March 2015
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

Sanitation

Improving sanitation services in informal settlements

A completed Water Research Commission (WRC) study investigated an approach towards developing technical sanitation solutions for informal settlements.

Background

The world population is characterised by an increasing population and rapid urbanisation, which has seen the bourgeoning of informal settlements. These settlements are located in low-lying areas, floodplain or hilly zones and wetlands, and have been cited as a critical challenge for those in charge for providing services to urban centres in developing countries.

Providing services in informal settlements is one of the most complex issues on the municipal agenda, and must be viewed in the context of broader spatial development and housing delivery objectives.

The overall aim of this WRC study was to investigate current technologies used to service informal settlements with respect to innovation trends with the view to developing a sanitation concept for technical sanitation solutions for informal settlements.

Communal ablution blocks in eThekwini.

Appropriate sanitation technologies for informal areas

The variable nature of sanitation challenges faced by informal settlements are interlinked across social, institutional, economic and technical perspectives. This is due to various reasons.

Socially, sanitation problems are related to poverty, high levels of unemployment, disorganised social landscape, lack of leadership and accountability. Direct impacts of vandalism, negligence, theft and lack of ownership can be used as criterion to assess the adequacy of a sanitation solution.

Institutionally, sanitation problems are related to the lack of or poor governance, poor planning and lack of relationship service providers and users, and most importantly, fragmentation of responsibilities, complicated institutional arrangements, and lack of adequate and dedicated operation and maintenance budgets.

Economically, cost is a key determinant factor in selecting sanitation technologies for informal areas. Other incurred costs such as operation and maintenance, replacement and suitability to the physical settlement conditions are intentionally ignored, thus making the provided sanitation solutions unsustainable.

From a technical perspective, sanitation problems can be attributed to the lack of alternative options, poor or inadequate design, low level or lack of O&M, high O&M costs, difficult or inadequate operational requirements, and irrelevance of the sanitation solution to the local context.

These findings suggest that the interlinked nature of challenges encountered in informal areas can impact severely on sanitation infrastructure. The extent of impacts varies according to the nature of the challenges.

In view of the current sanitation backlog and the increasing number of people living without access to basic sanitation, municipalities have provided a number of sanitation technologies. Communal sanitation technologies provided to informal areas include ablution facilities, communal ablution blocks, shared facilities, full flush communal toilets, pour flush toilets, etc. Individual sanitation technologies include urine diversion, VIP, Enviroloo etc.

Communal sanitation technologies are being provided in dense informal areas where spaces are lacking, while individual sanitation technologies are provided in low and medium dense informal areas. It emerged from this research that users prefer waterborne sanitation technologies to dry systems, citing comfort and equity (meaning that sanitation technology should be the same for formal and informal settlements) as main reasons.

Success and failure of sanitation technologies provided to informal areas were identified and documented with the view to find innovation and drivers that can inform further development of sanitation solutions. Findings emerged from this review suggest that success of sanitation systems is registered where the interaction between service providers and users are evident.

Appropriate design, adequate and planned operations and maintenance, consideration of local conditions, technology choice and compliance with the operational requirements were identified as key to the success of the sanitation technologies in general.

Failure of sanitation technologies is attributed to the lack of long-term vision, poor design and inadequacy of the sanitation solutions, lack of operational planning and poor management. A sanitation technology may be successful in one area and fail in another.

It is therefore suggested that failure is considered as a motivation for further improvement rather than an opportunity to criticise the service providers or designers. Success should be used as well for further improvement and uptake; however, it should be noted that success may not be replicable in a general manner – but should be based on similarities or contextualised where applicable.

Innovative sanitation solutions and drivers

Using the approach for developing sanitation concepts and solutions (presented in the final report of the project), 13 concepts emerged. Most of these were either alternative, conventional or ecological sanitation.

Three of these were selected based on their relevance to sanitation problems and were further explored. The selection was based on their technical appropriateness and potential in addressing sanitation problems in informal areas.

The concepts developed emerged from the innovation sanitation solutions and related drivers were used to inform the sanitation solution.

The most important concepts of relevance to informal settlements were found to be those focusing on resource recovery and reuse, low O&M, zero waste generation and economic incentive for both users and service providers.

Sanitation solutions

Having identified the sanitation concepts relevant to the informal area conditions, this study established that communal sanitation systems are the most suitable option within the context of informal settlements. This choice is mainly driven by factors such as lack of sense of ownership, settlement density and physical site characteristics which do not permit individual facilities.

Two options are suggested. The first option is dry communal sanitation, while the second is wet sanitation systems, with latter facilities located close to a sewer line or septic tank system.

Key functional elements of each option include toilet, containment or collection and conveyance, treatment, reuse or disposal. Findings suggest that each of the components of the sanitation solution should be carefully studied and designed according to specific local conditions, while considering social aspects.

In the context of informal areas, the following issues related to the sanitation solutions were identified:

- Toilet: Water repellent or self-cleansing pedestal (self-cleaning pedestal)
  - Low or no water use (micro-flush or pressurised flushing)

- Robust structure (shipping container)

- Conveyance should be made of solid pipes laid at shallow depth, with inspection chambers at each and every 50 m (in case of waterborne sewerage treated off-site because misuse and vandalism)
- Containment to be designed according to the number of user and provision to be made for a standby containment tank.
- Treatment to be considered on site preferably and rapid dehydration and further treatment leading to safe reuse to be envisaged.
- Features such as rainwater harvesting tank, laundry point and urinals were accepted
- Separation of users (according to gender) and the inclusion of security were acknowledged by users.

Conclusions

This study has provided an overview of the development of sanitation concepts and solutions for informal areas. It is understood that sanitation technologies are developed to respond to particular sanitation challenges that can be viewed from social, institutional, economic or technical perspectives.

From social and technical perspectives, sanitation challenges are related to the profile of the served community and the components of sanitation solutions respectively. These challenges include non-compliance with operational requirements, poverty, density, inadequate design, operation and maintenance.

Several sanitation technologies including individual and communal are being developed in responses to these issues. These include individual and communal designs which are different in terms of components, operational requirements and level of management, and are designed for specific conditions and contexts. Some have been successful while others have totally failed.

Success is attributed to many factors including a sense of ownership amongst users, level of management and planning, etc. Failure is attributed to poor design, lack of collaboration amongst sanitation stakeholders, poor operation and maintenance, etc. This research established that both success and failure should be considered as an opportunity to understand and analyse, with a view to identifying gaps and drawing lessons for further uptake.

Further, the research established that innovative sanitation solutions are mainly related to the components of sanitation and cover containment, conveyance, treatment and reuse or storage. The key trend emerging from these innovations is the beneficial use of human excreta for various purposes, the need to generate zero waste, use less or no water and generate energy from waste.

These innovations are driven mainly by the need for functional facility and appropriate components that respond to a particular situation.

Each of these emerging innovative sanitation solutions should be considered in the context of informal settlement based on their relevance to address particular sanitation challenges. It is important to note that sanitation innovation solutions may not provide the expected outcomes to the sanitation challenges as such; each proposed solution should be carefully explored and the context of its application established prior to selection.

The sanitation concept should be developed by assigning prioritised drivers to a particular or group of innovative sanitation solutions. This will allow further understanding of the meaning and manner by which the developed concept will address the sanitation problems.

Knowledge of the sanitation concept and its intention can assist in assigning functional elements to the concept and develop sanitation solutions that can be later translated into models.

From the information captured in this report, it is evident that sanitation solutions should be developed using concepts that are appropriate to specific contexts; as it will assist in developing solutions that respond to users' needs while addressing number of challenges.

Consequently, sanitation solutions cannot be developed without a relevant and documented sanitation concept. The concept cannot be developed without understanding of the innovation solutions, emerging trends as well as associated drivers.

Further reading:
To order the reports, ***An approach towards developing technical sanitation solutions for informal settlements*** (**Report No. 2098/1/14**) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.