Meeting Plant Water Requirements with Greywater

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PRESENTATION OUTLINE

• External water use in Perth & the need for an integrated approach to water conservation in sustainable urban landscapes

• Greywater characteristics, quantities & regulations governing its reuse in WA

• Dispersal system sizing guidelines as a barrier to effective irrigation with greywater

• Strategies for improving irrigation performance
Perth’s Water Scenario

Mains supply network

- Dams @ approx 40% capacity
- Groundwater supplies under pressure
- New desal plant providing 17% Perth’s domestic scheme water
- Proposed second desal plant to have double capacity
- Permanent water saving measures introduced 2007 = irrigation 2 / week

Source: Water Corporation 2007
Private and Public Bore Water

• Permanent water saving measure introduced in 2007 = irrigation 3 / week
• Acid sulphate soils issues in some areas limits bore use
• Stricter review of water projected LS water use and management required for new projects
• Allocations for developments can be cut by DoW
Perth’s Water Consumption

Perth Metropolitan Demand 1999/2000

- Non-Residential: 21%
- Single Residential: 62%
- Other Domestic: 8%
- Non-Revenue: 9%

Single Residual Demand Components

- Watering: 47%
- Showers: 16%
- Washing machine: 13%
- Toilet: 10%
- Taps: 8%
- Leaks: 2%
- Total other: 2%

Per person:

<table>
<thead>
<tr>
<th></th>
<th>1981/82 study</th>
<th>Current study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kL/yr</td>
<td>%</td>
</tr>
<tr>
<td>In-House</td>
<td>57</td>
<td>58</td>
</tr>
<tr>
<td>Ex-House</td>
<td>41</td>
<td>42</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>42</td>
</tr>
</tbody>
</table>

Source: Water Corporation 2000
‘Water-wise’ Gardening Practices

• Increase in soil conditioning

• Awareness in design for improved microclimate

• Promoting low water use plants – particularly natives

• Improvements in irrigation efficiency & alt. sources
‘Water-wise’ Gardening Practices

- Reduced green life
- Increased hard surfaces
- Use of artificial plants
Water Conservation in Sustainable Urban Landscapes

- Water Sensitive Urban Design (WSUD)
- Plant selection
- Soil conditioning
- Drip irrigation
- Rainwater harvesting
- Greywater reuse
Greywater Characteristics

- Laundry (34%)
- Shower, bath and sink water (55%)
- Kitchen (11%)
  - Pathogens and nutrients
  - Salts and chemical residues from products
  - Little or no treatment required (except for kitchen which is typically excluded)
Greywater Regulations in WA

DoH. (2005), *Code of Practice for the reuse of greywater in Western Australia*. Water Corporation, Department of Health and Department of Environment

Since 2002 Greywater can be used via:

- Manual bucketing
  - No permission required
- An approved DIVERSION or TREATMENT system
  - Must meet Health Dept. guidelines
  - Application lodged with Health Dept. & local council
  - Connection must be done by a licensed plumber
DoH Approved GW Diversion Systems

• Range from simple direct diversion systems (either gravity fed or pumped), through to more sophisticated systems with temporary retention/storage capacity

• Costs range from $400 for simple direct diversion systems through to $8,000 for higher-end systems

• Variation in the cost of these systems correlates with their effectiveness and reliability at providing irrigation
Key Requirements (Diversion Systems)

- Greywater to be kept within the confines of a property
- Maximum storage of 24 hours (untreated greywater)
- Divert and overflow to sewer.
- No opportunity for mosquito breeding
- Isolate from mains water and stormwater systems
- No direct contact with edible part of food plants (fruit trees, staked tomatoes etc OK)
Key Requirements (Diversion Systems)

- Exclude human and animal contact by application of untreated GW below surface or under 100mm mulch
- All pipe work to be purple coloured for clear identification
- Irrigation setback distances of 500mm from buildings and 300mm from sealed (i.e. fenced) boundaries
- 100m set back from surface water / wetland ecosystems.
Barriers Limiting the Uptake of GW Reuse

Since 2003, the West Australian Government provides rebates for the purchase of and installation of WA Department of Health approved greywater systems. Despite this, uptake has been low, with only 182 rebates being processed to date. Reasons for this include:

- Public perception
- Cost/logistics (including accessibility to greywater plumbing)
- Environmental concerns
- Public health
- Authorities perceptions
- Regulations and regulators

Ng. M (2004), *Household Greywater Reuse for Garden Irrigation in Perth*, Centre for Water research, University of Western Australia
Additional Barriers Limiting Installation

- Insufficient GW dispersal area due to smaller block sizes and increased hard landscaping
- Insufficient setbacks
- Concerns about soil and plant health
- Poor irrigation performance
GW Dispersal System Sizing & Irrigation Underperformance

- Wastewater dispersal fields are sized to disperse estimated household wastewater volumes based on DoH guidelines.

- Volumes are calculated by the number of bedrooms (assuming two people in the first bedroom and one person in each additional bedroom), multiplied by estimated wastewater figures per individual (figures based on 1998 - 2001 Water Corporation Perth Water Use Study).

- Design Loading Infiltration Rate for the irrigation field is typically 10mm/m² on sandy soil.

- The volume of wastewater generated by a household is often not sufficient to meet total plant water demand.
## Greywater Dispersal Area

<table>
<thead>
<tr>
<th>Bedrooms</th>
<th>Laundry</th>
<th>Bathroom</th>
<th>Kitchen</th>
<th>Total</th>
<th>Area Req</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>168</td>
<td>204</td>
<td>NA</td>
<td>372</td>
<td>37</td>
</tr>
<tr>
<td>4</td>
<td>210</td>
<td>255</td>
<td>NA</td>
<td>465</td>
<td>47</td>
</tr>
</tbody>
</table>

Greywater production (L/hh/d) and minimum area required for irrigation (m²) as prescribed by CoP GWR.
Household Occupancy

Number of occupants per three and four bedroom dwellings in Perth, WA (ABS, 2006)

<table>
<thead>
<tr>
<th>Occupants</th>
<th>3bed</th>
<th>4bed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>52%</td>
<td>30%</td>
</tr>
<tr>
<td>3</td>
<td>24%</td>
<td>21%</td>
</tr>
<tr>
<td>4</td>
<td>18%</td>
<td>29%</td>
</tr>
<tr>
<td>5</td>
<td>4%</td>
<td>14%</td>
</tr>
<tr>
<td>6</td>
<td>1%</td>
<td>6%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Estimated GW Generation Compared with Plant Water Demand – DoH Guidelines

3 Bedroom Home

- Application Rate 2 Occupants
- Application Rate 3 Occupants
- Application Rate 4 Occupants
- Irrigation Demand - CF = 0.8
- Irrigation Demand - CF = 0.5

4 Bedroom Home

- Application Rate 2 Occupants
- Application Rate 3 Occupants
- Application Rate 4 Occupants
- Application Rate 5 Occupants
- Irrigation Demand - CF = 0.8
- Irrigation Demand - CF = 0.5
Additional Water Required to Meet Plant Water Demand

3 Bedroom House
Cumulative Topup Water Required

4 Bedroom House
Cumulative Topup Water Required
Reduced Greywater Flows through Improved Water Efficiency

<table>
<thead>
<tr>
<th></th>
<th>CoP GWR</th>
<th>With Water Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laundry</td>
<td>42</td>
<td>21</td>
</tr>
<tr>
<td>Bathroom</td>
<td>51</td>
<td>33</td>
</tr>
<tr>
<td>Kitchen</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>93.0</strong></td>
<td><strong>54.6</strong></td>
</tr>
</tbody>
</table>

Laundry – 49% reduction based on changing top loader to front loader (Patterson 2004)
Bathroom - 35% reduction (14L/min to 9L/min shower head and 9L/min to 6L/min taps)
Estimated GW Generation Compared with Plant Water Demand – Water Efficient House
Additional Water required to Meet Plant Water Demand

### 3 Bedroom House - Water Efficient

Cumulative Topup Water Required

- **2 Occupants**
- **3 Occupants**
- **4 Occupants**
- **5 Occupants**

### 4 Bedroom House - Water Efficient

Cumulative Topup Water Required

- **2 Occupants**
- **3 Occupants**
- **4 Occupants**
- **5 Occupants**
Design Responses

- Selection of drought tolerant plants
- Installation of a mains water top-up line
- Installation of dual irrigation lines
Mains Water Top Up Line

- Additional irrigation water is applied via the greywater distribution system.
- Direct connection of mains water into greywater irrigation piping is not permitted, so this option must be done with an air gap in place between the mains water line and the greywater system overflow point.
Systems with surge or retention tanks are considered more suited to this strategy as the likelihood of mains water being inadvertently diverted to sewer via the automatic overflow, if inflow exceeds outflow via the greywater dispersal system, is reduced.

The advantages to this approach is that it utilises the existing greywater dispersal system, saving costs associated with installing a separate irrigation system.

A disadvantage is that delivery of the water requires operation of the greywater system pump which increases electricity consumption and pump wear.
Dual Irrigation

• Installation of dual irrigation (supplied by mains water)

• Greywater irrigation piping is lilac coloured to differentiate it from standard mains supply irrigation lines to prevent accidental cross-connection

• This is the more expensive option due to increased materials as well as increased level of complexity in design and installation

• The advantage is that it provides the greatest degree of control in irrigation and therefore water use efficiency
Conclusion

- Likelihood of underperformance of greywater irrigation based on the WA DoH sizing guidelines which aren’t responsive to actual household occupancy.

- Compounding this is the likely reduction in actual greywater generation resulting from the increased uptake of water efficient fixtures and appliances that contribute to bathroom and laundry greywater.

- Any reduction in water use figures identified in the current Perth Water Use Study, being undertaken by the Water Corporation, should be reflected in revised DoH greywater system sizing guidelines.

- Householders need to be aware of the likely limitations of their greywater systems in meeting the peak plant water demand of high-water-use plants during the summer months and should incorporate suitable supplementary irrigation into their system design.
Questions?

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