Annexure D
National Strategy for Water re-use

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Table of Contents

INTRODUCTION

South Africa has limited fresh water resources and has been defined as water stressed by International standards[1].

The re-use of water in South Africa accounts for approximately 14% of total water use, and return flows account for a large part of water available for use from some of the important river systems[2]. The National Water Resources Strategy (First Edition) identifies water re-use as one of a number of important strategies to balance water availability with water requirements in future and the extent of water re-use in South Africa is very likely to increase substantially over time. There is an associated risk that water re-use is unplanned, unregulated and/or results in unintended or undesirable consequences.

The re-use of water is widely practiced in the world, both in developed and emerging economies. Many countries have developed water re-use policies and associated laws and regulations. Water re-use internationally contributes to reconcile the gap between water availability and water needs in such countries as the United States of America, Spain, Australia, Israel and China.

Within the above context, this document provides a strategy for a considered approach to implementation of water re-use projects that is consistent with the National Water Resource Strategy[3] and national water policy and legislation.

1.1 Defining water re-use

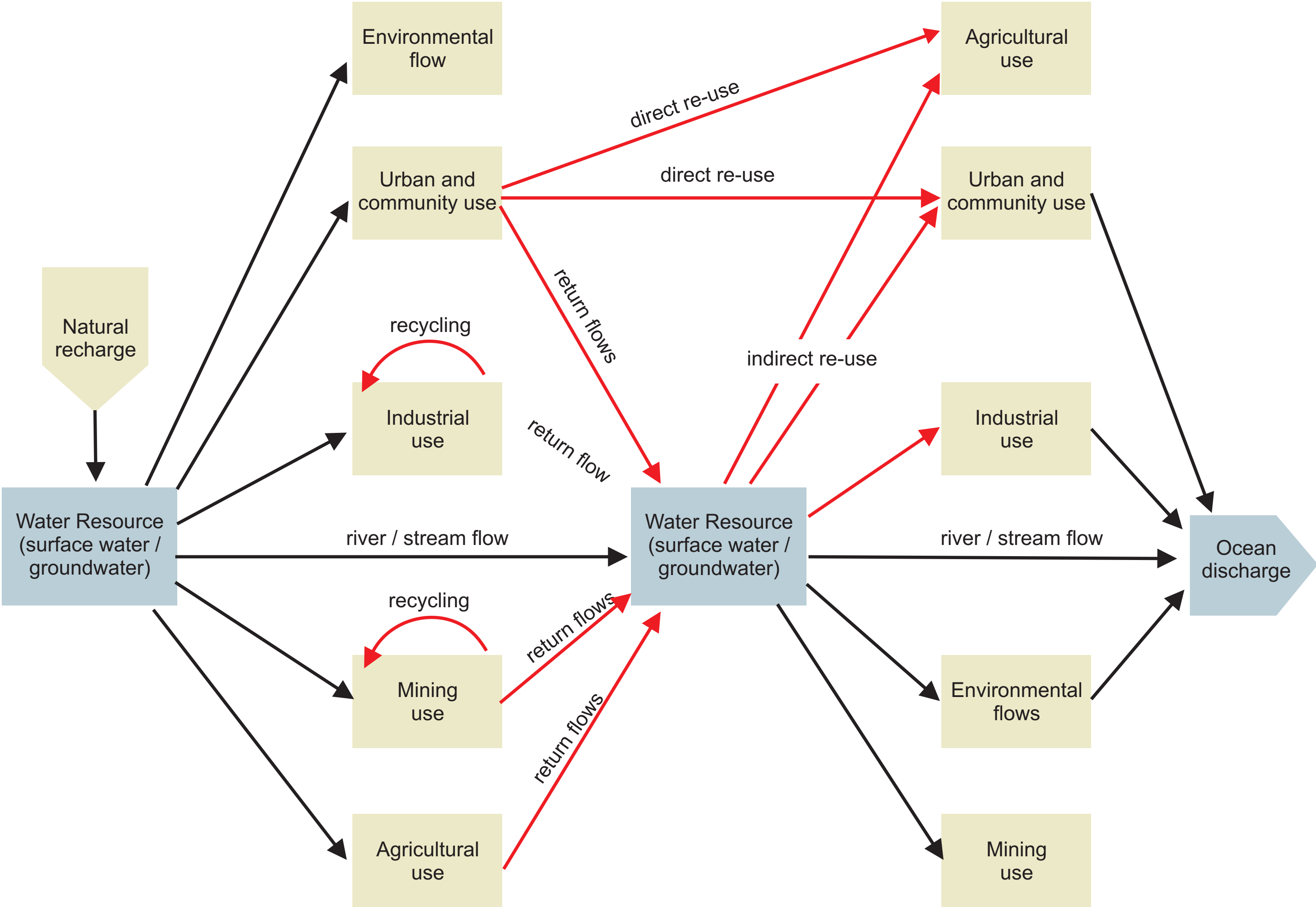
Water re-use can be direct or indirect, intentional or unintentional, planned or unplanned, local, regional or national in terms of location, scale and significance. Water re-use may involve various kinds of treatment (or not) and the reclaimed water may be used for a variety of purposes. These different kinds of water re-use have different implications for a re-use strategy. It is therefore important to be precise in the use of terminology. Definitions of commonly used terms are given in **Table 1.**

Figure 1 illustrates how water can be re-used and recycled. This illustration does not cover all possible methods of water re-use, but is only intended to demonstrate the concepts involved in water re-use and water recycling.

Table 1: Water re-use terminology

[1]Water Re-use, An International Survey of Current Practice, Issues and Needs. Editors Blanca Jimenez and Takashi Asano. IWA Publishing. 2008.
[2]Integrated Water Resource Planning for South Africa. A Situation Analysis 2010. Department of Water Affairs. Report No RSA 000/00/12910.
[3]National Water Resources Strategy, Department of Water Affairs and Forestry, First Edition, September 2004.

Term	Definition
Water re-use	Utilization of treated or untreated wastewater for a process other than the one that generated it, i.e. it involves a change of user. For instance, the re-use of municipal wastewater for agricultural irrigation.
Water recycling	Utilization of treated or untreated wastewater for the same process that generated it, i.e. it does not involve a change of user. For instance, recycling the effluents in a pulp and paper mill.
Direct re-use	Re-use of treated or untreated wastewater by directly transferring it from the site where it is produced to a different/separate facility for the next use.
First water use	Water coming from a fresh water source receiving no identifiable upstream wastewater discharges.
Indirect re-use	Re-use of treated or untreated wastewater after it has been discharged into a natural surface water or groundwater body, from which water is taken for further use.
Intentional or planned re-use	Use of treated or untreated wastewater as part of a planned project. It is always performed intentionally, consciously and using reclaimed water for a specific user.
Unplanned or incidental re-use	Subsequent use of treated or untreated wastewater after it has been discharged into a surface water or groundwater body from which water is taken for drinking purposes or another use. Initially, it always occurs as a subconscious activity; with time it might occur consciously but not as part of a planned project in which wastewater is properly treated and water quality monitored for the specific water use purpose.
Reclaimed water	Wastewater that has been treated to a level that is suitable for sustainable and safe re-use.
Return flows	Treated and/or untreated wastewater that is discharged to a natural surface water or groundwater body after use.
Wastewater	Water derived from any of a number of uses of water and typically containing residual pollutants associated with the use of the water.
Grey water	Wastewater derived from the domestic and household use of water for washing, laundry, cleaning, food preparation etc. Grey water does not contain faecal matter.
Black water	Wastewater containing faecal matter and urine associated with water use in toilets and urinals.



Note: This figure does not show all possible water use, re-use and recycle, but demonstrates the concepts

Figure 1: Illustration of different ways that water can be re-used and re-cycled

2 UNDERSTANDING RE-USE IN THE CONTEXT OF WATER SUPPLY

There are essentially three generic sources of 'used' water associated with different scales of water re-use:

- At a micro-level, the water that has been used by a household, a business, an institution or industrial facility, a power station, a farm or a mine. The key feature is that this used water is available at a specific and local geographic location. The quantity and quality of water available for re-use will depend on how it has been used and if there is any local (on-site) treatment or not.
- At a community or facility level, where wastewater has been collected from a group of users (typically within a natural drainage basin), and typically through a sewer network. In this case, the used water is available at the discharge point of the treatment facility at a quality that is dependent on both the characteristics of the inflow to the treatment facility as well as the treatment technology used and its effectiveness (both in terms of design and operational performance).

- At a river system level, where used water (treated and untreated) has been discharged (or found its way) back into the river system. In this case, the used water is blended with the 'fresh' water in the river system. The quality of the river water will depend on the quality and quantity of the return flows, the state of the receiving water body and its assimilative capacity, and the ratio of fresh water flows to return flows (the dilution effect).

At a river system level, it is estimated that approximately 1 800 million m3 per annum of water flowing in our rivers is return flow, that is used water, accounting for 14% of the total available water in South Africa. At the treatment facility level, South Africa has in excess of 1 000 municipal wastewater treatment works, discharging approximately 2 100 million m3 per annum of treated effluent, back to the river systems[4]. At the "micro level", the availability of South Africa's water for re-use may be broadly categorized and aggregated into different industrial, mining, power generation and agricultural sources[5]:

Mines, in addition to using fresh and re-using water, may also 'generate' water. This occurs through the filling of mine cavities and the need to pump this water, or the natural decanting of this water where pumping does not take place. This water is referred to as mine decant or mine drainage. This water may be acidic, saline and may contain heavy metals. The mine water typically needs to be treated before it can be re-used

3

UNDERSTANDING THE NEED FOR WATER RE-USE

3.1 Key drivers affecting water re-use choices

There are five key considerations that affect choices related to water re-use as an option for water supply and augmentation:

- Water quality and security of supply
- Water treatment technology
- Cost relative to other water supply alternatives
- Social and cultural perceptions
- Environmental considerations

Although these are likely to be inter-related in practice, it is useful to discuss each in turn.

3.1.1 Water quality and security of supply

The cost of water is strongly related to the source of water, the required water quality and the associated treatment requirements (for both supply and discharge). Where water quality requirements are relatively low or where wastewater discharge costs are high, the re-use of water is likely to be more attractive.

Water quality as it relates to public health is important in considering water re-use as a water supply option. Any real or even perceived threat to public health would be considered a fatal flaw.

The re-use of water may increase the security of supply for specific users and may therefore be attractive in these cases, even where the cost exceeds alternative supplies. Note that it is not necessarily the case that increased water re-use increases the security of supply for an overall water supply system.

3.1.2 Water treatment technologies

The choice of treatment technology is a function of both the nature of the pollutants in the water and the required quality of the re-use water. An overview of applicable treatment technologies is given in **Table 2.**

The best practice in water re-use projects applies the multiple barrier approach to the control and removal of pollutants. This implies that in the sourcing, treatment and distribution of reclaimed water several control, technological and management barriers are set up to achieve a high level of assurance with respect to pollutants removal and producing a reclaimed water fit for use and safe for human consumption.

[4]Wastewater Treatment in South Africa: From Crisis to Compliance. Water Research Commission. Report No. 8001/8295/3/P, August 2006.
[5]A First Order Inventory of Water Use and Effluent Production by South African Industrial, Mining and Energy Generation Sectors. Water Research Commission. Report No. 1547/1/10, April 2010.

Table 2: Applicable water treatment technologies for water re-use

Category of Pollutants	Applicable Technologies
Macro-organics, COD and BOD5	• Biological treatment (activated sludge, trickling filtration, fixed film reactors, membrane bioreactors) • Chemical coagulation/flocculation and clarification
Particulate and suspended solids	• Chemical coagulation/flocculation and clarification • Granular media filtration • Membrane filtration
Nutrients – Nitrogen	• Biological nitrogen removal (nitrification/denitrification) • Air stripping (ammonia) • Chemical coagulation/flocculation and solids separation
Nutrients – Phosphorus	• Biological phosphorous removal (enhanced biological phosphorus uptake) • Chemical precipitation (typically metal salt addition) • Chemical precipitation (packed bed reactors)
Microbiological Agents: •Bacteria •Viruses •Parasites	• Membrane filtration • Chemical disinfection (chlorine, bromine compounds etc.) • Ultra Violet (UV) radiation
Salinity, inorganic salts	• Precipitation • Ion exchange • Membrane desalination (nanofiltration /reverse osmosis)
Metals	• Precipitation • Chemical adsorption • Membrane separation
Micro-organics: •Volatile Organics •Pesticides •Pharmaceuticals •Endocrine Disruptors	• Advanced oxidation (H2O2/UV) • Adsorption by activated carbon (granular/powder) • Membrane separation (nanofiltration /reverse osmosis) • Biologically enhanced adsorption (BAC)
Disinfection byproducts	• Modify disinfection agent in upstream processes • Advanced oxidation • Adsorption by activated carbon (PAC/GAC) • Membrane separation (nanofiltration /reverse osmosis)
Radionuclides	• Precipitation • Chemically enhanced adsorption • Membrane separation (nanofiltration /reverse osmosis)

The wastewater and effluent treatment technologies for re-use applications are generally proven for South African conditions. A local knowledge base exists to plan, design, construct, operate and maintain a wide range of treatment technologies. However, some of the more sophisticated technologies such as advanced oxidation, membrane desalination etc. have been applied to a limited number of local projects. The South African water industry will need to grow capacity to confidently implement some of the more advanced water re-use technologies.

3.1.3 Cost considerations

Where water re-use is more cost-effective compared to other alternatives (such as reducing water requirements, securing a fresh water supply or desalinating sea water), then water re-use becomes an attractive choice provided that the quality of water can meet the necessary requirements and there are not any important cultural or social objections to the use of this water.

Costs are affected primarily by water quality requirements (related to both supply and discharge and the associated treatment requirements) and the relative geographical locations of water supply and needs. As supply costs increase and with the introduction of waste discharge charges, the cost of re-using water is becoming increasingly competitive with the traditional supply alternatives and this will be a key driver for increasing re-use of water in future[6].

The typical increasing cost of different water sources is reflected conceptually on **Figure 2.** Water re-use must be considered as one of several options to augment water supply to a city, industry or mine, once the conventional fresh water resources are fully developed or the cost of water re-use becomes comparable to development of conventional water sources.

The economic value/cost of water must also be seen in the broader context of affordability, reliability and responsible use of a limited resource.

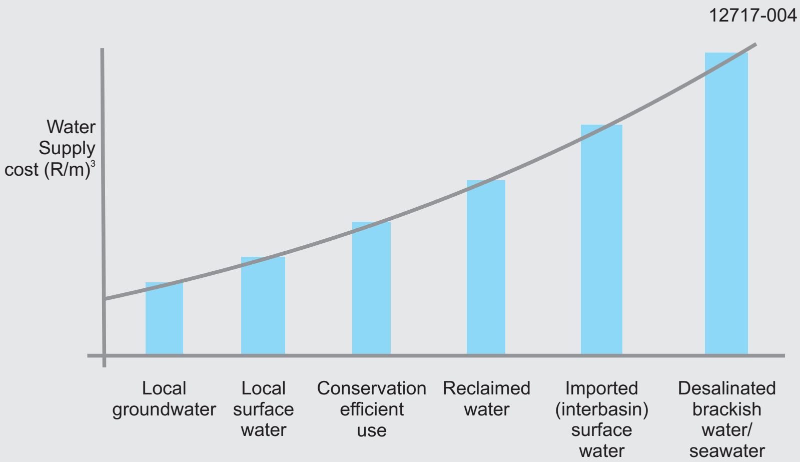


Figure 2: Comparative cost of different water sources

3.1.4 Social and cultural perceptions

Public perceptions and cultural taboos may create obstacles to certain water re-use applications. The two most important of these relate to the re-use of suitably treated municipal wastewater (comprising domestic sewage) for irrigation of food crops and for potable water supply. People attach religious, cultural and aesthetic values to water and any water re-use project must remain sensitive to these values[7].

3.1.5 Environmental considerations

Receiving water quality objectives (related to the actual and desired environmental status of a water resource) may affect abstraction rights and volumes, discharge standards, waste discharge charges and associated rights and obligations to return used water to a water system. These will ultimately affect the relative costs and benefits of re-use compared to other alternatives.

Re-use of water will typically have positive environmental benefits, specifically on the water environment through protection of aquatic ecosystems by not having to abstract more water from a natural source, and avoiding degradation of natural waters by not discharging wastewater, but rather using reclaimed water. Water re-use projects may, however, still have an environmental footprint and energy usage depending on the water reclamation technologies used. Water re-use must therefore be evaluated in the context of other water supply and water augmentation options with consideration of environmental impacts, carbon footprint, ecological footprint and energy usage.

Wastewater treatment to produce reclaimed water fit for re-use typically produces a waste stream. The handling and disposal of waste (such as brine from a mine water reclamation plant) will typically have environmental impacts. The potential exists and should be actively researched and developed to extract useful products and energy from such waste.

3.2 The need for water re-use by sector

3.2.1 Agricultural sector

Even though the agricultural sector uses about 7 680 million m^3 per annum (accounting for about 60% of total water use in South Africa), only a small proportion of irrigated agriculture directly uses treated wastewater. In contrast to this, Israel has a strategic objective to collect and treat all of its domestic wastewater for re-use in agriculture.

[6]Assessment of Ultimate Potential and Future Marginal Cost of Water Resources in South Africa. Department of Water Affairs. Report No. PRSA 000/00/12610, September 2010.
[7]Religious, Philosophical and Environmentalist Perspectives on Potable Wastewater Re-use in Durban, South Africa. Wilson Z and Pfaff B. Pollution Research Group, School of Development Studies. University of KwaZulu-Natal.

Therefore considerable potential exists to substantially expand the use of treated wastewater for irrigation purposes in South Africa. This will bring many benefits. Irrigation is often labour intensive and expanding the area under irrigation may create jobs. Wastewater return flows are typically available close to urban areas and thus close to urban markets for agricultural produce, provided suitable land is available for irrigation. Treated wastewater can substitute for freshwater, thus making more freshwater available for other uses[8].

Any such re-use of water by agriculture will have to be balanced by the competing other requirements and historical allocations of water in the specific water management area.

3.2.2 Municipal sector - non-potable water

The main source of water for re-use in municipal (urban) areas is wastewater from municipal treatment works. This typically comprises a mix of domestic sewage and other wastewater. Other sources of water for re-use include grey water (usually available at the household/water user level only) and industrial effluents.

The main potential uses of treated wastewater from municipal wastewater treatment works is for the irrigation of public open spaces (parks etc.) sports fields (municipal, schools and clubs), golf courses and cooling (related to industry and power generation). The return flows from wastewater treatment works can also be important for urban water systems (rivers, lakes, dams and wetlands). Treated wastewater and/or grey water can also be used for fire fighting, toilet flushing, cooling systems, street cleaning, dust control and a variety of applications that do not require potable water.

Of the total volume of municipal wastewater treated, it is estimated that only a small fraction is re-used, most of it is for the irrigation of public open spaces, sports fields, golf courses and cooling systems. In the past, the urban/municipal re-use of treated wastewater was not actively promoted due to the cost of such systems and the potential public health risks. Some re-use of water, for example in the irrigation of recreational areas and golf courses may be in competition with other essential water uses.

3.2.3 Municipal sector - potable water

Used water can be treated to a standard fit for domestic use (drinking purposes). Treated water can be supplied directly to households (direct re-use) or be discharged back to the (fresh) water resource where it is blended with other water and subsequently abstracted, treated and distributed for use (indirect re-use).

There are many potable water re-use schemes in operation in the world. The majority of these schemes are based on an indirect re-use approach. Indirect water re-use for potable purposes is well established in South Africa. It is common for a treated wastewater effluent to be discharged to a river system and for water to be abstracted downstream of this discharge point and to be treated and used for drinking water. The direct re-use of used water for potable purposes has not been implemented in South Africa, but has been successfully implemented in Windhoek, Namibia, since the 1970's[9].

The main concerns related to both the direct and indirect re-use of water for potable purposes include the following: the presence of pollutants such as pharmaceuticals, health care products, pesticides, industrial chemicals, heavy metals etc. in municipal wastewater and industrial effluents that may be difficult or costly to treat adequately, the associated risks in terms of the ability to design and manage treatment processes with a suitable level of confidence and to predict the public health impacts of re-using water for drinking purposes. Public perceptions and acceptance of direct and indirect re-use of water for drinking purposes are also challenges and in this case sophisticated and reliable technical and management systems will be required.

3.2.4 Industrial sector

The re-use of water is already widely implemented by water intensive industries (through process water recycling and cascading water uses). The extent of re-use and the specific details as to how water is re-used is industry and process specific. Nevertheless, industrial water use is typically organized according to the quality of water required, as follows:

- Processes requiring high quality water such as steam generation, wash-water in clean environments, foods processing, final product rinsing, product make-up etc;
- Processes requiring moderate water quality such as for cooling, refrigeration, general washing and rinsing, etc; and
- Processes requiring low water quality such as for raw material hydraulic transport, ore washing and milling, dust control, minerals processing etc.

Many industries do not require high quality water for process applications and can therefore use treated wastewater from municipalities and treated effluents from other industries. The wastewater from the upstream user must, however still be adequately treated and prepared for subsequent industrial use.

Industries can be operated as zero effluent discharge (ZED) facilities by adopting the principle of water recycling and re-use. This may require the treatment of industrial effluent to a high standard to allow re-use of water even by sensitive water users, such as for human consumption. **Figure 3** shows an example of potential water re-use applications in a soft drink bottling industry.

[8]The Wealth of Waste: The Economics of Wastewater Use in Agriculture. Winpenny J et al. Food and Agriculture Organisation of the United Nations. Rome. 2010.
[9]Direct Potable Re-use – A Path Forward. Tchobanoglous G. et al. Water Re-use Research. California. 2011.

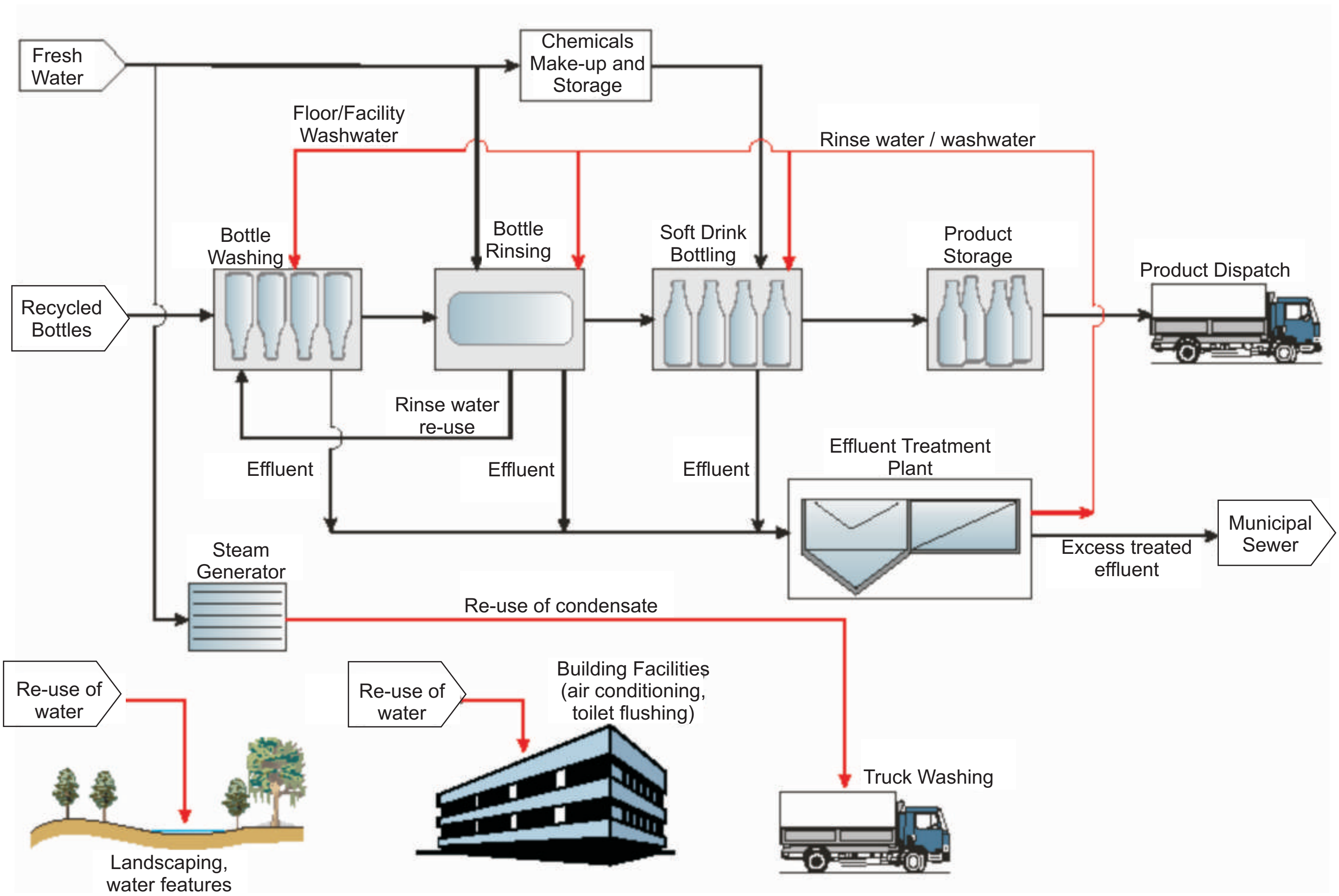


Figure 3: Water re-use applications for a soft drink bottling facility

3.2.5 Mining sector

Mining and minerals processing facilities use large volumes of water and recycling and re-use is widely implemented to reduce costs and to meet environmental requirements. Typical water re-use applications include:

- Cascading use of fresh intake water to different processes which require different water qualities, for example, blowdown from cooling towers can be used to mill the ore
- Capture and use of mining impacted water to replace fresh intake water
- Return and re-use of water from mining waste facilities, such as tailings deposition facilities

Water re-use opportunities in the mining and minerals processing industry are illustrated in **Figure 4.** The issue of acid mine drainage (AMD) is pertinent to the mining sector. AMD can potentially have very negative impacts on the natural aquatic environment and downstream users if left to decant and flow untreated into the fresh water resources. The collection, treatment and re-use of AMD turns the negative impacts into a positive beneficial water use.

3.2.6 Power generation sector

The power generation sector has in the past used and continues to use large quantities of fresh water, requiring in many cases inter-basin transfer of water. As the available fresh water resources become fully utilized, the sector has implemented dry cooling technologies. The need for improved air emission control has, however increased the water requirements. Coal-fired power stations in South Africa are typically operated as zero effluent discharge facilities. The sector is continuously improving the efficient use of water, specifically in the handling and management of ash and waste.

The water requirements and water re-use opportunities in nuclear power generation and renewable energy facilities will have to be understood as South Africa progressively moves to energy diversification.

3.2.7 Environmental requirements

Water supports and sustains natural and man-made aquatic ecosystems by, for example, maintaining minimum flows and appropriate flow regimes in streams, rivers and estuaries, recharging wetlands and maintaining the water levels of man-made water features such as urban lakes and dams.

Re-used water can play an important role in the above, supplementing or even partially substituting for freshwater. However, care must be taken to clearly define receiving water quality objectives and to manage the impact of water re-use on water quality. More advanced treatment may be required to further encourage this form of water re-use and to meet strict receiving water quality requirements.

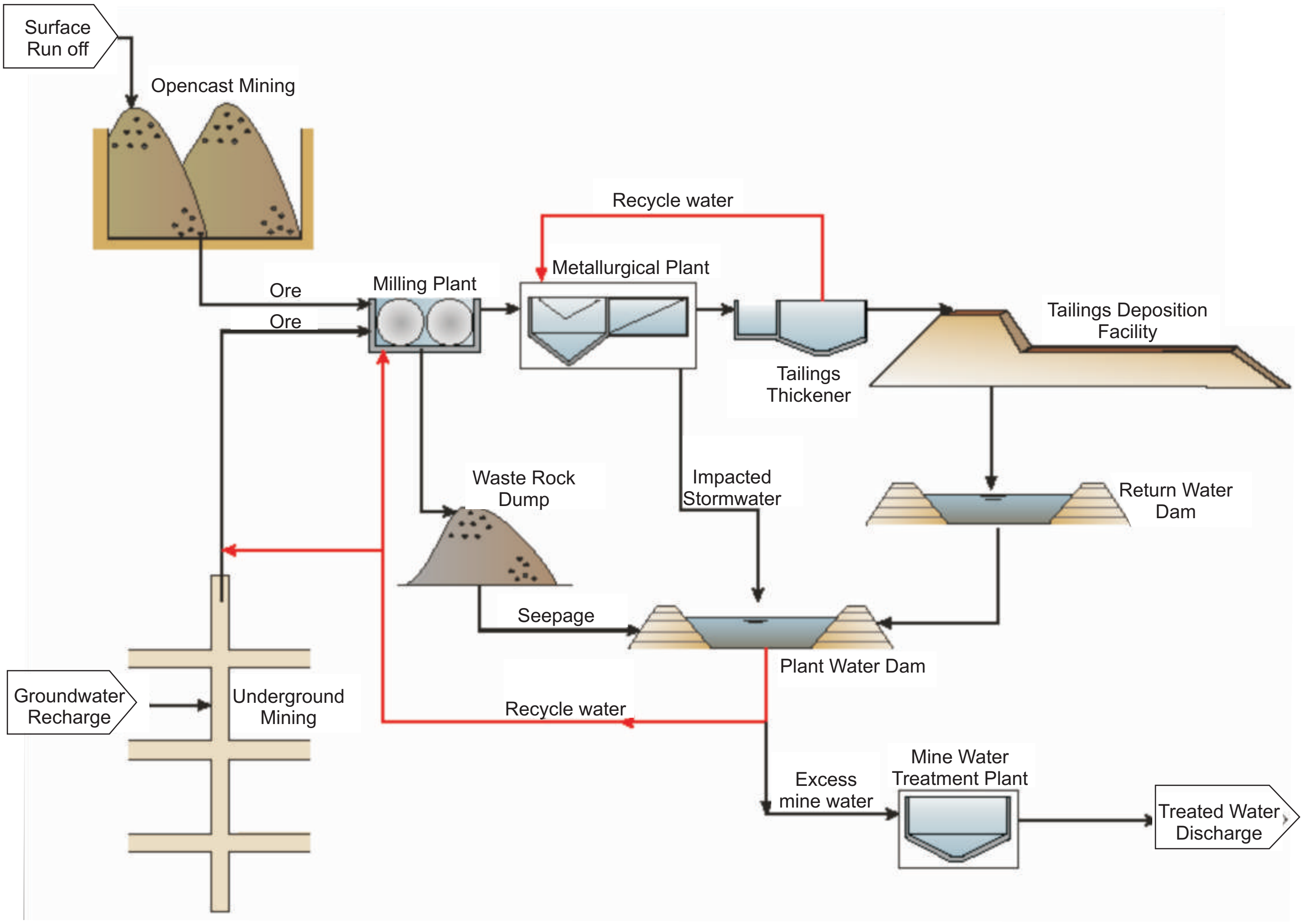


Figure 4: Water re-use applications in the mining and minerals processing industry

4

WATER RE-USE CASE STUDIES

The cost of re-using water relative to other alternatives is one of the most important factors that will determine water re-use decisions. It is therefore important to understand the key factors that will affect costs and how these vary between different applications of re-use and are likely to change over time, relative to other water supply alternatives. It is also important to understand how these costs might be reduced so as to make water re-use more economically attractive. The key determinants of cost are location, water quality, treatment technology and volume (scale).

Because the possible applications of water re-use (and hence the appropriate treatment technologies to be used) are very extensive, it is not feasible to discuss these exhaustively or in any detail here. Instead, five main applications of water re-use are discussed in the form of 'case studies' with the understanding that the approaches and principles emerging from these cases can be applied to other similar water re-use applications. The six 'case studies' are:

- The use of treated municipal wastewater for urban uses
- The use of treated municipal wastewater for industrial use
- Zero discharge mining/industrial facilities
- Rethinking household sanitation and grey water
- The direct re-use of treated municipal wastewater for potable use purposes
- The treatment of acid mine drainage

Appendix A contains a list of selected South African case studies to demonstrate some existing local water re-use projects.

4.1 Using treated municipal wastewater for urban uses

The re-use of treated wastewater for urban applications such as public parks, sports fields, golf courses etc. could replace the use of freshwater. The construction and operation of a separate recycled water reticulation system is relatively expensive and has been an impediment to implementation. Water re-use systems ("purple pipes") have, however been successfully implemented in many countries with appropriate controls and safeguards. The concept of small scavenging wastewater treatment plants, taking wastewater from the sewers and producing a water fit for re-use at the local point of the water requirement may be more cost effective. Municipal bylaws would have to be adapted to encourage but also better regulate such re-use of water.

4.2 The use of treated municipal wastewater for industrial uses

Several successful projects to re-use treated municipal wastewater for industrial processes are in operation in South Africa – refer to Appendix A. These projects typically involve a large wet industry such as a steel mill or pulp/paper mill linked to a source of treated wastewater. The concept is well established and the project drivers are a combination of the factors listed in Section 3.1 of this document. Some innovative implementation models involving private sector financing, operation and maintenance are available. Since an industry is involved, private sector resources can be readily deployed to implement such water re-use projects.

4.3 Zero discharge for mining/industrial facilities

Industries discharging effluents to municipal sewers may require pretreatment to achieve trade effluent standards set in bylaws. Industries discharging effluents back to streams/rivers implement treatment systems to achieve licensed discharge standards. Many wet industries now implement water recycling and re-use projects based on considerations of water availability and cost. Stream/river discharge standards may be strict and the quality of a treated effluent may be adequate for re-use, thus saving the cost of purchasing fresh water. The re-use of a treated industrial effluent may also be a strategic decision to improve the availability of water and diversify on sources of water.

4.4 Rethinking household sanitation and grey water

Conventional waterborne sanitation uses potable standard water to wash away human faeces, in the process combining good quality water with potentially valuable resources (faeces and urine) to create polluted water that needs to be treated. This is not an efficient system in a context where fresh water is scarce and precious and where fertilizer inputs for agriculture productivity are limiting. As resource scarcity and prices change over time, it may make increasing sense to rethink our conventional sanitation solutions and to invest in more environmentally friendly and sustainable alternatives.

Similarly, the implications of current practices of adding phosphates to detergents and soaps used in washing processes, and then combining this water (grey water) with domestic sewage will need to be carefully considered. These practices are likely to need to change in future as fresh water becomes more valuable and the cost of treating polluted water resources becomes higher.

A limited number of countries in the world have implemented urine separation and collection systems, with the aim of nutrient (nitrogen, phosphorous and potassium) recycle to agriculture.
Changing household practices at this fundamental level may have significant implications for water use and the availability of wastewater for re-use in the long term. A water re-use strategy that is forward thinking over ten to twenty years needs to take these possible changes into account. The economic tipping point for the implementation of alternative household sanitation approaches will dictate the speed of change.

4.5 Direct re-use of treated municipal wastewater for potable purposes

The direct re-use of treated municipal wastewater for potable purposes is practised at a limited number of locations in the world. The knowledge of municipal wastewater composition and sophisticated treatment technologies has advanced to the point where this can be considered as an option in the spectrum of water supply alternatives. Specific opportunities exist in the coastal communities and cities where treated municipal wastewaters are discharged to the ocean, effectively losing an opportunity for water re-use.

The implementation of such direct re-use projects will, however, have to overcome perceptions and risks related to public acceptance, trust in scientific knowledge and engineered systems, trust in water supply authorities, social justice and fairness.

Direct re-use of treated municipal wastewater for potable purposes would only be practical where sophisticated technology, competent operational and management systems and safeguards are in place to protect the public health.

4.6 Treatment of acid mine drainage

Acid mine decant or drainage is a potentially important source of water for re-use. This water must be treated to limit current and future environmental damage to water resources, and can be treated for re-use for industrial and even potable water use purposes.
Several AMD treatment and re-use projects have now been implemented in South Africa demonstrating the technical feasibility, financial viability and stakeholder acceptance of such projects. Challenges remain to address the issues of appropriate and long term (post mine closure) operation and maintenance of such AMD re-use schemes.
AMD treatment and re-use projects could utilize the large storage available in mining workings, do not have to contend with evaporation loss of water and can deliver reclaimed water in proximity to several large urban areas, such as the Witwatersrand and Mpumalanga Highveld. .

5 NATIONAL STRATEGY FOR WATER RE-USE

5.1 Promoting sound decision making

The implementation of water re-use can take place at different scales or levels: at a very local level involving a single facility such as a building or a factory, for a group or cluster of facilities, at a treatment facility level (for example, such as a municipal treatment works) or at a river system level (natural drainage areas/catchments). Decision-making will vary across these applications and could involve individual or groups of households or businesses, municipalities and national government (including entities owned by government).

The intent of the water re-use strategy is to encourage wise decisions relating to water re-use for all of these different decision makers. There are three important factors that can enable and support good decision making:

- A sound and clear policy and legislative framework, that is, decision-makers and water users know what their rights and obligations are, and what they can and cannot do.
- The benefits, risks and costs are clearly understood, and prices and costs accurately reflect the relative benefits and costs between alternatives so that incentives are not distorted.
- Decision makers have access to relevant information and support to make informed decisions, with the necessary support and backup to implement water re-use projects.

Each of these aspects are addressed in further detail below.

5.2 Creating a clear policy and legislative environment

Water re-use projects typically involve a range of activities that are subject to regulatory authorization and control. These controls exist in a range of legislation that includes, but is not limited to the National Water Act, (Act 36 of 1998), the Mineral and Petroleum Resources Development Act, (Act 28 of 2002), the National Environmental Management Act, (Act 107 of 1998), the National Environmental Management: Waste Act, (Act 59 of 2008), the Water Services Act, (Act 108 of 1997), the National Environmental Management: Integrated Coastal Management Act, (Act 24 of 2008), and municipal by-laws.

The fact that these controls exist in so many different acts, and that regulatory approaches may differ between the acts, makes it difficult to implement water re-use projects confidently, speedily and cost-effectively. This makes water re-use projects less favourable compared to other alternatives, even where it is practical and cost-effective to re-use wastewater.

The Department of Water Affairs will address this issue by:

- Developing clear and practical guidelines for typical water re-use projects on what regulatory approvals are needed, the status of reclaimed water in terms of right to use and how these can be obtained cost and time effectively (see 'guidelines' below)
- Working with other national departments to align legislation, reduce the regulatory burden wherever practical, and unblock regulatory obstacles to water re-use
- Act as the lead regulatory authority to assist in working with other Departments in getting approval for justifiable water re-use projects
- Working with municipalities to ensure that municipal by-laws support the appropriate re-use of water
- Ensuring the water quality standards implemented are appropriate in a context where water re-use is a strategic imperative (see 'reviewing water quality standards' below)

- Use the water licensing process as a key tool to promote water use efficiency
- Implement the waste discharge charge system

The Department will also review water related laws and regulations to assess the need for revision driven by water re-use. Legislation may then be revised to accommodate the need to facilitate, streamline, encourage and control water re-use projects.

5.2.1 Reviewing water quality standards

Water quality standards for discharges into the water resource and water quality standards and regulations for different types of water use (for example, minimum standards for potable water use, irrigation use for food and non-food crops) play a large role in influencing water re-use decisions. It is important that these standards are not so onerous that they make treatment for re-use prohibitively expensive and not so lax that they compromise public safety and the environment.

This is a complex area of regulation and considerable attention has already been paid to this in South Africa. The following standards exist:

- South African Water Quality Guidelines for a number of different water user sectors (DWAF, 1996)
- Drinking water quality standards (SANS 241, 2005, Edition 6), and the
- General and Special Standards pertaining to the discharge of treated wastewater to the water resource.

These standards and guidelines were not specifically developed to address the issues associated with water re-use. Worldwide research into water re-use is producing new information, which needs to be considered in guiding and regulating water re-use projects. The Department will review and/or develop standards and guidelines for water re-use.

Water re-use projects may be implemented for a large spectrum of potential water users. The different categories / types of water re-use will require quantitative standards to define and manage the fitness for use. The standards must be developed to address the following aspects:

- Water quality variables of concern in a specific water re-use application
- Quantification of risk and acceptable risk levels, and
- Monitoring requirements in terms of water quality variables, frequency and location of sampling / analysis.

5.3 Clear incentives

Water re-use projects are much more likely to be implemented where it is more cost-effective compared to other water supply alternatives. Households and business have limited budgets and will generally choose least cost options to meet their water use needs. Similarly, municipalities are resource constrained and typically opt for least cost choices related to securing water supplies for their residents in order to limit water price and municipal rates increases.

Sound water re-use outcomes will arise where the relative costs and benefits of alternatives are not distorted. Where fresh water supplies are heavily subsidized, water users are much less likely to choose water re-use options even if these options are cost-competitive with the cost of securing additional fresh water supplies. Conversely, subsidizing the re-use of water is unlikely to lead to least-cost outcomes and the efficient allocation of resources.

The Department will take the importance of price signals and incentives in water re-use decisions into account when reviewing the raw water pricing strategy.

5.4 Information to support sound decision making and implementation

The Department recognizes the important role that good information plays in supporting sound decisions. There are three aspects of information to consider: educating users with respect to the benefits and acceptance of water re-use; providing people who are considering water re-use with clear guidelines on how to implement water re-use projects, and sound methodology in the evaluation of options to balance water requirements and supply.

5.4.1 Methodologies for evaluating water resource development options

Water resource reconciliation studies undertaken for specific catchments and water systems in South Africa routinely consider conventional water supply augmentation options alongside water re-use, desalination and water conservation and demand management options.

The Department will continue to develop and refine the methodologies used to assess options to ensure that options are evaluated on a comparable basis and that the methodologies employed support sound decision making.

5.4.2 Guidelines for implementing water re-use projects

The Department will develop guidelines for the implementation of water re-use projects. These guidelines will support sound decision making and implementation. The guidelines will address the management and control, project implementation, choice of technology, operations and maintenance, project financing, development and implementation of tariffs and public and stakeholder education, engagement and consultation. Separate guidelines will be developed for different types of water re-use projects.

5.4.2.1 Technology selection

The selection and implementation of the appropriate treatment technology are key to the successful implementation of water re-use projects. It is strategically important to achieve this objective by:

- Selecting capable agencies/organisations with knowledgeable and competent staff to implement and operate re-use projects;
- Planning and executing the procurement of technology with the appropriate emphasis on functionality and proven performance;
- Ensuring that local knowledge of and support for the technology are available; and
- Providing technology guidance and training to re-use project implementing agencies/organisations.

5.4.3 Public education and awareness

The concept and implementation of water re-use will require a focused and sustained public education program to develop and entrench awareness of the different facets of water use and specifically water re-use.

Multiple awareness creation and information campaigns related to a spectrum of water related matters are launched by the Department, public institutions and private companies each year. It is important to develop and incorporate communication material related to water re-use into these campaigns.

Public perceptions and opinions vary on the topic of water re-use, specifically as it relates to indirect or direct water re-use. A structured communication strategy must be developed and implemented based on:

- An understanding of the diversity of perceptions and opinions
- Appropriate material to inform the public and stakeholders
- Active communication and debate on the topic
- Targeted media coverage

The overall objective of public awareness creation and information dissemination programs is to enhance the understanding and promote informed decision making related to water re-use. The current public perceptions and awareness of the poor operation, maintenance and performance of municipal wastewater treatment plants pose a specific challenge. It will be difficult to gather support for municipal water re-use within the current situation. The national efforts to address the poor performance of municipal wastewater and effluent treatment plants may have to show results on a consistent basis, before placing municipal water re-use onto the national water agenda.

5.5 Technology innovation and development

A range of water re-use projects have been implemented in South Africa (see Appendix A). South Africa has the potential to be a leading innovator in water re-use technology, particularly in the area of the treatment of acid mine drainage.

The Department will encourage the Water Research Commission (WRC) to make water re-use technology development a key focus area, and encourage the development of centers of excellence at selected universities.

5.6 Capacity to implement

5.6.1 Competent implementing agencies

Water re-use projects have many sophisticated technical, engineering, financial, operational and maintenance aspects. A key consideration to any such project is the fact that the water typically has to be treated to improve/upgrade its quality, before it is fit for re-use by a downstream user. The downstream user must be guaranteed an appropriate quality of water to protect designated use of the water. Re-use projects therefore require a high level of confidence in the implementation and operating agencies.

A public sector agency, such as a municipality or water board must have a minimum threshold of capacity and competency, (in terms of technical expertise, planning ability, project management capability, financial strength and rating), be a trusted water services deliverer and be accepted by the community and stakeholders as a reliable organization, before it can be considered as capable of implementing a water re-use project.

An agency/organisation must be able to demonstrate the capability to implement water re-use projects. It is therefore likely that the agencies and organisations with an acceptable capability and capacity profile to implement water re-use projects would be limited to metropolitan municipalities, water boards, some larger local municipalities, private companies specialised in the water sector and public private partnerships.

Private sector management, engineering and financing capacity related to water re-use, as demonstrated by several successful water re-use projects in mining and industry, is well established in South Africa. International interest in local water re-use projects has been expressed. The substantial private sector capacity must be leveraged in the implementation of water re-use projects.

The Department will investigate, together with established professional bodies in the water sector; the merits of establishing an industry-agreed evaluation/accreditation system for agencies/organisations implementing water re-use projects.

5.6.2 Developing the necessary skills for operating and maintaining water re-use systems

Water re-use projects will typically incorporate more sophisticated treatment technology and systems compared to conventional surface water and groundwater treatment. Such projects will fail unless trained, knowledgeable and motivated operations and maintenance staff is available. It is strategically important to implement the following actions:

- Prepare an assessment of the current and future skilled and trained people needed to operate water reclamation, water recycling and water re-use projects
- Encourage water services authorities and water services providers to consider and plan for the staffing and training needs to support water re-use projects, and
- Alert training and educational institutions in the water sector of growing needs for trained and skilled operations and maintenance staff.

The planning and implementation of water re-use projects must also include a comprehensive assessment of operations and maintenance aspects, including staffing, resources and system requirements.

5.7 Financing water re-use projects

Water re-use projects can be financed through the Municipal Infrastructure Grant, loans from development and commercial banks, project financing linked to public-private partnerships and through bonds issued by agencies such as the Trans Caledon Transfer Authority (TCTA). The waste discharge charges can also provide a source of funding for water re-use projects. This may specifically apply to indirect water re-use projects, where an upstream wastewater discharge containing residual waste is re-used by a downstream water user. The downstream user may have to implement relatively sophisticated and expensive water treatment technology and systems to produce water fit for use. The income generated by the waste discharge charge system may be applied to offset the incremental treatment cost associated with a re-use project.

Financing considerations are similar to those for other water resource development projects, except that the risk profile of the project may be different.

Tariffs can be applied specifically for different water re-use applications. Tariff setting may be subject to the National Water Act (Act No. 36 of 1998), the Water Services Act (Act No 108 of 1997), the Municipal Systems Act (Act No. 32 of 2000) and the Public and Municipal Financial Management Acts (Act No. 1 of 1999), depending on the specific application.

5.8 Enforcement

The performance of existing wastewater treatment plants in terms of meeting discharge standards and reliability is critical to the successful application of water re-use in South Africa. These facilities discharge water that impacts on the safety, economy and fitness for use by downstream users. Strict enforcement of discharge standards, and addressing the management and performance failures of municipal wastewater treatment plans is therefore critical to the future of indirect water re-use.

5.9 Recognition of success

South Africa has implemented a number of successful water reclamation and re-use projects in diverse sectors of the economy. It is also necessary to recognize water re-use as an important aspect of the efficient and responsible provision of water services. Consideration may in future be given to a "purple drop" recognition of safe and successful water re-use projects and operations, similar to the blue drop and green drop awards.

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APPENDIX A
Selected Water Re-use Projects in South Africa

Source of Reclaimed Water			Reclaimed Water User		Type or Re-use	
Water Services Authority	**Facility**	**Level of treatment**	**Institution/**	**Category of use**	**Planned / unplanned**	**Direct/Indirect**
City of Cape Town (Metropolitan Municipality)	Potsdam WWTP	Secondary, tertiary	Organization	Industrial, process water	Planned	Direct
Saldanha Bay Local Municipality	Urban Stormwater	Storage, infiltration	Chevron Refinery	Recharge of aquifer	Planned	Direct
City of Johannesburg (Metropolitan Municipality)	-	Secondary, disinfection	Kelvin Power Station	Industrial, cooling water	Planned	Direct
Rustenburg Local Municipality	Rustenburg WWTP	Secondary, disinfection	Platinum Mines	Metallurgical process and mining process water	Planned	Direct
City of Tshwane Metropolitan Municipality	Rooiwal WWT	Secondary, disinfection	Rooiwal Power station	Industrial, cooling water	Planned	Direct
eThekwini Municipality (Metropolitan)	Southern WWTP	Secondary, tertiary	Mondi Paper Company	Industrial, cooling water	Planned	Direct
Metsimaholo Local Municipality	Sasol 1 WWTP	Secondary trickling filtration	Sasol, Sasolburg	Industrial Process water	Planned	Direct
Emalahleni Local Municipality	Emalahleni Water Reclamation Plant	Advanced, disinfection	Emalahleni Municipality	Drinking and municipal water	Planned	Direct
Steve Tshwete Local Municipality	Optimum Water Reclamation Plant	Advanced, disinfection	Steve Tshwete Municipality	Drinking and municipal water	Planned	Direct
Steve Tshwete Local Municipality	Boskrans Wastewater Treatment Plant	Secondary, disinfection	Kanhym Feed Lots	Agro industry use	Planned	Direct
Lephalale Local Municipality Polokwane Local Municipality	Lethabo Water reclamation Plant	Advanced membrane treatment	Lethabo Power Station	Industrial, cooling water	Planned	Direct
Polokwane Local Municipality	Pietersburg Wastewater Treatment Plant	Secondary, disinfection	Platinum Mines	Mining and metallurgical process water	Planned	Direct
City of Johannesburg (Metropolitan Municipality)	Southern Wastewater Treatment Works	Secondary, disinfection	Water users along Middle Vaal River	Full Spectrum	Planned	Indirect
City of Johannesburg (Metropolitan Municipality)	Northern Wastewater Treatment Works	Secondary, disinfection	Water users along Crocodile West River	Full spectrum	Planned	Indirect
City of Tshwane Metropolitan Municipality	Zeekoegat Wastewater Treatment Works	Tertiary, disinfection	City of Tshwane via Wallmansthal Plant	Potable	Planned	Indirect
Msunduzi Local Municipality	Darvill Wastewater Plant	Secondary, disinfection	Umgeni Water	Potable from Inanda Dam	Planned	Indirect
Emalahleni Local Municipality	Wastewater Treatment Works	Secondary, disinfection	Loskop Dam water users	Mainly irrigation, but full spectrum	Planned	Indirect