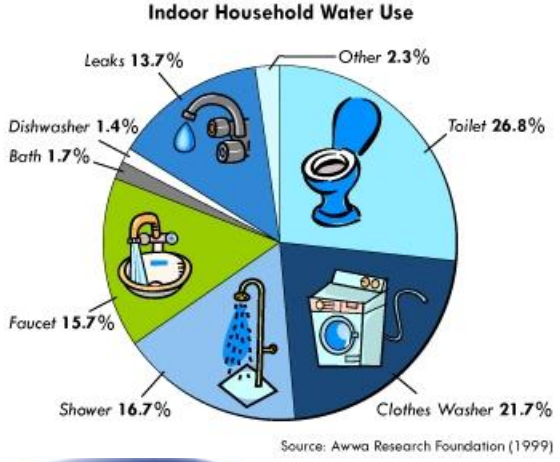
Optimal Water Resources Mix for Metropolitan Adelaide

Project, October 2012 – March 2014

GOYDER INSTITUTE FOR WATER RESEARCH



Presenter Kathryn Bellette

On behalf of task leaders •Susan Cuddy •Shiroma Maheepala •Graeme Dandy •Mark Thyer •Jennifer McKay •Darla Hatton Macdonald •Rosemary Leonard

Presentation outline

- Introduction
- Project design
- Progress to date

Project introduction

To identify and evaluate integrated mixed water supply and security options for Metropolitan Adelaide:

to inform water supply policy and planning

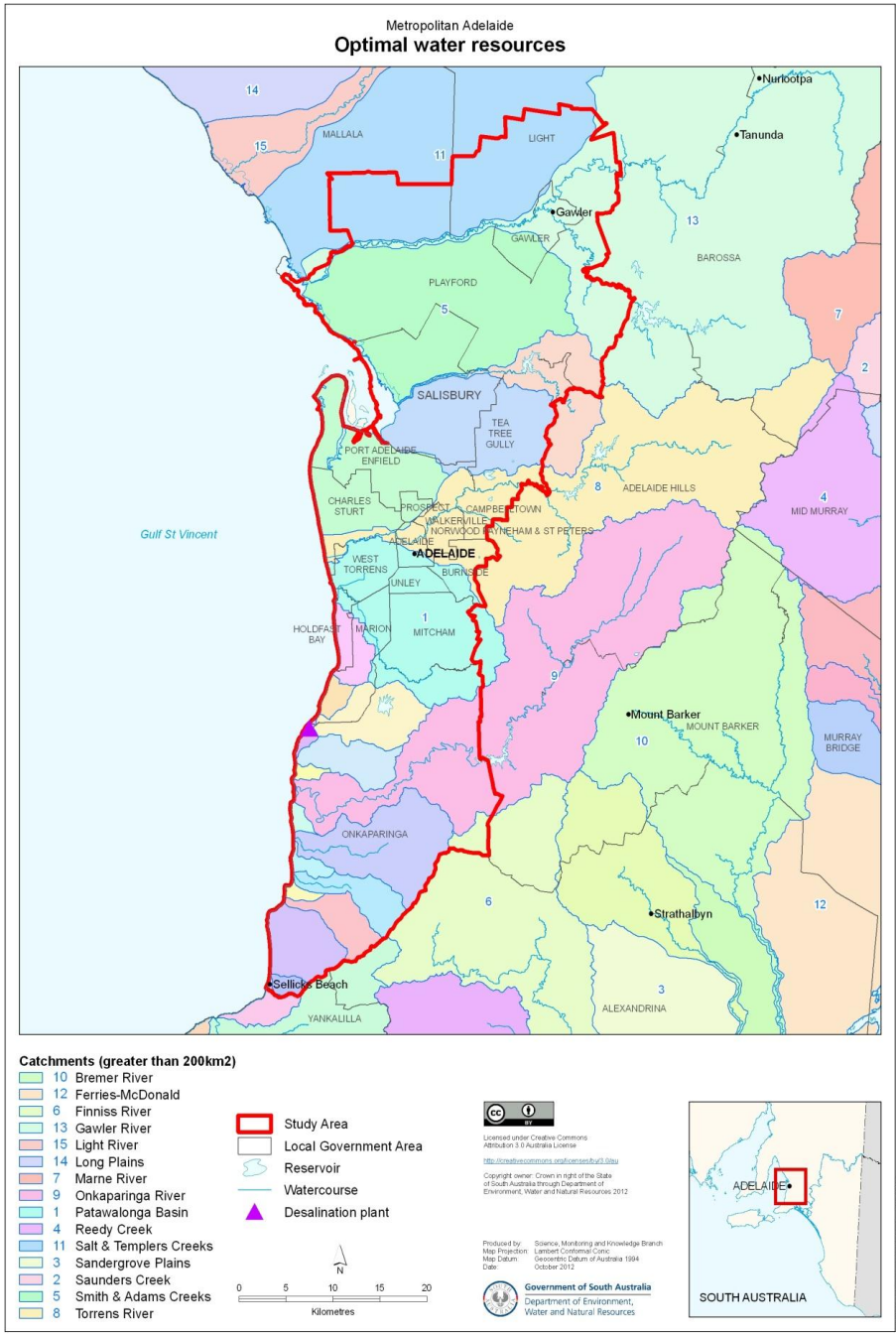
Geographic extent

Metropolitan Adelaide Area, not including ‘outer metro’

But includes the major growth areas located outside the Gawler local government area

Excludes the Adelaide Hills local government areas

Excludes water supply catchments, but includes the inflow from supply catchments



Water sources

Mt Lofty Ranges catchments		Recycled wastewater	
River Murray		Stormwater	
Groundwater		Rainwater/ roof water	
Seawater (desalinated)		Demand management	

Introduction cont.

The optimal mix framework: inputs

- capturing the relationships between supply, demand and the water delivery network
- estimating economic costs and benefits from the different options
- eliciting community attitudes to alternative water supply options
- measuring household water use patterns and behavioural drivers of water use
- assessing institutional risks associated with alternative supply options

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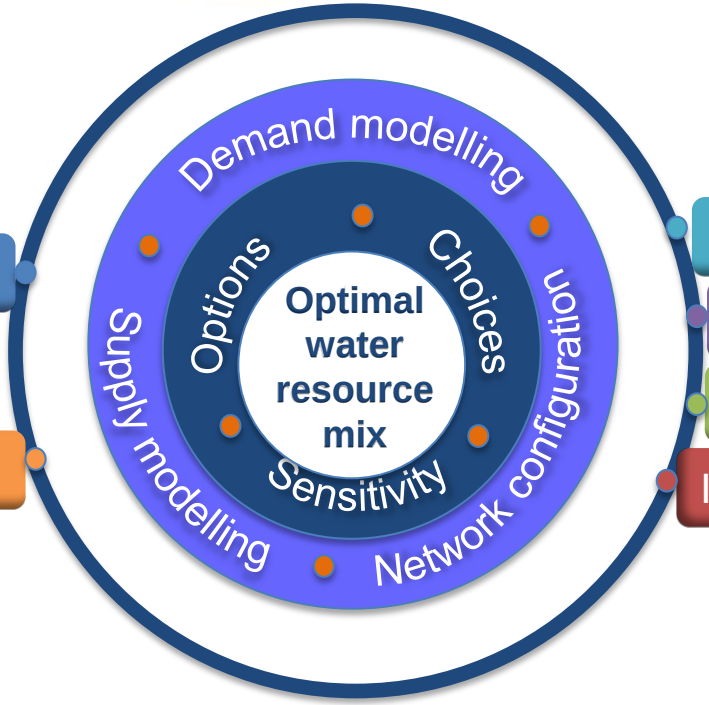
Project Design

What are the factors being considered in when determining the optimal water supply mix?

Project design … linking the components



Stakeholder reference

Project governance

Household water use

Costs/benefits of each source

Community attitudes

Institutional risks

Kathryn Bellette, Finders Uni

Susan Cuddy, CSIRO

Graeme Dandy, Uni Adelaide

Shiroma Maheepala, CSIRO

Mark Thyer, Uni Adelaide

Darla Hatton Macdonald, CSIRO

Rosemary Leonard, CSIRO

Jennifer Mackay, Uni SA

Optimisation Decision support framework - G. Dandy et al.

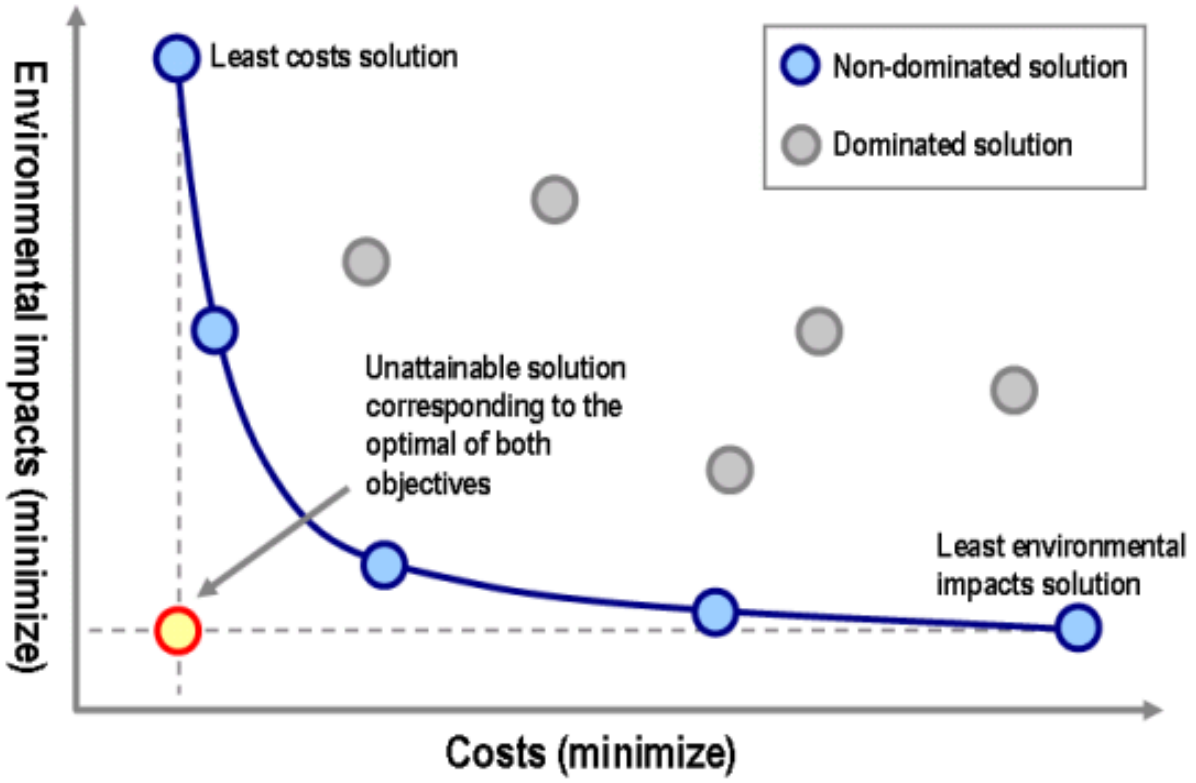
Objectives (developed via stakeholder workshop)

- Develop a fit for purpose system that is flexible, robust and balances security with affordability within the resource capacity
- Minimise/improve/manage environmental impacts that are associated with water mix options: ensure positive environmental change
- Ensure community acceptability and ownership
- Minimise infrastructure lifecycle costs and maximise infrastructure lifecycle benefits

Input parameters for optimisation activities

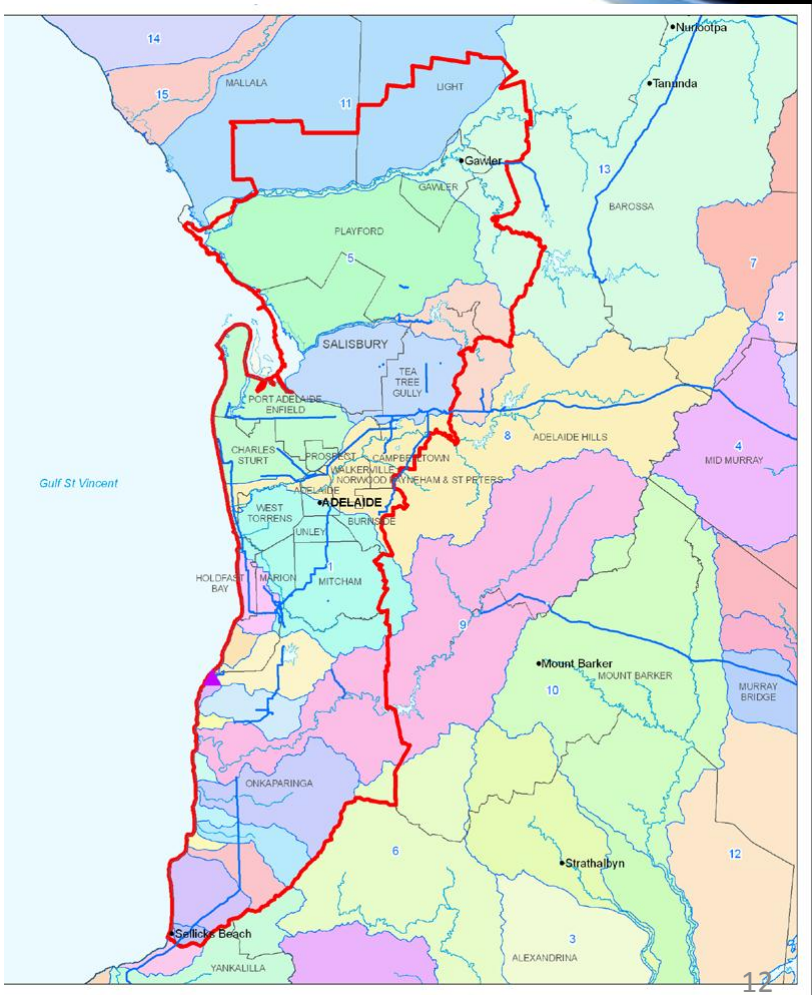
- A **summary of the capital and operating costs** of all major sources of water supply for Adelaide including water from the following sources: surface reservoirs, the River Murray, desalination, groundwater, harvested stormwater, recycled wastewater, rainwater and demand management
- A **summary of the energy associated** with the major sources of water supply for Adelaide
- An optimisation decision support framework that brings together a range of information, such as **water quantity, energy usage, infrastructure costs/benefits, costs/benefits of (some) externalities, community preferences and household usage behaviour**
- A **preliminary set of curves showing supply security, economic, environmental and social trade-offs** of various combinations of sources

Method


Least costs solution
Non-dominated solution
Dominated solution
Unattainable solution corresponding to the optimal of both objectives
Least environmental impacts solution
Environmental impacts (minimize)
Costs (minimize)

Products

- Integrated urban water system model*
- Multi-objective optimisation framework*
- Synthesis report
- Series of technical reports



* Interim, not fully operational

Sub projects

optimisation inputs

Supply, demand and delivery modelling S. Maheepala et al.

- To quantify changes to supply security and wastewater and stormwater discharges, of utilising different mixes of water sources
  - Under both historical and future climatic conditions
  - At the whole-of-system scale

- To couple the water quantity analysis with multi-objective optimisation
  - For seamless evaluation of the utility of different mixes of water sources

Key parameters

- Base year: 2012/2013
- 50 year simulation
- Monthly time step
- Allows to identify ‘best’ mix, with three sources
- Developed using Source Integrated Modelling System

Key Model Inputs

- Inflows series
- Demand series
- Dam evaporation series
- Environmental flow series
- Pump and pipe capacities
- Targets storage levels
- 5 year River Murray pumping limit

Key Model Outputs

- River Murray pumped volumes
- Demand supplied
- System storage levels
- North-South pumped volume
- ADP production
- Costs
- Greenhouse gas emissions

Expected Outcomes

- An improved understanding on
  - The potential contribution of feasible mixes of water sources to Adelaide's water supply security
  - Changes to runoff and wastewater discharges, of utilising different mixes of sources

- A simulation model of Adelaide's water supply system that links sources, to household water use, to discharges from the Adelaide catchment, and the skills required to run it, embedded in SA Water

Social Analysis: R. Leonard et al.

Focus groups using “the card game” with

A) groups with differing positions on water eg community gardeners, swimming pool owners

B) various demographic groups

Examining the risks, side benefits, & quality control issues for 7 water sources

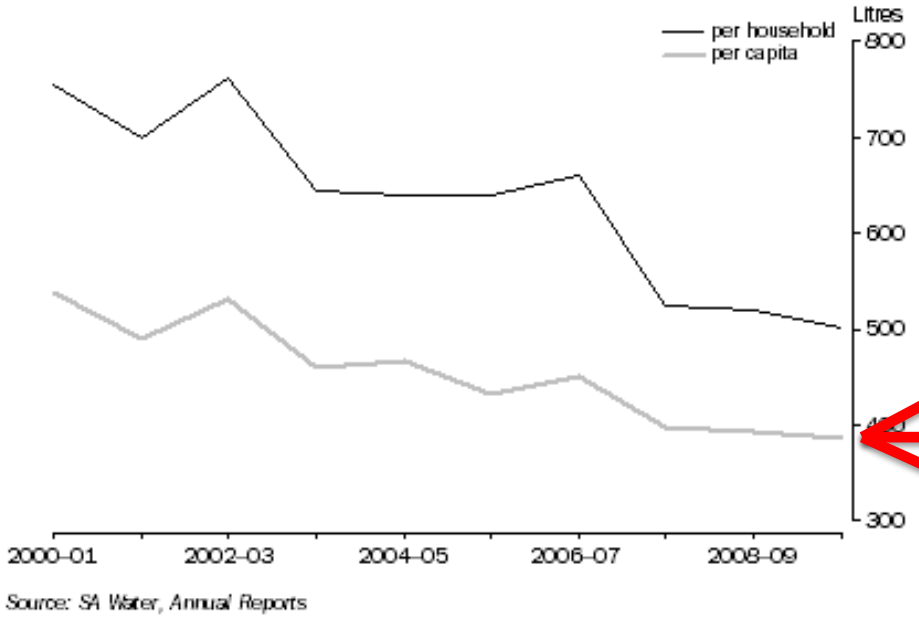
Emerging results

15 focus groups completed

- Huge diversity of responses – many new ideas
- Distinct positions emerging eg save the Murray at all costs cluster, reduce & recycle cluster, lowest cost cluster
- Strong call for better community education and water management transparency & no-one supports privatisation

Understanding and predicting household water use: M. Thyer et al.

Daily water consumption, residential water per household, total water per capita



Future Water Use?

Rebound?

Static?

Increase efficiency?

Source: ABS

Approach

150 Smart meters measure high resolution water use (0.014L/pulse) at 10 sec intervals

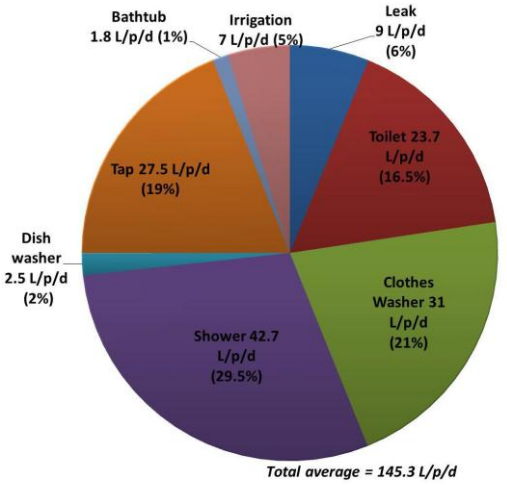
Data downloaded via laptop

Flow trace and water use analysis

Predictive model of household water use
- behaviour
- appliances etc.

Expected outcomes

- Evaluate end-use composition for study households
- Influence of household appliance/efficiency on water end-use
- Understanding of key behavioural drivers of water use variability for study households
- Provide household water use simulations for Task 2
  - Evaluate different water source options (e.g. rainwater tanks)
  - Estimate demand management options
  - (e.g. water efficient appliances)



Economics of different water sources: D Hatton McDonald et al.

<u>Greenspace</u>

Results from a participatory mapping exercise and survey indicates that physical activity are a function of park type.

E.g. linear parks - high intensity activity and irrigated community parks - a range of environmental, social and mental health benefits. Albeit causal links cannot be made.

Economics of different water sources: Hatton McDonald et al.

- Externalities
- Summary of grey and published lit. on externalities for each water source

- Coast/marine internet survey on willingness to pay and willingness to reallocate state budget for fish/reefs/water clarity close to ready to go (assistance from SA Water, DEWNR, EPA, SARDI and AMLR)

Institutional arrangements for diverse water portfolios: J. McKay et al.

Purpose

- to explore the institutional risks related to diversifying the supply portfolio in Metropolitan Adelaide in the future

Approach

- extensive literature review of institutional arrangements for implementing a portfolio of supply sources in Australian cities as well as internationally
- subsequently interview key actors

Use & management of new water sources (waster water, stormwater and desalinated water)

- National, States and Territories
  - 1. What is the legislation framework within water and wastewater supply and management?
  - 2. What are the current policies for water and wastewater supply and management?
  - 3. Who are the present authorities/utilities in water and wastewater supply and management?
- USA/European countries/UK /Singapore

Commonwealth of Australia

- CoAG and NWI
- The key elements of Commonwealth water legislation in Australia are:
- *Water Act 2007*
- *Water Amendment Act 2008*
- *Water Regulations*
- Water charge and water market rules
- Other water legislations include:
- *Water Efficiency Labelling and Standards Act 2005*
- *Environment Protection and Biodiversity Conservation Act 1999*
- Water for Future is built on four key priorities: Taking action on climate change, Using water wisely, Securing water supplies, Supporting healthy rivers

South Australia

Legislation	Policy and Programs	Agencies/Utilities
Natural Resources Management Act 2004	Environment Protection (Water Quality) Policy 1993	Department of Environment, Water and Natural Resources
Environment Protection Act 1993	SA Reclaimed Water Guidelines	Environment Protection Authority SA
South Australian Water Corporation Act 1994	Water for good	NRM Boards
Water (Commonwealth Powers) Act 2008	Regional demand and supply statements	SA Water
Water Efficiency Labelling and Standards Act 2006	Water Allocation Planning	
Waterworks Act 1932		
Murray Darling Basin Act 2008		
Water Regulations		

Source: AWA (2013)

Progress to date …

Stakeholder reference	☑ Reference panel established ☑ Stakeholder workshop #1 held
Integrated modelling	☑ Supply module developed for base case (2012/13 infrastructure, 50-year simulation period (July 1962-June 2013)) ☑ Modelled demand and Mt Lofty catchment inflows for simulation period ☑ Identified discharge objectives for environmentally sensitive locations
Multi-objective optimisation	☑ Draft of report summarising capital and operating costs of, and greenhouse gas emissions from, all major sources of water ☑ Formulated the multi-objective optimisation framework
Household water use	☑ Initial survey of appliance-type for ~1600 households ☑Installed smart meters on 150 households ☑ Ready to start attitudinal/behavioural surveys

Progress to date

Costs/benefits of each source	☑ **Greenspace** – draft of report on use of greenspace as a function of park type ☑**Externalities** – draft of report summarising grey and published literature on externalities for each water source ☑**Coast/marine survey** on willingness to pay and willingness to reallocate state budget for fish/reefs/water clarity close to ready to go
Community attitudes	☑ 1 pilot and 15 focus groups completed (around 120 people) ☑ Draft of report under way
Institutional risks	☑ Draft of report reviewing institutional arrangements for implementing a portfolio of supply sources in Australian cities as well as internationally - a common aspiration
Project governance	☑ Progressing!

Highlights to date

- High level of community interest in being involved in household water use survey
  - 1600 households responded to initial survey , quadruple response rate of interstate studies
- Synergies of working together
  - Universities, CSIRO, SA Water, DEWNR, EPA, SARDI, AMLR
- Benefits of multi-disciplinary research
  - Biophysical, socio-technical, socio-economic, economic, informatics, continuous engagement

Highlights

- FIRST TIME
  - Water quantity impacts of a wide range of decentralised sourcing options quantified at whole-of-city scale
  - Multi-criteria optimisation of water supply options at whole-of-city scale
  - Community acceptance mapped for members of social groups rather than as individuals
  - Detailed data on household end uses measured and analysed in a SA context
  - Analysis of legal and governance risks associated with potential portfolios of supply sources