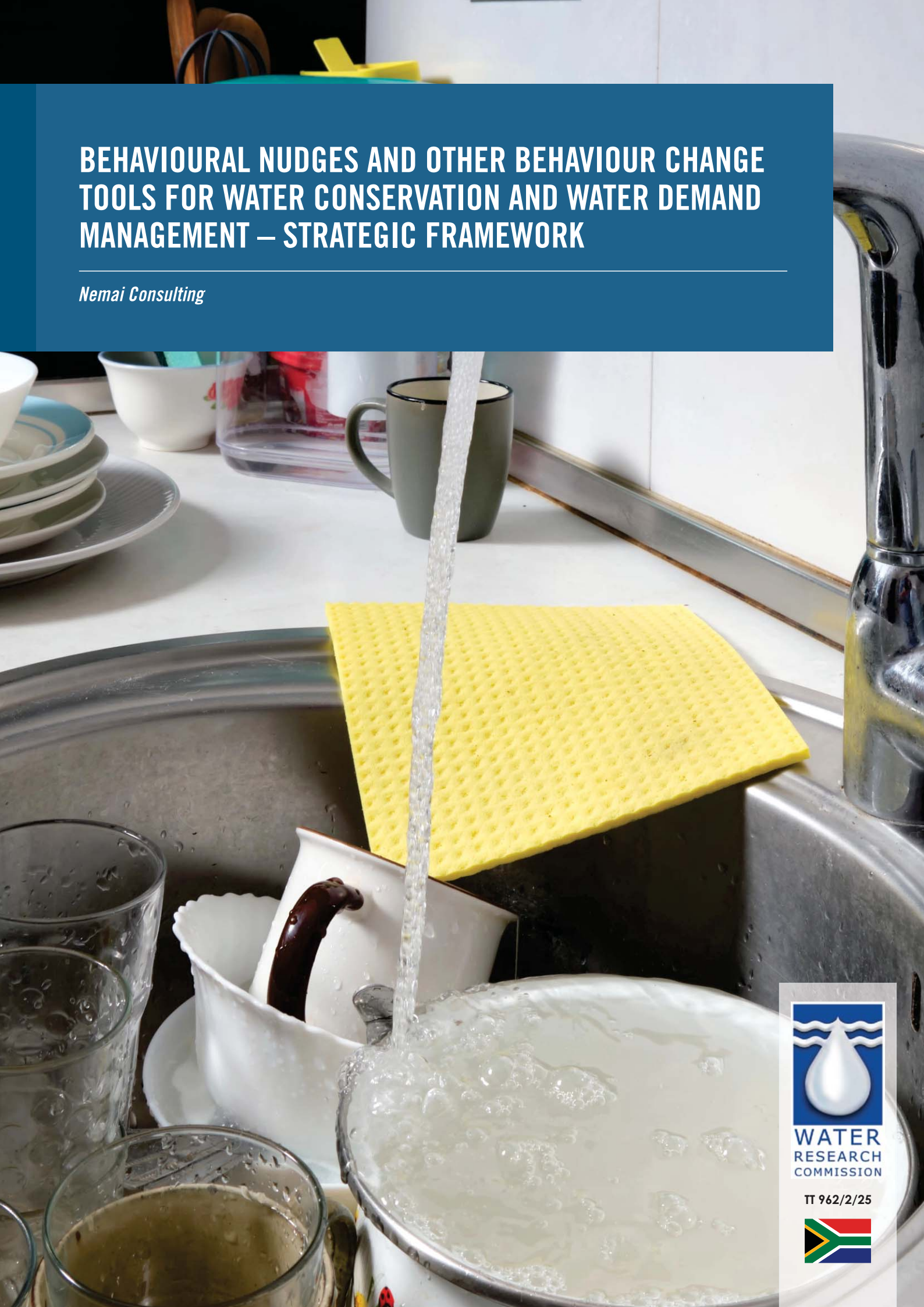
BEHAVIOURAL NUDGES AND OTHER BEHAVIOUR CHANGE TOOLS FOR WATER CONSERVATION AND WATER DEMAND MANAGEMENT – STRATEGIC FRAMEWORK

Nemai Consulting



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Behavioural Nudges and Other Behaviour Change Tools for Water Conservation and Water Demand Management – Strategic Framework

A Report to the Water Research Commission

by

Nemai Consulting

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List of Abbreviations

CLO	Community Liaison Officer
DWS	Department of Water and Sanitation
EPWP	Expanded Public Works Program
KPI	Key Performance Indicator
NGO	Non-Governmental Organisation
NWA	National Water Act
NWRS	National Water Resource Strategy
POPIA	Protection of Personal Information Act
SFWS	Strategic Framework for Water Services
WC	Water Conservation
WDM	Water Demand Management
WRC	Water Research Commission
WSA	Water Services Act
WSDP	Water Services Development Plan

1 INTRODUCTION

1.1 Background

South Africa is a highly water stressed country, with unreliable and unevenly distributed rainfall patterns, an overexploitation of the existing freshwater supply, and ailing and badly maintained infrastructure (Department of Environmental Affairs, 2017). The effects of climate change, urbanisation, industrialisation, and population growth are putting an even bigger strain on South African water resources. Global warming as an effect of climate change has increased the likelihood of extreme weather events, such as heatwaves, floods and droughts, and precipitation levels are steadily declining. Climate variability and droughts accompanied by high temperatures can cause extreme water shortages, especially in urban areas (Schewe et al., 2014; Diffenbaugh et al., 2015). The City of Cape Town experienced this first hand when they narrowly avoided 'day zero', the day levels in major dams supplying Cape Town's fresh water would fall below 13.5%. The City of Cape Town is not unique in this regard. In the summer of 2016/17, seven out of eight metro municipalities in South Africa were forced to impose water restrictions due to low dam levels.

Governments can employ a wide range of techniques to combat water shortages, including increasing the supply of water, as well as reducing the demand. Considering the cost implications related to the increase of water supply through the construction of water schemes and associated infrastructure, reducing water demand offers an alternative that requires less human and financial resources and is an essential tool in the reduction of water scarcity, particularly in developing countries such as South Africa (Pamla et al., 2021). Water Conservation and Water Demand Management (WC/WDM) strategies and interventions are designed to encourage efficient and sustainable consumption of water resources. These strategies and interventions include a variety of types of mandatory and voluntary interventions, including economic incentives, technological solutions, and policy instruments and regulations.

Considering the history of South Africa and persistent economic inequality between South African citizens, non-price and non-punitive interventions must be utilised for WC/WDM purposes. Behavioural nudges and associated behaviour change interventions offer a way to modify the individuals' behaviour in manner that does not forbid options or significantly changes economic incentives (Thaler & Sunstein, 2009). Many types of behaviour change interventions have been successfully piloted for both energy conservation (Allcott & Rogers, 2014; Barbu et al., 2013; Jorgensen et al., 2021; Kaiser et al., 2020; Kemp-Hesterman et al.,

2014) and water conservation purposes (Addo et al., 2019; Bernedo et al., 2014; Cauberghe et al., 2021; Daminato et al., 2021; Fang & Sun, 2016), both internationally and in South Africa. However, successful interventions are not replicated across the country. Improved scaling and ensuring the uptake of interventions that have been proven effective across municipalities in South Africa is essential to effectively reducing water consumption and demand.

1.2 Purpose of the Framework

This strategic framework was commissioned by the Water Research Commission (WRC) to inform the uptake and national scaling of behaviour change interventions for WC/WDM purposes in South Africa. The framework aims to provide an overview of the current application of behaviour change interventions in South Africa, international and national best practices, and key considerations for planning and implementation purposes. It also presents a variety of approaches and mechanisms to improve national scaling of behaviour change interventions for WC/WDM. The strategic framework will inform the development of a formal strategy and action plan to direct the rollout of the strategy.

The purpose of the framework is to provide guidance on the design and implementation of behaviour change interventions, in a way that improves their uptake and provides opportunities to scale interventions to a national level. Current constraints and barriers to the uptake and national scaling of behaviour change interventions are summarised and the framework offers potential ways that these constraints can be mitigated or addressed within the context of South Africa. The recommendations and considerations included in the framework are based on the local economic, political, institutional and environmental context of South Africa and were informed by the literature review that has previously been conducted, as well as semi-structured interviews held with six municipalities in South Africa.

1.3 Concepts and Definitions

1.3.1 Water Conservation and Water Demand Management

In a water scarce and stressed country such as South Africa, carefully managing already limited water resources is essential. WC/WDM) is an important tool in meeting the national goal of providing water to all South Africans in a sustainable way. Decreasing the demand for water instead of increasing water supply through investment in new water schemes can significantly reduce the pressure on water resources and services. A great variety of types of WC/WDM interventions can be identified, include technical interventions, institutional interventions, financial intervention and behaviour change interventions.

Water conservation (WC) is defined by the Department of Water Affairs (DWS) as “the minimisation of loss or waste, the care and protection of water resources and the efficient and effective use of water”. WC is particularly relevant for drought and water restriction scenarios. Water demand management (WDM) is the “adaptation and implementation of a strategy by a water institution or consumer to influence the water demand and usage of water in order to meet any of the following objectives: economic efficiency, social development, social equity, environmental protection, sustainability of water supply and political acceptability”. WDM constitutes a long-term, integrated approach to managing water in a way that conserves water, controlling use, influencing demand and promoting efficient use. It requires intensive cooperation between a variety of role-players through technical expertise, good governance, and a re-evaluation of the importance of water and recognition of cumulative impact of individual use. WC/WDM are so intertwined that they are generally addressed simultaneously.

The Water Services Act, Act 108 of 1997, stipulates that all municipalities that have been given the status of water services authority must provide measures to promote WC/WDM in their WC/WDM strategy and business plan, as well as Water Services Development Plan (WSDP). Despite the wide range of resources that are available to water supply managers to develop WC/WDM strategies and plans, many municipalities in South Africa do not have a dedicated WC/WDM strategy and the ones that do exist often lack specificity.

1.3.2 Behaviour Change Interventions

Behaviour change interventions are sets of activities that are designed to change specific behaviour patterns (Michie et al., 2011). They are designed to target a specific process (i.e., Mechanism of Action) through which behaviour change occurs, which changes as a result of the ‘active ingredient’ within an intervention (i.e., behaviour change intervention). Behaviour change interventions can be used to target reflective, semi-reflective and automatic decision-making processes. The reflective route involves conscious processing of information (system 2), where attitudes are shaped by rational arguments, relevant experiences, and knowledge. The automatic information processing route relies on an automatic or subconscious response (i.e. system 1), without the involvement of cognition. The semi-reflective process acknowledges the reality that interventions often exist within a continuum, ranging from reflective to automatic behaviour. People use rules of thumb and simple heuristics to form attitudes and make decisions. They look for peripheral stimuli, which are easy cues that tell them what choices to make.

Behaviour change interventions have been successfully implemented in a variety of sectors. A rich history exists of health care practitioners using behaviour change interventions to influence unhealthy behaviours, such as smoking, excessive alcohol consumption and

unhealthy eating habits (Michaelsen & Esch, 2022). Behaviour change interventions have also been extensively implemented in the fight against HIV/Aids (Coates et al., 2008; Flowers et al., 2017; Ndebele et al., 2012). Interventions to influence energy consumption have also proven to be successful (Barbu et al., 2013; Alcott & Rogers, 2014), albeit with varying results (Sussman & Chikumbo, 2016). Behaviour change interventions that encourage pro-environmental behaviour, such as reducing waste and recycling more (Truelove et al, 2022; Oke et al., 2021), consuming less meat (Gerber et al., 2013; Kwasny et al., 2022), and selecting environmentally conscious modes of transportation (Pronello & Gaborieau, 2018) have also been found to have a positive desired effect.

The implementation of a wide variety of behaviour change interventions to influence water consumption and efficient use has been documented. Interventions that have been piloted include interventions that focus on increasing knowledge and awareness, often through education or awareness campaigns (Wang et al., 2019; Xiong et al., 2016) and interventions that target the individuals' belief in themselves and their ability to conserve water by empowering them through encouragement, as well as the provision of practical tips and strategies (Addo et al., 2019; Lee & Tansel, 2013). Other common behaviour change interventions target the consumer's desire to conform to their social environment by presenting information on their water use, in comparison with the use of peers (i.e., neighbours or members of the same group) (Feizi & Khatabiroudi, 2023; Lede et al., 2019; Bernedo et al., 2014; Bhanot, 2018). Behaviour change interventions that frame messages to fit specific groups of consumers can increase the perceived value of water (Cauberghe et al., 2021) and make people more susceptible to water conservation messages (Katz et al., 2018; Zhuang et al., 2018). Tailoring interventions use personalisation and individualisation of messages to maximise effect. For example, by using smart meter data when giving feedback to consumers on their water consumption (Cominola et al., 2021; Daminato et al., 2021; Visser et al., 2021). Other interventions use emotional shortcuts to elicit an emotional response to encourage behaviour change through the development of games, mascots and by describing future scenarios to elicit an emotional response (Fang & Sun, 2016; Koop et al., 2019).

2 LEGISLATIVE AND POLICY FRAMEWORK

WC/WDM strategies, plans, and interventions are regulated by a comprehensive legislative and policy framework, as outlined in table 2.

It is clear from the legislation and policy review that water conservation and demand management are sufficiently addressed in South African law. Municipalities have a clear mandate to protect and conserve water and to undertake and promote WC/WDM activities.

Table 1. Legislative and Policy Framework

The National Water Act 36 of 1998 (NWA)	The NWA affirms the responsibility of the National Government, acting through the Minister, to "ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons and in accordance with its constitutional mandate". The NWA requires that a national water resource strategy is established that includes strategies, objectives and guidelines related to the protection, use, development, conservation, management and control of water resources. The NWA stipulates the obligation for government to conserve and protect water and provides that water users may not waste water. It is the main legal framework for the efficient management of water resources.
The Water Services Act 108 of 1997 (WSA)	The WSA regulates the water supply of water services authorities. The WSA requires municipalities to develop conditions for the provision of water services that includes water conservation, recycling and environmental protection measures in their WSDP and WC/WDM strategy. Section 9 of the WSA makes provision for the Minister to prescribe compulsory national standards relating to (a) the provision of water services, (b) the quality of water taken from or discharged into any water services or water resource system, (c) the effective and sustainable use of water resources for water services, (d) the nature, operation, sustainability, operational efficiency and economic viability of water services, (e) requirements for persons who install and operate water services works, and (f) the construction and functioning of water services works and consumer installations. Section 10 of the WSA makes provision for the Minister to prescribe norms and standards in respect of tariffs for water services. The Act also makes provision for the Minister to prescribe WC/WDM measures to be taken by water services authorities, as well as prosecute anyone who continues the wasteful use of water

	after being called upon to stop. Chapter III of the WSA stipulates that all water services authorities must compile bylaws which include conditions for the provision of water services.
Municipal Structures Act 117 of 1998 (Structures Act)	The Structures Act provides for the establishment of municipalities and the divisions of functions and powers between categories of municipalities. Municipalities are required to review the needs of the community, its priorities to meet these needs, processes for involving the community, organisational and delivery mechanisms for meeting the needs and its overall performance in achieving objectives.
Municipal Systems Act 32 of 2000 (Systems Act)	The Systems Act provides for the core principles, framework and procedures to enable municipalities to uplift their communities and guarantee affordable universal access to basic services. Informative billing is a requirement under the Systems Act, as well as accurate measuring of consumer consumption. The Systems Act also stipulates that municipalities are obliged to provide community members with accurate and complete information on the standard of services that are provided (Sect. 6(2)(f)).
Strategic Framework for Water Services 2003 (SFWS)	The SFWS suggests that the accountability of water services providers must be improved and WC/WDM measures should be implemented to enhance efficient water use. The SFWS deems it necessary for water services institutions to develop an appropriate and comprehensive WC/WDM strategy, to be included in their water services development plans. The SFWS states that water institutions should be required to minimise water losses and promote water demand management among their consumers through the WC/WDM strategy. Moreover, the SFWS states that municipalities should ensure that accurate data on water services provision is available.
National Water Resource Strategy (NWRS) (2013)	The NWRS emphasises the importance of reducing water losses and increasing water efficiency, particularly through the implementation of WC/WDM measures. Municipalities are required to report on the reduction of NRW levels and the measures taken to achieve such a reduction on a quarterly basis. The NWRS stipulates that, to effectively execute its duties related to collecting and assessing water data, DWS requires access to complete and reliable information. The NWRS states that curbing NRW must a priority of each institution and individual in South Africa, particularly through WC/WDM interventions. Even though the NWRS underscores the need for municipalities to enhance their NRW

	reduction efforts and implement effective measures, this is not formulated as a duty.
Free Basic Water Implementation Strategy of 2007	The Free Basic Water Implementation Strategy of 2007 consolidates and maintains the provision of free basic water services to poor households in South Africa. The strategy also addresses the challenges of water conservation and demand management, water supply infrastructure, water quality, and institutional arrangements. It is stated that it is the duty of the water services authorities to provide regular feedback on the implementation of free basic water to DWS for monitoring and evaluation purposes. The responsibility for collecting data and information on the implementation of the free basic water policy in their area lies with municipalities and should be reported on in their water services development plans.

3 APPLICATION IN SOUTH AFRICA

From the literature review and through engagements with a variety of municipalities across South Africa, a clearer picture emerges on the past and current use of behaviour change interventions for water conservation purposes in South Africa, as well as the key challenges and constraints that municipalities face when implementing such interventions. Most of the literature published on the use of behaviour change interventions in South Africa focuses on the City of Cape Town and the measures that were taken during the 2017/18 drought. Cape Town is referenced as an example of drought management done well and extensive literature is available on the lessons that can be learned through Cape Town's experience of successfully reducing water demand. However, it is important to recognise that what works in Cape Town might not work in another context.

3.1 Educational and Awareness Raising Interventions

Most behaviour change interventions that are implemented in South Africa revolve around educational and awareness raising objectives. These types of interventions target the consumer's knowledge about water scarcity, what causes it, the negative consequences of water scarcity and inefficient use, and what they themselves can do to reduce their water consumption. These knowledge transfer interventions rely on the knowledge-deficit model, which states that in the absence of information, behaviour will not change (Ehret et al., 2016). It is predicated on the idea that the more knowledge people have around water scarcity issues, the more likely they are to adopt water conservation behaviours. Awareness raising interventions, on the other hand, are aimed more at changing people's attitudes towards water and water conservation practices and increasing their intention to act . Practitioners believe that consumers need to be empowered to believe that behaviour change is feasible, expected of them, and will have a positive effect on the issue at large (Ajzen, 1985). Extensive interventions are being and have been implemented in South Africa to target the consumer's knowledge of and attitude towards water conservation. These interventions do not directly target consumer behaviour, but they are based on the understanding that increased knowledge and a change in attitude will lead to behaviour change.

National and provincial information campaigns include the Water Wise Conservation and Education Campaign implemented by Rand Water and the National Water Week. Both campaigns are aimed at educating the public on their responsibility to protect and conserve water and providing them with practical tips and strategies to do so. Education and awareness campaigns are also commonly implemented by municipalities of all sizes in South Africa and

can include a multitude of outreach activities. They can be long-term campaigns that are implemented year-round, or short-term campaigns that are implemented during droughts or other periods of extreme water scarcity. These types of campaign interventions include a wide variety of activities and components, such as radio and print media ads, social media messaging, handouts of pamphlets and brochures, newsletters, and use of billboards and other available advertising spaces. In general, all residents of an area are targeted through these interventions. However, municipalities do acknowledge that some ways of reaching out to consumers is more effective and appropriate for certain target groups. One municipal official explained that radio ads on local radio stations are more effective at reaching lower-income areas than posting an ad in a newspaper. The message is centred around the importance of conserving water and the negative consequences related to continuing high water consumption levels, as well as to provide tips and strategies on how to conserve water. In general, municipalities found these types of interventions to be effective. One particular municipality reported implementing an awareness campaign in the area with great success. Most residents live in very rural areas, and it was clear that they did not know how to report water leaks and burst pipes and were not aware of the reasons why water conservation is important. After the campaign was over, the municipality measured a reduction in water consumption in the area. One clear disadvantage to these types of activities is the high cost associated. Most municipalities complained about the high cost of things like printing and buying advertising space and reported it to be the main reason that they do not campaign more intensively.

Most municipalities organise educational programmes and workshops with the aim of educating learners on water conservation needs and practices. This is done through a variety of activities, including presentations and demonstrations at schools, use of water conservation mascots, inter-school water conservation competitions with prizes, theatre plays, puppet shows, arts and crafts competitions, and games. Educational programmes are specifically targeted at youth and learners. When asked about the reason for targeting learners, one municipal explained that they find that young people are more receptive to a water conservation message and more willing to amend their behaviour. They also find that learners will go home and convince the other members of the household to conserve water as well. Most municipalities that implement educational programmes agree that engaging the learners through fun and creative activities is crucial to the success of the programme. Two metro municipalities reported developing a water conservation mascot specifically to help educate learners about water scarcity and conservation. One metro municipality developed a board game and computer game that teaches young people about water leaks and other water efficiency issues in a fun way. Most municipalities target their educational interventions at all

schools in the area. However, some only target schools in areas with indigent users who do not pay for water services. A common assumption exists that children in a lower-income or indigent area know less about water scarcity than children in high-income areas. Moreover, some municipalities only want to reduce water consumption in indigent areas, for fear of losing revenue. However, when one municipality conducted a survey on water knowledge amongst different schools in the area, they found that children in lower-income areas were more knowledgeable on water scarcity issues than their high-income counterparts. Similar to information campaigns, educational programmes are not very cost-effective and require ample time and resources.

Interventions that focus on direct and one-on-one engagement with community members and consumers are also implemented by municipalities in South Africa. Examples of such interventions are presentations during water committee meetings, going door-to-door, appointing a community engagement liaison officer who engages with the consumers on the municipality's behalf, and organising public events, such as water Indabas, Imbizos and seminars. One metro has been successfully implementing a community representative programme for the past 15 years through the Expanded Public Works Programme (EPWP). Unemployed community members receive training and are sent into their communities to spread a water conservation message and engage fellow residents on water conservation issues. Roughly 1000 temporary jobs were created through this intervention. The same metro developed a multifunctional trailer to go to shopping centres and other places where high-income residents are found. The trailer is used to present and demonstrate water saving devices such as taps and shower heads with different flow rates and low flow toilet systems. The trailer also incorporates games and other educational interventions for children. Another municipality appoints Community Liaison Officers (CLOs) to go into the field and engage directly with consumers. They also organise Imbizos in every ward in the area to engage with the community, answer their questions and hear their concerns. This type of intervention is generally considered effective by all municipalities because it allows the consumer to ask questions, it fosters trust and transparency between consumers and municipalities, and the message is more impactful when delivered in real time. Both high-income and low-income groups can be successfully influenced through these interventions, as long as the design of the intervention is appropriate. In general, low-income users are more often targeted through behaviour change interventions. One municipal official argued that high-income users should be targeted more, especially when it comes to behaviour changes that require financial investments, such as the installation of water saving devices.

Not all municipalities spend a lot of time considering which group to target with an intervention. Some municipalities strictly target indigent users and users in areas with high levels of water

losses, with the aim of reducing non-revenue water. This is especially true for municipalities that are experiencing high levels of non-revenue water and problems with their reticulation systems, rather than municipalities that suffer from water shortages because of droughts. In water scarce areas where droughts are naturally occurring, behaviour change interventions for water conservation are mostly aimed at the general public. The latter group of municipalities are more likely to differentiate between target groups when designing their interventions. However, this is not always supported politically. One metro municipality reported that the political parties in the metro could not agree on whether high-income and high-use residents should be targeted, as they can bare a bigger burden, or whether indigent users should be targeted, as they do not pay for water to begin with. Municipalities also reported that some target groups are more receptive to certain messages and types of interventions. For example, one municipality reported that high-income users were are less receptive and even hostile towards education and awareness raising efforts by the municipalities. They explained that residents that live in high non-revenue water areas with a lot of indigent users do not want to engage in water conservation practices, because “at least they pay for their water”.

It is difficult to say anything meaningful about the impact of the interventions listed above, as most were not designed with comprehensive monitoring and evaluation in mind. Some municipalities will they that interventions were successful. However, there is often no data to support their claim. However, there is a consensus amongst municipalities that simply providing the consumer with information is not enough to effect real behaviour change. Education and awareness interventions must be engaging to be effective.

3.2 Behavioural Nudges

Whereas increased knowledge and a change in attitude can lead to a change in behaviour eventually, behavioural nudges are aimed at directly changing the behaviour of a consumer. These types of behaviour change interventions are not as widely used by South African municipalities as education and awareness raising interventions, despite their potential successful implementation in other sectors. In South Africa, they are mostly implemented by category A municipalities.

Interventions using social norms comparison have been implemented in South Africa, with mixed results. During a drought, one metro municipality created a digital map of the entire area and indicated which households used less than 10.5 kilolitres of water that month by placing a green dot on their house. Households that used more than 10.5 kilolitres would not get a dot. By playing into the psychological preference of people to ‘fit the norm’, the

intervention nudged consumers to reduce their water consumption to also get a green dot. The map was visible for everyone to see, increasing social pressure to reduce water consumption. By playing into the need for social recognition, residents will achieve social praise or avoid shame by reducing their water consumption. The municipal official indicated that the intervention was successful and worked as intended. However, it was not feasible to continue the intervention after the drought was over, as it is labour intensive to update and maintain the system and database of households. Another metro municipality wanted to implement a similar intervention after learning of its success. Due to legislative constraints related to privacy and the Protection of Personal Information (POPI) act, the municipality was forced to amend the intervention. Rather than directly comparing households, the municipality decided to compare water consumption per ward instead. The intervention was not well received by high income users who argued that they are entitled to use as much water as they like, since they pay for it. Moreover, the political environment of the municipality could not agree on which wards should reduce water consumption. Some argued that high-income users should decrease consumption, as they use the most water. Others argued that users in indigent areas should decrease water consumption, since they do not pay for water services. This causes the intervention to fail.

Other behavioural nudge interventions that have been implemented by municipalities in South Africa elicit an emotional response to influence someone to change their behaviour. The same municipality that implemented the ward comparison map developed an intervention to try and scare people into consuming less water, by painting a picture of residents queueing at water collection points to get water, after the water would be shut down city wide. By visualising the negative consequences of not reducing water consumption, it was thought that residents would be encouraged to change their behaviour. The municipal official indicated that residents did not seem receptive to the intervention. High income residents did not accept the message as they believe that because they pay for water services, they should be allowed to use as much water as they want. Indigent and low-income users were unimpressed because they are used to queueing for services. A different metro had previously implemented a similar intervention with more promising results.

Both municipalities reported that the interventions implemented were aimed at all residents. Intervention were more successful in the metro municipality with low levels of non-revenue water and whose population trusts their government. In contrast, the municipality that experienced political unrest, lack of trust in government and high levels of water losses found more consumer resistance when implementing interventions. This indicates the importance of political stability and general trust in government when implementing voluntary and non-price interventions for water conservation. This is likely also linked to the levels of water losses

experienced in the area. The literature also indicates that some messages are more effective when targeted at high or low-income households. Particularly messaging around social recognition and public good have a bigger impact on high-income consumers (Brick et al., 2023).

3.3 Key Barriers and Constraints

The literature review and engagements with municipalities illustrate a variety of barriers and constraints that prevent the uptake and success of behaviour change interventions for water conservation purposes. Municipalities that experience such barriers and constraints should consider mitigation measures to increase the success of an intervention.

3.3.1 Financial and Human Resource Constraints

Municipalities across the board agree that constraints in terms of financial and human resources are barriers to the effective implementation of behaviour change interventions. They are referenced as reasons why interventions are implemented at a small scale and for a short time frame, have a limited impact, and lack monitoring and evaluation data.

One official explained that the department can only afford to employ two educational officers to conduct daily school workshops, for a vast geographical area. The two staff members are currently able to target one region per year, in a Metropolitan area with seven regions. This means that every region will be targeted once every seven years. This is not enough engagement for interventions to have a significant or lasting impact. Moreover, they do not have the financial resources to print enough supporting material, such as brochures and pamphlets. Another municipality explained that interventions are sometimes approved, but not with the proposed budget. This means that interventions cannot be implemented in the way they have been designed, which negatively effects the impact.

One way to mitigate financial and human resource constraints is to create partnerships with external stakeholders, including private sector partners, NGOs, research institutions, and faith-based organisations. Partners can provide both implementation and funding support, depending on what they have to offer and what incentivises them to participate. A similar mitigation measure is to leverage existing programmes. The integration of water conservation needs into the EPWP is more cost-effective than developing a new programme. Convincing management to provide more financial support is also possible. One municipality conducted an economic evaluation and calculated the financial benefit to the municipality of implementing the proposed interventions. This gave decision-makers the confidence to commit more financial resources to the implementation of interventions. One metro municipality explained

that creativity and out of the box thinking are essential to overcoming financial and human resource constraints. Another important way of mitigating resource constraints is to design interventions that are resource effective and take into consideration the institutional environment. Educational workshops with printed materials are inherently costly and time-consuming interventions. The program might have to be redesigned in a way that more can be done with less. However, this requires staff to have the requisite knowledge and capacity to do so. Staff should be exposed to best practices for general intervention design, particularly how to use behaviour change interventions for water conservation. More training and capacitation might be required to overcome resource constraints. There might also be an opportunity for more systematic knowledge sharing between municipalities in South Africa to share in what works, does not work and why. Currently, knowledge sharing on behaviour change interventions for water conservation is limited.

3.3.2 Lack of Political and Institutional Support

Several of the municipalities that were engages reported a lack of political or institutional support as a major constraint to the effective and long-term implementation of behaviour change interventions. All municipalities agree that political and institutional support is essential to the success of any intervention. Without that dedicated support, interventions are implemented in an ad hoc and inconsistent manner.

One municipality reported having a dedicated awareness officer in the past. When this official moved to a different department, they were not replaced. The staff member working under them continued with their work on a voluntary basis, because they believe in the importance of raising awareness for water conservation. This has negatively impacted the financial resources available to do the work, as well as the time that can be dedicated. The work is done on an ad hoc basis because the political and institutional support is not there. Another municipality reported how the politically unstable environment they have been in for the past couple of years has created a situation wherein politicians do not want to make unpopular decisions, and the different political players cannot agree on the WC/WDM approach and groups that should be targeted. The official reports that many interventions have failed because of political infighting. Municipalities that have stable governments that are supported by residents have a bigger chance of successfully implementing interventions, especially long-term.

Even though the political situation in an area is out of the control of water services departments, steps can be taken to increase institutional support. One municipality found that presenting a business case to political leadership and presenting the financial benefits of increased water conservation and efficiency, along with the negative consequences of not

acting accordingly, was effective in increasing political and institutional support for their proposed water conservation strategy. A different municipality has taken a similar approach, but emphasised the importance of carefully selecting the person who would present. Messages are received differently, depending on where they are coming from. NGOs and academic institutions may have a role to play here if independence and political neutrality is of value.

3.3.3 Legislative Constraints

Legislative constraints are not widely reported as major barriers to the implementation of behaviour change interventions for water conservation. However, legislation, in particular by-laws, can be amended to create more opportunities for municipalities to implement certain types of interventions, and to improve their efficiency and reach.

One reported constraint in terms of the legislation refers to the use of personal information in terms of the POPI Act. The municipality was not able to implement an intervention that directly compares and publishes the water consumption levels of individual consumers. Instead, they had to resort to comparing water consumption levels of the different wards in the area. They felt that this negatively impacted the positive effect of the intervention and created more political disagreements. A different municipality reported that the legislation that governs public-private partnerships can be restrictive. They are not in the position to accept a lot of opportunities for cooperation from a variety of partners, including private sector, NGOs and international delegations. Receiving any financial assistance is also problematic. Despite the understanding that the municipality has regarding its role as a local authority and the necessary limitation of private sector influence, they argued that the legislation can be improved. The same municipality explained that land-use legislation can also act as a barrier to the municipality's ability to implement interventions. Public campaigns are an important tool in creating awareness and must have a wide geographic spread to be effective.

3.3.4 Lack of Trust in Government and Institutions

When residents do not have high levels of trust in their government and institutions, they are less likely to listen to water conservation messages and act when asked to do so. Residents need to trust that the local government is doing everything in their power to remedy water shortages before they are susceptible to water conservation messages. Consumers do not feel accountable and responsible for water scarcity issues in their area of residence, unless there is trust in the government that they are doing all that they can.

One metro reported that indigent consumers in areas with problematic service delivery were not receptive to water conservation educational campaigns. They already experience high

levels of water restrictions and did not think it was fair of the government to ask them to further conserve water. It is also likely that they view the existing water shortages as shortcomings by the government, not circumstances that are outside of the government's control. The same is true for high-income consumers. In areas with high levels of non-revenue water, residents may not believe that conserving water is their responsibility. Especially not if they pay for water services. Water conservation messages and programs are better received in areas with low levels of non-revenue water and a general trust in government and its functioning.

Increasing trust in government and institutions is not easy and depends on a variety of factors that are out of the control of water services departments. However, it can and should be considered when designing an intervention to increase the chances of success. Interventions that work in one area may not work in another and cannot simply be transplanted. There are no one-size-fits-all interventions.

3.3.5 Lack of Consumer Understanding

When municipalities do not fully understand the consumer they are trying to influence, it can negatively impact the effectiveness of an intervention. The literature is clear that different target groups respond better to different types of interventions and messaging. It is important to understand the consumer that is targeted to design an intervention that will work for them and their circumstances. Moreover, a lot of assumptions are made about the wants, needs and perceptions of consumers and used to design and implement interventions. Instead of making assumptions, municipalities should spend more time and resources improving their understanding of the target group.

Some municipalities report using the water balance to determine which areas they will target using behaviour change interventions. However, not all municipalities have a comprehensive and accurate water balance at hand. One municipality reported that when they conducted a survey to test the existing knowledge of learners on water scarcity, where it comes from and what to do about it, they found that schools in lower-income areas know more about the subject than learners in high-income areas. This was a surprising find, as they assumed that learners in low-income areas would need more education on the subject. Conducting a survey was found to be an excellent way of understanding the consumer before an intervention is designed in order to maximise the impact. Surveys can also be used to determine what is causing high water consumption levels (i.e., watering gardens, filling pools, internal leaks, faulty water meters, burst pipes, long showers, etc.). Only once there is clarity on the nature and behaviour of the consumers can appropriate interventions be designed to effect behaviour change.

4 PLANNING FRAMEWORK

Careful planning of interventions is essential to improve the uptake and national scaling of behaviour change interventions for water conservation purposes. Proper planning allows implementers to improve the impact, sustainability and scale of an intervention and it improves the design and development of future initiatives. Moreover, it allows implementers to expand, adapt and sustain interventions to benefit more people, which is the goal of (national) scaling. Interventions are often found to be effective when they are implemented in a specific area and at a small scale. However, the challenge lies with scaling up interventions and implementing them in a different context. Planning an intervention with scalability in mind will make the scaling up process easier and more successful. Scaling up activities should happen throughout the planning process.

The figure below outlines the planning process, from scoping to evaluating of interventions. It is important that continuous validation is taking place throughout the process. Guidance is given on key considerations that can improve the scalability of interventions.

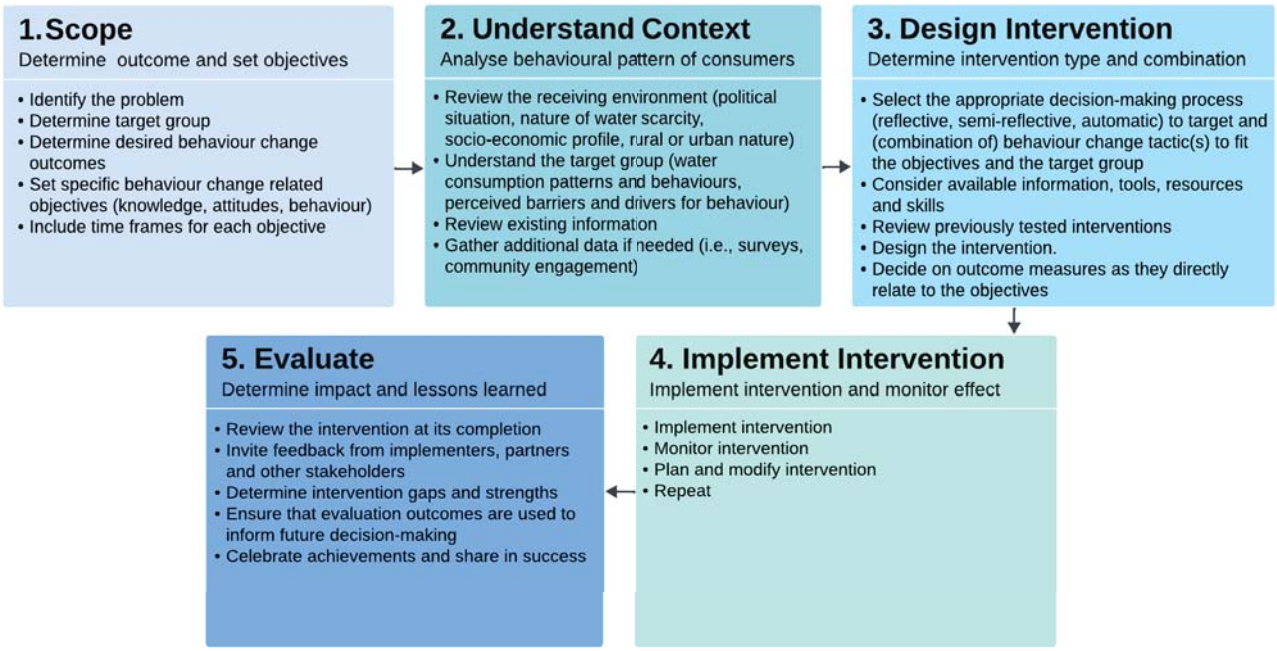

Figure 1. Intervention Planning Process

4.1 Scope

Determining the desired outcome and setting specific objectives related to behaviour change are essential first steps. Many interventions designed to effect behaviour change do not have

quantifiable objectives that are related to a specific behaviour for a particular target group. Instead, overall behavioural and communication objectives are defined. This almost always causes issues for the evaluation of the intervention, as there are no objectives against which to evaluate. In practice, KPIs (Key Performance Indicators) are often used to measure progress (i.e., how many brochures were handed out, how many consumers attended a meeting, etc.). Other common ways for implementers to measure impact is through self-reported data, such as a change in attitude towards water conservation and self-reported changes water conservation behaviour. This type of information is unreliable and of limited use to the continuous improvement and possible scaling of interventions.

The first step to designing an effective intervention is identifying the problem you want to address. Water scarcity is causes by a multitude of factors related to consumer behaviour. The problem in an affluent area might be the practice of watering gardens in the middle of the day and not covering pools, or the lack of adoption of water saving practices and devices, such as rainwater harvesting and installation of water saving devices. In lower-income areas, high-levels of water usage are more likely to be attributed to the underreporting of burst pipes and leaks. In South Africa, where non-revenue water levels are high, looking at the water balance and other available information on the nature of water scarcity in the area is a good place to start.

Picking the right behaviour or problem is the first step in a successful scale up process. The behaviour can be tested by asking key questions, such as ‘will there be significant consequences if people do not do this?’, ‘is it a common behaviour?’, ‘are other stakeholders also trying to change this specific behaviour?’, ‘will it be easy to change this behaviour?’, and ‘do we have the capacity and interest to target this specific behaviour?’. By asking these questions at the scoping stage, implementers can be sure that they have made an informed decision regarding which behaviour to target, which will support scaling efforts.

It is also crucial to carefully consider the group that will be targeted by the intervention. There is no one-size-fits all intervention that will be effective for all groups in society and different messages and types of interventions will have an impact on different target groups. For example, groups that lack knowledge on water conservation respond better to educational campaigns, whereas highly educated users may be more susceptible to interventions that highlight environmental concerns. Moreover, South Africa is a highly unequal society. Equitable water governance is at the heart of sustainable development and one of the aims of water demand management in South Africa is the social equity of water supply. Some argue that high-income users should be targeted, as they consume a lot of water and have the means to invest in water saving devices. Others, especially those that stay in areas with high levels

of non-revenue water, argue that indigent users should be influenced to use less water since they do not pay for their consumption. In the context of South Africa, it is worthwhile to consider whether the strongest shoulders should carry the heaviest water conservation burden. Political support is an important prerequisite to making these kinds of decisions.

Once the problem and the target group have been identified, the desired behavioural outcomes can be determined. Behavioural outcomes are overt behaviours that can be seen directly and are centred around actions, such as timeously reporting burst pipes, closing the tap when brushing your teeth, investing in water saving appliances, and covering your pool on hot days.

Clear objectives that are related to a specific behaviour need to be determined for implementers to consciously work towards them. If behaviour change related objectives are not defined, the intervention runs the risk of drifting, and the wrong things may be measured in evaluations. This limits the ability of implementers to improve the intervention, rather than just design the next intervention that seems like a good idea. It also allows implementers to work on maintaining behaviour change that has been achieved. It is also essential to include timeframes for each objective. When intervention endpoints are not clearly defined and directly related to objectives, it becomes very hard to accurately measure the effectiveness of an intervention.

Behaviour change objectives can be defined according to changes in a variety of outcomes. Three potential outcomes are *knowledge, attitudes* and *behaviour*. A change in knowledge and attitude can lead to behaviour change and should, therefore, have a direct connection to behaviour over time.

	Description	**Example of Objective**
Knowledge	The level of knowledge on water conservation practices a participant has gained by taking part in the intervention.	Immediately after hearing a radio advertising campaign, the target consumer will be able to identify at least three ways to reduce their water consumption in their home. This improved knowledge will be maintained six weeks after the end of the campaign.
Attitudes	The attitude a participant has towards water conservation needs and practices.	Immediately after participating in an educational programme on water conservation in school, learners will demonstrate an improved attitude towards water conservation practices.

Behaviour	The change in behaviour that is exhibited by participants through taking part in the intervention	At least one month after the appointment of a community liaison officer, household water consumption in the designated area will show a decrease of at least 5%.

4.2 Understand the Context

Gaining a solid understanding of the receiving environment and target group is crucial to effective intervention design. South Africa is a geographically and culturally diverse country, ranging from sparsely inhabited rural areas to sprawling and densely populated metropolitan areas. What works in Cape Town might not work in the rest of South Africa. Interventions do not exist in a vacuum and copying interventions and implementing them in a different environment will likely not garner the same results. This is why the receiving environment must be considered and thoroughly understood when designing an intervention.

Taking into consideration the political environmental is important when designing an intervention. Political stability is essential to creating an environment that is conducive and receptive to behaviour change interventions. It fosters a sense of goodwill and trust in government amongst consumers, making it easier for politicians to implement unpopular but necessary interventions. It also enables political leadership to consider long-term impacts and interventions and provide continued financial and institutional support. The cause of water scarcity should also be thoroughly understood. Consumers that live in areas that suffer from reticulation system issues and high levels of non-revenue water are less willing to partake in voluntary water conservation activities than consumers that live in areas where water scarcity is related to natural factors, such as droughts. The socio-economic profile of the consumer that is targeted, as well as the rural or urban nature of the area they are living in, will also play a role in the way they can be reached and their susceptibility to certain interventions and messages.

Having a clear picture of the water consumption patterns of the specific group that is being targeted, as well as understanding their needs, wants and perceptions, assists municipalities with designing an effective intervention. Determining the *perceived drivers* and *perceived barriers* of the target group can be useful create a more focussed method and intervention that is more likely to hit the mark.

- Perceived drivers are those aspects that drive someone to behave in a specific way (i.e., the joy experienced when watering a garden, or the belief that one's water consumption does not have a significant impact on the system).

- Perceived barriers are those aspects that discourage someone from behaving in a specific way (i.e., the guilt experienced when watering one's garden, or the knowledge that water will be restricted if usage levels do not go down).

When the perceived driver outweighs the perceived barrier, a change in behaviour is not likely. Implementers can influence behaviour is by introducing new drivers (i.e., the belief that the value of one's house will increase after the installation of a rainwater tank, or newly acquired knowledge on how to conserve water in your house) and minimising the perceived barriers. Unless the thought process behind behaviour is assessed and understood, the intervention might mis its mark entirely.

Reviewing existing information is a good place to start, when trying to understand the environment and target group. Conducting new research is recommended, if needed, to identify the perceived drivers and barriers of the target group and to better understand what is needed to change their existing behaviour. Surveys and public meetings are good ways of engaging with the target group and collecting new information on their needs, wants and perceptions.

4.3 Design Intervention

Interventions must be designed in a systematic and thoughtful way to operate effectively and maximise the impact. It also improves the ability of implementers to monitor and evaluate outcomes which can assist in improving existing interventions and designing new ones. Implementers that plan in this way are more likely to gather information from a variety of sources and finding the requisite human and financial resources. Designing an effective intervention involves specific and measurable objectives for the appropriate context and selecting the best type of intervention to do this, based on evidence and the experiences of others. The processes and tactics outlined below can be used to make an informed decision and design an effective intervention.

It is important that you **pick feasible interventions**. If an intervention is not feasible, it will not have potential for impact at scale. This increases the likelihood of planned interventions that work well in theory but fail to work in practice, at least at a significant scale. To determine whether the intervention is feasible, ask the following questions: 'is the intervention within budget?', 'can the intervention be implemented as intended?', 'will the intervention be cost-effective?', 'will the intervention be accepted by the relevant stakeholders?', 'can I foresee any potential side-effects or unintended consequences?', and 'will the intervention reduce or increase existing inequalities between different groups in society?'.

This framework distinguishes between three distinct decision-making processes (i.e., reflective, semi-reflective and automatic) and eight behaviour change tactics: Interventions that target reflective decision-making processes are (1) *knowledge transfer* and (2) *increasing self-efficacy*. Interventions that work through the semi-reflective route of information processing are (3) *social norms*, (4) *framing*, and (5) *tailoring*. The automatic route includes interventions that target subconscious decision-making processes through (6) *emotional shortcuts*, (7) *priming* and (8) *nudging* (Koop et al., 2018). Implementers should select a behaviour change tactic or combination of tactics that is best suited to the objectives and the target group's perceived drivers and barriers.

Table 2. Overview of Behaviour Change Tactics

Behaviour Change Tactic	Mechanism of Action	Example Relevant to Water Conservation
Knowledge Transfer (reflective)	The more knowledge someone has about an issue, the more likely they are to augment their behaviour.	Education and awareness campaign that teach individuals the necessity and importance of conserving water.
Increasing Self-Efficacy (reflective)	Individuals are more likely to change their behaviour if they are empowered to perform a specific behaviour through increased confidence and skill.	Including practical tips and strategies on how to conserve water on the water bill.
Social Norms (semi-reflective)	Individuals are likely to bring their behaviour into conformity with their peers, once confronted with information that describes their behaviour in relation to the behaviour of their peers. Norms can be *descriptive* (simply describing the behaviour of others) or *injunctive* (convey social approval/disapproval).	Public awareness campaigns on the usage level of different geographical areas and how they compare.
Framing (semi-reflective)	The way a message is framed by selecting and emphasising specific aspects of the message changes its meaning, and influences how individuals interpret and respond to it, based on their perspective and characteristics.	Framing water as a unique natural resource, rather than a basic need, to increase the value individuals attach to water and the concern they have for its scarcity.
Tailoring (semi-reflective)	Individualising or tailoring a message to address the individual's perspective and	Using smart meters to provide individualised and real-time

	characteristics maximises its impact and effect.	feedback on water use, which allows consumers to be better informed about the amount of water they use and for which activities.
Using Emotional Shortcuts (automatic)	When an emotional response is evoked through emotional shortcuts, individuals are more likely to pay attention to a message and act accordingly. This includes the use of fear, humour, and games.	Social media campaign that uses images of people queuing for water to warn what will happen if water is not conserved.
Priming (automatic)	Exposing individuals to stimuli that activate certain unconscious associations or schemas in their minds creates a favourable context for the desired action and increases the salience of the benefits or costs associated with the behaviour change.	Priming consumers with words like 'achievement', 'prevail' and 'accomplish' when communicating about water conservation to empower them to change act.
Nudges (automatic)	Changing the choice architecture, or set of potential choices available to an individual, by making the preferred option more convenient or salient nudges individuals to perform specific behaviours.	Installing timers in public showers that will change colour from green to red when a specific amount of time has passed.

Designing the optimal intervention will greatly increase the likelihood of an intervention being scaled. Amending an existing tool or even using previous interventions as a tool to design a new intervention will help in designing interventions, as the wheel does not have to be invented twice. It is rarely the case that an intervention is not (loosely) based on a previously implemented intervention. It is worthwhile reviewing the context in which the intervention was previously implemented, try to identify the mechanism of action or 'active ingredient' of the intervention, and redesign the intervention to fit the relevant context.

Consider the following aspects in the design of the intervention:

- What financial resources are available to the project? Can funding be increased or the costs be reduced? Financial constraints will always be relevant in the context of local

government in South Africa. Creative and out of the box ways to increase funding or reduce costs exist.

- Consider the institutional capacity of the municipality. Does implementation staff have the requisite capacity to implement the proposed intervention? If not, re-evaluate the design of your intervention to make it easier to implement.
- Do the municipal by-laws support the proposed intervention? Consider this before moving on to the implementation phase of the intervention.
- Is the intervention design based on evidence and data and is it aligned to the key objectives and target group? This will maximise the impact of the intervention.

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The intervention design should also include the outcome measures as they directly relate to the key objectives. Outcome measures should be formulated to say something about the effectiveness of the intervention in meetings its behaviour related objectives. Implementers must be cautious against formulating outcomes measures to answer the question 'did we do what we said we would do?', which is what KPIs are for. Instead, outcome measures answer the question 'did the intervention have the intended effect?''. Being alert to low-cost data and information gathering opportunities is advised.

Picking a scalable intervention is essential for any scaling effort. Determining early on whether the intervention is suitable for scaling can assist in making decisions on whether to proceed or not. Key questions to ask include 'will the intervention reach a bigger audience than the alternatives?', 'will the intervention be more effective at producing the desired behaviour change than the alternative?', 'will the intervention cost less than the alternatives?', and 'will this intervention have more positive effects one year after implementation than the alternatives?'

4.4 Implement Intervention

When it comes to implementation of the intervention, it is important that regular monitoring takes place. This will also allow for implementers to see opportunities for improvement and expansion, particularly by including additional partners or stakeholder. Numerous unanticipated factors are like to influence the intervention, requiring a continuous process of implementation, monitoring, planning and modifying. Unanticipated factors include:

- Inproper implementation of the intervention requires it to be amended.
- Additional (funding) support may become available (from partners or stakeholders).
- Financial or implementation support may be withdrawn.
- The intervention is not working as planned and the target group is not responding as expected.
- Unexpected changes in the environment, such as dam levels filling up to do rainfall.
- Community tragedies or other force majeure events.

The continuous cycle of implementing, monitoring, planning and modifying interventions requires dedicated and capable implementation staff.

Assumption testing can be a useful tool during the implementation phase to reduce uncertainties and improve the chances of an intervention being successful. The four steps in assumption testing are: identify key assumptions made during the planning phase that are essential to the intervention's effectiveness; develop tests for each assumption; evaluate test results to see whether the results validate the assumptions; proceed if assumptions are validated, pivot if they are not validated, or stop.

4.5 Evaluate

It is important to conduct an evaluation when the intervention is at its conclusion. When this step is skipped, it is likely that interventions are not improved, and no new targets are set. Moreover, successes are not properly identified and celebrated, which keeps the focus on problems rather than achievements. The groundwork for proper evaluation is laid throughout the intervention planning process.

By identifying intervention gaps and strengths, an evidence base is created for future decision-making regarding resource allocation and intervention design. This not only improves the sustainability of an intervention, but also the processes by which interventions are designed and implemented at municipalities. This also provides a base for advocacy activities to

increase political and institutional support and buy-in for additional interventions and creates opportunities for knowledge sharing between municipalities in South Africa.

A final evaluation is an excellent opportunity to invite implementation staff, partners and other stakeholders to provide comments and feedback on the intervention. Their experiences can offer valuable ideas on additional improvements to the intervention. Moreover, stakeholders feel motivated and empowered when they are involved in the process and their input is valued. It is essential to celebrate intervention achievements together with partners and stakeholders.

5 RECOMMENDATIONS FOR NATIONAL SCALING

Behaviour change interventions are not sufficiently implemented at scale in South Africa. Interventions are implemented at the local level and the design and implementation is highly dependent on local knowledge, expertise, resources and commitment. Intervention design is often based on one person's 'good idea' and are implemented for as long as financial and human resources are available. It has been proven challenging to achieve impact at scale in South Africa. Successful local interventions should be expanded, adapted and sustained to have an impact across broader communities and geographies to be a truly impactful tool for WC/WDM in South Africa.

The planning framework iterates the importance of keeping scaling considerations in mind when designing and implementing interventions. Understanding the target audience and the behaviour you want to change is an essential first step in improving the chances of an internation being scaled. Designing an intervention purposefully and carefully is crucial to encourage high-fidelity use of interventions. Lastly, implementers should not try to re-invent the wheel. By focusing on interventions that have been proven to be appropriate for scaling, no time, money or resources are wasted on attempting to scale ineffective interventions. It is essential that implementers have a solid understanding of the interventions that have been implemented in the past and the subsequent lessons that can be learned.

The following components are key to scaling up interventions for WC/WM purposes in South Africa:

- Carefully and continually plan, monitor, and evaluate the intervention.
- Do not re-invent the wheel. Instead, base intervention design on lessons learned and best practices.
- Use intervention gaps and strengths, as identified through the evaluation process, to modify interventions accordingly. Consider those attributes and features that can influence the scaling up process.
- Preserve and gain political and institutional support and buy-in. Individuals, institutions and policies should advocate for the intervention.
- Foster and build collaborations, partnerships and networks with stakeholders.
- Clarify and coordinate the roles and responsibilities of all stakeholders involved in the scaling up process.
- Enable relevant stakeholders to participate in and take ownership of the intervention.
- Determine the required skills, knowledge and capacity for scaling and capacitate accordingly.

- Plan and implement scaling activities according to a strategic approach.
- Mobilise and sustain durable availability of financial and human resources.
- Leverage existing programs, value chains and partnerships.

6 REFERENCES

Addo, I. B., Thoms, M., & Parsons, M. (2019). The influence of water-conservation messages on reducing household water use. *Applied Water Science*, *9*(5). https://doi.org/10.1007/s13201-019-1002-0

Ajzen, I. (1985). From Intentions to Actions: A theory of planned behavior. In Springer eBooks (pp. 11–39). https://doi.org/10.1007/978-3-642-69746-3_2

Allcott, H., & Rogers, T. (2014). The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation. *The American Economic Review*, *104*(10), 3003–3037. https://doi.org/10.1257/aer.104.10.3003

Barbu, A., Griffiths, N., & Morton, G. (2013). Achieving energy efficiency through behaviour change: what does it take? *European Environment Agency*. https://doi.org/10.2800/49941

Bernedo, M., Ferraro, P. J., & Price, M. K. (2014). The persistent impacts of Norm-Based messaging and their implications for water conservation. *Journal of Consumer Policy*, *37*(3), 437–452. https://doi.org/10.1007/s10603-014-9266-0

Bhanot, S. (2021). Isolating the effect of injunctive norms on conservation behavior: New evidence from a field experiment in California. *Organizational Behavior and Human Decision Processes*, *163*, 30–42. https://doi.org/10.1016/j.obhdp.2018.11.002

Cauberghe, V., Vazquez-Casaubon, E. C., & Van De Sompel, D. (2021). Perceptions of water as commodity or uniqueness? The role of water value, scarcity concern and moral obligation on conservation behavior. *Journal of Environmental Management*, *292*, 112677. https://doi.org/10.1016/j.jenvman.2021.112677

Coates, T. J., Richter, L., & Caceres, C. F. (2008). Behavioural strategies to reduce HIV transmission: how to make them work better. *The Lancet*, *372*(9639), 669–684. https://doi.org/10.1016/s0140-6736(08)60886-7

Cominola, A., Giuliani, M., Castelletti, A., Fraternali, P., González, S. L. H., Herrero, J. C. G., Novak, J., & Rizzoli, A. E. (2021). Long-term water conservation is fostered by smart meter-based feedback and digital user engagement. *Npj Clean Water*, *4*(1). https://doi.org/10.1038/s41545-021-00119-0

Daminato, C., Diaz-Farina, E., Filippini, M., & Padrón-Fumero, N. (2021). The impact of smart meters on residential water consumption: Evidence from a natural experiment in the Canary Islands. *Resource and Energy Economics*, *64*, 101221. https://doi.org/10.1016/j.reseneeco.2021.101221

Department of Environmental Affairs. (2017). *South Africa's 2nd Annual Climate Change Report*. Retrieved September 28, 2023, from https://www.dffe.gov.za/sites/default/files/reports/southafrica_secondnational_climatechnage_report2017.pdf

Diffenbaugh, N. S., Swain, D. L., & Touma, D. (2015). Anthropogenic warming has increased drought risk in California. *Proceedings of the National Academy of Sciences of the United States of America*, *112*(13), 3931–3936. https://doi.org/10.1073/pnas.1422385112

Ehret, P. J., Hodges, H. E., Kuehl, C., Brick, C., Mueller, S., & Anderson, S. E. (2020). Systematic Review of Household Water Conservation Interventions Using the Information–Motivation–Behavioral Skills Model. Environment and Behavior, 53(5), 485–519. https://doi.org/10.1177/0013916519896868

Fang, Y., & Sun, M. (2016). Applying eco-visualisations of different interface formats to evoke sustainable behaviours towards household water saving. *Behaviour & Information Technology*, *35*(9), 748–757. https://doi.org/10.1080/0144929x.2016.1189965

Feizi, M., & Khatabiroudi, N. (2023). Social and environmental nudges and water usage: Evidence from a field experiment in Iran. *Water Resources and Economics*, *42*, 1–10. https://doi.org/10.1016/j.wre.2023.100223

Flowers, P., Wu, O., Lorimer, K., Ahmed, B., Hesselgreaves, H., MacDonald, J., Cayless, S., Hutchinson, S., Elliott, L., Sullivan, A., Clutterbuck, D., Rayment, M., & McDaid, L. (2017). The clinical effectiveness of individual behaviour change interventions to reduce risky sexual behaviour after a negative human immunodeficiency virus test in men who have sex with men: systematic and realist reviews and intervention development. *Health Technology Assessment*, *21*(5), 1–164. https://doi.org/10.3310/hta21050

Gerber, P., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A., & Tempio, G. (2013). Tackling climate change through livestock : a global assessment of emissions and mitigation opportunities. In *Food and Agriculture Organization of the United Nations (FAO) eBooks*. https://portals.iucn.org/library/node/29403

Jorgensen, B. S., Fumei, S., & Byrne, G. (2021). Reducing Peak Energy Demand among Residents Who Are Not Billed for Their Electricity Consumption: Experimental Evaluation of Behaviour Change Interventions in a University Setting. *International Journal of Environmental Research and Public Health*, *18*(16), 8406. https://doi.org/10.3390/ijerph18168406

Kaiser, M., Bernauer, M., Sunstein, C. R., & Reisch, L. A. (2020). The power of green defaults: the impact of regional variation of opt-out tariffs on green energy demand in Germany. *Ecological Economics*, *174*, 106685. https://doi.org/10.1016/j.ecolecon.2020.106685

Kemp-Hesterman, A., Glick, S., & Cross, J. E. (2014). Reducing electrical energy consumption through behaviour changes. *Journal of Facilities Management*, *12*(1), 4–17. https://doi.org/10.1108/jfm-02-2013-0006

Koop, S., Van Dorssen, A., & Brouwer, S. (2019). Enhancing domestic water conservation behaviour: A review of empirical studies on influencing tactics. *Journal of Environmental Management*, *247*, 867–876. https://doi.org/10.1016/j.jenvman.2019.06.126

Kwasny, T., Dobernig, K., & Riefler, P. (2022). Towards reduced meat consumption: A systematic literature review of intervention effectiveness, 2001–2019. *Appetite*, *168*, 105739. https://doi.org/10.1016/j.appet.2021.105739

Lede, E., Meleady, R., & Seger, C. R. (2019). Optimizing the influence of social norms interventions: Applying social identity insights to motivate residential water conservation. *Journal of Environmental Psychology*, *62*, 105–114. https://doi.org/10.1016/j.jenvp.2019.02.011

Lee, M., & Tansel, B. (2013). Water conservation quantities vs customer opinion and satisfaction with water efficient appliances in Miami, Florida. *Journal of Environmental Management*, *128*, 683–689. https://doi.org/10.1016/j.jenvman.2013.05.044

Michaelsen, M. M., & Esch, T. (2022). Functional Mechanisms of Health Behavior Change Techniques: A Conceptual review. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.725644

Ndebele, M., Kasese-Hara, M., & Greyling, M. (2012). Application of the information, motivation and behavioural skills model for targeting HIV risk behaviour amongst adolescent learners in South Africa. *SAHARA-J*, *9*(sup1), S37–S47. https://doi.org/10.1080/17290376.2012.744903

Oke, A., McDonald, S., Korobilis-Magas, E., Osobajo, O. A., & Awuzie, B. (2021). Reframing Recycling Behaviour through Consumers' Perceptions: An Exploratory Investigation. *Sustainability*, *13*(24), 13849. https://doi.org/10.3390/su132413849

Pamla, A., Thondhlana, G., & Ruwanza, S. (2021). Persistent Droughts and Water Scarcity: Households' Perceptions and Practices in Makhanda, South Africa. *Land*, *10*(6), 593. https://doi.org/10.3390/land10060593

Pronello, C., & Gaborieau, J. (2018). Engaging in Pro-Environment Travel Behaviour Research from a Psycho-Social Perspective: A Review of Behavioural Variables and Theories. *Sustainability*, *10*(7), 2412. https://doi.org/10.3390/su10072412

Schewe, J., Heinke, J., Gerten, D., Haddeland, I., Arnell, N. W., Clark, D. B., Dankers, R., Eisner, S., Fekete, B. M., Colón-González, F. J., Gosling, S. N., Kim, H., Liu, X., Masaki, Y., Portmann, F. T., Satoh, Y., Stacke, T., Tang, Q., Wada, Y., . . . Kabat, P. (2013). Multimodel assessment of water scarcity under climate change. *Proceedings of the National Academy of Sciences of the United States of America*, *111*(9), 3245–3250. https://doi.org/10.1073/pnas.1222460110

Sussman, R., & Chikumbo, M. (2016). *Behavior Change Programs: Status and Impact* (No. B1601). American Council for an Energy-Efficient Economy.

Thaler, R. H., & Sunstein, C. R. (2009). *Nudge: Improving Decisions about Health, Wealth and Happiness*.

Truelove, H. B., Raimi, K. T., & Carrico, A. R. (2022). Curbing single-use plastic with behaviour change interventions. *Nature Reviews Earth & Environment*, *3*(11), 722–723. https://doi.org/10.1038/s43017-022-00356-y

Visser, M., Booysen, M., Brühl, J., & Berger, K. J. E. (2021). Saving water at Cape Town schools by using smart metering and behavioral change. *Water Resources and Economics*, *34*, 100175. https://doi.org/10.1016/j.wre.2020.100175

Wang, Y., Chang, M., & Liou, J. (2019). Effects of water-saving education in Taiwan on public water knowledge, attitude, and behavior intention change. *Water Policy*, *21*(5), 964–979. https://doi.org/10.2166/wp.2019.173

Xiong, Y., Hao, X. R., Liao, C., & Zeng, Z. (2015). Relationship between water-conservation behavior and water education in Guangzhou, China. *Environmental Earth Sciences*, *75*(1). https://doi.org/10.1007/s12665-015-4873-x

Zhuang, J., Lapinski, M. K., & Peng, W. (2018). Crafting messages to promote water conservation: Using time-framed messages to boost conservation actions in the United States and China. *Journal of Applied Social Psychology*, *48*(5), 248–256. https://doi.org/10.1111/jasp.12509