Life beyond our rivers
Sedgefield case study

INTRODUCTION AND BACKGROUND

The period December 2008 to January 2009 saw the Southern Cape experiencing one of the worst droughts ever. Sedgefield, a seaside town on the Garden Route, situated within the Knysna municipal area, effectively ran dry in January 2009 when the Karatara River stopped flowing.

While potable water was tankered in to Sedgefield, the Knysna Municipality sought an urgent solution, and alternatives were examined to implement rapid, short- and medium-term options. Although the conventional storage, treatment and conveyancing structures meet peak demand, these fail in severe drought conditions, with the resulting water shortages having a devastating effect on all aspects of the local economy.

Existing Water Supply

The town relied on the in-stream flow of the Karatara River to supply water, as there are no dams or impoundments to provide water in the event that the river stops flowing.

Sedgefield Water Augmentation Report 2003

In 2003 a comprehensive long-term plan to provide water for Sedgefield up to the

1 The desalination plant at Myoli Beach, Sedgefield

LIFE BEYOND OUR RIVERS – SEDGEFIELD CASE STUDY

SPECIAL AWARD – Technical Excellence category

KEY PLAYERS

Client Knysna Municipality
Professional Team SSI Engineers & Environmental Consultants (Pty) Ltd – Knysna Office
Main contractors Grahamtek Systems (Pty) Ltd
Major Subcontractors and Suppliers Constructive Civil Engineering (Pty) Ltd

year 2030 was developed by Ninham Shand Consulting Engineers.

The plan consisted of abstracting water from the Hoogekraal River, storing it in an off-channel dam, down-grading the present Ruigtevlei WTW on the Karatara River to a pumping facility, and constructing a new WTW on the Cloud Nine Hill above Sedgefield town. The total budget in 2008 for the scheme was R110-million.

The plan was not implemented due to a lack of funds, although some funding (R14,2 million) was obtained from National Treasury, following the August 2006 floods, for relocating the WTW.

Sedgefield Waste Water Treatment Works

The existing WWTW is located on a small site with restricted boundaries, between dunes and existing residential developments. A portion of the discharge flows into the Groenvlei, which is a sensitive water receptor; this has resulted in strict performance criteria being set by the Department of Water Affairs (DWA).

The existing SBR units are rated to treat up to 750 kℓ/day. The current treatment configuration does not meet the required Special Limit Values (SLVs), imposed by the DWA. The SLV limits are not met due to high hydraulic loading in peak seasons and the higher than average sewage strength.

The municipality initiated a study in 2007 to investigate the upgrading options to meet the SLV standards for effluent discharge.

PROPOSED SEDGEFIELD WATER AUGMENTATION PLAN

To cope with the crisis conditions in January 2009 certain interventions had to be implemented immediately to prevent interruptions to the town's water supply, and as alternatives to the expensive transfer of potable water from George/ Wilderness by road tanker.

Short-term options were also examined for implementation after the initial crisis measures had been put in place, and these are described below under the Accelerated Water Augmentation Plan.

Subsequently, the investigation was expanded to examine the medium-term and longer-term options, and to develop an integrated plan for the proposed water supply augmentation measures that would mitigate the risk of overall supply failure should one, or more, of the sources fail.

The immediate, short-, medium- and long-term supply options combine the conjunctive use of surface water, ground water, desalinated water and the re-use of final effluent from the waste water treatment works. These sources were ranked based on costs and risk of failure to provide for Sedgefield's long-term water needs.

The proposed scheme will be implemented in phases to provide water as demand increases. In addition, the scheme provides "insurance" against peak season failure in the short- to medium-term. At present the peak season demand is 30% higher than the average. Figure 2 shows the distribution of the amounts of water produced from the different sources.

2 Distribution of the amounts of water produced from the different sources

3 URV values and utilisation of the available water sources

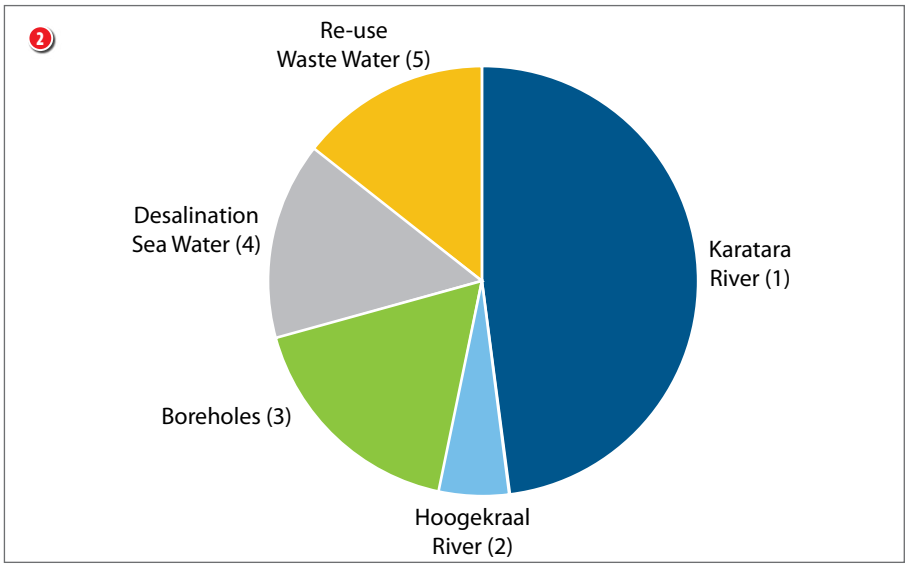


Table 1 Estimated Operating and Maintenance Costs

Description	Cost* (R/m³)
Power costs (based on R0,50 per kWh**)	1,90
Consumables (chemicals, filter, cartidges)	1,90
Maintenance / replacement costs	,40
Operator costs	,40
Total estimated O&M cost	3,40

Notes:
* Based on the plant running 24 h/day, producing 1,5 Mℓ/day, i.e. lowest unit cost
** R0,50 per kWh assumed due to Eskom tariff increases (2009 power costs were initially R0,30 per kWh)

ACCELERATED WATER AUGMENTATION PLAN 2009

Hoogekraal River Transfer – rapid (complete)

The Hoogekraal River continued to flow throughout the months of December 2008 and January 2009. The catchment area is steep and responds well to precipitation. As a rapid intervention a portable pumpstation and 110 mm diameter pipe was installed to pump water from the Hoogekraal River to the Ruigtevlei Water Purification Works on the Karatara River. The pipeline was laid above ground as an interim measure. The pipeline is 3 600 metres in length and can deliver approximately 1 Mℓ to the Ruigtevlei WTW. The cost to implement the scheme was R1,3 million (excl VAT).

Well Points – rapid (complete)

Existing privately-owned well points at Lake Pleasant and Windemere, which could be brought into production rapidly, were investigated. The yield of the well points is approximately 0,290 Mℓ/day. The cost of equipment and transferring the water into the supply system was R0,4 million (excl VAT).

Hoogekraal River Transfer – short-term (complete)

The Hoogekraal transfer scheme had to be made permanent by burying the 110 mm diameter HDPE pipe, and providing a permanent position and electrical power for the pumps. The estimated cost was R0,5 million (excl VAT).

Emergency Drilling Program – short-term (complete)
A number of shallow boreholes were drilled and preliminary testing indicated a borehole yield of 1,5 Mℓ/day. The aquifer yield has not been accurately determined and for planning purposes only 0,5 Mℓ/day is included in the scheme. The cost of the plantation borehole field was R3,0 million (excl VAT).

Karatara River Weir – short-term (initiated)
To prevent further sea water contamination from the Swartvlei into the Karatara River at the Ruigtevlei WTW, temporary weir plates were placed at the culvert openings. A permanent installation is however required to prevent further contamination. The estimated cost for this work is R2,5 million (excl VAT).

MEDIUM-TERM WATER AUGMENTATION PLAN

In the short- to medium-term the following options were examined for implementation as the water demand grows.

Desalination (complete)
To meet the immediate demand approximately 3,5 Mℓ/day assured supply is required.

The surface water supply from the Karatara /Hoogekraal River should be curtailed at 1,5 Mℓ/day, and supply from boreholes at 0,5 Mℓ/day. The difference of 1,5 Mℓ/day will be made up from the desalination of sea water.

The Sedgefield desalination plant is a single-pass, reverse osmosis (RO) system that can produce 1,5 Mℓ/day of potable water. The plant consists of two 0,75 Mℓ/day modules in two separate 12 m steel shipping containers. Extracting sea water and disposing of the concentrate (brine) is achieved by using beach wells. More than twice the amount of sea water is required to produce 1,5 Mℓ/day of potable water – with 45% being harvested as product and 55% returned to the sea as concentrate (brine).

SSI is proud to have completed this project within three months: the appointment contract was signed on 1 October 2009 and the plant was functional on 18 December 2009 – in time for the December holiday peak.

Due to time constraints and the need to have the plant ready for the December holiday period, the Environmental Processes were conducted in parallel with the procurement of the plant. It was decided to procure a containerised (mobile) plant that could be moved should the environmental process show negative impact on the surroundings. The cost reflected in the business plan was based on the option of placing a mobile plant near the sea at the Myoli Beach parking area and pumping the desalinated water to the Blombosnek reservoirs to blend in with the water from other sources.

There are a number of scenarios for the operation of the plant – from running it as much as possible (resulting in the lowest unit cost for the desalinated water), to running it as little as possible (resulting in a relatively high unit cost).

The cost of the desalination plant and feed water pumping scheme is R16,0 million (excl VAT).

Re-commissioning the Ruigtevlei WTW
The Ruigtevlei WTW cannot meet acceptable standards at a supply of 2,2 Mℓ/day. Therefore it is proposed that the surface water supply be limited to 1,5 Mℓ/day. To meet an acceptable supply standard of 1,5 Mℓ/day and to minimise downtime after flooding of the Karatara River, the works require refurbishment of the sedimentation and filter units. The cost to refurbish the works to 1,5 Mℓ/day is R4,0 million (excl VAT).

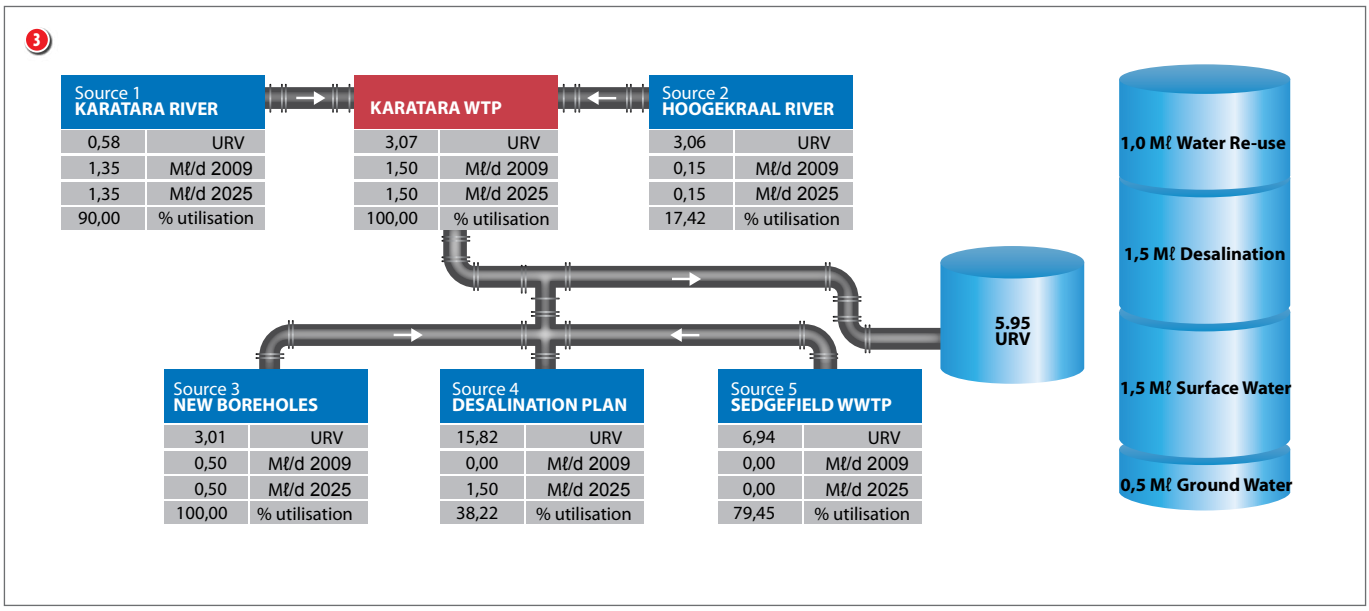
LONG-TERM WATER AUGMENTATION PLAN

The long-term option of waste water re-use is proposed as follows:

Upgrading the Waste Water Treatment Works
The Waste Water Treatment Works must be upgraded from 750 kℓ/day to 2 Mℓ/day. To achieve the required SLV effluent, it is recommended that the works be upgraded to a membrane bio-reactor plant. The MBR process will also provide good quality effluent which will be the building block for waste water re-use. The cost for upgrading the works to 2 Mℓ/day is estimated at R15,0-million (excl VAT).

Reverse osmosis for waste water re-use
To provide the ultimate potable water supply of 4,5 Mℓ/day an additional 1 Mℓ/day will be provided from the WWTW through direct reverse osmosis. The cost for final polishing of the final effluent to potable standards is estimated at R7,5 million (excl VAT).

Additional Storage
To provide adequate reservoir storage capacity, a 4 Mℓ additional storage facility will be needed. The cost to provide additional storage is estimated at R8,0 million (excl VAT).



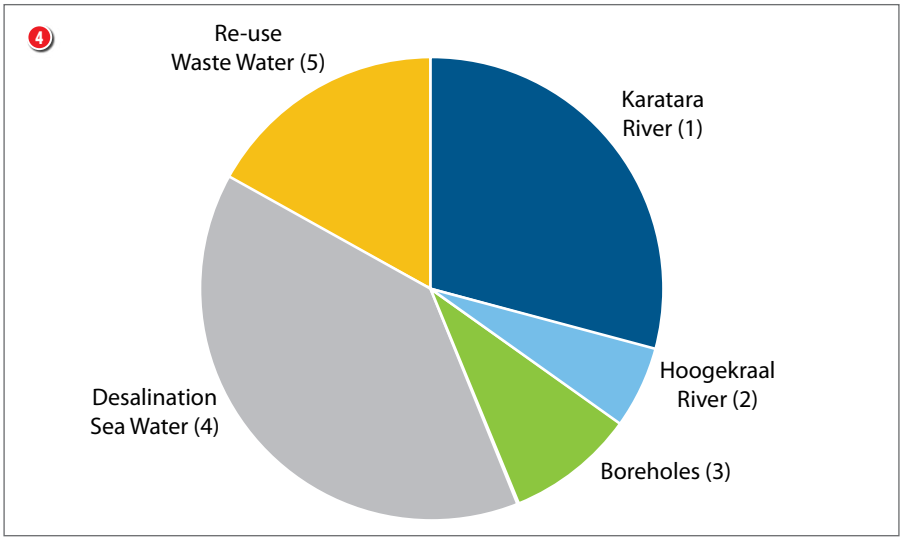
COST BENEFIT ANALYSIS AND UNIT REFERENCE VALUES (URVs)

The proposals were subjected to a cost benefit analysis which was also used to determine the Unit Reference Value (URV) of the proposed plan, as well as that of the individual components of the plan. The URV values and utilisation rates for the different sources of supply are shown in Figure 3.

The cost benefit analysis indicates an average positive value of R2,05 per kℓ of water produced. Further work is planned to develop a cost model to inform the process of optimising the water tariffs for Knysna.

The URV value for the overall scheme is calculated to be R5,95 per kℓ of water produced. It should be noted that this includes the additional capacity ("insurance") to meet peak season demands.

4 Distribution of cost of water from sources



CONCLUSION

An innovative, demand-based approach was developed to address the water supply crisis in Sedgefield, and this proved to be cost-effective and achievable within the tight time constraints.

The Sedgefield project was the forerunner, coining the phrase "Conjunctive Water Use", and paved the way for Mossel Bay, George, Knysna and Plettenberg Bay to re-assess all available water sources.

The approach was based on making better use of the available water resources and to supplement the traditional, inexpensive supply sources with ground water, desalinated water and the re-use of final effluent. The conjunctive supply approach limits the risk of supply failure from a single source, and ensures sustainable potable water security for Sedgefield into the future. Indeed – there is life beyond our rivers! □