Water scarcity: responding to SA's Master Plan

In the light of the recently published National Water and Sanitation Master Plan (NWSMP), Aveng Water process engineer, Andrew Hammond, presents a holistic view of South Africa's water challenges and highlights the need for innovative solutions and a committed response from us all.

Water is an essential life giving source and forms part of our daily value chain through a multitude of economic activities from agriculture and mining to the domestic supply through the municipalities.

Poor quality of water resources result in adverse health effects, which impact on the social welfare of people and their ability to be economically active. Poor management or the lack of water resources adversely affect all aspects of economic activity.

It stands to reason that in a water scarce environment, consumers will be willing to pay substantially more to meet their needs. However, in such an environment, indigent portions of the population cannot afford higher prices, bringing a social responsibility aspect into the equation when determining tariffs for this valuable resource.

South Africa is considered a semi-arid country, with average annual rainfall lower than the global average. The recently published *'National Water and Sanitation Master Plan (NWSMP)'* published by the Department of Water and Sanitation earlier this year, shows that without demand management and augmentation interventions, South Africa will face a country wide deficit of 3.6-billion m^3 per annum by 2030. Bridging this gap is likely to take considerable investment over and above the investment required by the department to maintain the current infrastructure. The department has indicated that additional capital investment – above that already supplied by the fiscus – of R33-billion per year will be needed over the next 10 years, with a total capital spend of approximately R900-billion required to address the water infrastructure shortfall.

In a constrained fiscal environment, this shortfall will need to be raised in the financial markets, for which financial stability of the water utilities as well as the macro-economic environment will be required.

The WED-OECD report of 2015 notes that only a fraction of the worldwide investments by financial institutions are being targeted at sectors and regions that advance sustainable development. In many regions of the world, the tariff imposed on the consumer is not sufficient to recover the cost of treatment. The typical tariff structure in many countries, as is the case in SA, follows a block pricing model, were consumers pay a certain block rate for a specified quantity of water, thereafter, the tariff increases as the consumption increases. Since the tariff structure is consumption driven, in periods of drought, when supply has to be sharply reduced, the revenue generated by the utility drops dramatically. This creates an untenable situation for the water provider as the required fixed costs of supplying the water remain.

The financial considerations of the utility aside, no availability dramatically impacts everybody within the value chain. South Africa is heading towards a large countrywide supply/demand deficit, which already exists in areas such as Cape Town and parts of the Eastern Cape.

Demand management

There are two ways one can view the supply and demand relationship, the first being to increase the supply of water through unconventional sources. Alternatively, one could focus on demand and catchment management.

The NWSMP notes that current annual water losses within the reticulation system amount to 1.45-billion m^3 or 36% of the total production. Lost revenue is estimated to amount to R6-billion. With assistance from the WEF, Government is implementing a 'No Drop Programme' to monitor and intervene to limit these losses.

The Middelburg Water Reclamation Project (MRWP), developed by Aveng Water on an EPCM contract, is a 20 Mℓ/d mine-impacted water (MIW) treatment plant that produces 7.3-million m^3 of potable water per annum. Photo: Aveng Water.

The South African average daily water consumption per capita in urban areas within South Africa stands at 267 ℓ/c/d, which is substantially higher than the global average of 180 ℓ/c/d. According to the NWSMP, just by reducing consumption patterns of domestic urban consumers to that of the international average, domestic demand could be reduced by about 1 467-million m^3 per annum.

Agriculture is by far the largest consumer of water in South Africa, contributing 61% to total consumption. Even a small reduction in this consumption through water wise interventions such as drip irrigation could have a major impact on overall consumption.

Alternate water resources

South Africa's national water supply predominately comes from surface water sources such as dams and rivers that, when not polluted, are sources of good quality water that requires minimal treatment. However, once those sources are exhausted, alternate sources, which require more extensive treatment, will need to be added to the water mix. Ground water, mine-impacted waters (MIW) and seawater present viable additional resources to augment supply.

The treatment for ground water generally only requires the removal of a few groundwater contaminants such as iron and manganese. Mine-impacted waters (MIW) however, have wildly varying water qualities that differ from location to location and directly affect the operating cost of treatment, which can vary between R5 and R15/m^3 produced. The technology exists to treat these waters and produce a product that complies with the requisite drinking water standard. There are nominally six mine-impacted water plants of different capacities in the Mpumulanga coal belt that have an installed capacity of 40-million m^3 per annum.

Each of these plants utilise reverse osmosis (RO) membrane technology as the workhorse for producing the water quality required. In addition to the Mpumalanga plants, there are three neutralisation plants built around the Witwatersrand area that have a capacity of about 200 Mℓ/day. These plants partially treat the MIW decant from defunct underground workings and there are plans to desalinate the effluent further to augment the potable water supply to the Johannesburg region.

Seawater desalination has received notable attention during the recent crisis that gripped Cape Town City and a few small membrane desalination plants were installed to assist with supply. Membrane desalination is the worldwide workhorse process for seawater and is still the most cost-effective treatment solution. The negatives around desalination focus on the capital cost of implementation, running costs and the belief that when scarcity diminishes, the plants will be superfluous.

The Erongo Desalination plant in the Erongo Region of Namibia is the largest seawater desalination plant in Southern Africa with a design capacity of 20-million m^3 per annum. Photo: Aveng Water.

While some of these concerns are valid, solutions need to be looked at within the context of the area of supply. In the Western Cape, the area is already water deficient, there is substantial urbanisation and it is currently the third largest contributor to South Africa's GDP. With water being so essential in the value chain, the lack of sustainable supply directly impacts economic growth of the region.

The viability of seawater desalination for a coastal region should be seen in the context of long-term planning and not a response to an emergency situation. To receive the benefits of seawater desalination plants, they must operate as part of the base load water supply.

The overall cost of seawater desalination has decreased in recent times. If one looks at a 20-year payback for a 100 Mℓ/day facility, the operating costs of such a facility are now about R10/m^3 produced, with capital repayment costs in the region of R5 to R10 per m^3 produced.

The latter can be substantially reduced depending on the level of grants received for the project and, if the selection of the desalination site is done wisely, the water produced from these plants can be targeted to supply higher paying customers in industry, which would reduce the demand on conventional upstream resources for other users. This approach also ensures security-of-supply independent of climate change or cyclical rainfall patterns.

Water reuse

Water reuse is becoming an essential component of the water mix within South Africa and throughout the world. It allows sustainable use of the resource and can be done at a reduced cost when compared to membrane desalination. The estimated total cost of treatment is around R10/m^3 produced.

In general terms, water reuse refers to the reclamation of municipal wastewater for use in agriculture and industry – as is the case in Singapore– or directly for potable water – as is the case in Goreangap in Windhoek.

As with mine water treatment, the technology is available for large-scale treatment of treated wastewater. In general, most technologies focus around the use of membrane filtration technology, ultrafiltration and reverse osmosis, in combination with advanced oxidation processes such as Ozone or UV disinfection. These combination processes can remove pathogens as well as micro pollutants such as endocrines.

The key challenges for the large-scale introduction of water reuse – outside of fiscal constraints – are the stigma associated with drinking reclaimed waters; the complexity of the treatment; and the required level of monitoring, which is substantially higher than that for conventional municipal water and wastewater treatment plants.

Closing remarks

South Africa is certain to have water shortages in the future and there exist challenges in terms of capital resourcing, demand management and available supply. None of these challenges, however, are insurmountable. The capital and the technology is available if the projects can be made bankable and the bottlenecks in the system can be alleviated.

Innovative solutions are likely to be required: from domestic users, industry, government and financial professionals, however.

What is clear is that the impacts of a water deficit on the indigent, the economy and the country have to be avoided. Government has laid out the challenges in the NWSMP: it remains the responsibility of all of us to respond. ❑