January 2012
The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Drinking water

A recent study published by the WRC investigated household on-site water as a supplementary resource to potable municipal supply.

Background

Water resource managers, water demand managers and water infrastructure planners alike are faced with an acute lack of knowledge regarding on-site household water use as additional water source to potable municipal supply. The most common on-site household water sources (HWS) include:

- groundwater abstraction by means of garden boreholes or any other type of groundwater abstraction point (GAP);
- rainwater harvesting systems (RHS) that gather water from rooftops; and
- greywater reuse (GWR).

The legal status of the use of these resources is addressed indirectly in the National Water Act (No. 36 of 1998) and to a limited extent also in the Water Services Act (No. 108 of 1997). In general, the use of HWS for domestic purposes in a serviced area could be deemed "legal". No registration of the particular use would be required unless a municipality has put appropriate by-laws in place to regulate such use.

The nature and extent of the application of HWS by individual water users in residential areas impacts all infrastructure elements of the water supply and waste cycle. Application of HWS creates an apparent load reduction on piped reticulation systems, treatment works and on water resources. If managed properly, this could be an advantage, since HWS could be seen as a means to reduce water demand on the municipal supply system. Alternatively, it could be a concern where guidelines for estimating water use are based on analyses of data from consumers' water meters, since the water needs of residential consumers would not be accurately reflected.

Unfortunately, HWS are often neglected during urban and resources planning exercises. In order to address this gap, it has been necessary to strategically assess the ***status quo*** of HWS and attempt to establish to what extent and in what manner water demand and wastewater flow can be influenced by the application of HWS. To this end, initial investigations were focused on the Western Cape.

Groundwater abstraction

The use of on-site groundwater abstraction in South Africa is relatively common. Water is abstracted from a well-point, garden borehole or a shallow well. Groundwater abstraction in South African residential areas has been investigated in the past, but an acute lack of knowledge still remains regarding this water use in residential areas.

The cost of installing a GAP varies greatly depending on type and geology but, in general, it turns out to be relatively expensive. Owing to plumbing complexities and water quality concerns, GAPs are commonly used exclusively to meet outdoor needs, mainly for the irrigation of gardens.

Although fairly common in the Western Cape, groundwater use in residential areas is limited predominantly to low-density high-income areas. Analysis of data for Cape Town suggests that about 15% of residential properties with area exceeding 1 000 m^2 registered a GAP during the water restriction period of 2003-2004. Presuming that only half of all existing GAPs were registered at that time, the incidence of properties with GAPs could easily be about 30%. Previous research done in the Pretoria area had revealed a similar finding, i.e., that an estimated 38% of properties had GAPs.

This relatively large percentage of properties with GAPs, combined with the relatively large yield from these sources, is expected to have a notable impact on AADD analyses based on municipal water meter reading, carried out, for example, in accordance with recently published AADD-guidelines. The reduced consumption from the municipal water distribution system revealed by the meter readings leads to under-estimates of AADD, although the extent of the underestimation is difficult to determine because of the difficulty in estimating water volumes used from GAPs.

Rainwater harvesting

From information gathered, RHS currently appear to be uncommon in residential areas of the Western Cape, for the following reasons:

- the relatively high cost of storage tanks;
- the negative visual impact of rainwater harvesting systems; and, most importantly,
- the fact that the summer high water-demand period corresponds to the dry season in this region.

By contrast, rainwater use is more prevalent in other areas of the country, for example the central Karoo, where the negative seasonal effect is less pronounced.

Contrary to GAPs, it is relatively easy to obtain theoretical estimates of the volume of water yielded by a RHS. The available yield is a function of the impervious catchment area (typically the roof), storage tank size and rainfall. Relatively large-roofed houses in low density residential areas in the Western Cape are generally not limited with regard to catchment area, but tank yield would be low during the summer months when water is needed. By contrast, small-roofed houses with small catchment areas in high density residential areas can only yield low volumes of rainwater overall. The financial benefits of a RHS generally prove to be limited and households would typically recoup the initial capital expenditure only after many years. However, from a water conservation point of view, potential savings from the implementation of RHS could be notable, despite the poor financial incentive.

Greywater reuse

From information gathered, residential on-site greywater reuse, while contentious, can be earmarked as a promising alternative water source for urban communities, particularly in the low-density high-income suburbs where health concerns are less pronounced and the greywater generation rate is notably higher than in high-density townships. Reuse is economically viable if greywater is not treated in any way. However, when treated and disinfected prior to reuse, the product water becomes relatively expensive and this option is less attractive financially.

The quality required for greywater reuse has been addressed in the UK, where it has been suggested that bathing standards need to be met if the intended use is for toilet flushing. When used for irrigation, the natural rate at which pathogens die on exposure to the natural environment is a valuable safety factor which encourages reuse of greywater for garden irrigation.

Relative supply volumes of on-site water sources

The greywater generation rate of a typical suburban property is about 280 ℓ/stand/d, significantly less than the typical yield from a GAP. The yield from RHS in the Western Cape winter-rainfall region is even less than this and, given a realistic rainwater tank size, RHS would fall far short of meeting garden irrigation demand. For a typical GAP, a yield of 1 000 ℓ/h seems to be a "best guess" estimate, based on information and data gathered from the Western Cape coastal area. This translates to an abstraction rate of 1 000 - 2 000 ℓ/d, assuming the need to irrigate a typical suburban garden for 1-2 hours daily. It can thus safely be assumed that groundwater alone would be sufficient to meet 100% of garden irrigation demand on a property having a GAP.

Estimated impact of HWS on water demand

Information gathered suggests a reduction of up to 40% in water use in a relatively low-density residential area if HWS were used extensively to meet outdoor water needs. The corresponding impact on water distribution and sewer systems could be significant.

Overall trends

Findings of the current investigation into the role and impact of household on-site water sources in relation to municipal water services cannot be viewed in a static way. At certain times a particular water source will be more highly regarded than at other times.

From the investigation, it has become apparent that:

- once a HWS is in use it typically remains in use long after the "need" for it (e.g., to carry the user's garden through a period of water restrictions) has passed;
- groundwater use is currently the only notable HWS in terms of penetration and available volume;
- from 0% to 60% of users in a particular suburb might have access to groundwater via some type of GAP, with about 30% of users typically having access in low-density

residential suburbs;
- the yield from a typical GAP is about 1 000-2 000 ℓ/d, which is relatively high compared to other HWS yields and a significant contribution to meeting the total water demand of residential properties;
- rainwater harvesting is heavily influenced by spatial aspects, being uncommon in urban residential suburbs (e.g., Cape Town) but an essential part of the water supply to, e.g., low-cost housing developments in the arid Karoo;
- the use of RHS, locally common in the past when supply to urban dwellings was unreliable or not available, has declined over the past 4 decades since the inception of more reliable municipal water distribution systems;
- in most regions of South Africa rainwater tanks are relatively low-yielding and are not viable from the financial viewpoint of the home owner; and
- on-site greywater reuse in serviced municipal areas, though still uncommon, is a relatively new trend but still a contentious issue in terms of community health and should arguably not be encouraged on a large scale until further research has been conducted with regards to impacts on health.

In conclusion ....

The commissioning of a HWS by a private home owner is mainly drought-driven, after which it typically remains in use, even when the water supply situation has returned to normal. Given a sufficient and relatively inexpensive supply of water from a municipal source, few users would in the past have considered a HWS. However, there seems to be a developing trend where consumers with a concern for the environment choose a HWS despite poor economical returns.

Currently, the only HWS of notable incidence is groundwater abstraction. Indications that groundwater users significantly impact the AADD on the water distribution system by creating a perceived water saving based on municipal water meter readings has been confirmed in a single case study in the Hermanus area of the Western Cape. Further research in the Cape Town area is recommended, with analysis of the groundwater registration data of paramount importance to better understand how and why groundwater is used – and how it impacts on the WDS and sewer flow. In particular, the GAP yield should be assessed by means of individual metering at the point of abstraction. Similar data from other regions in the country would allow the assessment to be extended towards countrywide coverage.

Climate change would influence the yield of GAPs and also RHSs, but should have little impact on the greywater generation rate. The possible impact of climate change on HWS, and particularly the water use from GAPs, is clearly a future research need.

Further reading:
To obtain the report, ***Household On-site Water as Supplementary Resource to Potable Municipal Supply*** (**Report No: 1819/1/10**) contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; E-mail: orders@wrc.org.za; or Visit: www.wrc.org.za