Case Studies WA
Bridgewater, Erskine
National Lifestyle Village

Source Information:

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Biophysical Description:

Bridgewater has been developed by National Lifestyle villages and is located in the high population growth corridor adjacent to the Peel Harvey Estuary; in the City of Mandurah's suburb Erskine, WA.[1] The area experiences high water table levels and is close to RAMSAR protected wetlands. The site is located in an environmentally sensitive area where conventional water infrastructure is not available due to the inability to dig underground.

Water Sensitive Urban Design Objectives and Principles:

In WA, there are currently large scale projects (regional) and small scale projects (household) to manage water resources. Bridgewater is a suburb-scale project demonstrating decentralised wastewater treatment, water conservation and water recycling in a metropolitan area.

At the suburb scale, the developer owns and maintains the development's infrastructure. The developer therefore has an interest in reducing the operation and maintenance costs of the village and higher capital cost infrastructure improves the long term financial viability of the development. Across the village, there are vegetated roadside swales, 700mm concrete buffer strips on all roads rather than curbs and a third pipe bore water irrigation network delivering water to every home and for construction use. The centralised drip irrigation system allows the village management to irrigate all of the gardens in the village from one location and on strict watering schedules to not overdraw the limited freshwater lens (0.5 to 1 meter) above the saline water table. There are no sprinklers in homes or public spaces in the village. The irrigation system minimises drawdown through a large diameter bore liner surrounded by gravel and infiltration galleries, a low flow submersible pump sends the fresh water to four interconnected

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[1] http://maps.google.com.au/maps?q=Erskine,+WA,+Australia&sa=X&oi=map&ct=title

storage tanks with a total capacity of 100kL. These tanks are topped up by rainwater from the clubhouse roof and any overflow is returned back to the bore well for direct recharge. Plant selection for public areas is exclusively from endemic and local species appropriate to the Karrakatta and Vasse soil types which exist on this site. Homes and public spaces are periodically mulched, organic waste is recycled at an on onsite, commercial scale composting station and worm farms, improving the soil structure, adding nutrients and reducing water requirements.

At the household level, the development has sought to reduce domestic water consumption, by ensuring that each house is fitted with water efficient appliances, AAA shower heads, water saving taps with aerators, flick mixers where appropriate and flow regulators. Each house also has a rain water tank, 1500L and the hot water systems is generally located near the kitchen and bathroom. In a more recent development, the rainwater tanks are connected to toilets and there are plans to connect to washing machines as well. Gardens are constructed of native, drought tolerant plants that use less water. Exotics and other plants are permitted, such as roses; they must be kept in pots and hand watered. Lawns are permitted in small areas of approx. 3 sq meters and are made of a special, hardy species. Each of the 380 village homes has its own individual Grey-Flow© greywater treatment system which irrigates its garden. There is a nutrient reduction strategy for each system in the 88 houses that have a high average groundwater level (less then 500mm). The greywater system is treated through a lined evapotranspiration trench (ETT) which is subterranean.

Planning Issues and Milestones:

The legislative environment in WA has had a significant impact on the planning and approval process of this project. There are two legal instruments that a development utilising greywater technology must be in compliance with: the WA Government Sewerage Policy for Perth Metropolitan Area (Policy) and the WA Health Act (1911) (Act). Compliance with the Act and the Policy presented challenges for the Bridgewater Lifestyle Village development, as approval requirements appeared confusing to the developer. To allay this confusion, the management at Bridgewater conducted a review of the legislation and pre-organised documents where possible to mitigate delays.

Decentralised local treatment systems are not currently addressed by the Policy or the Act. As there is no legislation regarding Integrated Water Cycle Management at the suburb scale level, developers have been less likely to use it in their plans. A common perception, held by some working on the development, has been that the current framework is a barrier to decentralised wastewater systems in the Perth metropolitan region. This has resulted in few systems from which to assess the quality, robustness and efficiency of such designs. With monitoring, scientifically proven results and successful case studies, it is hoped that water sensitive designs will become mainstream practice. A number of research projects are in the works to simplify the legal requirements and to develop guidelines to assess water sensitive designs. In many cases, government bodies rightly require monitoring and testing of new technologies to ensure public safety.

A license to construct, testing and inspection by the Department of Health and the local council was necessary with original copies signed by each individual owner. As these are precious documents, the developer was able to negotiate to wave the license and original copy requirement, and was permitted to use copies instead. This was likely a specific characteristic of the village being a centrally manage lifestyle community and may not be applicable to regular subdivisions.

Design Issues and Milestones:

Given that greywater recycling is still seen as a relatively new innovation, a significant challenge to the project was gaining approval from the Department of Health.

In particular, the ETT system was carefully reviewed. The ETT systems are subterranean, comprising drip irrigation technology covered with a 10 cm layer of mulch. The Department of Health, NLV staff and residents needed to be convinced of the safety of using wastewater and be assured that it would not lead to changes in the local mosquito population. The developers considered the mosquito threat extremely low due to its subterranean nature which is designed to prevent surface pooling of water. To test the system, an extensive monitoring program was put in place. Over the eight week monitoring period, the researchers found no increase in mosquitoes and no above ground water pooling resulting from the system. However, undertaking longer term monitoring would be prudent, as mosquito production in other types of constructed water bodies has been shown to take several years to escalate. There were also no reports of wastewater contact to humans or pets. However, appropriate scientific benchmarking can require a number of years, up to ten, of testing and monitoring.

Implementation Issues and Milestones:

There is research from Australia and around the world advocating the importance of community involvement and good communication in such projects. Due to the greywater system being a relatively new technology for people, both the management team and residents needed to be confident they could trust the system. The Bridgewater village was able to have the system designers train general grounds workers and homeowners to use the system and undertake maintenance and repairs. For homeowners, this involves only the regular checking and washing of the filters. This partnership approach has negated the need for high cost, specialised personnel, making the system very cost effective.

The development of good working relationships between the management team and the residents is paramount in establishing a level of trust for the system. Trust began by establishing clear responsibilities for the management staff and for the residents. In addition to managing the public areas, the village management is responsible for maintenance or repairs of the greywater system, including turning diversion pipes to bore water or sewage pipes when necessary. The residents are in turn responsible for on-site, household scale monitoring and reporting any potential disruptions to the management staff immediately. They also must inform management when they are away for extended periods (to use bore water) and use low phosphorus and salt products. While the foundations have been laid for an effective partnership, there is still a long way to go in educating the public and the end user about proper use of the greywater systems.

Operational Issues and Milestones:

Each system automatically bypasses all greywater flows to the sewer in the event of greywater pump system failure and whilst maintenance is being conducted.

The Grey-Flow© unit will be connected to every home, including those with an ETT. Adding and fitting the pipes to a bore bypass system was found to be a labour intensive process however it is necessary for the system to work while residents are away and is assumed the long term benefits will far outweigh these initial costs. The units consist of an interception unit, a sensor activated pump station and a primary & secondary filter and is connected to a low-pressure subsurface drip irrigation system. The Grey-Flow is designed to intercept domestic greywater (laundries, basins and bathrooms only). Filtration of the greywater is required to prevent clogging, achieved by two sponge type filters in series. If these filters become clogged, greywater will flow across the surface of the filters and flow to the sewer.

At an early stage, there were a few operational issues with how the end user reacted to their system. For example, many residents believed that their plants were not getting watered, because the irrigation system is subsurface, so they were watering their gardens with scheme water. Further, if the residents went away for a long period, there was no greywater going through the system. In this case, the resident is to notify the manager, who will activate a bypass valve that uses bore water from a central bore. The management team predicts it will take some time for all residents to be convinced of the new system's effectiveness. Some residents had adjusted the bypass system to add bore water to their gardens.

Infrastructure and Ownership:

The residents buy their home and rent their land for 60 years. The rental fee includes all services associated with the clubhouse facilities and the operation and maintenance of the greywater system.

Performance:

This case study will be monitored by the WA Government, funded by the Premiers Water Fund until 2008.

The approval of the necessary regulations to build the village, the acceptance and buy-in of the community, and the effective management of the village systems thus far are positive testimony for the current performance of the village. To date, there have been no major issues documented. It has been projected to save 62% of the water an average multi-residential household in Perth would use each day.

Cost and Benefit:

Some urban fringe areas will have to wait up to ten years to be connected to centralised infrastructure. Areas designated as high environmental impact or of significant environmental diversity will benefit as decentralised wastewater treatment systems can be less intrusive to the natural environment.

Decentralised wastewater treatment systems provide an affordable option in peri-urban areas. Subsurface systems such as Grey-Flow are designed to be site specific, low cost, low-energy and require minimal operation attention. The simple mechanical design costs less and is easy to replace, providing additional cost savings. Further costs are saved as the system does not require specialised maintenance personnel.

The developer was able to negotiate for lowered headworks charges, which helped to make the project economically possible. Additionally, the developer expected to receive the rebate for each individual water system. Unfortunately for the developer, the individuals receive the water rebates to pass on to the management facility and there has been some difficulty in the developer being able to recover costs, changing the economic viability of the greywater system.

Volume – flow, water saved, etc.:

The total domestic irrigated area amounts to approximately 2 ha, with a total irrigation delivery requirement of 10.5 mL/year.

Based on a WA Sustainable Industry Group presentation, the below tables show how much water is saved and how.

Table 1

Water Use	Perth Average Single Dwelling	Perth Average Multi-residential	Bridgewater Lifestyle Village
	L/HH/day	L/HH/day	L/HH/day
In-House Water Use	523*	365*	160**
External Water Use (excluding public open space)	707*	389*	133***
Total	1230	754	293

* These are actual figures as measured by Water Corporation
** Projected figures provided by Murdoch University
***Majority of garden reticulation is recycled greywater

Table 2: Water Conservation Unit Block Scale

Outside (non scheme)		
Harvested Rainwater	68 L/day (24 L/a)	Rainwater
Rainwater Use	14 L/day (5 kL/a)	Rainwater
Overflow to Groundwater	54 L/day (20 kL/a)	Rainwater
Unit Block Stormwater runoff	58 L/day (21 kL/a)	Rainwater
Scheme Water	Total 160 L/hh/day (58 kL/a)	
Kitchen	33 L/day (12 kL/a)	Blackwater
Toilet	29 L/day (11 kL/a)	Blackwater
Bathroom	67 L/day (24 kL/a)	Greywater
Laundry	45 L/day (11 kL/a)	Greywater
Blackwater to sewer	62 L/day (23 kL/a)	Drainage

Below is an excerpt taken from J Hunt's paper as presented at 2007 Rainwater and WSUD conference.

A number of water volume studies are being conducted on residents' water use. The two main advantages of in having a detailed level of knowledge of the development's water use was to negotiate headworks charges and estimate the appropriate pipe sizing to the sewer network. In theory, greywater systems would reduce sewer flows dramatically. This theory is being monitored in 23 homes. The known occupancy rate per home in the development is 1.7. 'In Preliminary findings for seven homes (average occupancy rate of 1.4) for a six month period are shown in Table 3. Where applicable, this data is compared to a domestic water use study (DWUS) (simple residential homes) conducted in Perth in 1998 to 2001 (Loh and Coghlan, 2003). However, care must be taken in comparing these two studies as there are significant differences that can provide misleading conclusions (Cordell et al, 2003).

Table 3

Source	Bridgewater	DWUS
Inhouse	171	155
Blackwater	51	62
Greywater	106	93
Hot Water	56	
Toilet	33	33
Hot Kitchen Tap	14	
Cold Kitchen Tap	4	
Exhouse	14	211
Outside Tap	14	
Rainwater	1.6	

The data is yet to be of sufficient sample size and duration to be able to conclude too much, however, some initial observations can be drawn. One notable observation is that the total in house scheme water use was higher than the DWUS result. A possible explanation is that five out of seven of the households do not have employment, are therefore more likely to be home more of the time and therefore may use more water. Adding to this is the average occupancy of the seven homes is 1.4. This is lower than the village average of 1.7 and lower than the DWUS rate of 3.35. In general the higher the average occupancy the lower the water use per person as more of the water use from cooking, cleaning and washing is shared. Another point of interest is that 32% of all scheme water used is for hot water and that the kitchen hot water tap has three to four times the flow of the kitchen cold tap. It is also clear that rainwater tanks are not being utilised to their full potential.'

Perception – Support of the Community:

The age group of the case study, over 50 years old, is statistically less likely to accept new water technologies and is a significant user of potable water. With this challenge in mind, the management team tailored their workshops to allow for residents to voice their concerns and gain valuable information about the system.

The Centralised clubhouse sells approved products to the residents at cost. The demographic of the village, mostly retired, make regular trips to the clubhouse; making the store and the sale of approved products convenient for this demographic. Select products are for cleaning, such as laundry and soap, must be used in greywater systems to minimise harmful chemicals entering the groundwater and irrigation systems.

Evaluation:

Although greywater systems face challenges for implementation in WA, there is growing evidence that they are an effective means of reducing water consumption from mains sources and reducing evapo-transpiration, so plants are more efficiently watered. The relative costs and water savings outlined above indicates that subsurface greywater systems represent an effective method treating wastewater at the subdivision level. The Bridgewater case presents a number of challenges for policy makers and planners. These include the need to ensure administrative costs and head-works charges are non-prohibitive. Furthermore there is a need to align the WA Health Act (1911) and the Government Sewerage Policy to simplify approvals processes. The developers of Bridgewater also illustrated the need for effective community consultation and training to ensure monitoring and maintenance costs are able to be kept to a minimum in the future.

The true success of this project will only be established after a number of years of monitoring by Murdoch University Environmental Technology Centre to ensure that the projections in water reductions and cost savings are realised.

2007 HIA GreenSmart "Water Efficiency" Award Winner
2007 HIA GreenSmart "Development of the Year"
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Further information:
http://bridgewaterlifestylevillage.com.au/

Department of Health (WA) webpage about greywater:
http://www.health.wa.gov.au/envirohealth/water/greywater.cfm

Water Corporation, Department of Environment and Department of Health 2005, Code of Practice for the Reuse of Greywater in Western Australia:
http://www.health.wa.gov.au/envirohealth/water/docs/Code_of_Practice_for_the_Reuse_of_Greywater_in_WA.pdf

Department of Health (WA) - Greywater fact sheet

http://www.health.wa.gov.au/envirohealth/water/docs/factsheet_greywater.pdf

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