



*Creating*  
**Water Sensitive  
Communities**

**WSUD 2018 & HYDROPOLIS 2018**

**12TH – 15TH FEBRUARY 2018**  
CROWN TOWERS, PERTH, WESTERN AUSTRALIA

**10TH INTERNATIONAL CONFERENCE  
ON WATER SENSITIVE URBAN DESIGN**

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# Systems analysis and big data reveals benefits of new economy solutions at multiple scales

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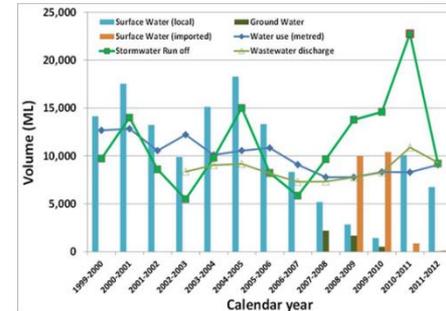
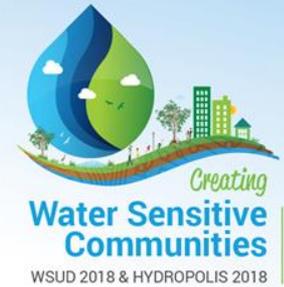
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# Introduction

## - a key question for WSUD

- Water efficient appliances and behaviours, and rainwater harvesting ensured many Australian cities did not run out water during the drought
- But, benefits of water efficiency, rainwater harvesting and local solutions remain contested as uneconomic and inefficient
  - Eg; Productivity Commission (2011, 2017)
- Many others have found benefits
- So we tested these assumptions using real data
- ***A key question for WSUD: local actions provide whole of society benefits but what are the benefits and do they manifest across scales?***

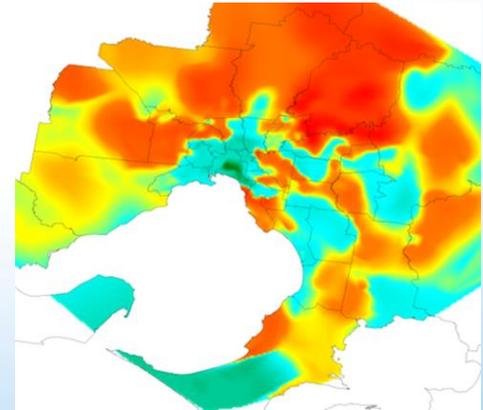


# Methods

- Used metadata from government agencies and utilities
- BOM, ABS, NWC, regulators, utilities, RBA, treasuries, manufacturing industry, BASIX
  - 2003 – 2017
  - Utilised spatially detailed raw data from ABS on water use, efficiency, rainwater harvesting
- Selected capital city regions with similar general characteristics
  - Desalination plants, different levels of support for water efficiency and rainwater harvesting
  - Adelaide, Melbourne, Perth, Southeast Queensland, Sydney regions
- Combined with detailed “bottom up” systems analysis to understand historical benefits
- Examined household welfare, economic efficiency, utility water operating costs and marginal costs

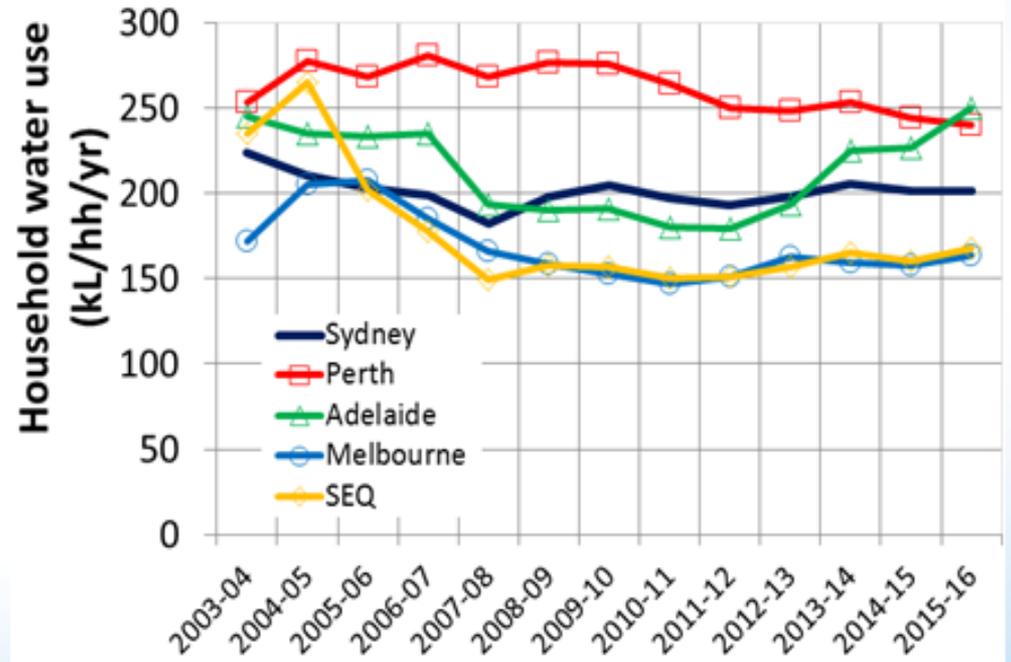


Greater Melbourne:  
Observed Water Use



# Household water use (2003 to 2016)

- Average annual household water use reduced in most cities
  - SEQ: 28%
  - Sydney: 10%
  - Perth and Melbourne: 5%
- Adelaide household use increased by 2%
- Achieved in context of high population growth
  - SEQ: 29.8% (high)
  - Sydney: 14.9% (low)



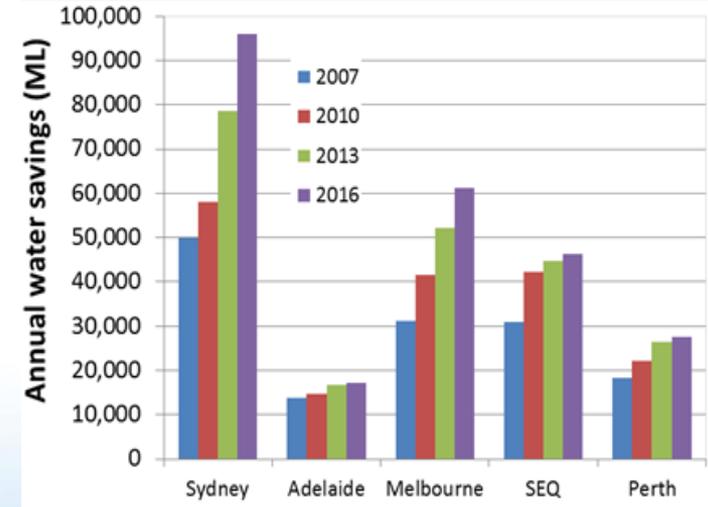
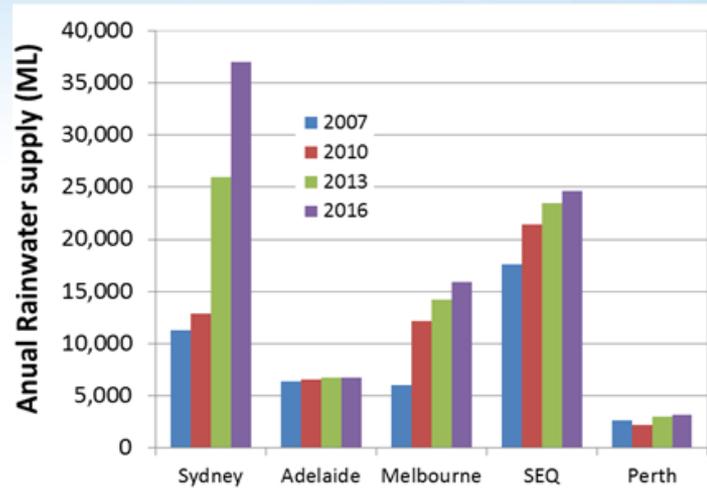
# Household water efficiency and rainwater harvesting



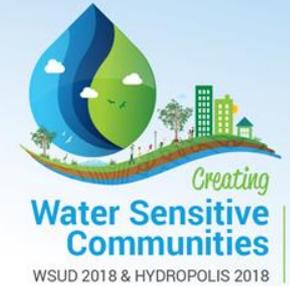
- Examined detailed spatial data from ABS and BASIX (2007 – 2016)
  - Dual flush toilets, low flow showers, water efficient clothes washers, demographics
  - Rainwater harvesting, indoor & outdoor rainwater use, mains water connections
- All regions had increases in water efficient appliances in dwellings
  - Highest growth in dwellings with dual flush toilets in Sydney (19.1%)
  - Highest growth in dwellings with water efficient clothes washers in Adelaide (9.9%)
- Greater proportions of dwellings with rainwater harvesting in Sydney, Melbourne & SEQ
  - Larger proportion of rainwater supply to indoor uses in Sydney (42%)
- This detailed spatial data included in the Systems Framework with climate sequences and calibrated household water uses to determine water savings

# Household water savings

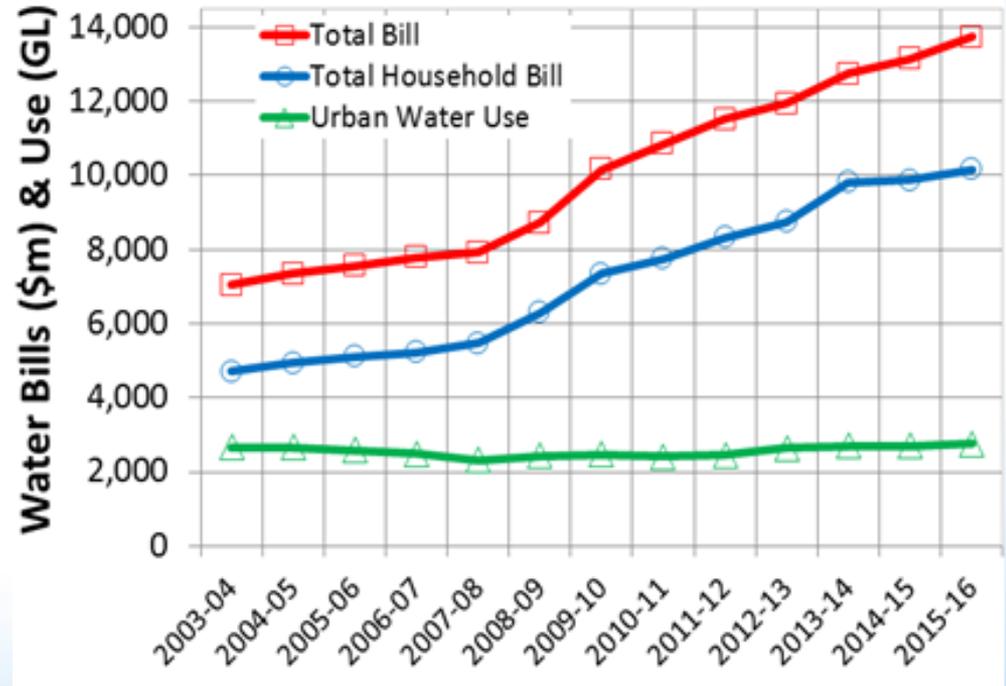
- All regions had growth in rainwater supply and water efficient appliances
- Sydney, Melbourne, SEQ higher growth in rainwater supply driven by policies or subsidies
  - Highest increase: Sydney 27,730 ML
  - Lowest increase: Adelaide 348 ML
- All regions had growth in total household water savings
  - Highest: Sydney 46,440 ML (93%)
  - Lowest: Adelaide 3,253 ML (23%)
- ***Pattern of water savings in Sydney different to Brisbane and Melbourne***



# National customer expenses and use of utility services



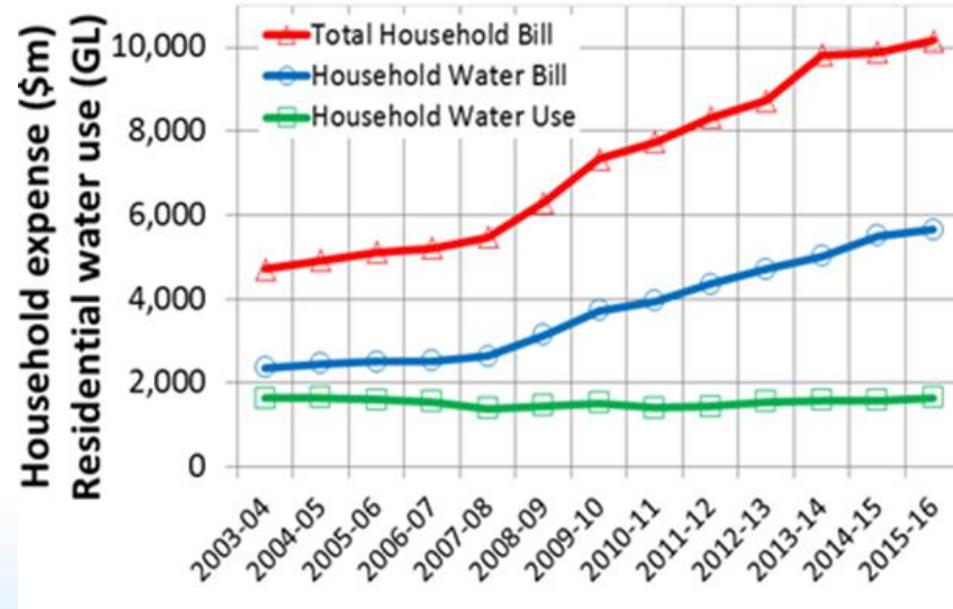
- Total customer expenses on urban water services increases by 95% (\$6.7**b**)
- Household expenses increased by 116% (\$5.5**b**)
- Only 3% (88 GL) increase in use
- CPI: 38% (inflation)
- Thus 41% real decline in economic efficiency
- National average marginal cost of urban water services: \$46/kL



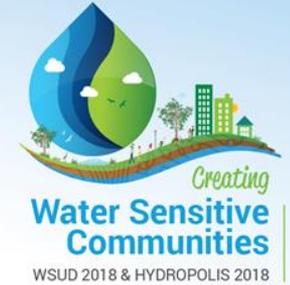
# National household expenses and use of utility services



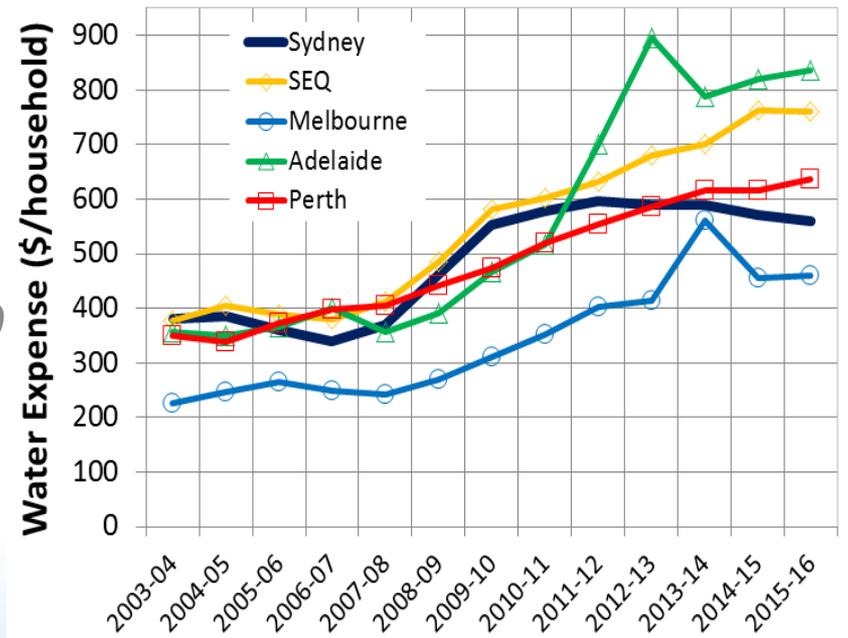
- Proportion of household expenses increased 67% - 74%
- Household water bills increased by 140% (\$3.3b) for 1.7% greater use (28 GL)
- Real increase in household expense of 74% (loss of economic efficiency)
- Historical marginal cost of household services: \$140/kL



# Regional household expenses for utility water services

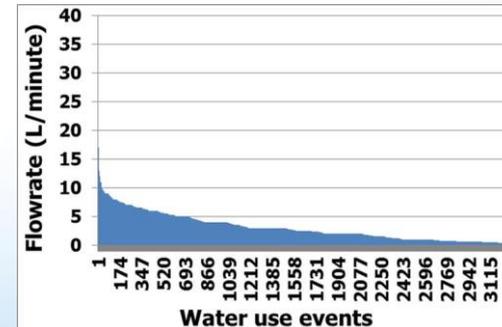


- Average annual household expenses in each region
  - Increases in all regions
  - Highest: Adelaide (71%, \$343) real
  - Lowest: Sydney (7%, \$35) real
- ***Pattern of Sydney household expenses is different after 2009-10***
  - Corresponds with 46,440 ML additional household water savings
  - Declining expenses after 2011-12
  - BASIX policy is ongoing

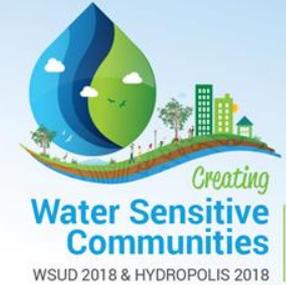


# Household welfare

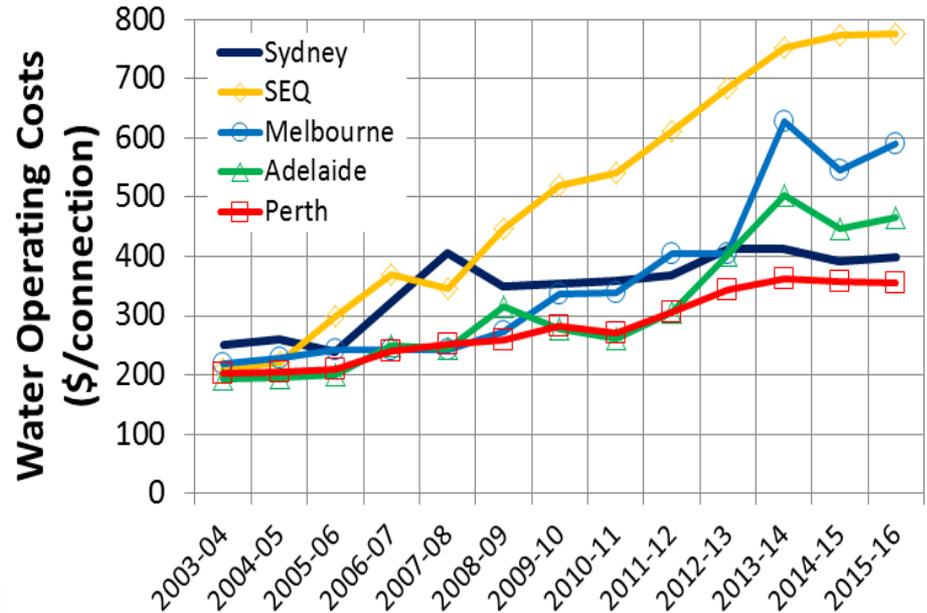
- Household expenses for utility water services the smallest proportion of available median income in Melbourne (1.18%) and largest proportion in Adelaide (2.52%)
  - Smallest change in Sydney (0.08%)
  - Largest change in Adelaide (1.04%)
- Low income houses (< \$650/week)
  - Water expense greater than 2.3% for 17% of income for Sydney dwellings
  - Greater than 10.5% of income for 23% of Adelaide houses
  - 9.6% to 5.8% of income in SEQ, Perth and Melbourne
- ***Higher growth in household water savings has driven down utility water tariffs which decreases household expenses for all Sydney people – especially low income houses***



# Utility water operating costs

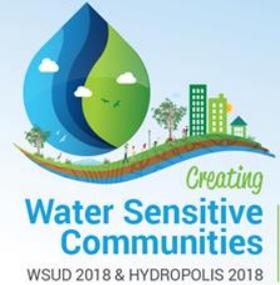


- Utility water operating costs have increased since 2003-04 (declining economic efficiency)
  - Lowest real increase in Sydney 15% (\$53/property)
  - Highest real increase in SEQ 167% (\$485/property)
- ***Sydney has a different pattern of increases in water operating costs that stabilises after 2007-08***
  - Consistent with household water savings
- SEQ has high growth in costs associated with a regional water grid

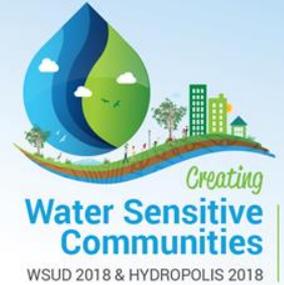


# Insights

- Examined a long timeline of historical Big Data at fine spatial detail
  - Demographic, socioeconomic, economic and water resources
- Investigated historical data in a bottom up Systems Framework rather than using regional averages (see Barry & Coombes presentation)
- Macroeconomic (household welfare, national efficiency) & microeconomic (utility operating costs, marginal costs) objectives
- Growth in water efficient dwellings in all cities which is stabilising growth in urban water demands
- Greater household savings in Sydney is driven by the state environmental planning policy BASIX with water saving targets
  - Decreases tariffs for all dwellings, improves water operating costs and diminishes marginal costs of utility services
  - Greatest benefits to lower income houses
  - Independent legislation created regulatory competition
  - Reduced operating costs of \$53 m - \$810 m
  - Reduced household expenses of \$218 m - \$578 m



# Conclusions



- Systems analysis and big data reveals benefits of distributed solutions
- Policy requirement for new and renovated dwellings to meet water saving targets has acted as an economic market mechanism to drive:
  - Higher household water savings
  - Lower utility water tariffs
  - Greater household welfare
  - Improved economic efficiency of utilities
- These methods and insights have broader application for understanding the whole of system/society value of WSUD
- Use of “bottom up” spatial data and systems analysis rather than regional averages permits this understanding