

## Water Diaries: generate intra-household water use data – generate water use behaviour change

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### ABSTRACT

With the current 'water crisis' essentially a crisis in water management, the need to clearly understand domestic water use is critical. In recent years there has been a growing awareness of the need to manage demand in all water sectors. However, demand mechanics at the intra-household scale are not well understood, with many utilities adopting a 'command and control' mentality rather than engaging with household water users, their water use knowledge and behaviours. This paper describes the Water Diary, a method to generate intra-household water use data, as a tool to promote water use behaviour change through sensitising users to their water behaviours and practices. Anecdotal evidence, of participants' increased water use sensitisation encouraging behaviour change, received following each of three Water Diary surveys (2007–2009), was quantified in 2010 with questionnaires and interviews of 40% of households that participated in the Water Diary surveys. The interviews revealed only three households did not become more aware of their water use and all but four recorded water use behaviour change, consequent to Water Diary participation. Requiring a high level of householder participation, water diary keeping can sensitise householders to their water use, to the point of enduring behaviour change.

**Key words** | behaviour change, household water use, participatory research, sensitisation, water diary, water use data generation

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With increasing demands for domestic water (Glieck 1995) and limited understanding of household water use allocation practices (Bolt & Bird 2003), methods to generate intra-household water use data and to find effective ways to promote enduring water use behaviour change within households are required. By providing water use data and information about water behaviours and practices, such methods could prove useful tools to manage domestic water demand. Details of water use beyond the data captured by water meters are required for a number of reasons, including: to inform water infrastructure design and provision; to develop demand management policies and strategies; to understand intra-household resource allocation processes; or to investigate inequity in access to water within households (Lahiri-Dutt & Harriden 2008).

The Water Diary method was initially developed to provide a reliable and flexible method to collect gender

differentiated intra-household water use data. The emphasis on gender disaggregated data and the geographical transferability of the method, distinguishes this method from other water diaries used for household water research. In Australia, for example, the Everyday Water Project (Allon & Sofoulis 2006) included a diary keeping element. This diary keeping was a largely reflective exercise, designed to explore how individuals feel about water, and their water use, rather than the ostensibly quantitative approach of the Water Diary. Additionally, Strengers conceived of a 'comfort and cleanliness' diary, but it did not include recording water use (Lahiri-Dutt & Harriden 2008). For institutional water managers, in development contexts particularly, the Water Diary offers a simple, low-tech method to collect a rich body of data that does not rely on water meters or other technological interventions. It also offers a simple approach for small communities to collect their

own domestic water use data for use at a local scale. As supply is increasingly unable to meet the demand for domestic water, generated by a growing population and increasing urbanisation, the need for such data escalates.

A participatory approach is the most appropriate way to conduct water use diaries, given the private nature of the research sites (i.e. people's homes) and the detail of data generated. Given that many water uses and practices are 'routinized and embedded in taken for granted rhythms of daily life' (Shove 2003: 141), high levels of user participation has the advantage of forcing participants' attention to what are largely unconscious and habitual water behaviours. Thus, as the Water Diary method has participants recording the data, they become aware of not just their water behaviours, but also the volumes of each and every water use. Placing the householders in the role of data collector provides them with information whose veracity they can neither dispute nor ignore. This increased awareness sensitises individuals, to varying degrees, to their water use. In turn, this increased awareness forces participants to assess, and frequently change, water use behaviours. Water Diary participant sensitisation, to the point of behaviour change, and its enduring nature, is the focus of this paper.

## METHOD

Through the course of the three Water Diary surveys conducted in the Australian Capital Territory (ACT) region, informal evidence of the potential of Water Diary participation to sensitise participants, to the point of behaviour change, emerged. The use of diaries to promote behaviour change through self-monitoring has been used in medical contexts (for examples see Carels *et al.* 2005; Steurer-Stey *et al.* 2010). In the energy sector, Kantola, Syme and Campbell's study of cognitive dissonance and high electricity consumption

concluded 'this study suggests that if consumers are made aware of a discrepancy between their attitudes and behaviour then more consistency might be observed' (Kantola *et al.* 1984: 421). By directly recording their resource use, householders generate evidence of discrepancies between household behaviour and individual attitudes. A lack of evidence of diaries being used to promote water use behaviour change prompted the decision to interview Water Diary participants about the nature, if any, of the sensitisation resulting from diary participation. The results of these interviews (and questionnaires), conducted in October 2010, contribute to the understandings of how Water Diary participation promotes water use sensitisation presented in this paper.

The paper begins describing the Water Diary method, and provides some examples of the range and applicability of the data generated. Detailed attention is paid to the participatory aspects of the method. The nature of participants' sensitisation, as recorded in the 2010 questionnaires and surveys, resulting from Water Diary participation is the subject of the following section, titled 'The diary, a sensitisation effect and behaviour change'. The concluding discussion outlines some of the opportunities the Water Diary presents to institutional water management in two important water management activities – generating adequate intra-household water use data and influencing household water use behaviours.

## WATER DIARY

Developed in response to the unmet need for methods to generate intra-household water use data (Bolt & Bird 2003), the suite of practices composing the Water Diary presented here were trialled and refined over three Water Diaries in the Australian Capital Territory (ACT) region from 2007 to 2009 (Table 1). Acknowledging the diversity

**Table 1** | Water Diary and Sensitisation Surveys

| Survey                      | Date Conducted    | Households | Participants | Return rate |
|-----------------------------|-------------------|------------|--------------|-------------|
| Rural (RT)                  | Dec 2007–Jan 2008 | 2          | 4            | 33%         |
| Water Diary 2008 (WD08)     | Oct 2008          | 23         | 57           | 85%         |
| Water Diary 2009 (WD09)     | Oct 2009          | 20         | 57           | 83%         |
| Sensitisation survey (WD10) | Oct 2010          | 17         | n/a          | 100%        |

of households, the Water Diary is designed to be readily modified for use in all households, regardless of location, water supply or technology.

In brief, the Water Diary requires all water used within the household to be recorded by time, volume, activity and individual, for seven consecutive days. Participants also provide household information, including demographics, income, water supply sources, property size and use and start and end date meter readings where possible. Qualitative information, to complement the quantitative data, is obtained through an accompanying questionnaire. In WD08 and WD09, half of the participating households were interviewed, using the questionnaire as a guide; the remaining households completed it on a self-paced basis during the diary week. Participants received a booklet containing the seven day water use diary, questionnaire, household information page, information about the project and researchers and a consent statement. To promote accurate data entry, a demonstration page, complete with

demonstration calculation to encourage participants to calculate their water use, was also included (Figure 1). To enhance estimate accuracy, an information page was also included in the Water Diary booklet. This page included space for washing machine, air-conditioner and dishwasher water consumption rates, a table of generic water using activities and their average water consumption rates and a series of water estimation exercises. A stamped, addressed envelope was provided to encourage the booklet's return.

To enhance estimation accuracy, the techniques included in the Water Diary are:

- the data entry and daily water use total calculation examples provided in the demonstration page: (Figure 1);
- the table of generic household water-using activities and their average consumption rates;
- space to include manufacturer specified water consumption rates for washing machines, dishwashers and air-conditioners; and

**DEMONSTRATION PAGE**  
Different uses are recorded differently - unless specified otherwise, indicate the number of uses.

Day 4 Wednesday 21 October 2009

| Time Used | dishes - hand | dishes - machine | washing machine | toilet - full flush  | toilet - half flush | bath (L) | shower (mins) | personal hygiene | food prep drink (L) | cleaning (L) | pets (L) | garden (mins) | pool/spa (L) | cooler (mins) | misc (L/min) |
|-----------|---------------|------------------|-----------------|--|---------------------|----------|---------------|------------------|---------------------|--------------|----------|---------------|--------------|---------------|--------------|
| 0030h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0100h     |               |                  |                 | inc. hand & face washing & shaving; record in L or seconds |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0130h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0200h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0230h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0300h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0330h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0400h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0430h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0500h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0530h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0600h     |               |                  |                 |  | f1, m2              |          | f1 10         |                  |                     |              |          |               |              |               |              |
| 0630h     |               |                  |                 |  | m1, f2              |          |               |                  |                     |              |          |               |              |               |              |
| 0700h     |               |                  | f1              |  |                     |          | m1 7          | m1 30s           |                     |              |          |               |              |               |              |
| 0730h     |               |                  |                 |  |                     |          |               |                  |                     | f2 1.25      |          |               |              |               |              |
| 0800h     |               |                  | m1              |  |                     |          |               |                  |                     | f2 1.25      |          |               |              |               |              |
| 0830h     |               |                  |                 |  |                     |          |               |                  | f2 0.5              |              |          |               |              |               |              |
| 0900h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 0930h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 1000h     |               |                  |                 |  |                     |          |               |                  |                     |              |          | m2 12         |              |               |              |
| 1030h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 1100h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 1130h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 1200h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 1230h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 1300h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 1330h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |
| 1400h     |               |                  |                 |  |                     |          |               |                  |                     |              |          |               |              |               |              |

Use questionnaire key to identify who performed which activity.

water used = (2 x top loader) + (4 x half flush) + (1 x 10mins + 1 x 7min shower) + 30 secs tap + (0.5L) + (1.25 + 1.25L) + (12 x 5L hose)  
 = (2x 130L) + (4 x 6L) + (90L + 63L) + 2.5L + 0.5L + 2.5L + 60L  
 = 260 + 24 + 153 + 2.5 + 0.5 + 2.5 + 60  
 = 502.5L

Figure 1 | Water Diary 2009 Demonstration page.

- a short series of water estimation training exercises (WD09 only), the results of which could be entered into the table of generic household water using activities.

The last three techniques are all included in the Water Diary booklet information page. An estimation error (%) for each household can be assessed by comparing the estimated water use (recorded in the Water Diary) and the actual water use (from the meter readings).

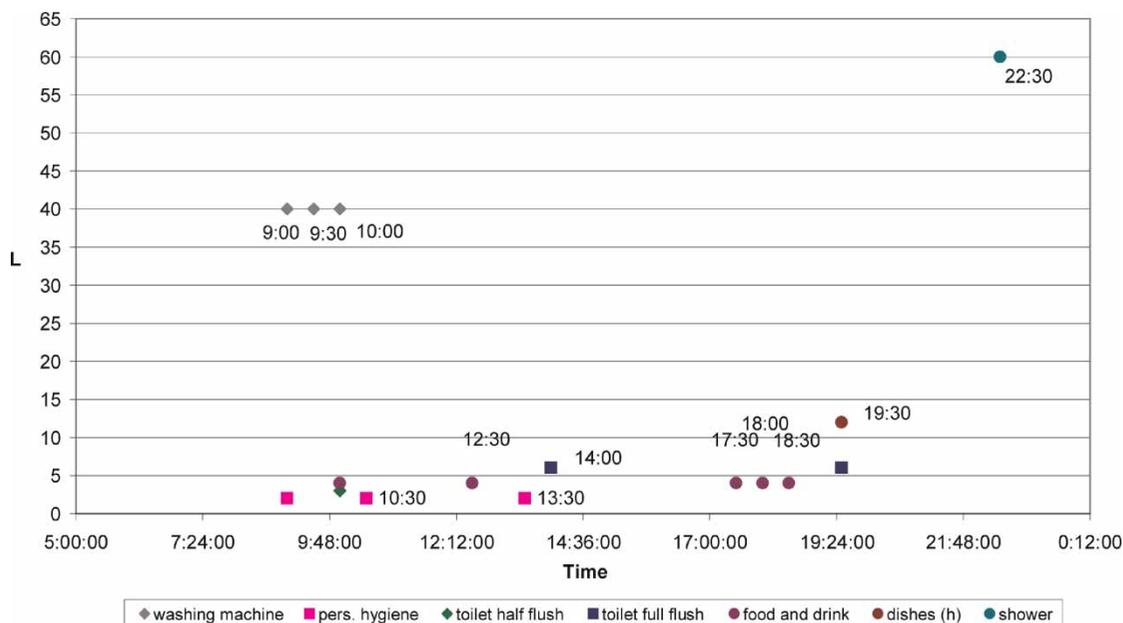
The Water Diary method, including the booklet, was designed for application in a wide range of domestic environments. There is no need for the household to be connected to reticulated supply and metered, or have a single water source and it can be applied in rural households. The surveys described here were conducted in an industrialised context, with rural and urban households included. The Water Diary method could be particularly useful in a development context as it neither requires complex or expensive technology to gather the data nor presupposes that the households are connected to a particular form of domestic water infrastructure, if at all. A detailed conceptual background to the Water Diary and the rural trial results can be found in [Lahiri-Dutt and Harriden \(2008\)](#). A discussion regarding applying the method in development contexts is available in 'A methodology for differentiating (measuring

gender) intra-household water use: Water Diary 2008' ([Harriden 2009](#)).

### Water Diary data

Water Diaries generate detailed data, able to be interpreted at many scales. For example, the total water consumed by any one Water Diary group can be analysed by variables including gender, age, income, location or water supply. The same variables can be used for data analysis within and between individual households. An individual's detailed water use on a specific day (by 30 minute increments) can also be readily analysed ([Figure 2](#)). For aesthetic purposes, [Figure 2](#) covers 05.00 h to 24.00 h, although the Diary provides for water use to be recorded at any time of the day (or night). No water use was recorded in the part of the day not represented in [Figure 2](#).

[Figure 2](#) shows the water used by the female resident of Household 6, WD09, on day five of the Diary week. There were two adult males and one adult female residing in the dwelling during the Diary week. A free standing house on a rural property, tank water was the sole water supply. The water used during the Diary week, calculated from the drop in tank levels, was 1,430 L. The estimated weekly water use, recorded in the diary, was 1,758 L.



**Figure 2** | Female water use, Household 6, WD09, Day 5 by time, volume and activity.

On Day 5, 408 L of water use was recorded in the Diary, across eight activities. The female resident used 239 L of water, performing seven water using activities; the male residents 169 L, performing six activities (toilet flush full, toilet flush half, bath, shower, personal hygiene and food preparation/drinking). In spite of the data suggesting the female resident was home all day, her 'peak demand' in water use was in the mid-morning and mid-evening periods.

Data can also be analysed from a water use activity perspective. Although the examples provided in Figures 3 and 4 consider water use by gender, this analysis can also be done using any of the variables recorded in the household information page of the Water Diary booklet. The following figures show the gender performance of water chores in WD08 households. Figure 3 shows female performance; Figure 4 male. It is quite obvious that, on average, women perform a higher number of water chores than men. They also use more water performing each chore than men do, suggesting women perform that particular chore more often. Only Household 21 had the male residents performing more water chores than female residents. In households 4 and 8, no male residents performed any water chores. No household recorded resident females performing no water chores.

The information (or variables) about each participant, and the residence, provided in the household information sheet includes sex, age, occupation, income, water supply (and supplier), dwelling type, property size, water saving devices (e.g. low-flow shower heads, dual flush toilets) and conservation practices. With this range of information, not only can comparisons between participating households be made but it is possible to compare Water Diary keeping households with the broader population, within the limits of publicly available data. That is, while per capita and other high-level data could be compared, it would be difficult to compare the minutiae of the broader population's household water use, as this data is not widely or routinely collected. While a worthwhile endeavour, comparisons between Water Diary keeping households and the general public remains beyond the scope of the current Water Diary research project.

### Householder participation

As noted, to generate data beyond those provided by the household water meter, householder participation is appropriate. The participation methods employed by the Water Diary are outlined here.

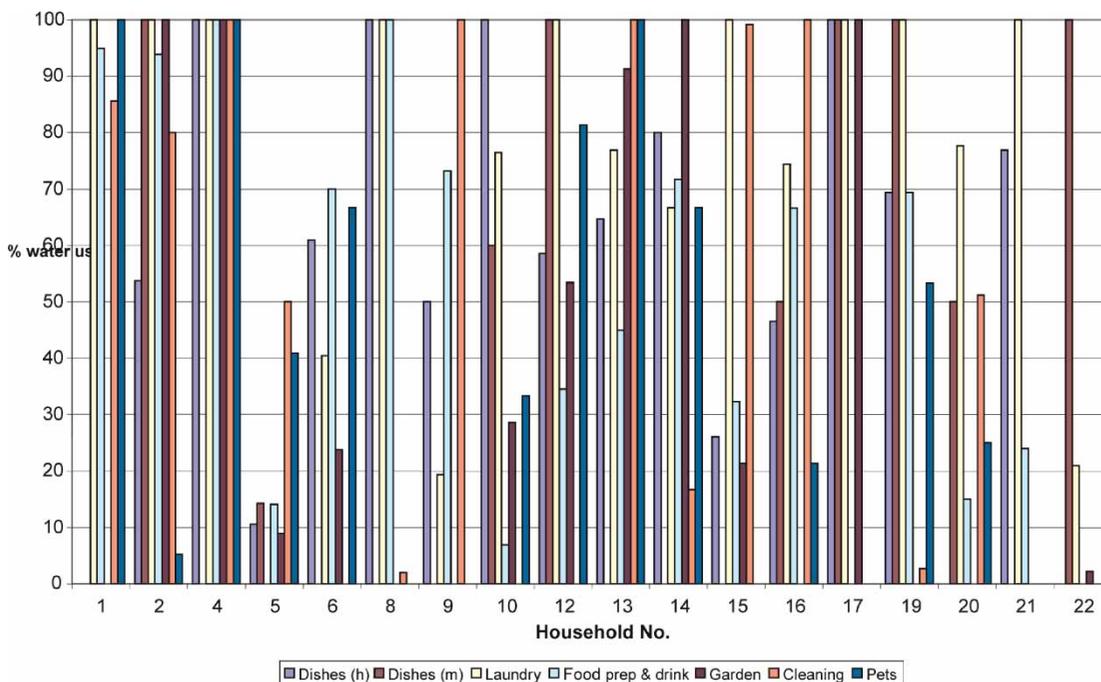


Figure 3 | WD08 household water chores, by gender – women.

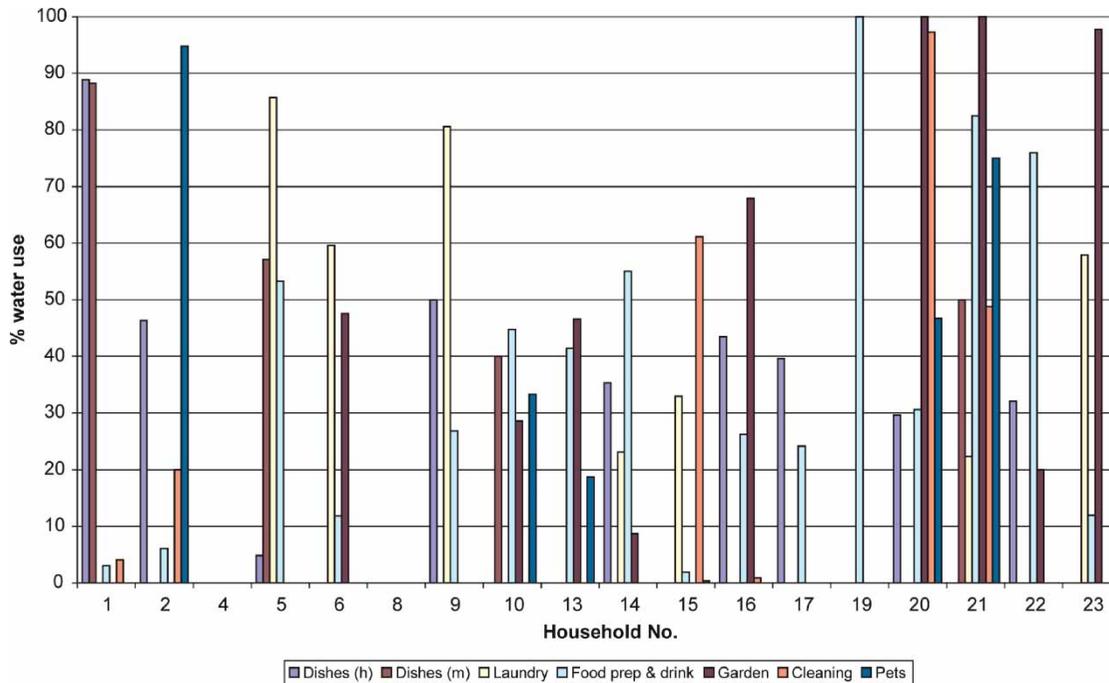


Figure 4 | WD08 household water chores, by gender – men.

### Self-selection

Diary participants respond to calls for volunteers, rather than being approached specifically or individually. This approach reflects the researcher's desire that no one be compelled to participate and consequently, potentially, not fully cooperate. Electing to be involved suggests a genuine interest and willingness for participation. Participant willingness is vital with the diary being a seven day commitment.

### Water meter readings

The information page of the Water Diary booklet requests participants with water meters to record two meter readings. The first reading is the value at the start of the diary recording period; the second is at the end of the recording period. A space is also provided for participants to calculate the difference. For some participants it was the first time they had read their meter or measured their water use.

### Questionnaire

A questionnaire, on any topic relevant to the purpose for conducting a Water Diary, is used to gather qualitative

water use data from the participants. In the ACT region, Water Diary survey questions about water restrictions, water reuse practices, water allocation practices and water chore performance were asked. The questionnaire, included in the Water Diary booklet, is conducted on a self-paced basis during the Diary week. Handwritten, the questionnaire responses tended to be brief.

### Interviews

The later Water Diary surveys had 50% of the participating households, randomly selected, complete the questionnaire as an interview. The detail in these responses was greater than the written responses. Additionally, interviews conducted in participants' homes offered an opportunity to see first-hand the water saving devices and practices recorded in the questionnaire.

### Estimate training

To increase water use estimation accuracy, participants were asked to complete a short series of simple water estimating activities. The results of these activities provided household specific consumption data to add to the table

of common water using activities in the booklet. Performing these activities, for example recording how many seconds of kitchen tap water flow releases one litre of water, also gave participants an 'eye' for that volume and sense of how the household water system functions.

### Diary keeping

The most onerous of the participation methods. All water use, by all residents and visitors, over seven consecutive days is recorded. To make recording easier, each resident and guest is represented by a unique key and all water uses are recorded in time (seconds or minutes) or by the number of uses. There has been no prescription about who records or how diary entries are managed. Who is responsible for entering diary data appears to vary from household to household, judging by the variety of writing, pens and markings found in the diaries.

### Calculations

Additional to the encouragement to calculate the difference between the start and end date meter readings, participants were also encouraged to calculate the total daily and weekly estimated water use recorded in the diary, with each diary page having space for the daily calculation. The volume of water used per activity was calculated using data generated by the estimation activities or found in the table of generic water using activities in the information page.

### Participant report

A purpose-written report was provided after the initial data analysis so participants can see the results of their contribution. To allow comparison between the participating households, a table of the basic water use data for all households is included. Each household receives a copy of its full data – including questionnaire responses and consumption totals (by day, gender, activity) – as a report attachment. The report is a tangible link completing the participation cycle of each Water Diary survey.

## THE DIARY, A SENSITISATION EFFECT AND BEHAVIOUR CHANGE

As noted already, informal evidence of water diary participation inspired behaviour change, such as shorter showers, less garden watering and increased water reuse, and piqued interest in follow-up research with Water Diary participants. To explore the sensitising effect, if any, on diary participants, consenting households completed an interview or questionnaire (i.e. WD10). These were conducted at the same time of year as the preceding Water Diary surveys. The results are presented here. Of the 43 households that participated in the three Water Diary surveys, 17 (40%) agreed to participate in the sensitisation effect follow-up research. Ten households agreed to an interview. The balance completed a self-paced questionnaire. In summary, WD10 results strongly indicate that:

- keeping a water diary sensitises people to their water use – both the volumes and activities;
- this sensitisation effect can promote changes in water use behaviours, primarily towards conservation;
- this sensitising effect is enduring; and that
- the results, and experiences, generated by the Water Diary are used by householders to develop, and continually modify, household water use policies and practices.

These results, and evidence for them, are discussed in the following sub-sections.

### Diary keepers sensitised to their water use

The degree of water use sensitisation, and associated likelihood of behaviour change, initially related to the level of water use awareness within the household prior to Water Diary participation. Only three households reported no change in their level of water use awareness following diary participation. Two were rural households relying on rainwater for all domestic water needs, during a drought. The third household 'had been cutting down on water consumption for well over two years' (WD0817) before keeping a diary. That is, those households reporting no post-participation sensitisation effect were, immediately prior to the diary-keeping period, already highly aware of their household water use.

For those households reporting heightened water use awareness following keeping a diary, the act of recording water use is the most important participatory element behind any sensitising effect. Putting water volumes to activities and counting each time an activity is performed, proved a powerful activity. Household WD0802's comment that increased water use awareness was 'certainly due to quantitative aspect and being more focussed on individual items of water use' reflected the experiences of many participating households. Household WD0805 echoes this sentiment: 'more of a picture of what volume really is'. This outcome reflects other findings identifying that water use knowledge has an important influence in individual's potential to conserve water (see [Dziegielewski 1991](#); [Graymore et al. 2010](#)). The frequency of water use was a less significant awareness-raising piece of information than the volume of water use per activity or household total. For example, the cumulative daily volume of incidental 'squirts' of water, compared to the amount of water used for washing up, particularly surprised household WD0803. Three households reported changing water use behaviour during the diary week due to the high volume of water recorded.

Gathering and recording data (i.e. diary entries and meter readings) almost inevitably sensitises participants to their water use. Participants have the complete data set for their household conveniently contained in a booklet for them to refer to as required. There is an increased awareness of household water practices and participants' knowledge about the volumes, results and timing associated with those water practices improves. Additionally, the participant report's inclusion of basic water use data about the other participating households provided another opportunity to further sensitise participants to their water use, as they are able to compare their results with similar (according to a number of variables) households. This 'delayed' sensitisation is indicated in household WD0911's description of their water use as, 'higher than expected – but only in comparison to other participants'.

The questionnaire/interview focus on water use also has a role in sensitising participants by getting them to consciously consider why they use water the way they do. The questionnaire responses also provide a context for participants to consider the recorded water use. The lag between participating in the questionnaire (or interview) and

completing the diary record provides a reflection period to balance what was recorded in the diary against the responses provided in the questionnaire (or interview). Self-reflection is known to contribute to behaviour change as it allows information to be processed before either (i) storing it for action; (ii) using it to enhance learning or inform behaviour; or (iii) dismissing it ([Graymore & Harriden 2011](#)). For example, responses to questions about the gender allocation of household water chores had some participants reflecting on how the recorded water use matched the intentions recorded in the questionnaire (or interview): '... should be asking more of older [male] child' (Household WD0815).

Sixteen households in WD10 responded that they thought the Water Diary was a good approach to raise household water use awareness. No one reported that it was not a good approach. The remaining household did not question the Water Diary's role in increasing water use sensitisation. Rather, they wondered if it was enough to prompt a 'change [in] mindset' (WD0817), particularly at the institutional level, where this participant felt much of the responsibility for current (in this participant's opinion, inappropriate) societal water beliefs and practices lies.

### Sensitisation prompts behaviour change

Four households reported no behaviour change, including the three reporting no sensitising effect, from diary participation. Twelve households reported behaviour change since keeping a Water Diary. Ten directly attributed Water Diary participation as, at least, part of the reason for change. Comments about the diary's role in water use behaviour change included 'using diary pushed me to do it' (household WD0919) and 'Water Diary focussed attention within the household' (household WD0823-0902).

The behaviour changes reported fall into four broad categories:

- showering/bathing practices
- adopting an allocation approach rather than fully complying with water restrictions (i.e. having a specific daily water allocation that can be used for any number of household activities, regardless of their water restriction status);
- more care taken to reduce water waste/increase reuse; and
- water using appliance practices.

There were also reports of the diary being used as evidence to settle family water allocation disputes. For example, household WD0805 decided to charge a resident adult offspring for his showers: 'he got to realise what 15 minutes of water use cost...a wake up call'.

As suggested by Kantola *et al.*'s conclusion (Kantola *et al.* 1984), Water Diary participants, the majority identifying as 'water conscious' households, identified practices for modification or elimination that largely resulted in reduced water use. With their increased awareness and greater knowledge, it was the only way to reduce the dissonance between their water conservation values and water profligate behaviours, without formally abandoning their 'water conscious' status. This sensitisation process reflects what has been described as a 'discursive unfreezing of embedded routine behaviours' (Jackson 2005: 120). That is, the participatory aspects of the Water Diary method provided participants with the knowledge (quantitative and qualitative) to critically consider their habitual water use practices and behaviours and the confidence to change behaviours as required.

### Sensitisation is enduring

It appears that the majority of households remained sensitised enough to their water use, over time, to not resume previous water use behaviours. It was a minimum of one year between keeping a diary and participating in WD10. For some households, it had been two or three years. Yet three specifically, and without prompting, noted that they continued to remain (at the time of WD10) aware of their water use. The enduring nature of the sensitising effect is also indicated by just three WD10 households reporting changed water use behaviour, since the initial 'discursive unfreezing' prompted by Water Diary participation, leading to increased water consumption. The increase in consumption through either new practices or re-introducing practices ceased due to Water Diary participation and suggests a decline in the level of water use sensitisation experienced by these residents. Of these households, one reported suspected behaviour change (to increased consumption) as they had 'got sick of pushing [household water conservation]' (Household WD0819-0908). A majority of households reported behaviour change that

continued to reduce their water use, suggesting they remained highly sensitised to their water use. Varying levels of sensitisation aside, it is evident that keeping a Water Diary can sustain the heightened awareness of water use and behaviours it generates over the long-term.

As well as temporal endurance, the sensitising effect may also be able to endure broad shifts in institutional water use standards. In the months prior to conducting WD10, water restrictions in the region were progressively eased. They were ultimately lifted in November 2010, the month following the WD10 interviews/questionnaires. In spite of these changes, and contrary to researcher suspicions, no WD10 households recorded changing behaviour due to water restrictions changes. It is possible that although low-level restrictions were in place and the end of restrictions announced at the time of WD10, householders were still in the 'habit' of them. In this context, it is worth noting that WD08 recorded very strong support for water restrictions. (WD09 did not include questions about water restrictions.) With no household disagreeing with water demand management as public policy, of the 21 household's subject to supplier imposed water restrictions, only two did not know the level of restrictions in effect during WD08. Indeed, a minority of WD08 households recorded the desire to keep water restrictions (at the high level of the time) as the minimum standard during non-drought periods. Given this combination of new institutional water arrangements and the high support for water restrictions, at least for the WD08 sub-group, among the WD10 participants, it is difficult to assess the significance of the increased water use sensitisation generated by diary participation on the low re-introduction rate of previous, or new, water using behaviours. However, as demonstrated in the next sub-section, the enduring nature of the sensitising effect Water Diary participants experience can influence household water management decisions.

### Sensitisation encourages on-going household water management

Keeping a diary provides participants the knowledge, and often the impetus, to change water use behaviours so that they more accurately reflect their beliefs about water management. Diary participation sensitises individuals to their water use, often over the long-term. WD10 provides some evidence

that the participants' greater awareness of the gap between their water practices and management beliefs and their enduring heightened water use sensitisation can merge, allowing individuals to continuously monitor household water use behaviours, adapting them to new information or circumstances as required. For example, Household WD0919, with a diary indicating low water use in comparison with other WD09 households and a love of showering, decided to add two more minutes to their shower, confident it would make relatively little difference to their overall water consumption. WD0817's water use also increased, as the Water Diary helped them realise they were not running enough water through the household water infrastructure. This household changed behaviour in an informed and considered manner as a consequence of their heightened water use awareness. The behaviour introduced did increase their water use, but it protected their plumbing system and it stopped unpleasant odours emitting from the drain. In both households the new, self-generated, information was used to actively manage their water use, and infrastructure. Reports of participants continuously applying the skills and knowledge developed during diary participation highlight their role as active water managers. Household WD0919 reports in WD10 that it is 'now a conscious decision about water use' demonstrating the potential for Water Diary participation to destabilise the embedded routines of daily life.

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## INSTITUTIONAL WATER MANAGEMENT OPPORTUNITIES

As a method to easily generate reliable household water use data, the Water Diary is a useful tool for institutional and community water managers. This is particularly the case in rural areas or regions with low levels of domestic water infrastructure, as the method does not rely on the presence of specific types of infrastructure. The data generated can contribute in a wide variety of applications, including supporting infrastructure requirement decisions and policy development, formulating demand management strategies and the creation of better targeted water use education campaigns. The Water Diary method can also be used as a tool to measure the success of water demand management strategies, especially in unmet regions (Graymore & Harriden 2011).

It is the participants' role in generating the data that elevates the Water Diary method beyond a simple data generation method into a potentially significant domestic water management tool. The evidence presented in this paper demonstrates that Water Diary participation prompts householders to acknowledge the gap between water behaviours and attitudes, and adjust behaviours accordingly. That is, Water Diary participation promotes self-enforced water demand management within households. With the mixed success of institutional demand management strategies, such a tool could provide the link between intervention and behavioural determinants that can be neglected in such strategies (Graymore & Harriden 2011). By incorporating the behaviours and attitudes of householders in behaviour change intervention programs, the capacity of institutional demand management strategies to effect enduring behaviour change in the target audience(s) could be greatly enhanced.

The Water Diary offers institutional water managers an effective tool to influence domestic water users' behaviours through improving their water use knowledge with self-monitoring and self-reflection. The process of generating the raw data sensitises residents to their water use, simultaneously providing the information and impetus to modify dissonant water use behaviours. Overall, behaviour modification results in reduced water use across the participating households. Further, the evidence presented in this paper indicates that the increased water use awareness generated can endure years beyond the diary-keeping exercise. Enduring sensitisation could mean, for example, less behaviour reinforcement messages need be broadcast to water users. Additionally, WD10 participants demonstrated increased confidence to apply, and develop, their water use knowledge over the long term. That is, they appeared to more actively manage their water use. Thus, with adequate knowledge and time to reflect, householders can act as more effective water managers, able to competently identify, and exploit, opportunities for more appropriate water use. A more water literate domestic sector could reduce the community education role of institutional water managers.

This brief discussion raised just some opportunities presented to institutional water management by the Water Diary. These opportunities stem from two important aspects of the Water Diary. The first is that diaries generate needed intra-household water use data. This data can be used for a

wide variety of purposes, notably policy development and infrastructure planning. Secondly, diary participation can sensitise participants beyond the point of sustained behaviour change, encouraging them to think, and behave, as active water managers.

## CONCLUSION

This paper demonstrates the Water Diary as an effective and useful tool to generate intra-household water use data, than can also generate enduring behaviour change among the participants. The Water Diary method was described and some examples of the range and depth of the data generated were provided. Particular emphasis was placed on the Diary's participatory aspects. This emphasis was appropriate as it is these aspects that sensitise participants to their water use, to the point of behaviour change. The evidence of increased water use sensitisation, and behaviour change, due to Water Diary participation, presented was gathered from interviewing Water Diary participants (i.e. WD10). This evidence reinforced the anecdotal evidence that motivated the WD10 research project. The paper concluded by highlighting some of the opportunities the use of Water Diaries might present to institutional water management. With both data and behaviour change able to be generated from one participatory research method, the Water Diary can assist moves from crisis-based water management to sustainable water use.

## REFERENCES

- Allon, F. & Sofoulis, Z. 2006 *Everyday water: Cultures in transition*. *Australian Geographer* **37** (1), 44–55.
- Bolt, V. J. & Bird, K. 2003 *The Intra-household Disadvantages Framework: A Framework for the Analysis of Intra-household Difference and Inequality*. CPRC Working Paper No. 32, Chronic Poverty Research Centre, London, UK.
- Carels, R., Darby, L., Rydin, S., Douglass, O., Cacciapaglia, H. & O'Brien, W. 2005 *The relationship between self-monitoring, outcome expectancies, difficulties with eating and exercise, and physical activity and weight loss treatment outcomes*. *Annals of Behavioral Medicine* **30** (3), 182–190.
- Dziegielewski, B. 1991 *The drought is real: Designing a successful water conservation campaign*, UNESCO/ORCAIT. Paper presented at the *Presented at Inaugural Ceremony International Seminar on Efficient Water Use*, Montevideo, Uruguay, October 21–25.
- Glieck, P. 1995 *Human population and water: To the limits in the 21st century*. American Association for the Advancement of Science Symposium: Human Population and Water, Fisheries, and Coastal Areas: Science and Policy Issues, Washington, DC.
- Graymore, M. & Harriden, K. 2011 *Water use diaries: A tool for household water management*. In *Conference Proceeding Efficient11* 29 March–2 April, 2011, Dead Sea, Jordan.
- Graymore, M., Wallis, A. M. & O'Toole, K. 2010 *Rural and regional urban water use behaviour change: A matter of personal contact and diaries?* Paper presented at the *ISEE 2010: Advancing Sustainability in a Time of Crisis*, 22–25 August 2010, Oldenberg and Bremen, Germany.
- Harriden, K. 2009 *A Methodology for Differentiating (Measuring Gender) Intra-household Water Use: Water Diary 2008*. Final research report for the Gender and Water Alliance (GWA) July 2009. Available from: [http://www.water.anu.edu.au/pdf/2009/final\\_report\\_waterdiary.pdf](http://www.water.anu.edu.au/pdf/2009/final_report_waterdiary.pdf) (accessed 28 Sept. 2011).
- Jackson, T. 2005 *Motivation Sustainable Consumption. A report to the Sustainable Development Research Network*. Available from: [http://www.sd-research.org.uk/wp-content/uploads/motivatingfinal\\_000.pdf](http://www.sd-research.org.uk/wp-content/uploads/motivatingfinal_000.pdf) (accessed 28 March, 2012).
- Kantola, S. J., Syme, G. J. & Campbell, N. A. 1984 *Cognitive dissonance and energy conservation*. *Journal of Applied Psychology* **69** (3), 416–421.
- Lahiri-Dutt, K. & Harriden, K. 2008 *Act on Gender: A peep into intra-household water use in the Australian Capital Territory (ACT) Region*. *Rural Society Journal* **17** (3), 230–243.
- Shove, E. 2003 *Comfort, Cleanliness + Convenience: The Social Organization of Normality*. Berg, Oxford.
- Sturer-Stey, C., Zoller, M., Moshinsky, C., Senn, O. & Rosemann, T. 2010 *Does a colour-coded blood pressure diary improve blood pressure control for patients in general practice: The CoCo trial*. *Trials* **11** (1), 38.

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