



CRC for  
Water Sensitive Cities

# Behavioural Roadmap

Prioritising water saving behaviours in households  
using measurements of impact and likelihood

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## **Behavioural Roadmap**

Prioritising water saving behaviours in households using measurements of impact and likelihood  
*Accelerating transitions to Water Sensitive Cities by influencing behaviour* (Project A2.2)  
A2.2 - 1 - 2016

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## Executive summary

### Background

Population growth and climate change are putting pressure on freshwater resources. Ensuring water security into the future requires a range of water management approaches. One element of these approaches involved managing water use in households.

There are many different behaviours which can reduce household water consumption. Each of these behaviours saves different amounts of water - they have varied *impact* on household water consumption. Identifying impact allows us to target high-impact behaviours for initiatives that seek to reduce household water use. Another dimension to consider when designing demand management programs is the likelihood that the behaviours will be adopted. Considering both likelihood and impact of water use behaviours allows identification of behaviours that are both high impact and high likelihood for targeting demand reduction initiatives. Behaviours that are high impact but low likelihood may also be suitable targets for behaviour change initiatives. A third key dimension is opportunity - what proportion of Australian households are not currently engaging in the behaviour?

We quantified the impact, likelihood, and opportunity of 31 key water-saving behaviours that can be adopted by Australian households, and used this information to identify key water-saving behaviours.

### What was found?

The top five behaviours ranked on their water saving impact were:

- Garden - replace lawn with drought tolerant covering
- Garden - reduce lawn area
- Garden - allow lawn to go brown
- Tank - plumb to toilet and laundry
- Washing machine - replace with efficient model

The top five behaviours ranked for their likelihood of uptake were:

- Taps - turn off tap when shaving or brushing teeth
- Toilet - flush less often
- Car - wash less often
- Shower - take shorter showers to save water
- Garbage disposal/ insinkerator - don't use

The top five behaviours ranked for the greatest opportunity were:

- Garden - group plants with similar water needs together
- Taps - install water efficient tap or other flow regulation device
- Garden - install a grey water system
- Garden - collect water from the shower or sink to use in the garden
- Dishwasher - buy/use economy program

### Recommendations

Recommendations for behaviour change programs focus on three key groups of behaviours:

## Target behaviours

These behaviours have the highest likelihood, impact and opportunity:

- Let the lawn go brown during dry seasons or replace it with drought tolerant plants
- Flush the toilet less: if its yellow, let it mellow
- Water the garden in early morning and evening, and only if it needs it
- Use a low-flow shower head

## High impact but cost limited behaviours:

These behaviours are high impact but with low likelihood because of financial cost. High effort may also be a barrier for some of these behaviours. Consider targeting these when incentives are available.

- Install greywater system
- Connect rain tank to bathroom and laundry
- Buy water-efficient front loading washing machine

## Easy behaviours that add up

These everyday behaviours are influenced by habits and social norms. Individually, they have low impact, but collectively generate a moderate or high impact.

- Fill the washing machine or dishwasher
- Avoid rinsing under a running tap - scrape plates and wipe vegetables
- Turn off taps when cleaning teeth or shaving
- Wash the car less

## How to use this report

One of the challenges with designing household demand reduction initiatives is selecting water-use behaviours to target for change. Behaviour change initiatives are more likely to have a significant impact on domestic water use if they target behaviours that (i) use high volumes of household water; (ii) can be adopted by households with relative ease; and (iii) have not yet been adopted by most households.

The Impact-Likelihood Matrix allows you to identify household water use behaviours that:

- Use higher volumes of water
- Are relatively easy for households to adopt
- Have not yet been adopted by the majority of households

There is no single behaviour that should be targeted for demand reduction programs. The selection of water-use behaviours will vary depending on the local climate, cultural practices of the local communities, and specific needs of the water organisations involved in the program.

## Background

This document provides information to water managers who plan to encourage householders to save water. This document is designed to highlight the development of the Behavioural Roadmap. The Roadmap presents assessments of the impact and likelihood of householders performing a range of water saving behaviours. It is produced as a guide to choosing the most effective water saving behaviours, and to support water managers developing strategies to encourage householders to implement those behaviours. This supplementary document provides further detail on how we generated the data on which the Roadmap is based.

### Behavioural Sciences and a roadmap to water sensitive behaviours

Behavioural Sciences include psychology, economics, sociology and anthropology, political sciences and other disciplines which include areas that seek to understand why people behave as they do. BehaviourWorks Australia, at the Monash Sustainability Institute at Monash University, uses behavioural research to understand and support behaviour change for environmental sustainability.

The Roadmap is a key output of the CRC for Water Sensitive Cities (CRCWSC) research project “*Accelerating transitions to Water Sensitive Cities by influencing behaviour*” (A2.2). The project offers a way to prioritise water sensitive behaviours performed in the household, based on how likely it is that householders will carry them out, and how effective the behaviours are. Water sensitive behaviours in the household include reducing water use, reducing pollution and mitigating flood risk. This roadmap focuses on reducing household water use.

At the core of the Roadmap is the Impact-Likelihood Matrix. The Matrix focuses on two aspects of water use reduction behaviours; impact and likelihood. The Roadmap also considers opportunity for change.

### Rationale for targeting household water use

Australia is the driest inhabited continent on earth (Pigram 2007, Potter et al 2007, Prosser 2011). Rainfall currently meets the needs of our population but the changes in rainfall patterns, along with population growth, will lead to increased pressure on Australia’s water supplies.

11 per cent of Australian water supply is consumed by households (ABS 2013), and it is clear that householders are responsive to appeals to save water. Public awareness campaigns alone can induce a saving of between 10 and 25 per cent (Syme, Nancarrow & Seligmann 2000), and in 2007 the Queensland Water Commission were able to prompt a 22 per cent reduction in average household water consumption with a campaign focussed on indoor water consumption (Walton and Hume 2011).

### Our approach

There are a large range of activities (or behaviours, in this context) available which can reduce household water consumption. Each of these behaviours saves different amounts of water - they have varied impact on household water consumption. Identifying impact allows us to target high impact behaviours for initiatives that seek to reduce household water use.

Impact is not the only dimension that will influence choice of behavioural targets. The second important piece of information is the likelihood that the behaviours will be adopted. Considering both likelihood and impact of water use behaviours allows identification of behaviours that are both high impact and high likelihood for targeting demand reduction initiatives. Behaviours that are high impact but low likelihood may also be suitable targets for behaviour change initiatives.

Three CRCWSC industry partner workshops held in Brisbane, Perth and Melbourne to identify water -saving behaviours (Kneebone and Smith 2013). In total, 27 participants from an array of CRC industry partners and five researchers attended the workshops. In total, 44 separate water conservation behaviours were identified. Overlapping behaviours were combined and behaviours not specifically focused on household water consumption were removed. The final list of behaviours focused on 31 water -saving behaviours. Impact, likelihood and opportunity were quantified for these 31 water -saving behaviours.

## Impact of behaviours on household water use

Quantifying the impact of specific behaviours on overall water use is challenging for a number of reasons.

Firstly, there are many ways to measure household water use and how it is modified by behaviour change. For some behaviours, research is available which objectively measures household water use over a period of time, and identifies how water use is different if certain behaviours are adopted. For example, this type of data can quantify the impact on water consumption of installing a front loading washing machine.

Unfortunately objective data such as this is not routinely available for many household behaviours. Where such data was not available, we calculated impact estimates using other information. For example, we were able to find recent data on the average length of shower for Australians, and for the number of showers taken per household per week and for the water that this consumed. From this, we were able to calculate impact on water use if everyone were to reduce their shower from the average seven minutes to the recommended four minutes. Where we could not find data from which we could estimate impact, we used grey literature (non peer-reviewed reports produced by government, academics, business and industry) and water use calculators to estimate impact.

Another factor that influences the actual impact of water-saving behaviours is the variation in water use across households and climatic regions. Water use within a household is influenced by household size and the age of residents, number of appliances in the home, presence and size of garden and other outdoor areas, and individual water use practices. Household water use also varies according to climatic conditions, seasonal rainfall patterns, peak and average temperatures, and levels of humidity. Each of these factors can influence both water consumption in the home and the actual impact of water-saving behaviours (Balling and Gober, 2007, Worthington and Hoffman, 2008). For example, research demonstrates that water use in the garden is highest in areas which experience hot and dry summers (such as Perth), and substantially lower in areas with wet, humid summers (such as Brisbane). This suggests that the actual impact of garden-related behaviours may be higher in Perth than Brisbane.

The result is a group of measurements and estimates of water saving impact, which is then ranked for use in the Impact-Likelihood Matrix, from high impact to low impact. These data are estimates. Actual water saving impact will vary depending on factors such as household size or local climate, whether the behaviour has been appropriately implemented, and whether individuals offset water-saving behaviours by engaging in other high water use behaviours. Table 1 shows the estimated saving for each water saving behaviour, in kilolitres per year.

**Table 1. Ratings of water-saving impact for behaviours (kilolitres per household per year)**

Behaviour	Impact
Garden - replace lawn with drought tolerant covering	54.5
Garden - reduce lawn area	54.5
Garden - allow lawn to go brown	54.5
Tank - plumb to toilet and laundry	52
Washing machine - replace with efficient model	39.7
Pool - use a cover for your outdoor pool	36
Shower - take shorter showers to save water	32.5
Tank - use for garden	29
Toilet - install dual flush toilet to replace single flush toilet	17.97
Toilet - flush less often	17.97
Shower - replace showerhead with low flow	16.5
Garden - use broom instead of hose to clean outdoor spaces	10.5
Garden - use efficient irrigation	10.4
Garden - install a grey water system	10.4
Garden - use a watering can, not hose	10.4
Garden - choose drought tolerant plants	10.4
Garden - use mulch	10.4
Garden - group plants with similar water needs together	10.4
Garden - collect water from the shower or sink to use in the garden	10.4
Garden - water according to conditions	10.4
Garden - water morning or evening to reduce evaporation	10.4
Washing machine - wash full loads of clothes	9.8
Leaks - fix leaks when you notice them	8.9
Taps - turn off tap when shaving or brushing teeth	6.9
Garbage disposal/ insinkerator - don't use	6.2
Pool - use water -efficient pool filter	6
Taps - install water efficient tap or other flow regulation device	5.45
Car - wash less often	5.4
Taps - don't use running water for rinsing dishes before dishwasher	3.45
Dishwasher – buy/use economy program	1.7
Dishwasher - run when full	1.7

Full details of all sources, assumptions and calculations are available from the authors.

## Likelihood of households adopting behaviours

Likelihood rankings were calculated based on ratings of effort for each behaviour. A survey of 150 Australian adults was used to generate data on effort involved in conducting water-saving behaviours (Kneebone and Smith 2013). For each behaviour, respondents were asked to rate three types of effort using the following questions:

- Physical effort: What, in your opinion, will be the level of physical effort involved in taking part in the behaviour?
- Mental effort: What is the amount of thinking and planning involved in taking part in the behaviour?
- Financial cost: How much you think it would cost to take part in the behaviour (or the amount of money saved by performing the behaviour)?

Each question was rated on a five-point scale. The highest effort rating of the three types of effort represents a barrier to uptake, so these effort scores were used to rank the behaviours, from highest effort to lowest effort. This was then converted to a likelihood ranking, ranging from high likelihood (low effort) to low likelihood (high effort).

**Table 2. Ratings of effort for each behaviour, from 'most likely' to 'least likely'**

Behaviour	Physical effort	Mental effort	Financial cost
Taps - turn off tap when shaving or brushing teeth	2.01	1.95	2.24
Toilet - flush less often	2.14	2.12	2.27
Car - wash less often	2.07	2.08	2.28
Shower - take shorter showers to save water	2.08	1.92	2.32
Garbage disposal/ insinkerator - don't use	2.14	2.1	2.35
Garden - allow lawn to go brown	2.11	2.14	2.36
Taps - don't use running water for rinsing dishes before dishwasher	2.36	2.29	2.14
Garden - water morning or evening reduce evaporation	2.34	2.31	2.39
Dishwasher - run when full	2.13	2.16	2.47
Garden - water according to conditions	2.33	2.49	2.38
Washing machine - wash full loads of clothes	2.17	2.23	2.51
Shower - replace showerhead with low flow	2.52	2.46	2.62
Taps - install water efficient tap or other flow regulation device	2.66	2.59	2.77
Garden - collect water from the shower or sink to use in the garden	2.8	2.33	2.16
Leaks - fix leaks when you notice them	2.81	2.67	2.8
Garden - group plants with similar water needs together	2.64	2.82	2.52
Garden - use mulch	2.9	2.68	2.85
Pool - use a cover for your outdoor pool	2.59	2.3	2.95
Garden - choose drought tolerant plants	2.77	2.89	2.99
Garden - reduce lawn area	2.99	2.98	2.96
Garden - use broom instead of hose to clean outdoor spaces	3.01	2.26	2.47
Toilet - install dual flush toilet to replace single flush toilet	3.04	2.82	3.1
Garden - replace lawn with drought tolerant covering	3.1	2.99	3.13
Pool - use water -efficient pool filter	2.85	2.62	3.24
Garden - use a watering can, not hose	3.26	2.49	2.47
Dishwasher – buy/use economy program	2.62	2.78	3.55
Washing machine - replace with efficient model	2.64	2.79	3.57
Garden - install a grey water system	3.48	3.4	3.67
Tank - use for garden	3.54	3.45	3.74
Garden - use efficient irrigation	3.61	3.5	3.79
Tank - plumb to toilet and laundry	3.66	3.54	3.81

Further data on behaviours is available in the Behaviour Assessment Database (Ramkissoon, Smith and Kneebone, 2015)

## Opportunity for change

The third consideration when selecting behaviour to target for change is the prevalence of that behaviour existing in the population. We consider this as the opportunity for change. Behaviours with existing high rates of uptake in the Australian population exhibit limited capacity for change. Conversely, opportunity for change is greatest for behaviours with limited existing uptake.

The table below shows the proportion of Australian households where that behaviour is already performed. These households are unavailable as targets for behaviour change. Opportunity is calculated as follows:

OPPORTUNITY = 100 per cent minus the per cent households already performing

So for example, if 7 per cent of households have grey water systems, then the opportunity for change is high (Opportunity =  $100 - 7 = 93$ ). Conversely, if 85 per cent of Australian households already have dual flush toilets installed, then the opportunity for change is lower (Opportunity =  $100 - 85 = 15$ ).

**Table 3. Ratings of opportunity behaviours, ranked from highest to lowest**

Behaviour	% households currently adopting behaviour	Opportunity
Garden - group plants with similar water needs together	3	97
Taps - install water efficient tap or other flow regulation device	6	94
Garden - install a grey water system	7	93
Garden - collect water from the shower or sink to use in the garden	9	82
Dishwasher - buy/use economy program	10	91
Tank - plumb to toilet and laundry	13	87
Leaks - fix leaks when you notice them	13	87
Tanks - use for garden	14	87
Garden - replace lawn with drought tolerant covering	14	86
Garden - allow lawn to go brown	17	84
Garden - use a watering can, not hose	18	82
Garden - use efficient irrigation	19	81
Pool - use a cover for your outdoor pool	23	77
Garden - choose drought tolerant plants	25	75
Car - wash less often	29	71
Toilet - flush less often	29	71
Garden - water morning or evening	29	72
Dishwasher - run when full	33	67
Taps - don't use running water for rinsing dishes before dishwasher	33	66
Garden - water according to conditions	34	66
Washing machine - replace with efficient model	34	63
Taps - turn off tap when shaving or teeth	39	61
Garden - use mulch	42	68
Washing machine - wash full loads	55	46
Shower - replace showerhead low flow	62	38
Garden - use broom instead of hose to clean outdoor spaces	63	37
Shower - take shorter showers to save water	64	36
Toilet - install dual flush toilet replace single	85	15
Pool - use water -efficient pool filter	data not available	
Garden - reduce lawn area	data not available	
Garbage disposal/ insinkerator - don't use	data not available	
Toilet - use cistern weight	data not available	

## The Impact - Likelihood matrix

Some water-saving behaviours are popular with high 'likelihood' of uptake but with limited water savings (low impact on consumption). Targeting high-impact behaviours, while considering the likelihood of uptake, can refine your campaigns:

- The top right quadrant includes high-impact behaviours, that may already be adopted. Ensure these behaviours are maintained
- The top left quadrant includes high impact behaviours with potential barriers to uptake. Consider addressing these barriers.

Note: The actual amount of water saved from adopting these behaviours may vary according to household and garden size, climate and other environmental conditions

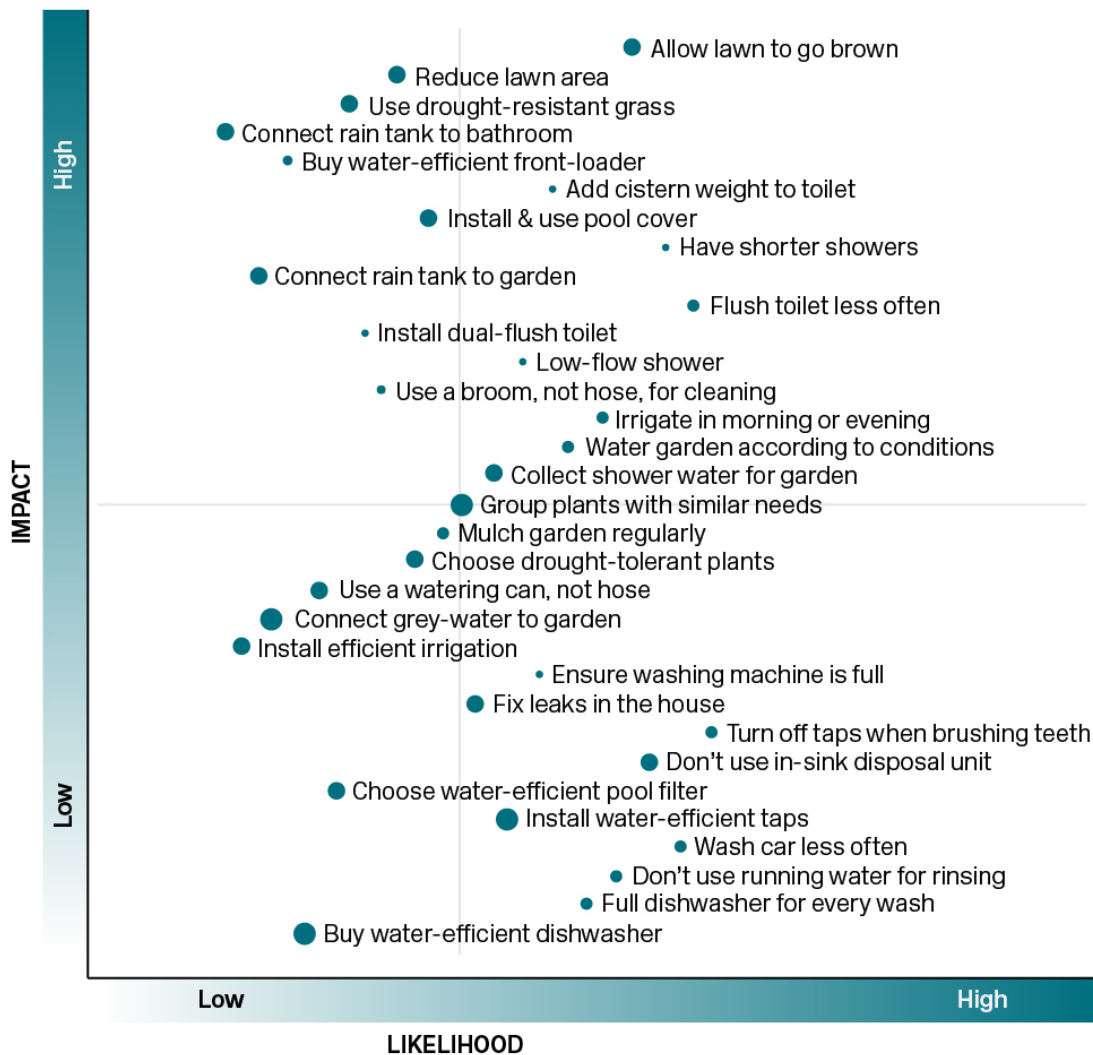


Figure 1. The Impact -Likelihood Matrix

## Choosing behaviours for targeted interventions

The data described above is the foundation for selecting behaviours as the focus for behaviour change. The Roadmap contains recommended behaviours in three categories. Below, we describe how behaviours in each category have been selected.

### **Target behaviours**

These are behaviours with high impact, high likelihood, and high opportunity. These behaviours were selected by identifying behaviours in the upper-right quadrant of the matrix that also had an opportunity of at least 70%. “Add cistern weight to toilet” was excluded because it is not performed in dual-flush toilets, and corresponding opportunity for dual-flush toilets is low.

### **High impact, cost limited**

These behaviours exhibit very high impact, but low likelihood because of a high financial cost. These behaviours may also have a relatively high effort score which may be because they are behaviours which involve installing a new appliance or fitting. They remain a group of high impact behaviours which could be targeted with subsidy intervention or other form of incentive.

### **Easy behaviours that add up**

Finally, a group of behaviours was identified for which likelihood is high, but which have low individual impact. These behaviours are performed regularly, with negligible cost. This means they could become habits supported by social norms. When undertaken as a group, these behaviours generally have a moderate or high collective impact.

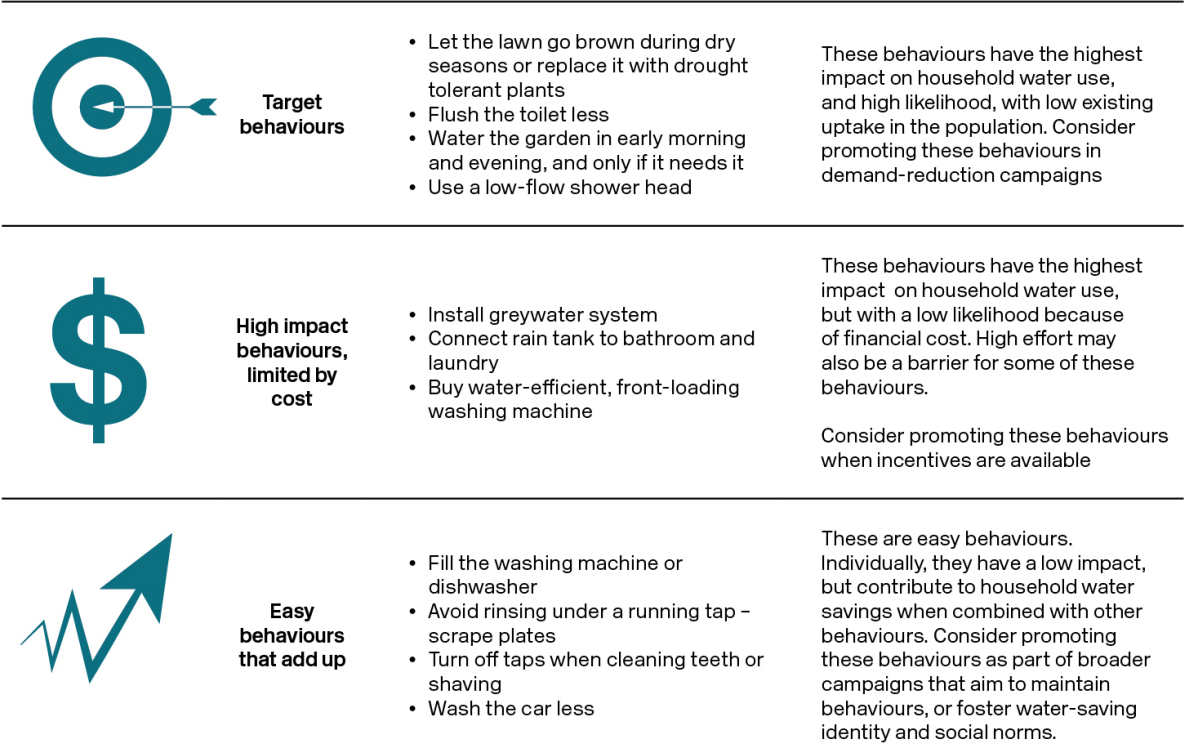


Figure 2. Targeting behaviours for change

## Conclusion

The Impact-Likelihood Matrix allow us to identify water-saving behaviours that have a major impact on household water use, and are likely to be taken up by the Australian population. This refines our selection of behaviours for water demand management programs. This information will be used to identify key behaviours to use in ongoing intervention studies.

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# Appendix A. Industry note: Behavioural Roadmap



## Reducing household water use – which behaviours should be prioritised?




**Industry Note**  
Program A: Society  
Project A2.2

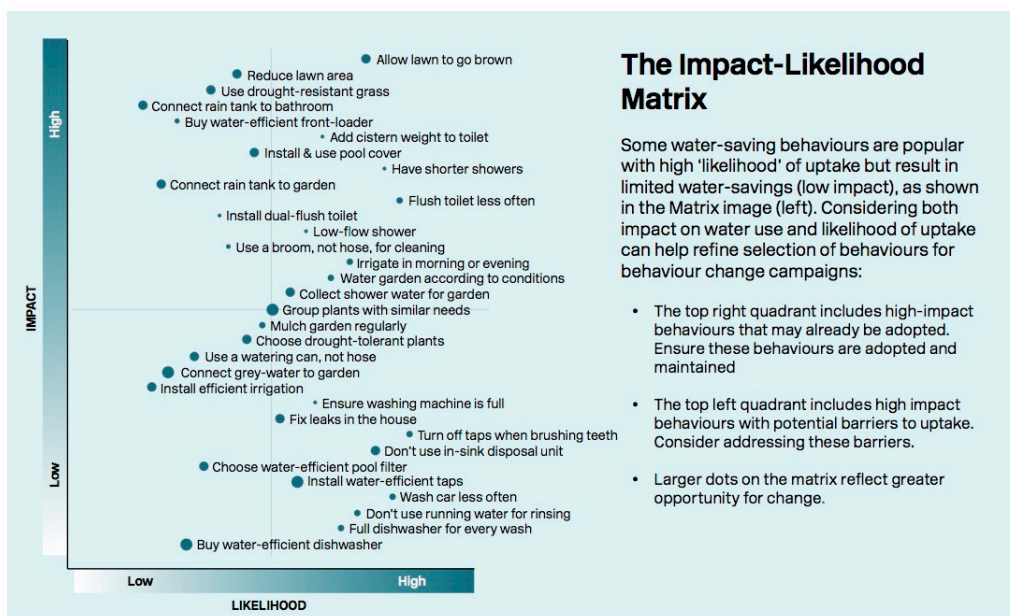
Households have the capacity to generate significant reductions in water use. There are many water-saving behaviours that households can adopt – but some have a greater impact on water use than others. Which household behaviours should demand-reduction campaigns prioritise?

### Choosing behaviours for targeted interventions

Water-saving behaviours have been rated according to their impact on household water use, the likelihood of being adopted, and the opportunity for change. These behaviours were then used to create an Impact-Likelihood Matrix. Behaviours which save the most water (high impact behaviours), have the highest likelihood of adoption, and

have the greatest opportunity for change can be identified (e.g. letting the lawn go brown, see Table below). This provides a 'roadmap for change' - a list of high-impact behaviours that can be prioritised in water demand-reduction programs.

	<b>Target behaviours</b>	<ul style="list-style-type: none"><li>• Let the lawn go brown during dry seasons or replace it with drought tolerant plants</li><li>• Flush the toilet less</li><li>• Water the garden in early morning and evening, and only if it needs it</li><li>• Use a low-flow shower head</li></ul>	These behaviours have the highest impact on household water use, and high likelihood, with low existing uptake in the population. Consider promoting these behaviours in demand-reduction campaigns
	<b>High impact behaviours, limited by cost</b>	<ul style="list-style-type: none"><li>• Install greywater system</li><li>• Connect rain tank to bathroom and laundry</li><li>• Buy water-efficient, front-loading washing machine</li></ul>	These behaviours have the highest impact on household water use, but with a low likelihood because of financial cost. High effort may also be a barrier for some of these behaviours.  Consider promoting these behaviours when incentives are available
	<b>Easy behaviours that add up</b>	<ul style="list-style-type: none"><li>• Fill the washing machine or dishwasher</li><li>• Avoid rinsing under a running tap – scrape plates</li><li>• Turn off taps when cleaning teeth or shaving</li><li>• Wash the car less</li></ul>	These are easy behaviours. Individually, they have a low impact, but contribute to household water savings when combined with other behaviours. Consider promoting these behaviours as part of broader campaigns that aim to maintain behaviours, or foster water-saving identity and social norms.



## Developing the Impact-Likelihood Matrix

Measurements of impact and likelihood of water-saving behaviours are the core of the Impact-Likelihood Matrix, and, with "opportunity", form the basis of choosing behaviours for targeted interventions.

**Impact:** The amount of water saved by each behaviour has been quantified and ranked using scientific studies to form an 'Impact' score. High impact behaviours are those that save greater amounts of water (see full report for details).

**Likelihood:** The 'likelihood' data comes from a survey of Australian adults which identified the effort they thought it would take to perform certain behaviours. Three types of effort were rated: physical, mental and financial. For each behaviour, the highest rated effort was recorded. The likelihood score is the reverse ranked order of the items

from most likely (lowest effort) to least likely (greatest effort).

**Opportunity:** 'Opportunity' is the percent of Australian households who have not yet taken up the behaviour. This data is taken from the Australian Bureau of Statistics and the CRC for Water Sensitive Cities' national survey of Australians. The capacity to change behaviours is greatest for behaviours that have high opportunity.

The actual amount of water saved from adopting these behaviours may vary according to household and garden size, climate and other environmental conditions. The suitability of each behaviour may vary across settings. This matrix is intended to help you select which behaviours to prioritise in your particular area.

This research was conducted as part of *Accelerating transitions to Water Sensitive Cities by influencing behaviour* (Project A2.2).

This project focuses on household behaviour that affects water consumption, quality and runoff as an important part of the solution to the issues of drought, flooding, and pollution. Specifically, it seeks to address the issue that there are many ways in which householders can act to help address these challenges through the identification, prioritisation and ultimately influence of behaviours that assist in transitioning to greater water sensitivity.

### Further reading

How influencing behaviours can accelerate the transition to a water sensitive city (<http://goo.gl/H7m4W9>)

### Further information

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Project website: <http://goo.gl/Y2INhl>



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