A desktop analysis of potable water reductions from internally plumbed rainwater tanks in South East Queensland

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Rainwater tank installation, capacity and water quality protection measures

P2 A rainwater tank must have A2 sufficient storage capacity to provide an acceptable contribution to meet water savings targets listed in Appendix B having regard to – (a) local rainfall pattern; (b) roof catchment area; and (c) area available to site the

rainwater tank.

A rainwater tank – (a) has a minimum storage capacity – (i) of at least 5,000 litres for a detached Class 1 building (ii) at least 3,000 litres for a Class 1 building other than a detached Class 1 building; or (iii) greater than (a) (i) or (a) (ii) as specified by the local government in a local planning instrument; and (b) is installed to receive rainfall from – (i) a minimum roof catchment area that is at least one half of the total roof area or 100m², whichever is the lesser; or (ii) a minimum roof catchment area that is greater than (b) (i), as specified by the local government in a local planning instrument; and (c) is connected to toilet cisterns and washing machine cold water taps (other than those connected to a greywater treatment plant or alternative water substitution measure); and

(ii) an external use; and

Background

• January 1 2007

•MP4.2 Water savings targets

• New dwellings: savings from mains water of 70 kilolitres per household per year (kL/hh/year)

v detached houses v in the following

Coast City Council, ley Regional Council,

Council, Sunshine Coast Regional Council, Toowoomba Regional Council.

Research aim

To conduct a desktop assessment on the potential *mains water use reductions from internally plumbed rainwater tanks* in new developments in south east Queensland. To achieve this aim the following objectives were:

• to develop a *desktop methodology using existing council billing data* to estimate reductions from internally plumbed rainwater tanks ("IPT"); and

• to *provide baseline data for further experimental work* (Stage 2) for the Decentralised Systems project.

Study areas

Caboolture (Moreton Bay Regional Council)

Pine Rivers (Moreton Bay Regional Council)

Redland City Council

Gold Coast City Council





Sample selection process

Data Field	Comment					
Property/meter ID	This can be used to identify duplicate data and match properties.					
Registration date/ application date/meter installation date/ water connection date	Used to indentify property age (i.e. pre or post 2007). Note that water meter installation date might include new/replaced water meters on pre-2007 properties, so at least 2 fields were used to identify post 2007 properties.					
Street and suburb name	Used to match pairs of same suburb / street. This is also a proxy for rainfall and climate similarities and, in the absence of higher resolution data, a proxy for similar socio-demographic factors.					
Land Use Code	Used to filter for detached single dwellings					
Tank rebated properties	Used to exclude pre 2007 properties that have an existing rainwater tank.					
Water tank available	Used to exclude (pre 2007) or include (post 2007) properties with rainwater tanks					
Dual reticulation	Used to exclude properties with dual reticulation (Pimpama- Coomera, Gold Coast).					
Lot size	Used to match pairs of similar lot size categories (\leq or > 700 m ²).					

Sample selection process





Analysis

- Two tailed, independent Student's t-test
- Non parametric rank tests (Wilcoxon Rank sum)
- TANK modelling & predictions from End Use data to determine expected range of mains waters reductions from IPT

Results – frequency distribution



Cumulative probability distribution

 Greatest observed differences between 60 and 350 kL/household/year

Water consumption (kL/household/year)

 For low and high end users little difference

Results – comparisons across regions

- n = 4,035 pairs for 2008
- Median water consumption less for IPT properties compared to No Tank
- No Tank = 154 to 201 kL/household/year
- IPT = 130 to 147 kL/household/year
- Estimated median savings
 = 1 to 52
 kL/household/year



Council	Median mains reductions (kL/household/year)
Caboolture	1 (n=2,853)
Pine Rivers	28 (n=649)
Gold Coast	52 (n=422)
Redland	40 (n=112)
Average	30 (40 ex. Cab)

Lot size and water use



Water restrictions



* Note GCCC off QWC restrictions between Feb and Nov 08.

	Restriction level declared by Queensland Water Commission								
Category of reticulated mains	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	High	Medium	PCM*
water use	(May '05)	(Oct '05)	(Jun '06)	(Nov '06)	(Apr '07)	(Nov '07)	(Jul '08)	(Mar '09)	(Dec '09)
Established gardens/lawns									
irrigation systems	Note 1							Note 11	Note 13
hand held hose with trigger/ twist		Note 1					Note 10	Note 12	
bucket / can				Note 1	Note 1	Note 1			
New gardens/lawns									
irrigation systems	Note 2	Note 2						Note 11	Note 14
hand held hose with trigger/ twist			Note 5						
bucket / can				Note 1	Note 1	Note 1	Note 1		
Topping up existing pools/spas	Note 1	Note 3	Note 3	Note 7	Note 8	Note 8	Note 8	Note 12	Note 15
Filling new pools/spas	Note 4	Note 4	Note 6	Note 7	Note 9	Note 9	Note 9	Note 12	Note 16
General outdoor cleaning									
(house/cars/boats/caravans)									
hand held hose with trigger/ twist							Note 10	Note 12	
bucket / can									

Notes:

1. Restricted times across 3 non-consecutive days. Not on Mondays.

2. As for note 1 and must be an automatic shut-off sprinkler only.

3. As for note 1 but hose to be hand held only.

4. Children's pools of <1000 L filled anytime. Hose does not need to be attended.

5. One hour of day using trigger/nozzle hose for 14 days after establishment only.

6. No portable / child pools to be filled by mains water.

7. Only when Qld Government recommended water efficient measures are shown to be used on the property.

8. As for Note 7 and restricted to 3 hours on non-consecutive days.

9. Requires written approval from local government to construct pools and spas.

10. Hand held allowed for half hour every 7 days.

11. Only if systems emit < 9 L per minute with a timer for up to 30 minutes a day.

12. Filled at anytime but requirements as per Note 7. Child pools less than 500 L capacity.

13. As for Note 11 but 4 pm to 10 am. No Mondays and using water efficient irrigation equipment.

14. As for Note 13 but can be watered anytime on day of establishment.

15. Only after all rainwater has been used to top up and 3 out of 4 water efficient devices installed in property. 16. As for Note 11 but 4 pm to 10 am. No Mondays and using water efficient irrigation

Results – per capita

- Per capita usage estimated from 2006 ABS data
- No Tank = 159 L/p/day
- IPT =130 L/p/day
- Per capita median water use ≈ 20% less in IPT households



Daily water consumption data (QWC)



Expected mains water use reductions from IPT

- 1. Measured end use data
- 2. Modelling using rainwater TANK model

- 1. End use Data:
- Willis *et al.* (2009) Gold Coast data from 150 dwellings: toilet + washing machine = 51 L/p/day
- Equivalent to ~ 52 kL/household/year assuming 2.8 household occupancy (ABS Census data 2006) for new developments.

Gold Coast (n=151) from Willis *et al*. 2009 per capita daily end use consumption



Expected mains water use reductions from IPT

2. TANK modelling:

 Rainwater demand ranged from 42 kL/household/year (Caboolture to 49 kL/household/year (Gold Coast)

Average 46
 kL/household/yr

Optimal combination
 of 5 kL tank volume and
 100 to 125 m2
 connected roof area

Region	Rainfall scenario	Yearly Rainfall (mm)	Rainwater Use (kL/yr)		
	Dry (2006-7)	1,006	40		
Caboolture	Av (28 yrs)	1,219	41		
	Wet (2008)	1,525	42 (1)		
	Dry (2006-7)	850	41		
Pine Rivers	Av (28 yrs)	1,131	41		
	Wet (2008)	1,201	46 (28)		
Gold Coast	Dry (2006-7)	1,193	47		
	Av (28 yrs)	1,372	47		
	Wet (2008)	1,766	49 (52)		
	Dry (2006-7)	956	43		
Redland	Av (28 yrs)	1,192	43		
	Wet (2008)	1,348	45 (40)		
Average	Dry (2006-7)	1,001	43		
	Av (28 yrs)	1,229	43		
	Wet (2008)	1,460	46 (30)		

Summary

• Summary of mains water use reductions as estimated by desktop study, modelling and end use data

Region	Desktop study	End Use approach	TANK model		
	(kL/household/year)				
Caboolture	1		42		
Pine Rivers	28		46		
Gold Coast	52		49		
Redland	40		45		
Average	30	52	46		

Conclusions and Recommendations

- 1. Clear evidence to show reductions in potable water consumption from properties with rainwater tanks
- 2. Water restrictions likely to have played a major role in low savings observed in Caboolture and Pine Rivers...although..
- 3. Would expect a minimum of around 45 to 50 kL/household/year for properties with internally plumbed tanks... but not seeing this for Caboolture and Pine Rivers
- 4. Need market and social research to answer questions on:
 - demographic data (household occupancy)
 - tank ownership
 - tank water use
 - water efficient fixtures / appliances

Stage 2: Mandated Rainwater Tank Survey- outline

Rigorous analysis to resolve uncertainty in savings from rainwater tanks in SEQ

- Resolve anomalies in the 2008 data set
- Recruit households (\approx 1000) to access their water billing records
- Recruit (\approx 30) households for water and energy monitoring
- Recruit households who will allow an audit of their rainwater systems (and roof size, connected roof area, garden size)

Mandated Rainwater Tank Surveyoutline

- Stage 1- telephone survey- permission and demographic data
- Stage 2 more comprehensive mail out survey- water use behaviour and household demographics
- Stage 3 household audit of participants recruited in Stage 2 – onsite inspection of rain tank systems and compliance with QDC MP4.2 rules



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