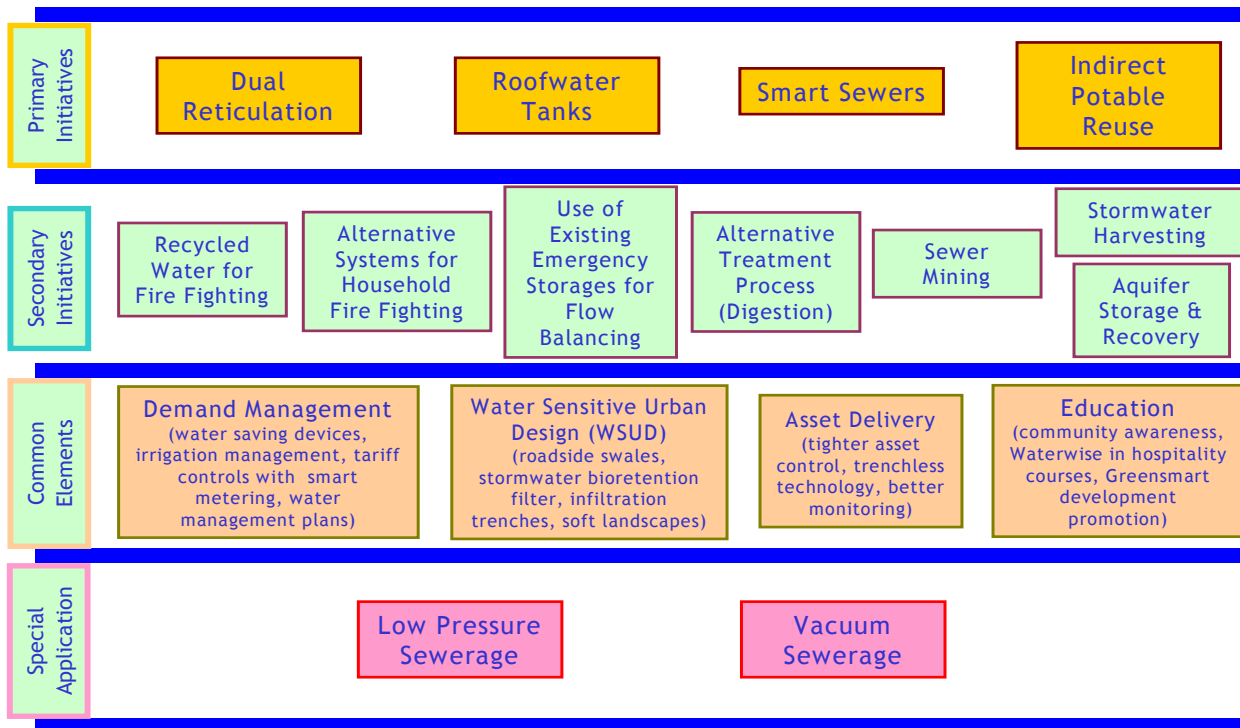


Figure 9 Water Efficiency Initiatives

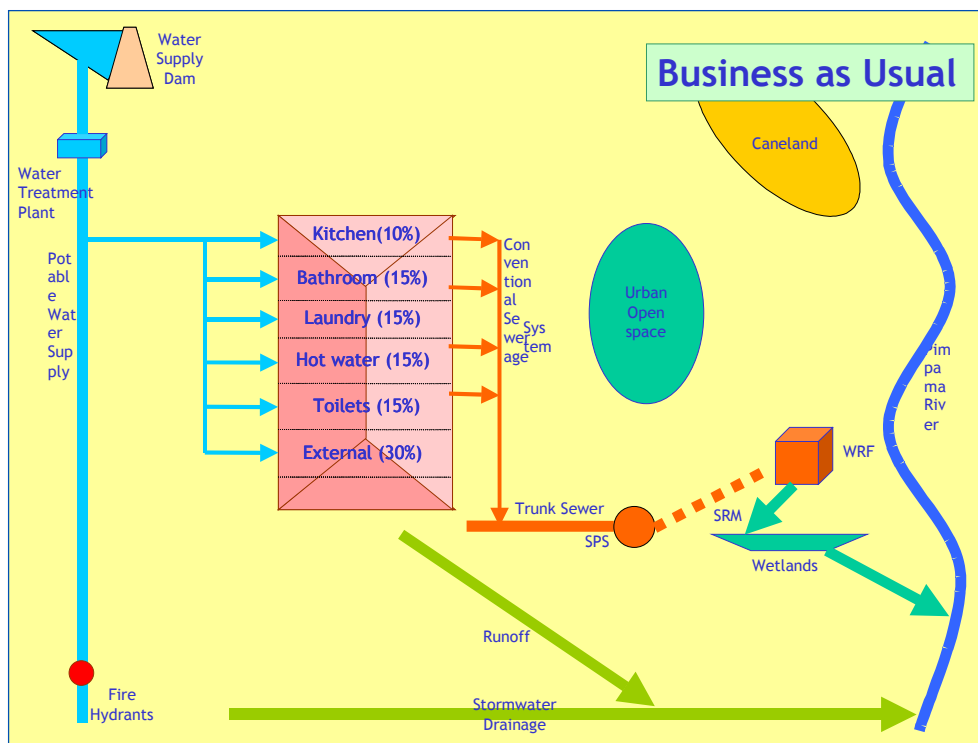


Figure 10 PCWF Option Schematic – Business As Usual

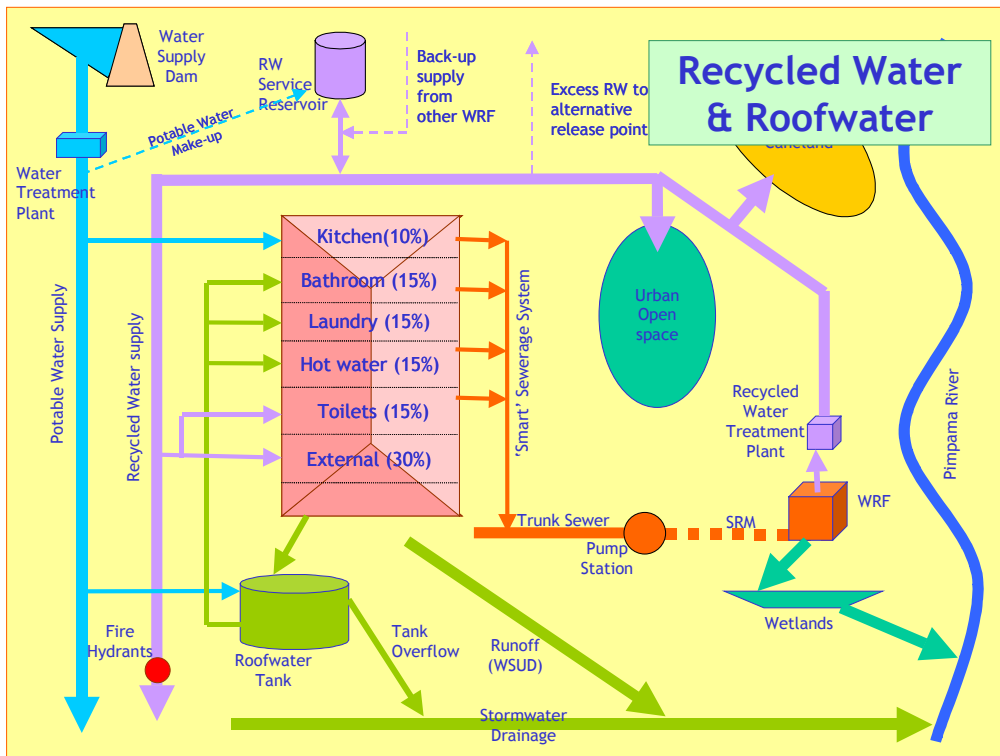


Figure 11 PCWF Option Schematic – Recycled Water and Roofwater Tanks

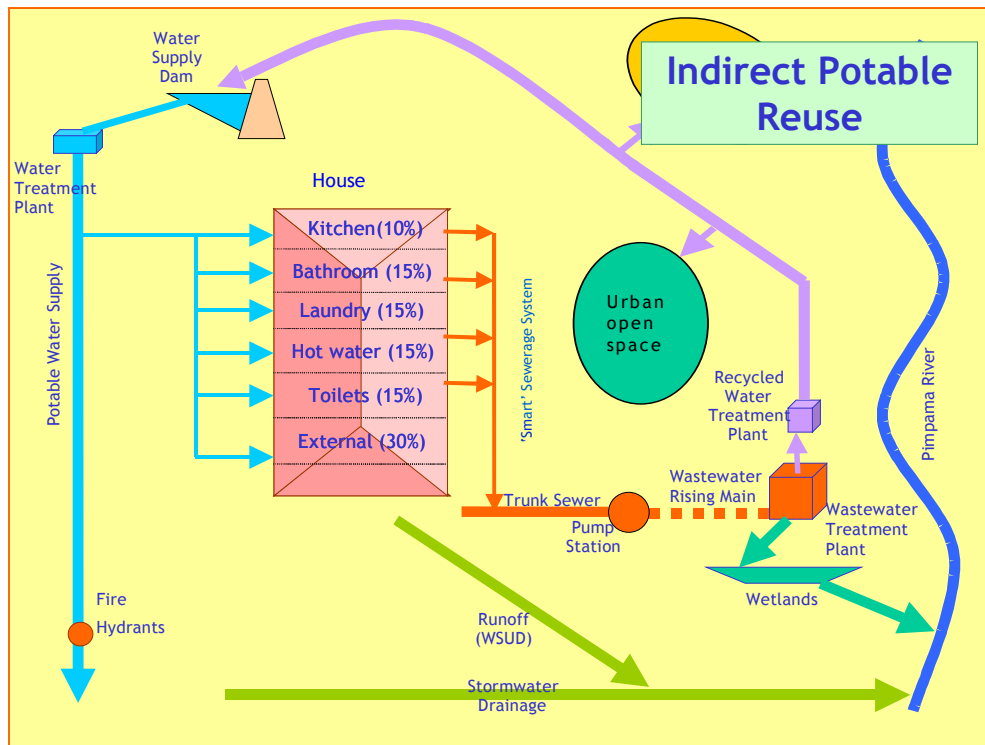


Figure 12 PCWF Option Schematic – Indirect Potable Reuse

Author Biography

David Hamlyn-Harris is a water industry practitioner, with 22 years experience with water and wastewater systems and management. He has a particular interest in strategic water system planning, water recycling and reuse. He has been involved with some of the most significant water management / reuse projects on the Australian east coast, including the Sydney Olympic Park Water Recycling and Management Scheme (WRAMS), the Rouse Hill wastewater treatment and reuse systems, the Wetalla (Toowoomba) recycled water scheme, the SEQ Recycled Water Project, and the Gold Coast's Pimpama Coomera Water Future Project.



David is Principal Engineer, Water Technology and Environment, with GHD Pty Ltd in Brisbane. He is a member of the Australian Water Association and a Fellow of the Institution of Engineers (Australia). He gained his Bachelor of Engineering from the University of Queensland and a Master of Engineering Science in Public Health from the University of NSW.

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