WATER RESEARCH COMMISSION

DRINKING WATER

WRC REPORTS

2024

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WRC: CREATING WATER AND SANITATION KNOWLEDGE

The Water Research Commission (WRC) was established in terms of the Water Research Act (Act no 34 of 1971) following a period of serious water shortage. It was deemed to be of national importance to generate new knowledge and to promote the country's water research purposefully, owing to the view held that water would be one of South Africa's most limiting factors in the twenty-first century.

Now in its fifth decade of serving South Africa, the WRC is working with its government and non-government partners to contribute new water knowledge and solutions to South African, African and global water challenges by developing and harnessing the water research and development capability in the country.

The primary functions of the WRC are to fund and steer the water research agenda in South Africa, and to effectively disseminate and communicate research findings. Administrative activities are carried out to ensure compliance with regulatory requirements and to provide an enabling environment for research management. In recent years the WRC has been increasingly called upon to not only develop new knowledge in the water and sanitation science and technology domain, but also to support and further develop human capacity and skill as well as lead technology, product and industry development.

The Research, Development and Innovation (RDI) branch offers new knowledge, technology and innovation in water and sanitation through targeted projects. The knowledge generated results in new and / or refined technologies and innovations which the WRC provides to the water sector to address specific needs and challenges. The branch is actively involved in human and institutional capacity development.

Several research initiatives have been supported to assist municipalities and other water service authorities to sustainably manage their drinking water facilities. This booklet highlights the latest and most popular guides under this theme.

CONVENTIONAL WATER TREATMENT

GUIDANCE ON DRINKING WATER TREATMENT PROCESS AUDITS AND PLANT OPTIMISATION

WRC report no. TT 755/18

The fundamental philosophy of the Blue Drop Regulation Programme is that regulatory performance is not enough. Water treatment and water supply must also remain sustainable in an environment where more has to be done with less on a day-to-day basis. This extends to producing more water from the same infrastructure with lower budgets against a more challenging water quality requirement. These processes must occur while consumers continue to have access to a safe and reliable water supply. This can only be achieved if plants and plant operations target best practice principles (optimisation). These guidelines are intended to be used by skilled plant designers, senior process controllers and decision-makers to inform decisions regarding the operation, maintenance and ongoing improvement of water treatment works. It is expected that the process inspector has an excellent understanding and experience of water treatment processes, operation and maintenance requirements, management functions and has a good knowledge of the regulatory framework. In addition to the guidelines, there is also a full report available (**WRC report no. 2578/1/18**).

Click here to download the guide
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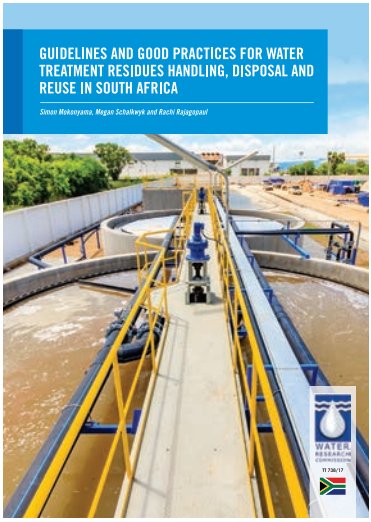

GUIDELINES AND GOOD PRACTICES FOR WATER TREATMENT RESIDUES HANDLING, DISPOSAL AND REUSE IN SOUTH AFRICA

WRC report no. TT 738/17

Water treatment residues (WTR) refer to the sludge that is formed during the production of potable water. Water treatment residues comprise typically 3-10% of the conventional drinking water plant throughput, with approximately 90-95% of the waste stream produced at the clarification stage of the water treatment process. The residue from potable water treatment processes was historically viewed as a 'waste' to be disposed to landfill, however, this is slowly becoming the least desirable method of WTR management. As such, this project aimed to document best practice principles and approaches considering both current and innovative solutions for WRT management. The output from this project is a guideline document, which provides a strategic framework which will assist with making a decision on the best WTR strategy.

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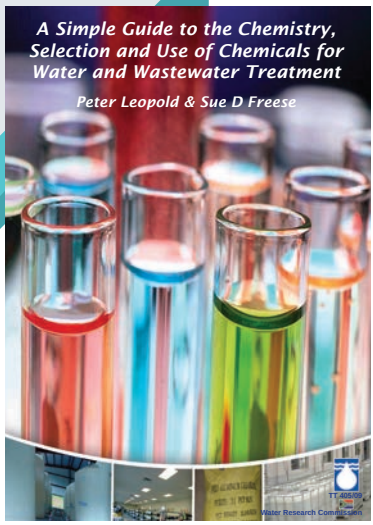

A SIMPLE GUIDE TO THE CHEMISTRY, SELECTION AND USE OF CHEMICALS FOR WATER AND WASTEWATER TREATMENT

WRC report no. TT 405/09

Every year in South Africa an estimated R500 million is spent on chemicals used in the treatment of drinking and wastewater. Most of this money is allocated on the basis of tenders issued and contracts awarded. The evaluation of tenders is generally undertaken by a team of people from various disciplines within the awarding organisation, and the decisions they make can have a significant effect on the quality of water or waste that is produced and also on the finances of the organisation for which they work. It is obvious therefore that these decisions – which chemicals to use, how much to use, how much should be paid, who is the most professional supplier – are important ones and ones that should be taken whilst in possession of the most factual and impartial information. This guide aims to provide those decision-makers, and other users of water treatment chemicals, with specific and useful information about water treatment chemicals. It is a chemistry text book aimed specifically at those people who have to make informed decisions but who have not had a formal education in chemistry or whose chemistry education has not been specific in detail relevant to water treatment chemicals.

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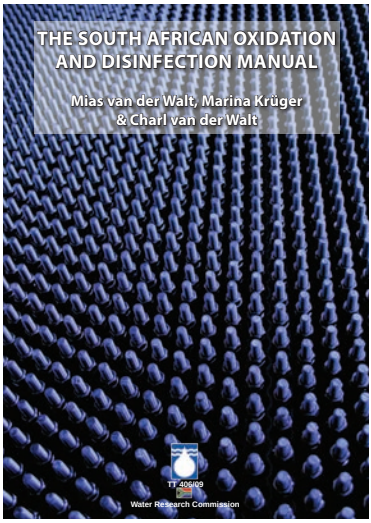

THE SOUTH AFRICAN OXIDATION AND DISINFECTION MANUAL

WRC report no. TT 406/09

The purpose of this manual is to assist the reader in making a logical selection in matching the water treatment challenges with appropriate treatment processes and technology. In order to sensitise the reader to the fact that this selection process is not that simple, a number of chapters were included that address aspects influencing the selection process. Firstly, the reader is introduced to some of the literature available on the subject. This is followed by a more detailed description of the most commonly found water treatment and distribution system challenges, source characterisation and water quality standards. A thorough discussion follows on the treatment processes that are available and the relative success in addressing treatment challenges. Once the process is selected some information is provided on the description of the technology, occupational health and safety aspects and consumer health aspects. Six case studies were also included to demonstrate how water suppliers approached different water treatment challenges.

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GUIDELINES FOR THE ASSESSMENT OF THE COMPLIANCE OF SOUTH AFRICAN POTABLE WATER SUPPLY WITH ACCEPTED DRINKING WATER QUALITY STANDARDS AND MANAGEMENT NORMS

WRC report no. TT 425/09

This report contains the guidelines and procedures that were developed for water service providers (WSPs) and water service authorities (WSAs) to assist them with assessment of the compliance of their drinking water supply systems with accepted drinking water quality standards and management norms. These guidelines aim at providing South African potable water providers with the required water quality targets and a set of other operational and management norms, as well as a tool that could be used to identify the reasons for non-compliance. The guide also suggests solutions to any problems experienced, which are preventing compliance to these guidelines and norms. A Diagnostic Tool was developed to establish the reasons for non-compliance and to provide remedial measures that can be used to achieve compliance. Compliance here not only relates to technical compliance, but also to compliance with non-technical (mostly human resources related) norms.

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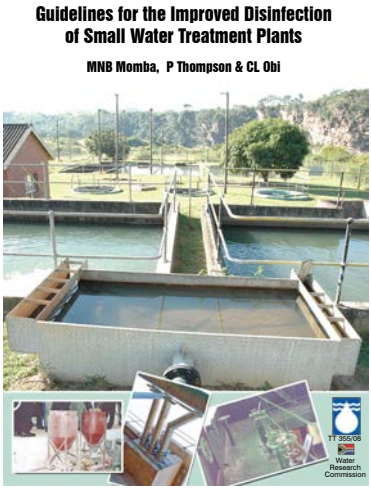

GUIDELINES FOR THE IMPROVED DISINFECTION OF SMALL WATER TREATMENT PLANTS

WRC report no. TT 355/08

These guidelines describe methods and processes for tackling the litany of problems associated with the drinking water supplied by small water treatment plants. This is critical as the supply of safe drinking water is a fundamental human right. The guidelines provide an overview of the problems and proffer practical solutions and precautions that maximise the efficacy of disinfection for safe drinking water supplies to rural communities for improved public healthcare delivery. In compiling the guidelines, emphasis was placed on the multiple barrier approach to optimising disinfection, which highlights the importance of source selection and protection as the primary barrier for the prevention of the contamination of the raw water. Appropriate planning, design and unit process selection are reviewed, highlighting critical design parameters that should be strictly implemented to ensure the optimum functioning of such water treatment plants. The criteria for the selection of disinfectants and details for the design and maintenance of gaseous chlorine systems are highlighted to ensure that proper maintenance practices are implemented because chlorination is the primary protocol practised in South Africa.

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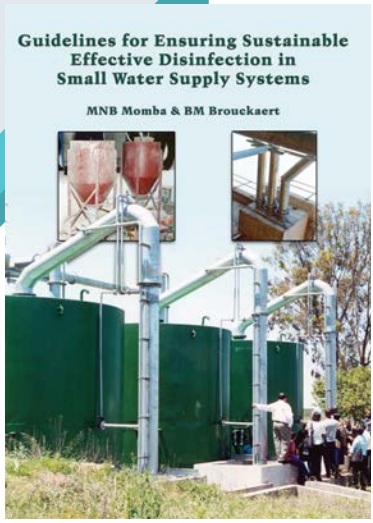

GUIDELINES FOR ENSURING SUSTAINABLE EFFECTIVE DISINFECTION IN SMALL WATER SUPPLY SYSTEMS

WRC report no. TT 249/05

This project investigated the causes of poor microbial quality of treated water supplies in rural areas and strategies for ensuring effective sustainable disinfection. The Eastern Cape town of Alice, home of the University of Fort Hare where the research team was based, was used as a case study. The guidelines draw on the authors' experiences in Alice and in several other small towns in the Eastern Cape which were visited as part of a WRC project on improving the efficiency of disinfection in small drinking water treatment plants. This document is written primarily for drinking water treatment plant operators, supervisors and municipal officials in rural municipalities and focuses on issues relating to the microbial safety of water supplied to consumers. Several common operating and management problems that the authors have encountered are discussed.

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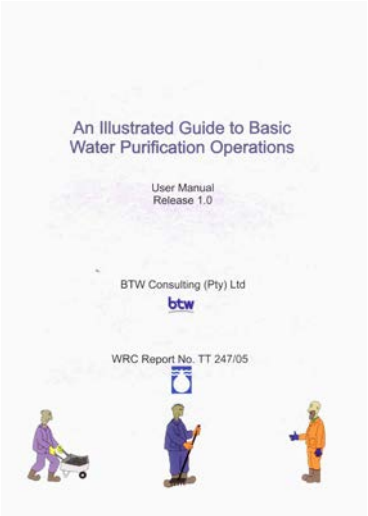

AN ILLUSTRATED GUIDE TO BASIC WATER PURIFICATION OPERATIONS

WRC report no. TT 247/05

This guide is aimed mainly at entry-level water treatment plant operators and, in particular, those who operate small and geographically isolated plants. The guide clearly emphasises the important role that these operators play in ensuring that safe drinking water is supplied to our communities. Particular attention has been paid to the needs of these operators who have limited literacy skills, with the basic concepts of water treatment and the correct operational procedures explained in simple terms in a humorous manner using cartoon illustrations. The guide is intended to be used as both a reference manual by professionals and managers.

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INVESTIGATION INTO THE INFLUENCE OF HYDRAULIC CONTACTING ON DISINFECTION EFFICIENCY IN SMALL WATERWORKS

This research project focused on the influence of hydraulic contacting on disinfection efficiency in small water works.

WRC report no. 2809/1/20

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PRINCIPLES AND APPROACHES FOR DRINKING WATER TREATMENT PLANT PERFORMANCE ASSESSMENT AND OPTIMISATION

This commissioned study set out to develop a guidance document laying out a best practice methodology for audits and optimisation to assist water services institutions. An analysis of 74 process audit reports highlighted the significant differences in the range and depth of the process audits undertaken by the different municipalities.

WRC report no. 2578/1/18

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GUIDELINES FOR THE UTILISATION AND DISPOSAL OF WATER TREATMENT RESIDUES

Potable water treatment plants produce a hygienically safe drinking water for consumption through a variety of treatment processes. However, they also produce waste products. This guideline deals with the requirements of different management options for the utilisation and/or disposal of water treatment residues.

WRC report no. TT 559/13

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NATIONAL STANDARDS FOR DRINKING WATER TREATMENT CHEMICALS

This project was initiated by Umgeni Water to investigate current international systems used for regulating drinking water treatment chemicals, to propose a set of standards that could be adopted for use locally, and to create awareness of the existence of such standards through a series of workshops.

WRC report no. 1600/1/09

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IMPROVING DISINFECTION EFFICIENCY IN SMALL DRINKING WATER TREATMENT PLANTS

This study involved 181 small water treatment plants across seven provinces of South Africa. The goal was to determine the nature and full extent of the problems and provide practical and user-friendly guidelines for intervention.

WRC report no. 531/1/08

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HANDBOOK FOR THE OPERATION OF WATER TREATMENT WORKS

The purpose of this handbook is to provide comprehensive information specifically on all aspects related to the treatment of water for domestic use. The focus is on the operational aspects of treatment plants and processes and not on process design.

WRC report no. TT 265/06

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ELEMENTARY HANDBOOK OF WATER DISINFECTION

The aim of this Handbook is to provide readers with an introduction to the processes of water disinfection. The emphasis has been placed on chlorination and chloramination, these being the two processes most commonly encountered in South Africa.

WRC report no. TT 206/03

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RISK GOVERNANCE

INTEGRATING CLIMATE INFORMATION IN WATER SAFETY PLANNING AND WASTEWATER RISK ABATEMENT PLANNING – A GUIDANCE NOTE

WRC report no. TT 876/2/22

Water services institutions (WSIs) struggle to interpret and incorporate climate data / information into their planning activities as in some cases data / information is not available at a local scale. Additionally, there is very little guidance on accessing, interpreting, and incorporating climate data / information in planning activities. This guideline attempts to bridge this gap by providing WSIs with a detailed list of climate related data / information sources, and a methodology to draw basic climate impact conclusions for use in risk management and planning activities. The methodology was piloted in three municipalities in South Africa, viz. Lephalale Local Municipality (Limpopo), Uthukela District Municipality (KwaZulu-Natal) and Witzenberg Local Municipality (Western Cape. This is one of two reports. The other is, ***Using climate data to help South African water services institutions improve water safety and wastewater risk abatement planning and enhance resilience to climate change at local and catchment level*** (**WRC report no. TT 876/1/22**).

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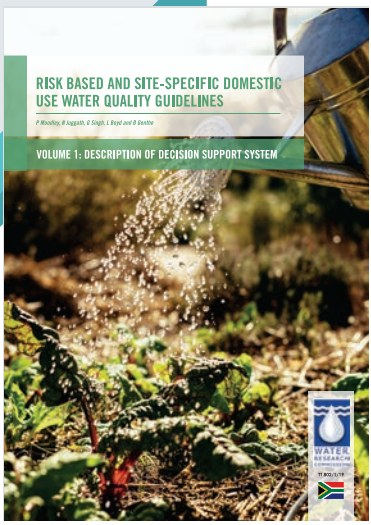

RISK BASED AND SITE-SPECIFIC DOMESTIC USE WATER QUALITY GUIDELINES

WRC report no. TT 802/2/19

Domestic water quality guidelines relate to the concentrations of physical, chemical or microbiological contaminants in water, allowable for consumption by humans during their lifetime, without the risk of significant health effects, or for nonconsumptive uses without significant economic and physical effects. The most effective means of ensuring safe drinking (and domestic) water supply should encompass a risk management approach at all steps in the water supply chain, from catchment to consumer. The objective of this project was to develop a risk-based methodology for determining water quality guidelines for domestic use enabled through a user-friendly and practical decision support system (DSS). The specific aspects that have been addressed in terms of meeting this objective include firstly, the development of the approach and methodology for the risk calculations based on supporting science to be included in the technology demonstrator; and secondly the development of the informatics for a demonstrator decision support system that addresses the main decision contexts for the use of the guidelines. This is one of two reports. The other report is, ***Risk based and site-specific domestic use water quality guidelines. Part 1: Description of decision support system*** (**WRC report no. TT 802/1/19**).

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BEST PRACTICE GUIDELINES FOR MANAGING WATER CONTAMINATION EVENTS

WRC report no. TT 798/19

The deterioration of water quality due to the intrusion of contaminants in water distribution systems has been associated with a significant proportion of waterborne and water-related illnesses internationally. The risk of these contamination intrusion events occurring is aggravated by inappropriate planning, design and maintenance, and water quality control. Significant investments are often required to implement the necessary rehabilitation measures to ensure drinking water safety. In addition, there are practical challenges in undertaking risk assessment, risk management and investment planning. The prime objectives of this study were to establish the frequency and causes of contaminant intrusions in water distribution systems, to identify the characteristics of distribution systems that contribute to these events, and to provide guidance on best practices of water quality control in water distribution systems using the water safety plan (WSP) as a framework.

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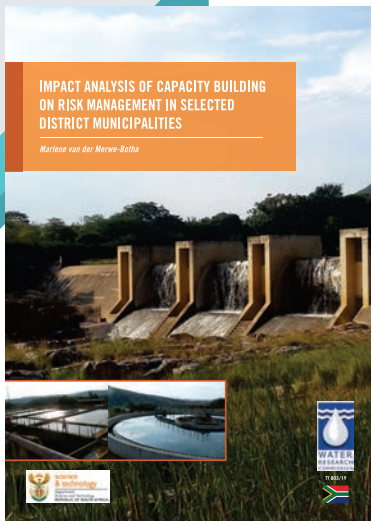

IMPACT ANALYSIS OF CAPACITY BUILDING ON RISK MANAGEMENT IN SELECTED DISTRICT MUNICIPALITIES

WRC report no. TT 803/19

A capacity building support project was implemented during 2014 to 2016 which assisted selected District Municipalities in KwaZulu-Natal and the Eastern Cape to prepare risk-based plans using existing tools and guidelines, whilst developing technical capacity through a learn-and-adapt approach. The municipalities experienced a number of water services and human resource challenges at the time, as identified from the Blue- and Green Drop results of 2013/14. The project methodology made provision to measure the impact of the capacity building project by comparing the Blue- and Green Drop results 'before' and 'after' the project. With the halt of the national Drop Certification programme, the impact could not be measured (WRC Report TT 693). Subsequently, the WRC commissioned a special study in 2018 with a two-fold purpose: 1) to determine the impact of the risk-based capacity building pilot project at the selected municipalities; and 2) to conceptualise a framework for the roll-out of risk-based capacity building on national scale, by considering the lessons learnt from the WRC capacity building pilot project, as well as other support studies.

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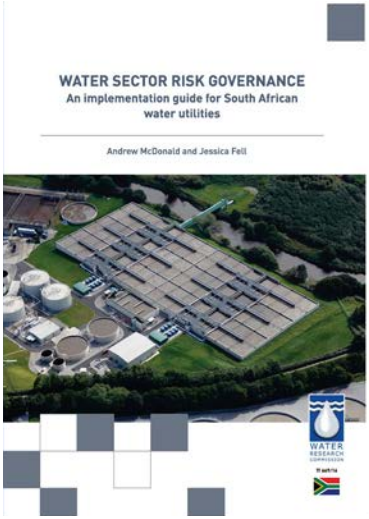
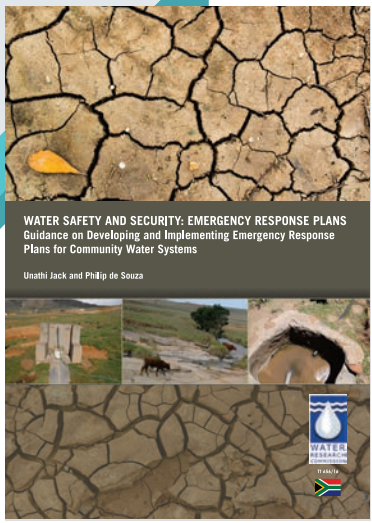


WATER SECTOR RISK GOVERNANCE: AN IMPLEMENTATION GUIDE FOR SOUTH AFRICAN WATER UTILITIES

WRC report no. TT 669/16

The implementation of sound risk management and governance practices is critical to finding meaningful solutions that contribute to sustainable water management. A paradigm shift in water sector risk management and governance is also required in order to secure the efficient provision of water services in SouthAfrica. An assessment of the risk maturity of water institutions in South Africa has shown that the overall average maturity varied from 2.4 (initial) to 3.9 (managed) on a scale of 5. The journey to risk governance excellence requires strong leadership; a clear vision; a policy, framework and implementation plan; commitment and resources to implement the plan; good governance structures; open and transparent reporting mechanisms and regular engagement with all stakeholders. This report forms part of a series of three reports. The other reports are *Risk governance in the South African water services sector: business value creation and best practice* (**WRC report no. TT 667/16**), *and Water sector risk governance: A compendium of South African and international case studies* (**WRC report no. 668/16**).

Click here to download the Implementation guide
Click here to download the business value creation
Click here to download the compendium of case studies



WATER SAFETY AND SECURITY – EMERGENCY RESPONSE PLANS

WRC report no. TT 656/16

All water services systems irrespective of size, location, etc. should have emergency response plans (ERP) to guide officials, stakeholders and consumers through emergencies as one way of managing risks in the water supply system. Emergencies in the water supply system may result from natural disasters, equipment failure, human error, intentional acts (e.g. vandalism), etc. An ERP prepares the organisation for emergencies and specifies instructions about what to do if there is an emergency situation that may affect the water system. This guideline illustrates how to develop a water safety plan (WSP) and an ERP. The corresponding templates are also provided respectively that can be modified to fit the specific needs of each system depending on the type, size and complexity of the system. Also available is the *Technical report – Water safety and security: emergency response plans* (**WRC report no. 2213/1/16**).

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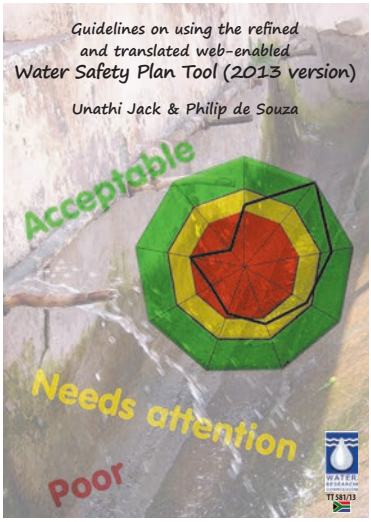

GUIDELINES ON USING THE REFINED AND TRANSLATED WEB-ENABLED WATER SAFETY PLAN TOOL (2013 VERSION)

WRC report no. TT 581/13

Water safety planning is a process of identifying and implementing possible and known risks in the water supply system. The process aims to ensure acceptable drinking water quality through all stages of the water supply system. The water safety planning process, in turn, assists the user in developing a water safety plan which is a guiding plan with respect to managing, avoiding, minimising/reducing chances of water contamination in the water supply system. A previous WRC project aimed to establish a methodology to identify and manage the risks of water services infrastructure and the means by which water services institutions are better able to identify and manage these through use of water safety planning. This project refined the tools with the objective to ensure that the methods used to develop water safety plans are in line with sector requirements and support the water safety planning process as much as possible. The water safety planning tools were created in both Excel and web-based formats.

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ANTIBIOTIC RESISTANT BACTERIA AND GENES IN DRINKING WATER

The presence of trace levels of antibiotics and antibiotic-resistant bacteria (ARB) in source water and final drinking water is an emerging quality and health issue. This study investigated the occurrence of antibiotic-resistant genes and ARB in selected raw water and water after being treated in drinking water production facilities.

WRC report no. 2585/1/19

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GUIDELINES FOR USING THE WEB-ENABLED WATER SAFETY PLAN TOOL

This project aimed to establish a methodology to identify and manage the risks of water services infrastructure and the means by which water services institutions are better able to identify and manage these through use of water safety planning.

WRC report no. TT 515/12

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THE DEVELOPMENT OF A GENERIC WATER SAFETY PLAN FOR SMALL COMMUNITY WATER SUPPLY

This guideline focuses on the methodology that can be used to develop a water safety plan for small community water supply in South Africa. A comprehensive checklist has also been included to ensure the proper development and maintenance of a water safety plan.

WRC report no. TT 415/09

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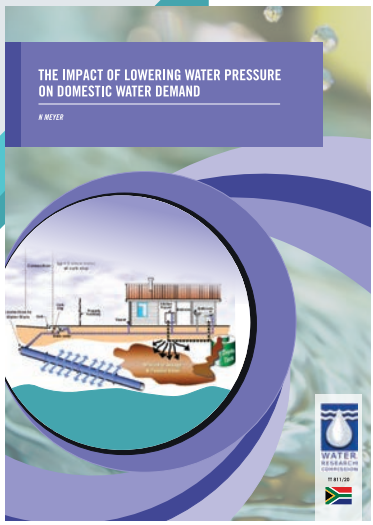
RETICULATION MANAGEMENT



THE IMPACT OF LOWERING WATER PRESSURE ON DOMESTIC WATER DEMAND

WRC report no. TT 811/20

Pressure management is commonly employed in water distribution systems as part of water conservation and water demand management strategies. The benefits of pressure management have been well documented to include reduced water leakage, extended life of water infrastructure, reduced pipe bursts, cost savings and reduced pressure dependent demand. This report presents a basic planning guide that can be used by municipalities to estimate the potential reduction in consumer demand and the potential reduction in DMA input volume from a pressure management perspective. A pressure management exercise should generally result in a reduction of the total input volume as well as a reduction in average consumer demand although the impact on consumer demand can, in some cases, be very low to negligible.

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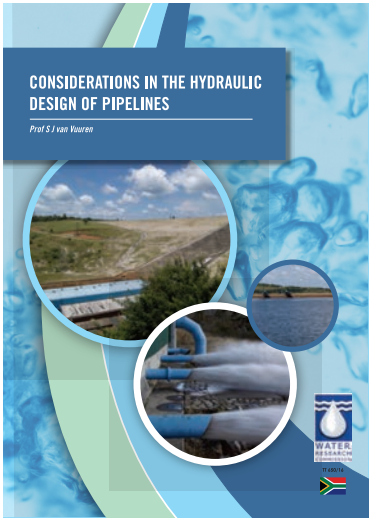

CONSIDERATIONS IN THE HYDRAULIC DESIGN OF PIPELINES

WRC report no. TT 650/15

The objective of the research was to investigate the hydraulic capacity of aging pipelines and to relate the reduction in hydraulic capacity to the major contributing factors. The report summarises the findings of pipe reviews which were conducted during the research project and highlights the following actions which should be considered during the hydraulic design of pipelines: review and incorporate available recorded hydraulic performance data of pipelines in the region in the design of new infrastructure; include the secondary energy loss associated with the dimensional details of the couplings in the calculation of the energy loss in the pipeline; use the proposed BRM (biofilm resistance model) to calculate a representative roughness for biofouled pipelines; implement the proposed procedure to determine the remaining useful life of pipelines to be able to prioritise the upgrading or replacement of system components; and provide monitoring points for the initial, continuous or intermittent hydraulic assessment of the pipeline.

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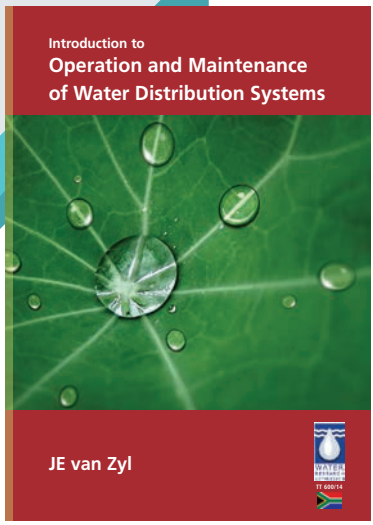

INTRODUCTION TO OPERATION AND MAINTENANCE OF WATER DISTRIBUTION SYSTEMS

WRC report no. TT 600/14

The aim of this book is to assist service delivery by making information on proper operation and maintenance practices available in a practical and accessible way. The book focuses on water distribution systems, including pipes, pumps, valves, storage reservoirs, meters and other fittings. It does not deal with other equally important elements of the water supply chain, such as the protection of water sources, raw water systems, water treatment plants and plumbing systems. In addition, the book focuses on technical issues of operation and maintenance and does not deal with associated factors, such as human resource management, data systems, funding and public participation and accountability.

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GUIDELINES FOR REDUCING WATER LOSSES IN SOUTH AFRICAN MUNICIPALITIES

WRC report no. TT 595/14

There is no single water demand management intervention that will always provide the best savings at the least cost. Every water-supply system is unique in some way and will have its own specific problems. In reality, reducing water losses from municipal water distribution systems is not complicated, but does require a dedicated and methodical approach if real and sustainable savings are to be achieved. It is often similar to detective work, where the first step in the process is to identify and understand the problem before trying to solve it. Too often, water loss reduction interventions are introduced which are inappropriate to the problems experienced in the reticulation system. The interventions must be selected to address the most serious problems experienced in a specific area to have any chance of success. This book aims to assist municipalities in understanding how they can reduce water losses from municipal reticulation systems.

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INTRODUCTION TO INTEGRATED WATER METER MANAGEMENT

WRC report no. TT 490/11

Water metering is particularly important for municipalities since it forms the basis for much of their income through the sale of water to their consumers. In South Africa, like in many other countries, there is a legal imperative on municipalities to meter consumers and manage water losses in compliance with legislation and standards. This book covers all aspects of water meters and water metering in municipalities. It covers the theoretical principles of meters, legal and metrological requirements, meter types, best practice guidelines as well as practical aspects of water meter management (among others). It is anticipated that this book will serve as a training aid and a valuable tool for water utility managers, engineering technical staff, operations and maintenance and meter reading personnel and researchers.

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LEAKAGE CHARACTERISATION OF BULK WATER PIPELINES

The aim of this project was to determine the characteristics and extent of water losses on bulk pipelines in the field. The study used pressure testing in combination with the latest models on the behaviour of leak areas with pressure to achieve this aim.

WRC report no. 2572/1/19

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RESPONSIVE PIPE NETWORKS

The work presented in this report is aimed at investigating the performance of a potential leakage detection system detecting leaks in newly installed piped water distribution networks. The envisaged system will comprise a fibre optic cable either fixed to the pipe or buried in the pipe bedding near the pipeline during pipe installation.

WRC report no. 2726/1/19

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GROUTED LINING SYSTEMS FOR THE RENOVATION OF OLD STEEL PIPELINES AND THE DESIGN OF NEW PIPELINES

This report reflects a summary of the findings for the WRC and Rand Water research with the objective to review alternative liner systems that can be used for the renovation of steel water pipelines.

WRC report no. 1448/1/12

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