Drought in Eden

An exploration of the 2009/10 drought in the southern Cape, Eden District Municipality, in terms of municipal responses, community impacts and lessons for water and climate change

EMG Water and Climate Change Research Series

Report 4

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October 2011

EMG
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Acknowledgements

Thank you to the municipal officials from the southern Cape who agreed to be interviewed and who shared their experiences and information so helpfully. To the community members from Herbertsdale who participated in discussions and workshops, appreciative thanks for your stories and your openness. Thanks to my EMG colleagues Jessica Wilson and Thabo Lusithi for their significant support in the writing of this report. Finally, the Open Society Foundation for South Africa are gratefully acknowledged for providing the funding which made this research possible.

Abstract

The severity and duration of the 2009/10 southern Cape drought came as a shock to the water managers of the affected municipalities. The major towns of Mossel Bay, George, Knysna and Plettenberg Bay all came close to running out of water. This is the kind of crisis that municipalities will increasingly face as a result of climate change, particularly in the Western Cape. A combination of extensive supply augmentation through new sources of water such as desalination, and stringent demand management through restrictions, emergency tariffs and awareness campaigns, succeeded in averting the crisis. However, these responses came at huge monetary cost to National Treasury, the municipalities, tax payers, and poor households living there. This report explores the southern Cape drought as a case study of municipal responses to climate change induced water scarcity, and highlights a number of key lessons. For example, this case study showed that awareness raising and water rationing is effective in causing wealthy users to reduce their water consumption, and that, in combination with increased tariffs, this reduced consumption does not necessarily lead to a reduction in municipal revenue from water. However, the emergency tariffs had the largest impact on poor households in certain municipalities, where the emergency step tariffs did not offer protection for poor households. Other key findings were: having long-term water resource planning in place was key to the success of the affected municipalities in averting the crisis; technical solutions were always prioritised over human-scale social responses; and large industry, PetroSA in particular, made no effort to reduce their water consumption, choosing instead to spend large sums of money securing new sources of supply, with dubious environmental and social implications.

Contents

Acronyms

DM: District Municipality

DWA: Department of Water Affairs

EIA: Environmental Impact Assessment

EMG: Environmental Monitoring Group

kl: Kilolitre = 1000 litres

Ml: Megalitre = 1 000 000 litres

LM: Local Municipality

ROD: Record of Decision

RWSS: Regional Water Supply Scheme

SCLC: Southern Cape Land Committee

WC/WDM: Water conservation and water demand management

WMD: Water management device

Introduction

The Garden Route is a picturesque region of the southern Cape that exists in the popular imagination and tourist brochures as a verdant stretch of idyllic, forested coastline, lush and abundant. It offers the indulgent luxury of a modern upmarket holiday destination, amid unspoilt beaches and mountain forests dense enough for elephants to hide in, undetected for decades.

The old joke about the city of George's license plate code (CAW) is that it stands for 'cold and wet'. George is used to receiving an average rainfall of 900mm/year, which usually comes in the form of soft drizzle for weeks at a time, but this is not always the case. In 2006, the region received more than 440 mm of rain in 48 hours, over half the annual rainfall in the short space of two days. In 2006 and 2007, the area experienced severe flooding and was declared a disaster area for both those years. In 2009, Eden District was declared a disaster area again, this time as a result of drought after the lowest rainfall in 132 years.

There have been dry spells before, but this extremely low rainfall, in combination with increased numbers of people and water-thirsty developments, resulted in several of the towns of the Garden Route coming very close to running out of water. The drought eventually broke by the end of 2010, but June 2011 saw several towns declared local disaster areas yet again after severe flooding.

This succession of disasters points to something changing, some imbalance. The municipalities of the southern Cape were not prepared for the 2009/10 drought. Historical data did not show rivers like Sedgefield's Karatara River running dry. The municipalities involved knew that at some point their water demand – exacerbated by rapid urbanisation and extensive water-thirsty development – would exceed their supply; but they were not prepared for it to happen so soon. Therefore, developments continued to be approved, and water augmentation was put off in favour of other projects. In 2009, when rainfall was at its lowest in recorded history and the extent of the looming crisis became clear, there was a hurried scramble to identify and secure new bulk water sources. Most of the towns in the district were declared 'disaster areas', which allowed them to apply for disaster relief funds from national government. This money, along with the municipal coffers and money from industry, was poured into new, state-of-the-art bulk water infrastructure. Desalination plants and water reclamation plants were proposed, approved and developed very quickly, bypassing the processes of public consultation and an EIA. Within the short space of two years, the Garden Route became home to four new desalination plants and the country's first direct re-use wastewater recycling plant, at massive financial cost, energy cost and uncertain environmental and social cost. At the same time, water demand was curbed via awareness raising, rationing and steep tariff increases.

The drought in the southern Cape is consistent with long-term climate change projections for the Western Cape. It is predicted that more municipalities will face similar climate change related water scarcity in the near future. The southern Cape story therefore offers the possibility of some interesting insights into the responses of municipalities experiencing unexpected, severe and prolonged water scarcity. This report focuses on municipal responses to the drought: the ways in which municipalities organised themselves to respond, the costs of their responses, and the implications of their responses for communities.

Section 2 outlines the aims of this research in the context of EMG's ongoing work on water and climate change. Section 3 describes the regional context, including the population, economy, environment and climate change projections for the southern Cape, and Section 4 describes the methodology used in carrying out this research. Section 5 presents the results

of the research, with some analysis, and Section 6 discusses the findings and their relevance in terms of key lessons for municipalities, communities and civil society.

Context and aims

EMG has been researching and highlighting the linkages between water service provision and climate change since 2008.. Our key focus has been to connect what climate change science is predicting with existing difficulties people have in accessing water services, particularly in poor urban areas. The intention is to 'climate-proof' water services so that the rights of all to reliable, safe, sufficient, affordable water is not compromised by the impacts of climate change, and that alternative strategies for providing water services do not in themselves contribute further to global warming. The prolonged drought in the southern Cape provides an ideal opportunity to try to understand these dynamics in more detail and better prepare us all for climate change impacts as they unfold.

For people living in urban settlements and receiving piped water, the impacts of climate change on water are mediated via municipal responses to water scarcity and unpredictability. Our research in other municipalities has shown that water conservation and water demand management strategies often place the heaviest burden on poor households, as municipalities tend to limit water first to those who cannot pay. Having said that, it is true that per household, the poor often do consume large quantities of water, for a number of reasons, including: leaks caused by shoddy plumbing; a larger number of people per household, multiple families (eg. backyard dwellers) per erf; and a general lack of understanding about the value and cost of water. Sadly, water conservation measures rarely address these social challenges directly, through engaging with people and supporting them to take informed responsibility for their household water. Instead, overly technical solutions are relied upon, which serve to disempower people further and deepen their precarious dependence on the state.

Our research has also shown that the water sector is not very good at planning for climate change. Despite climate change being mentioned in many speeches and policies, at the municipal level there is little to no evidence that climate change is considered in planning. The impacts of climate change on raw water and bulk infrastructure is going to be very costly, and yet it does not appear in budgets or IDPs. It is very difficult to plan for climate change, given its unpredictable nature; but some provision for its impending impacts is needed at the municipal water services level if we are going to adapt.

This report aims to use the southern Cape drought as a case study to explore these issues further, by observing and analysing the responses of municipalities to a situation of real water scarcity, and the resultant impacts upon people living in those municipalities. It is hoped that the findings of this research will contribute to a growing body of knowledge and awareness around climate change and water services, and that it will be used to advocate for just, pro-poor, environmentally sound approaches to climate change adaptation in the water sector.

The regional context

Eden District Municipality includes the local municipalities of Hessequa, Kannaland, Mossel Bay, Oudtshoorn, George, Knysna, Bitou, and a District Managed Area in the north-east of the district (map below). For the purposes of this study, we focussed on the four major urban centres of the Garden Route – Mossel Bay, George, Knysna and Bitou (Plettenberg Bay).

Eden District Municipality, Western Cape.

Population and Economy:

The District is home to 513 307 people. The majority of the population is concentrated in George, Mossel Bay, Oudtshoorn and Knysna, with the George and Mossel Bay municipal areas adding to almost half of the total population of the district. The district is predominantly urban with increased urbanisation having taken place between the 2001 and 2006 census periods. There was an increase of 39% in the urban population in this period in Eden District as a whole, compared to an increase of 19% in rural population (Eden IDP Review 2010/11).

Table 1: Population and growth rates in case study municipalities (Eden IDP Review 2010- 11).

Municipalities	Population 2007	% of Population in District	% annual growth rate 2001 - 2006	% annual growth rate 2006 – 2010
Bitou	39,002	8%	3,96%	3,57%
George	136,542	27%	2,38%	1,57%
Knysna	65,045	13%	1,42%	0,61%
Mossel Bay	117,838	23%	1,02%	0,75%
EDEN DM	513,307	100%	1,97%	1,20%

The area is characterised by a relatively wealthy urban population and upmarket housing developments in the urban centres and the resorts along the coast. In recent years there has been a substantial demand for new housing developments, holiday residential estates and golf course estates, which has resulted in increased water requirements (Dudenski 2007). There is a large inflow of visitors into the area during the holiday seasons, resulting in high peak water requirements.

There is a lot of agricultural activity in the area, particularly dairy farming, crops such as wheat, and commercial forestry. There are a number of small manufacturing businesses in the region, with PetroSA in Mossel Bay municipality being the largest industrial development.

Climate and water resources:

The recent historical climate in the area is temperate, with rain falling throughout the year, the highest rainfall occurring during spring (August to November) and again during late summer (February and March). Mean annual precipitation in the District ranges from over 900 mm in George to around 500 mm in the Mossel Bay area.

The largest dam in the area is the Wolwedans Dam, which supplies Mossel Bay and PetroSA. The second biggest is the Garden Route Dam, which supplies George. Knysna has the Akkerskloof Dam, which can only hold 2 months of water supply at a time; Plettenberg Bay does not have any significant dams. This lack of storage dams can be understood in the context of historical rainfall patterns – the area is known for steady, consistent rainfall, meaning that there is a constant adequate flow in the rivers – so Knysna, Sedgefield and Plettenberg Bay have all relied largely on direct river abstraction.

Climate change projections:
For the western-most part of the country, the climate change projections are for drier conditions on average. Moving further east, the projections are for wetting. The southern Cape is the transition zone between the country's winter and summer rainfall regions. It is therefore a difficult area to make projections for, as this zone falls between the winter drying and wetting trends.

There are a few things that can be said about the area: there will definitely be an average increase in temperature – with implications for soil moisture, so that even if total rainfall remains the same or increases slightly, soil will be drier; there will probably be a reduction in winter rainfall; there will possibly be more summer rainfall; there will possibly be a similar average annual rainfall as in the past, but with changes in the timing and intensity of rainfall (Tadross, *pers. comm*., 2010).

While the 2009/10 drought cannot be identified with any real certainty as the direct result of anthropogenic climate change, it gives us a clear picture of the kind of shock situations we need to prepare for under climate change, and is therefore a useful case study.

Methodology

This research was conducted via a process of literature review, personal interviews, community workshops and telephonic interviews. The analysis was carried out by the EMG researcher.

Literature review:
Prior to visiting the southern Cape and interviewing local stakeholders, a thorough online search was done for all press releases, media reports and official documents relating to the

2009/10 drought. Most relevant municipal documents, such as IDPs (Integrated Development Plans), budgets and tariff policies were available on the local municipal websites. Some of these websites also carried regularly updated headlines about the current drought status, including dam levels and remaining water availability, and detailed information about the water restrictions. In May 2010 the Western Cape Provincial Government hosted a *Drought Indaba* in Plettenberg Bay, where we received up-to-date information about the drought, including some examples of the monthly municipal drought status reports which municipalities were required to produce throughout the drought.

Personal interviews:

In October and November 2010, field trips were made to the southern Cape, and focussed interviews were conducted with municipal officials, members of civil society and affected communities. The following municipal officials were interviewed: Harold Basson (Senior Manager: Civil Engineering Services, George Municipality); Nico Liebenberg (Head of Planning, Project Management and Bulk Services, Mossel Bay Municipality); Gerhard Otto (Head of Eden District Disaster Management Centre); Esmé Cabral (Head of Revenue, Mossel Bay Municipality); Henry Geldenhuys (Civil Works Manager, Bitou Municipality); Nealle Perring (Technical Services Director, Knysna Municipality). The Director of a George based NGO, Angela Conway (Director, Southern Cape Land Committee), was interviewed, to gain local civil society perspectives of the drought and of the perceived effectiveness and appropriateness of municipal responses. Informal household interviews were conducted in Thembalethu (George Municipality), Karatara (Knysna Municipality) and Herbertsdale (Mossel Bay Municipality), in order to explore the impacts of the drought, and of municipal responses to the drought, on low income households.

Community workshops:

In addition to informal household interviews, a process of action research was initiated in Herbertsdale in Mossel Bay Municipality. An open community workshop was held in April 2011, where the impacts of the drought, as well as other water-related issues, were discussed. In August 2011 a smaller meeting of community leaders was held, to discuss a process going forward for building resilience to drought and other issues related to municipal water, such as leaks and high bills. These workshops provided insights into the experiences of people on the receiving end of municipal policies and practices.

Telephonic interviews:

Several conversations were held with specialists and stakeholders via phone, to check facts and explore different perspectives. The following people were interviewed telephonically: Mark Tadross (Climate Strategy and Action Group (CSAG), UCT); Steve du Toit (WESSA George); Ailsa Holloway (Disaster Mitigation for Sustainable Livelihoods Programme (DiMP), UCT); Peter Gelderbloem (Finance Department, George Municipality).

Municipal responses and analysis

This section outlines the results of the research, as well as some description and analysis of these results. A timeline of events is presented, followed by a brief description of the supply-side and demand-side responses. The specific responses of the different municipalities, in terms of the relative costs of their respective drought interventions, their emergency tariffs and other water demand management policies, and their water savings during the drought, is unpacked and compared. The impacts of these responses on communities are explored, in the form of a case study on the town of Herbertsdale, and the role of industry is explored in a case study on PetroSA. These findings, as well as other information and observations from the research, are then interpreted and discussed in section 6.

Timeline of events leading up to the declaration of municipal disaster areas

November 2007: All dams in Eden DM are 100% full, following years of floods

December 2008: Karatara River runs dry, leaving Sedgefield without water in peak holiday season

April 2009: Mossel Bay, George, Knysna and Bitou Local Municipalities introduce water restrictions; major dams at +/- 60%; rainfall lowest in 132 years

June 2009: Eden DM disaster management request all affected local municipalities to submit situational reports on water availability and storage capacity – these reveal that they are on the brink of crisis, as no municipalities have sufficient stored water, and there is no rainfall predicted for the near future (Gerhard Otto, head of Eden disaster management); major dams at +/- 45%

August 2009: First disaster management meeting, called by Eden DM disaster management and provincial disaster management services. This meeting includes representatives from the local municipalities, Eden and Western Cape disaster management, national Department of Water Affairs (DWA), provincial and National Treasury and Department of Agriculture. Major dams at +/- 30%. At this time it is projected that the Garden Route dam will be empty by February 2010.

September 2009: Minister Bredell, Minister of Local Government, Environmental Affairs and Development Planning for the Western Cape, sends the Executive Mayors of the affected areas notice of the drought situation, and a request to take action. DWA sets a consumption reduction target of 40% for affected municipalities. A district wide awareness campaign is launched, co-ordinated by Eden DM, adapted and built on by local municipalities.

November 2009: District and local municipalities declared disaster areas and receive disaster relief money. Eden DM continue in a co-ordinating role throughout the drought, leading the awareness campaign and hosting monthly disaster management meetings. All local municipalities implement emergency restrictions and aim to reduce their consumption by at least 40% (as required by DWA) and also begin to implement emergency water supply projects.

September 2010: EMG's research into municipal responses to the southern Cape drought commences

Supply side responses:

This section describes the existing and new sources of water supply in the case study municipalities. This is expanded upon to include quantities and sources of finance for these interventions in Table 4.

Mossel Bay:

The Mossel Bay Regional Water Supply Scheme (RWSS) supplies the Mossel Bay Municipality, as well as the industrial requirements for PetroSA. It consists of the Wolwedans Dam on the Groot Brak River (owned by DWA), and the much smaller Klipheuwel dam on the Moordkuil River and Hartebeeskuil Dam on the Hartenbos River (Dudenski 2007). Under normal conditions, the water in the Wolwedans dam is shared 50:50 between PetroSA and the rest of Mossel Bay Municipality. If the level of the dam were to drop below 10%, PetroSA would no longer be allowed access to this water. At its lowest point, in September 2010, the Wolwedans Dam was 15% full. When it reached this level, DWA placed a 60% restriction on water use for agriculture in the catchments of the Wolwedans Dam, the Moordkuils River and the Hartebeeskuil Dam. This meant that farmers pumping water directly from the Wolwedans Dam were required to reduce their daily extraction from 5 Ml per day to 2 Ml per day. (Internal News Release, 26 August 2010, www.mosselbaymun.co.za).

The emergency supply projects that were pursued in Mossel Bay municipality were:

- A reverse osmosis wastewater reclamation plant at Hartenbos, to provide 5 Ml/day of treated effluent water to PetroSA.
- Drilling of +/- 38 boreholes
- The largest desalination plant in South Africa to date, which was built at Voorbaai in Mossel Bay. This plant is capable of producing 15 Ml per day, 5 Ml of which will go to PetroSA. No EIA was conducted prior to the building of this plant. The municipality was able to go ahead without carrying out the legally required assessments and consultation because of their disaster status. The consultancy firm *Aurecon* is doing a retrospective EIA for the desalination plant.

George:

The George RWSS supplies all towns in the municipality, including George, Herolds Bay and Wilderness, via the Garden Route Dam, and water abstracted via pump schemes from the Kaaimans River and the Malgas River (Dudenski 2007). George municipality owns the Garden Route Dam, and is the water services authority – they are responsible for the entire water cycle within their municipality, from source to wastewater treatment. According to Harold Basson, senior civil engineer for George, this fact enabled them to plan and make decisions very efficiently, as they did not need to consult or negotiate with other stakeholders, such as DWA (Basson, *pers. comm.,* November 2010). They had many comprehensive plans in place, e.g. a bulk water augmentation plan from 2005, which meant they were prepared to respond quickly: 'Without having the necessary bulk water resource planning in place for a number of preceding years, George Municipality would not have been able to manage a drought of this magnitude with the success that has been achieved' (Basson and Mooiman 2010).

The emergency supply projects that were pursued in George Municipality were:

- Indirect re-use of treated effluent: the first in the country, this plant produces 10Ml per day of treated effluent, which is then released into the Garden Route Dam. The project was initially planned for implementation in the next 5 years, but was fast-tracked due to the drought. It was possible to fast-track it because the record of decision (R.O.D.) was already in place – the developers of *Destiny Africa,* a large new conference facility, helped to pay for the R.O.D. for the plant (as part of the conditions for their approval for development).
- Boreholes were drilled
- The catchment was burnt, to decrease the amount of water being drawn out by vegetation
- The Malgas pumping scheme and Kaaimans River pumping scheme were activated.

Knysna:

The Knysna RWSS supplies water to the towns of Knysna, Brenton-on-Sea and Belvedere. The raw water sources are the Knysna and the Gouna River Weirs, the Glebe Dam, the Akkerkloof off-channel storage dam, the Bigai Springs and the Belvedere Boreholes (Dudenski 2007). The water supply to Sedgefield is drawn from the Karatara River. The small towns of Rheenendal, Buffelsbaai and Karatara draw their water directly from local rivers.

The emergency supply projects that were pursued in Knysna Municipality were:

- Desalination plant at Myoli Beach, Sedgefield, capable of providing 1.5 Ml/day. This desalination plant has now been shut down due to technical problems.
- Desalination plant at Knysna Lagoon, capable of producing 2 Ml/day
- Boreholes drilled

Bitou:

Until now, Bitou has been predominantly dependent on river abstraction from the Keurbooms River for its water supply.

The emergency supply projects that were pursued in Bitou Municipality were:

- Desalination plant at Beacon Isle, capable of producing 2 Ml/day. The public consultation process was carried out at the same time as the construction was taking place. There was a lot of dissent, particularly from environmentalists who feared that building a desalination plant in the Piesang River estuary would disturb the ecosystem by extracting too much water. Construction went ahead anyway. By March 2011 this concern proved to be a reality and the desalination plant was shut down due to insufficient water (WWF 2011).
- Upgrade of Keurbooms River abstraction.
- Development of groundwater supplies.

Demand side responses

There was a co-ordinated district-wide water demand management strategy overseen by the Eden District Municipality, mandated by provincial government. Following the first provincial disaster meeting in August 2009, called by Eden DM Disaster Management, a

communication was sent out to the Executive Mayors in the drought stricken areas by Minister Anton Bredell, the Western Cape MEC for Local Government, Environmental Affairs and Development Planning, requesting the following immediate action (Basson and Mooiman, 2010):

- Implement emergency tariffs.
- Install low-flow or low-pressure water systems.
- Monitor consumers with high water consumption and take appropriate steps to limit their water use.
- Commit financial and human resources to Joint District Communications Team (district-wide public awareness campaign).
- Reprioritize operational budget - law enforcement, public awareness, flow control.
- Reprioritize capital budget - implement short- & medium-term solutions.
- Commit human and financial resources needed to address the crisis.

The Eden DM Department of Technical Services and Bulk Infrastructure co-ordinated the compiling and analysis of monthly water crisis status reports by all affected local municipalities. These reports were shared and discussed at the provincial disaster meetings.

All of the municipalities implemented emergency water tariffs for domestic water users. These consisted of surcharges on the existing tariffs, based on the severity of the drought, as measured by dam levels or river flows. The maximum surcharge was 200% on existing tariffs, which was implemented when dam levels were below 25%. This surcharge was in place from late 2009 until late 2010 in all affected municipalities. Table 2 unpacks these tariffs, showing the 200% emergency surcharge. This data is from the Municipal Tariff and Emergency Tariff documents for 2009/10 and 2010/11.

Table 2: Tariff increases during the drought

GEORGE	Without Emergency Tariffs (2009/10)	Emergency tariffs (2009/10)
Basic/month	R 47.52	R 47.52
0-6 kl	R 0.00	R 7.30
6 – 15 kl	R 7.30	R 10.95
15 – 30 kl	R 8.40	R 16.80
30 – 50 kl	R 10.08	R 30.30
>50 kl	R 12.10	R 60.00

MOSSEL BAY	Without Emergency Tariffs (2009/10)	Emergency tariffs (2009/10)
Basic/month	R 95.74	R 95.74
0-6 kl	R 0.00	R 0.00
7 – 20 kl	R 4.00	R 4.00
21 – 30 kl	R 5.00	R 15.00
31 – 40 kl	R 6.00	R 18.00
41 – 50 kl	R 9.00	R 27.00
51 – 60 kl	R 12.00	R 36.00
61 – 80 kl	R 15.00	R 45.00
>80 kl	R 20.00	R 60.00

BITOU	Without Emergency Tariffs (2009/10)	Emergency tariffs (2009/10)
Basic/month	R 162.56	R 547.68
0 – 25 kl	R 0.00	R 0.00
26 – 30 kl	R 4.29	R 12.67
31 – 40 kl	R 6.01	R 18.02
41 – 50 kl	R 7.29	R 21.88
51 – 60 kl	R 9.44	R 28.31
61 – 70 kl	R 12.01	R 36.04
>70 kl	R 23.60	R 70.79

KNYSNA	Without Emergency Tariffs (2009/10)	Emergency tariffs (2009/10)
Basic /month	R 97.00	R 97.00
0-6 kl	R 0.00	R 0.00
7-10 kl	R 7.21	R 11.63
11-20kl	R 11.57	R 17.27
21-30 kl	R 13.31	R 20.32
31-40kl	R 14.03	R 24.54
>40 kl	R 23.54	R 41.20

Note: These tariffs exclude VAT

Tariffs reflected here are per kilolitre of water

Basic charges are not paid by registered indigent households.

Each municipality has its own tariff structure, and the seemingly subtle differences between these structures have significant implications for households. It is important to note that the first 6 kl remained free to indigent households, and in fact free to all households, except in George, where non-indigent households were charged for the first 6 kl under emergency tariffs. The second tier of the tariff structure is important in terms of impacts on households. George Municipality increased the cost of the second tier under the emergency tariffs, which meant that poor households using over 6 kl per month would have experienced much higher bills than normal (discussed further below in relation to Table 3).

In contrast, Mossel Bay Municipality kept the price of the second tier constant under the emergency tariffs, which would have protected poor households to an extent. Bitou Municipality's tariffs were very easy on households using less than 25kl/month (no charge), but use in excess of 25kl per month was charged a high basic fee (R547.68 under the emergency tariffs).

It is also important to note that these emergency tariffs applied to household use and not to industrial or agricultural use. This is discussed further in the PetroSA case study (pg. 31).

Aside from the broad district-wide response, the local municipalities had different specific approaches to water demand management, as described in Table 3.

Table 3: Comparison of WDM in drought affected municipalities

	Mossel Bay	George	Knysna	Bitou
Awareness Campaigns	Campaign to 'pray for rain every Wednesday at 12' Banners and signboards in prominent places 24 hour crime line for reporting abuse	Presentations to schools, ward committees, municipal employees, businesses Water saving competition between schools Regular press releases and media campaigns Banners and signboard in prominent places 24 hour crime line for reporting abuse	Prominent signboards showing reduced consumption in Sedgefield and Knysna	Water saving notices on streetlamps and public places Publicity around desalination plant – intention to open it to the public as an educational centre.
WDM targeted at high consumers	Monthly consumption limited to 20kl. If this was exceeded, household received R1000 fine, and a warning. If exceeded again, received a water management device (WMD), which households had to pay for themselves, set to limit water to 20kl/month. New developments paused for duration of drought.	Technician appointed to monitor high users. Consumption in excess of 15kl/month was monitored and followed up with personal call; this had good results. If people continued to use excessive amounts, they received a fine of R1000. Industrial users were monitored and visited to discuss water saving options.	Hired consultants to identify top 20 consumers in each sector – industrial, commercial, domestic, sent letters of warning. Targeted schools, shut off their water supply over Christmas break.	Used a computer programme as part of IQMS (Integrated Quality Management System) to identify high users and carried out a targeted campaign. Warnings were issued to highest users, and the following month if consumption was not down, trickle devices were installed – mostly in very wealthy areas (for full explanation of trickle devices, see Herbertsdale case study, pg. 24)
WDM targeted at poor consumers	If people reported leaks, municipality would fix them. If people could not afford the R1000 fine for exceeding 20kl/month or could not pay for installation of WMD, they received trickle devices.	Repairs to leaks in indigent areas advertised, done at no cost to the household. Ongoing installation of trickle devices in households in arrears (not a specific drought intervention).	No specific approach in poor areas. Low cost areas are metered in bulk, and the last 700 low cost houses built are not metered at all.	No specific approach in poor areas. The IQMS map showed that there were no households using excessive amounts of water in poor suburbs.

A sample of drought awareness materials. Top left: Signboard outside Mossel Bay; bottom left: banner in Mossel Bay; right: poster produced by George Municipality.

All of the municipalities were required by the Department of Water Affairs (DWA) to aim for a 40% reduction in consumption. Figures 1 and 2 below show the actual and percentage savings achieved.

Fig 1: Reduction in daily municipal water consumption during the drought

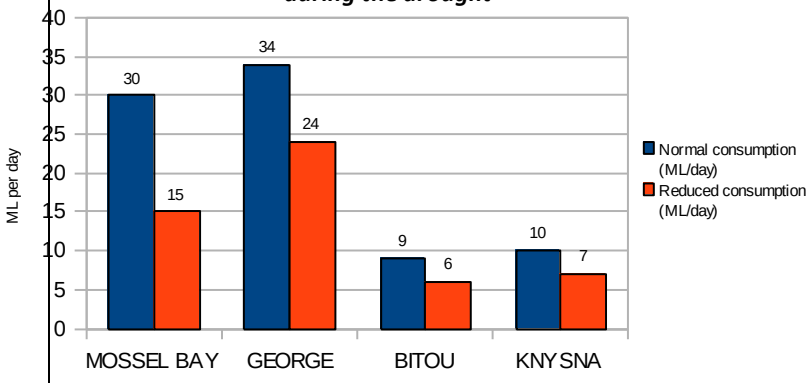
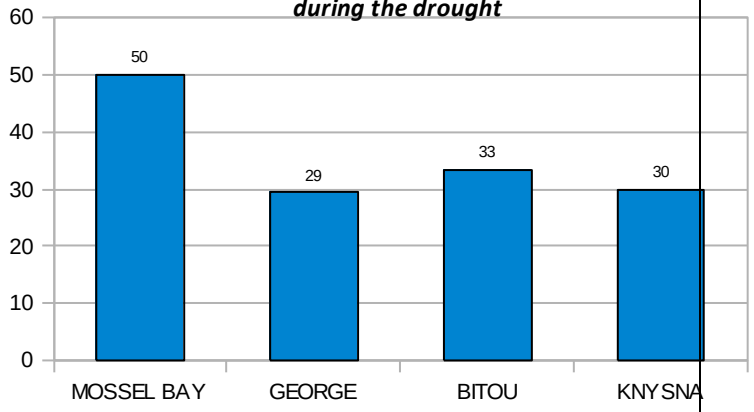


Fig. 2: Percentage reduction in daily municipal water consumption during the drought



All of the municipalities managed to reduce their consumption significantly. Mossel Bay municipality achieved the greatest reduction, of 50% (this figure excludes PetroSA). This was attributed to their strict adherence to the restrictions, and high incidence of reporting and penalising of transgressions (Otto, 2010; Liebenberg, 2010). They also took a more hard-line approach to restricting water in low income areas than some of the other municipalities, installing trickle devices in indigent households. Interestingly, industries within Mossel Bay municipality who receive municipal water achieved high savings - for example the Nestle factory reduced their consumption by 50% during the drought – while PetroSA, which has rights to half the water from the Wolwedans Dam, did not reduce their water consumption at all (see PetroSA case study on pg. 29).

Figure 3 below shows the reduction in water consumption in different suburbs of George. These figures are from research commissioned by EMG and conducted by Stephen Wright, a UCT economics honours student.

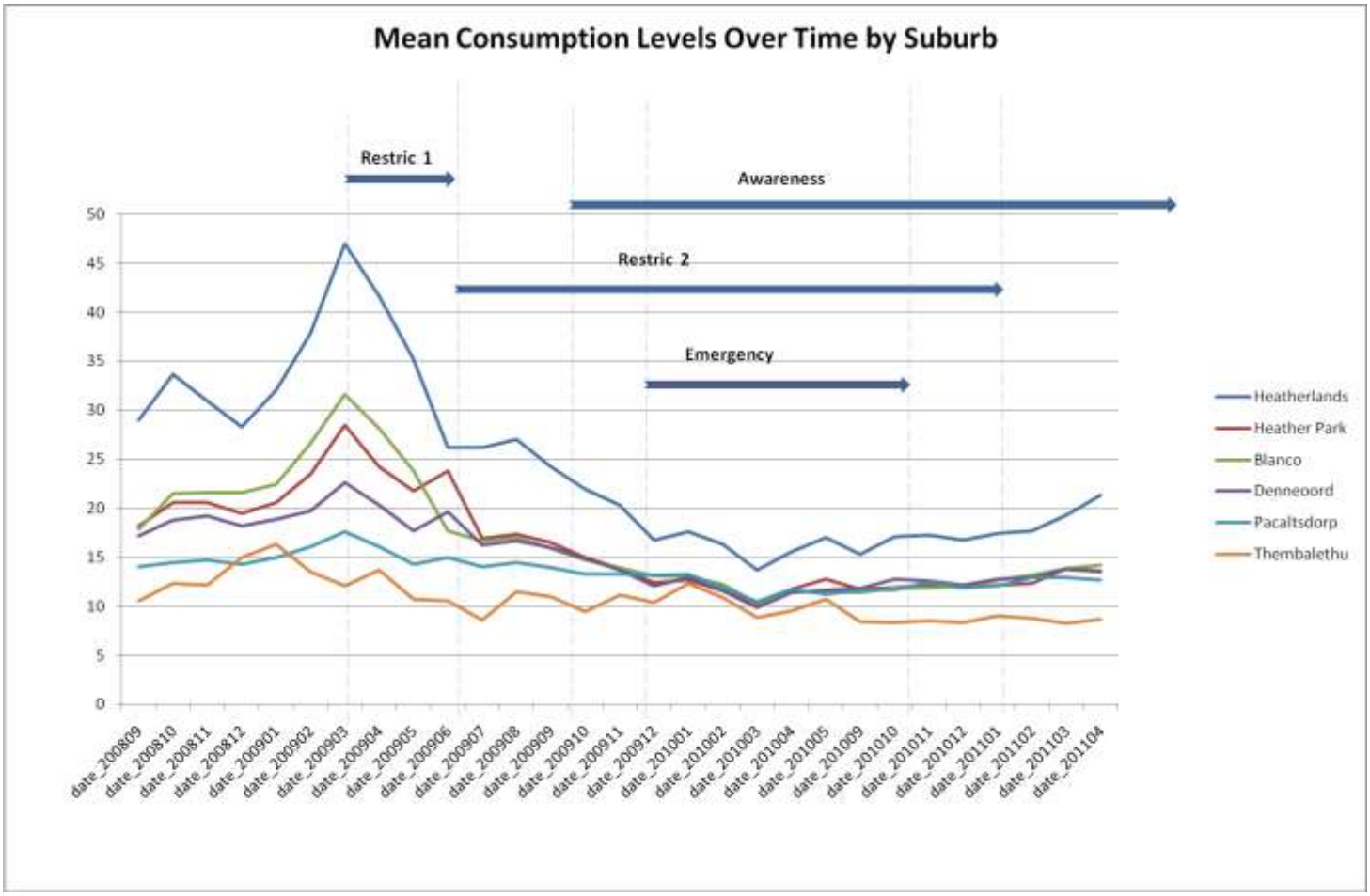


Figure 3: Mean monthly water consumption over time by suburb, George Municipality (Wright 2011).

Heatherlands, Heather Park and Denneoord are middle to upper class neighbourhoods, with the highest average household incomes, while Thembalethu is a predominantly working class neighbourhood with relatively lower household incomes and higher levels of unemployment (Wright 2011). This graph clearly shows that, prior to the restrictions and emergency tariffs, households in Thembalethu were using much less water than households in wealthier neighbourhoods – less than 15 kl on average, in fact, which was the rationed limit during the drought. It also shows that the households using more water were more responsive to the restrictions and awareness campaigns – the more water a household uses, the more it is possible to save. Once the emergency tariffs were implemented, Thembalethus' average consumption dropped even lower, to below 10 kl. This is a concerning finding, because, although 6kl per household per day is the national guideline for free basic water, this amount is often insufficient (Rudin 2008); further research would

be required to determine the extent to which this was the direct result of the introduction of emergency tariffs

The differential impact of the emergency tariffs on people's water bills is evident in Table 4.

Table 4: Changes in water bills due to emergency tariffs, George (Wright 2011).

Suburbs	Before Emergency Tariffs (R)	After Emergency Tariffs (R)	**% Change in bill**
BLANCO/RIVERLEA	124.87	243.42	**94.9**
DENNEOORD	120.99	198.99	**64.5**
HEATHER PARK	122.35	216.1	**76.7**
HEATHERLANDS	213.68	465.15	**117.7**
PACALTSDORP	111.88	250.47	**123.9**
THEMBALETHU	56.412	192.58	**241.4**

Thembalethu, the poorest neighbourhood on average, with the highest rates of unemployment, experienced the highest percentage change in household water bills, of 241.4%. This could be partly explained by the fact that the emergency tariffs included a charge of R7.80 per kl for the first 6 kl for non-indigent households, and increased the tariff of the second block (7 – 15kl) from R7.80 to R10.95 (see Table 1). Therefore, households that were poor but perhaps not registered as indigent were no longer receiving free basic water, and indigent and non-indigent households were paying higher tariffs for the second block in the tariff structure. Since all households were rationed to 15kl/month, the emergency tariff had to increase the price of the first 15kl in order to secure revenue. Rising block tariffs are usually intended to be most expensive for the highest users, so that high end users can subsidise the poor; however, in this case when all users were rationed to 15kl/month, the additional burden of emergency tariffs had the heaviest impact on poor households.

Herbertsdale case study

Herbertsdale is a small town in the foothills of the Langeberg mountains, about 40 km inland from Mossel Bay. It falls under the jurisdiction of Mossel Bay Municipality. Herbertsdale is home to about 850 people, and the main source of employment is temporary farm labour.

Herbertsdale's water supply system consists of four storage reservoirs, which hold water pumped from the Langtou River. All households have running water and flush toilets. Many people have vegetable gardens at their homes; there is also a large community garden which was started in 2010 by members of the farm workers committee, set up with the support of the Southern Cape Land Committee (SCLC).

Based on household interviews, workshops and discussion groups, the following issues emerged related to the impact of the drought on Herbertsdale's water services:

- During the drought, people in Herbertsdale had to find out about the water restrictions in the newspaper; they were not well informed, there was no awareness campaign. This is in stark contrast to the extensive publicity material in Mossel Bay and the rest of the Garden Route.

- There have been no cut offs, but people have problems with very high bills, people with vegetable gardens have had to stop watering their gardens, and some people have received R1000 fines for transgressing the restrictions. Some farm workers lost their jobs due to the drought.

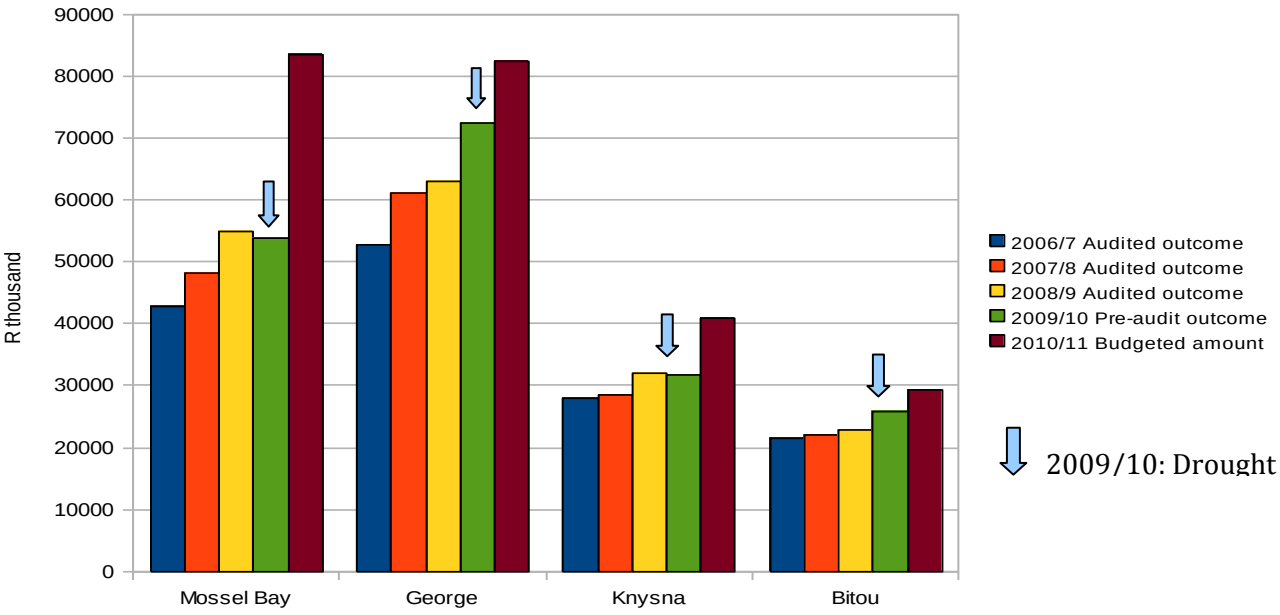
- According to municipal policy, and to the head of municipal finance for Mossel Bay (Cabral 2010), the municipality would fix all leaks in poor areas during the drought. However it does not seem that this service extended to outlying areas like Herbertsdale, and nobody in Herbertsdale knew how to access the service. This highlights the gap between policy and implementation.

Some people with unpaid debt were subject to the trickle system – this consists of a plastic disc with a tiny central hole which is placed in the main pipe and allows water through only a drop at a time. This was not a direct response to the drought, but was a measure used by the municipality to curb consumption by households in arrears. It is uncertain whether households who cannot pay the high bills they incurred due to increased tariffs during the drought will be put on this system. If someone wants to make an arrangement to pay back their debt, they have to travel to the offices of the service provider responsible for billing, Debt-Pac, in Hartenbos; it costs R300 to hire a vehicle to travel there, then there is the debt re-payment, and a R300 fee to have the trickle disc removed. This makes it exorbitantly expensive and prohibitive for poor households.

Herbertsdale community members who participated in this research have now formed a water committee, and with the support of EMG and SCLC are attempting to engage with the municipality around these issues.

Given the reduction in water consumption of between 30 and 50% in all of the municipalities, along with other strict demand side measures, including steep emergency tariffs, what was the impact on municipal revenue from water? Figure 4 shows the revenue from water in the affected municipalities from the 2006/7 financial year up until 2010/11.

Fig. 4: Municipal revenue from water
Between 2006/7 and 2010/11



At the time of the research, the audited figures for 2009/10 and 2010/11 were not yet available, so the pre-audit outcome and the budgeted amount were used, respectively (based on observation of previous budgets, the difference between pre-audit outcomes and audited outcomes are usually minor, therefore the pre-audit outcome is an appropriate proxy). The most telling change to note is between the years of 2008/9 and 2009/10, as 2009/10 was the year of the drought.

Mossel Bay and Knysna experienced a slight drop in revenue from 2008/9 to 2009/10 – this is the period over which the emergency tariffs and strict WDM policies were in place. Mossel Bay achieved the greatest reduction in water consumption, and this could account for their drop in revenue. However this trend does not hold true for George and Bitou – these municipalities both experienced increases in revenue over the drought period. The emergency surcharge may have made up for the drop in consumption in these municipalities. Certainly, this graph indicates that a reduction in overall consumption, which we have seen in Figure 3 was mostly a reduction in consumption by wealthy users, does not automatically result in a loss of municipal revenue from water. This is an important finding, as WC/WDM in wealthy areas is sometimes perceived as being risky to municipalities dependent on income from those areas. It would seem that steep emergency tariffs in combination with water rationing keeps income fairly stable. The very high

increases in budgeted income in 2010/11, particularly in Mossel Bay, are less easy to explain. Perhaps, with an augmented supply system and the lifting of the restrictions, municipalities were anticipating a spike in water consumption (but this is pure speculation).

Relative cost of drought interventions

The direct costs of the drought interventions, as well as the sources of funding and the amount of water they have the potential to provide (or save) are presented in Table 5. The data in this table was obtained from interviews with municipal officials, capital budgets and media reports (the figures published in media reports were all checked against at least one other source). There were some discrepancies between the figures quoted in interviews and those found in the budgets, and it was not always easy or possible to get confirmation of these exact figures from municipal officials. This highlights the challenges in engaging with municipal finances, despite policy which encourages public participation in governmental budget processes. For example, it was difficult to get figures for the cost of the WDM and awareness campaigns in Mossel Bay and Knysna; presumably these costs were represented in a few different line items in the operational budgets.

Table 5: Emergency supply augmentation and demand management undertaken in response to the drought: potential water provided, sources of funding and total costs[1].

		Potential water provided (ML/ day)	National treasury (R million)	PetroSA (R million)	Eden DM (R million)	Local municipal budgets (R million)	Other grants (R million)	**Totals (R million)**	**% paid by municipality**
Mossel Bay	Reclamation plant	5	16.5	22.5		10.5		49.5	21%
	Boreholes - drilling and pipelines	3.5		10		2.5		12.5	20%
	Desalination plant	15	92	96		22		210	10%
Sub-totals		*23.5*	*108.5*	*128.5*	*0*	*35*	*0*	*272*	*13%*
George	Effluent re-use plant	10	75			11.2		86.2	13%
	Malgas Pumping Scheme	5	15			28	24	67	42%
	Boreholes – drilling and pipeline	2.5			1.5	7		8.5	82%
Sub-totals		*17.5*	*90*	*0*	*1.5*	*46.2*	*24*	*161.7*	*29%*
Knysna	Sedgefield desalination plant	1.5	22					22	0%
	Knysna desalination plant	2	17.9			13.6		31.5	43%
	Groundwater abstraction	3.3			3	6.6		9.6	69%
Sub-totals		*6.8*	*39.9*	*0*	*3*	*20.2*	*0*	*63.1*	*32%*
Bitou	Desalination plant	2	20					20	0%
	Groundwater abstraction	3				3.4		3.4	100%
	Upgrade of Keurbooms abstraction	5				5.5		5.5	100%
Sub-totals		*10*	*20*	*0*	*0*	*8.9*	*0*	*28.9*	*31%*

1 Data from interviews with Harold Basson (Oct 2010), Nico Liebenberg (Nov 2010), Gerhard Otto (Nov 2010), Nealle Perring (Nov 2010), Henry Geldenhuys (Nov 2010), 'Mossel Bay Municipality Internal news release' (Oct 2010), Eden District Water Crisis Management Progress Report (May 2010), George capital budget 2010/11 – 2012/13, Bitou budget (2010 - 13).

This table highlights the large amounts of money that were spent during a short space of time. Many of these supply augmentation projects were planned for the next 5 – 10 years, and were fast-tracked in response to the drought. In order to receive the disaster relief grants from National Treasury, the local municipalities needed to reprioritise their capital budgets and prove that they had exhausted all available funds. They all spent significant amounts of money to respond to the emergency situation. Expenditure was higher in some instances as a result of the urgency of the situation – for example PetroSA paid an additional R16 million to have the desalination plant at Voorbaai finished a month earlier. However, had the emergency drought not occurred, and had they not received the disaster relief money from National Treasury (which they do not have to pay back), the municipalities would have had to find the funds for the capital costs of these augmentation projects elsewhere. This is one way in which the drought could conceivably have been advantageous from a municipal perspective.

This table only shows monetary cost; the environmental and social costs of interventions such as desalination plants should also be taken into account. The expense of desalination will be felt by the consumer in the long term. Desalinated water is approximately R8/R9 per kl, as compared to reclaimed water at R4/kl and dam water at R2/kl. Attempts to ascertain the operating costs of these desalination plants have been unsuccesful so far – the EIAs are not yet available. The environmental costs include extremely high energy use, which in a South African context means high greenhouse gas emissions from coal-based electricity. Solar powered desalination would be a greener option, but adds to the expense. The brine produced by desalination is toxic to the marine environment that it is released back into, and the process of taking in large amounts of water for desalination can impact on the ecological reserve of the ecosystem in which it is situated, which is what happened in the Piesang estuary in Plettenberg Bay.

Petro SA's injection of R16 million to fast-track the desalination plant by a matter of months is an indication of their desperation – and of their inability or lack of incentive to reduce their consumption.

PetroSA case study

PetroSA's gas to liquid (GTL) plant outside Mossel Bay requires approximately 15 Ml of water per day. During the drought, PetroSA did not reduce their water use at all. In contrast, the municipality of Mossel Bay achieved a reduction in water consumption of 50% (from 30 Ml per day to 15 Ml per day) , and other industries in the area managed to reduce their use significantly - for example the Nestlé factory in Mossel Bay achieved a 50% reduction in consumption, by recycling evaporated water from the production of milk powder. Instead of reducing their water use in response to the crisis, PetroSA threw money at the problem, seeking alternative sources to meet their large water demand. Specifically, they spent:

- R80 million on a desalination plant and an additional R16 million to fast track the completion of the plant (5Ml day)
- R22,5 million on an effluent water purification project (5Ml/day, now reduced to 2.5Ml/day since the Wolwedans dam is overflowing)
- R8 million for the recycling of their storm water (Approximately 50kl/hour to 120kl/hour depending on the availability and quality of storm water)
- R10 million for drilling 8 boreholes (3Ml/day)

PetroSA did not pay more for water during the drought. The Mossel Bay tariff policy states clearly that emergency surcharges are applicable only to metered connections of 25 mm or less – in other words, domestic water use. According to Nico Liebenberg, municipal water manager for Mossel Bay, the rationale behind targeting only domestic water use with increased tariffs is that the municipality did not want to jeopardise job creation (*pers. comm.*, October 2011). They had many meetings and visits to local industries to discuss possibilities for water saving, but industries were under no obligation to do so. Therefore, even during the most extreme drought in recorded history, while households were receiving extremely high water bills and spot fines for transgressing severe water restrictions, PetroSA did not reduce their water use at all, and did not pay any more for water than they usually do.

And what does PetroSA pay for water? They use approximately 370 Ml/month of untreated water directly from the Wolwedans Dam for their industrial processes, which they do not pay for – as per their water use allocation agreement with DWA, since they helped to finance the building of the dam, which was completed in 1989 with the dual purpose of providing water for PetroSA (then called MossGas) and the growing municipality.. They also use on average 11 800 kl/month of treated municipal water, for domestic use. For this, according to the 2010/11 tariffs, they pay a basic fee of R8616.33 per month, and R12/kl for any use above 6000 kl, which amounts to a monthly bill of approximately **R78 000**. If they were charged domestic rates, their bill would have been R236 000 before the drought (11 800kl @ R20/kl), and a whopping R708 000 during the drought (11 800 kl @ R60/kl), almost 10 times what they actually paid.

From a policy perspective, prices have two functions, they reflect the cost of producing a particular good and they provide a signal in the market to encourage or discourage people from buying that good. From both perspectives the price paid by Petro SA was clearly too low. Let's assume, for the sake of this argument, that the price paid before the drought by Petro SA and domestic consumers accurately reflects the costs getting water to them. (It is of course much cheaper to supply bulk water to industry than small amounts of water to many households.) Then the drought comes. The price for domestic users is tripled, but that of Petro SA stays the same. The higher price sends a signal to households that they should use less water. It is one way of capturing the 'scarcity value' that water now has due to its shortage. No such signal is sent to Petro SA. Their consumption does not come down and domestic users pay the full scarcity value, thereby subsidising Petro SA's operations.

The cost effectiveness of the water demand management initiatives implemented by two municipalities, George and Bitou, is presented in Table 6.

Table 6: The cost effectiveness of water demand management initiatives

Municipality	Reduction in water consumption (%)	Actual reduction (Ml/day)	Cost of WDM interventions
George	29%	10	R 800,000
Bitou	33%	3	R 600,000

The relative cost effectiveness of the different drought interventions, including water demand management and awareness for the cases of George and Bitou, is presented below in graph form.

Fig.5: Cost effectiveness of drought interventions in George

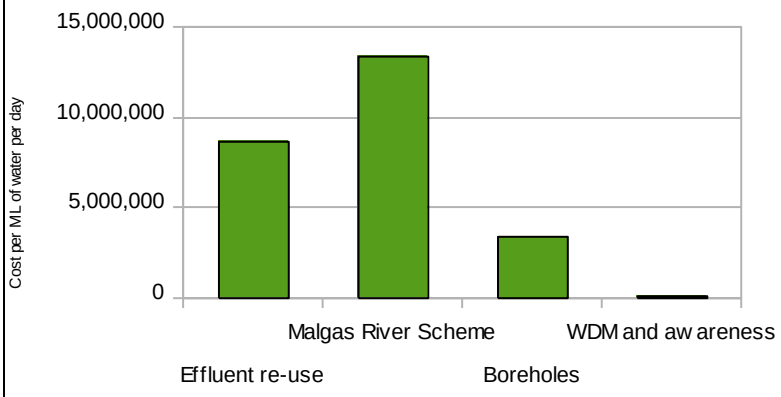


Fig. 6: Cost effectiveness of drought interventions in Mossel Bay

Fig. 7: Cost effectiveness of drought interventions in Bitou

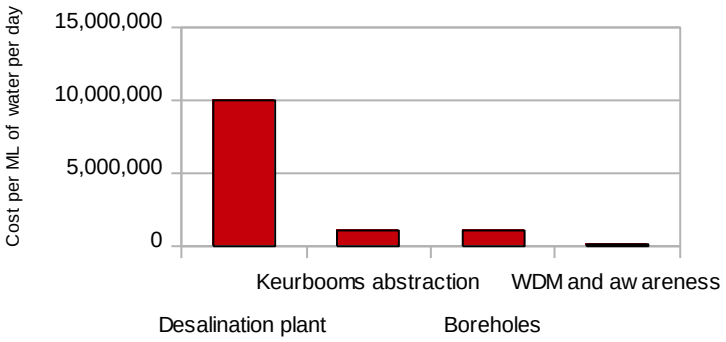
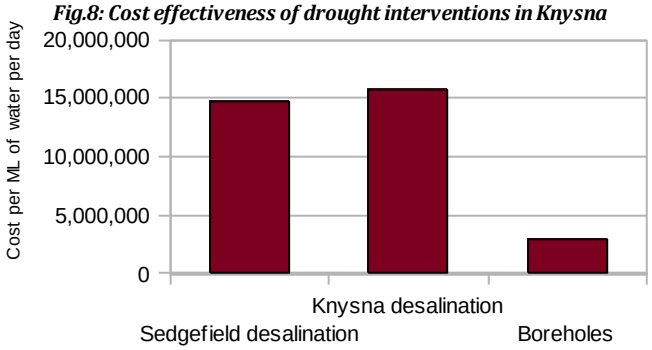


Fig.8: Cost effectiveness of drought interventions in Knysna



The huge differences between the value for money of desalination plants and WDM can be clearly seen. For comparable amounts of water, WDM is cheaper by an order of magnitude. These graphs compare the initial direct costs of interventions, i.e. the capital costs of

infrastructure, compared to the outlay costs of WDM and awareness campaigns. Although this does not take the operating costs of the infrastructure, nor the entire life-span of the infrastructure into account (over which time the amount of water it provides in total will improve it's 'rate of return' or cost effectiveness), it is nevertheless interesting to compare these interventions in this way. At the time of the crisis, when municipalities had to prioritise projects based on how much water they would provide in a short space of time, the amounts they spent on infrastructure were far higher than what they spent on water conservation and water demand management, for comparable amounts of water.

There is no doubt that this drought necessitated the securing of new sources of supply in addition to WC/WDM, otherwise these municipalities almost certainly would have run out of water. But, given the very high cost of desalination, and given that two out of the four desalination plants built during the drought are no longer in operation (WWF 2010), they seem a questionable choice. They are the 'emergency parachute', available as back-up for extreme circumstances such as this 1 in 200 year drought. Would a more refined, long-term WC/WDM campaign, targetted at wealthy users and industry, not have been a more sensible, cost effective and environmentally responsible choice[2]?

Key findings and Conclusions

The municipal responses to the southern Cape drought were ultimately successful in averting the short term crisis. No towns ran out of water, despite that seeming like a real possibility at times. Most households were able to access sufficient water for their needs throughout the drought (with the exception of rural farm-workers whose water access is controlled by farm owners). All of the municipalities are the proud new owners of large, technologically advanced desalination or water reclamation plants, which more or less guarantees that these towns will not come close to running out of water again in the near future. However, all of this came at huge monetary cost, and revealed some worrying trends in terms of the social and environmental impacts of municipal responses to water scarcity.

The key findings and lessons from this research are as follows:

It pays to be prepared:

Although the severity and duration of the drought was unexpected and unplanned for, there were water managers who had been anticipating problems of demand exceeding supply for a long time prior to this. Environmentalists and others in civil society had been warning of it too. The rampant expansion of these Garden Route towns, as well as the kinds of

2 It will be interesting to observe the consumption trends in these municipalities after the drought. The long-term potential of WDM is an area of potential future research.

developments favoured in the area (luxury resorts, golf estates, vast conferencing venues) is blatantly unsustainable and far exceeds the natural limits of the ecosystems in which they are situated. The Outeniqua Coast Water Situation Study (Dudenski 2007) had warned that the overall yield balance for the area was in deficit of 1.3 million kl/a, and that by 2025 this deficit would increase to 28 million kl/a. This study reported that even if all available surface water were utilised, the yield balance would still be in deficit of 8.4 million kl/a by 2025, and therefore the development of groundwater resources and the use of treated effluent was recommended to solve the deficit problem. For Mossel Bay, for example, the report recommended that they immediately do an evaluation of possible supply-side interventions, including groundwater, constructing a new dam, using treated effluent, and desalination as the last resort. George had done a comprehensive long term assessment of their bulk water supply options, and already had an ROD in place for the effluent treatment plant, which meant that they were able to move with more confidence into crisis response mode. Knysna had also done a bulk water supply planning study in 2007, and had identified the need to raise the wall of the Akkerkloof Dam amongst other options. According to Nialle Perring, Knysna water manager, he had been recommending that they build a dam to supplement Sedgefield's water supply for years, but it had been repeatedly postponed in favour of other municipal projects and developments (Perring, 2010). By the time this 1 in 200 year drought hit, there was no dam yet built, and so when the Karatara River, ran dry, a desalination plant was hastily built, at a far greater cost per ML than the proposed dam. Only an actual crisis caused action to be taken, and by that time, the action was rushed, expensive and, in some cases, inappropriate.

Clearly the most challenging thing about climate change, from a local government perspective is that it is unpredictable and uncertain. Even if one accepts that climate change is real (and certainly this is not the case with all municipal decision makers), the specific details are impossible to pin down, and it is therefore difficult to plan for it in the necessary detail. Planning and preparedness needs to take a more general flexible form, like budget allocations for 'potential' disasters, and holding back on unsustainable development 'in case' it exacerbates the effects of climate change. This is not the way municipal decision makers think or plan. It's not the way most of us plan. So, even if there *are* lone voices in municipalities advocating for climate change buffering within municipal plans, these are not often heeded. As this case study shows, however, a response deferred to the future, until crisis hits, costs more than being prepared and acting now.

A combination of co-ordinated and individual responses works well:

There was a cross-departmental task team set up by Eden District Municipality, which gave local water managers more legitimacy to get decisions passed by their councils and politicians: ‘The management of a crisis of this magnitude can never be attributed to a single person or department, but to the co-ordinated efforts of a multi-disciplinary and dedicated team, and co-operative governance’ (Basson and Mooiman 2010). Under the umbrella of

that co-ordinated response, there was room for individual municipalities to tackle specific issues their own way, allowing for more flexibility, with appropriate responses for the different local contexts – for example, strict regulations worked well in Mossel Bay, targetting wealthy non-compliant consumers with trickle devices worked well in Plettenberg Bay.

Official 'disaster' status allows for corners to be cut, lets municipalities off the hook, and can lead to bad decision-making: The urgency of the situation in the southern Cape led to a relaxing of protocols and allowed municipalities to bypass public consultation and thorough EIAs for new infrastructure. This meant a flurry of large new water augmentation schemes, including the country's first direct re-use effluent reclamation plant (George), and the country's largest desalination plant (Mossel Bay). Our concern is that the environmental, financial and social impacts of these projects were not properly considered. There is also a concern that the drought let the municipalities off the hook in terms of taking responsibility for their unsustainable development – it seems they were slowly heading for disaster anyway, as a result of their unsustainable development and lack of respect for the natural limitations of the ecosystems in which they are situated. The drought merely hastened the crisis, and allowed these municipalities to rapidly increase their water supply without having to answer for their lack of precaution, and without having to slow down or change their growth trajectory. Furthermore, rather than heeding the drought as a warning of the need to become more cautious and prudent, local politicians warned the water managers that they must ensure to 100% certainty that they would never run out of water again, because it jeopardised the luxury image of the region.

In retrospect, the huge amount of money spent on desalination plants seems wasteful and very short-sighted. At present, PetroSA is using only 1.5 Ml/day from the desalination plant they helped to finance (at a cost of approximately R96 million), and will only do so for a few more months, after which the plant will be 'moth-balled', due to high running costs. The dams, which are now full again, are obviously the much preferred source of water, since treated dam water is far cheaper than desalinated water. The desalination plants in Sedgefield and Plettenberg Bay are currently not working either.

Awareness campaigns and rationing works well in wealthy areas, and does not necessarily mean a drop in municipal revenue:

The extensive awareness campaigns, restrictions and emergency tariffs were very successful in reducing consumption – there was a reduction in consumption of between 30 and 50% in all municipalities. This reduction was mostly the result of wealthy users consuming less – partly because wealthy users use more, and for more non-vital uses, which makes it easier to cut back, and partly because the awareness campaigns seem to have been targeted at wealthier users. Despite these reductions, municipal revenue from water did not drop significantly. This is an important finding, as it challenges the perception that we

encounter in other municipalities which targets poor users in the name of water conservation, because targeting wealthy users is seen as a risk to income. Certainly these were exceptional circumstances: the undeniable urgency of the situation meant people were more accepting of the restrictions and the increased tariffs. It would be interesting to track the consumption trends after the lifting the restrictions, to see the long term impacts of the intensive WC/WDM measures.

Poor people were not targeted, but were most affected by tariff increases:

Unlike what we see happening in larger cities in the name of water conservation, there was not a targeted approach to limit water to poor people in the southern Cape municipalities. There are a number of possible explanations for this – the ratio of poor to rich in these towns is relatively low, therefore cross subsidisation is possible. The relatively newer townships in some of the towns do not experience the massive leaks, and therefore water wastage, that occurs in places like Khayelitsha in Cape Town. By the admission of several of the water managers, they do not know how to work effectively in the townships (Basson, 2010, Perring, 2010), and in the cases of Knysna and Bitou it seems that poor households are not billed or debt is written off, respectively. There were efforts to identify *actual* high users, and to engage with them directly, rather than applying blanket 'punishments'. These approaches were more effective and more just than the approach of restricting water to those who cannot pay. Nevertheless, as the Herbertsdale case study and the George case study (Wright 2011) show, the steep increase in water tariffs hit poor households hardest. The combination of water rationing and emergency tariffs meant that even low consumption was much more expensive than usual, and this resulted in poor households receiving much higher bills than usual. George had a particularly punitive tariff structure, where the price of the second tier was increased, offering no protection to poor households. The implications of unaffordable bills are dire for poor households, who either default on their payments and risk receiving trickle devices, being cut off or being summoned to court, or are forced to borrow money to pay their debt.

The power of industry:

The case of PetroSA reveals the power that big industry wields, and the inability of municipalities to influence them. PetroSA did not reduce their water consumption at all during the worst drought in recorded history, even as the municipality in which they are situated achieved a 50% reduction in consumption. Instead, they dealt with the problem by investing vast amounts of money in new, high-tech sources of water. Investment and pressure from industry was a deciding factor in the fast-tracking of major new infrastructure such as the desalination plant in Mossel Bay.

Hedonistic development is at odds with adaptation to climate change:

For wealthy developers and industry, water scarcity is merely a logistical hurdle to be overcome. In George for example, *Destiny Africa*, a conferencing and tourism venue, were told that their water requirements would exceed the available supply, but that they would be approved on condition that they helped to pay for a new source of water, in this case the effluent re-use plant. For the developers, this cost was affordable. This sends the message that the only constraint to water is cost, and that if you are wealthy enough water scarcity is not an issue, and has no consideration for the environmental and social costs of un-restrained development. The identity of these Garden Route towns as playgrounds for the wealthy, luxury retirement destinations and prestigious golfing facilities means that there is a large amount of pressure to avoid any sense of 'deprivation'. The water managers have been told to ensure to 100% certainty that they will not run out of water again, that there will be no need for restrictions again. Despite the huge success in reducing water consumption, there is no commitment to maintaining these shifts in behaviour and consciousness. These towns have therefore have all got back-up systems in place now – e.g. desalination plants that can be switched on and off, so that wealthy residents and visitors and investors need not be inconvenienced. The underlying attitudes and values that this reveals – luxury at any cost, complete disconnection from natural cycles, is extremely disturbing, especially in a climate changed world.

Water demand management is by far the most cost effective response to water scarcity, but it is not well understood:

There was an extensive awareness campaign, coordinated by Eden District Municipality, and water demand management approaches, such as educational programmes, increased tariffs, water restrictions, identifying and intervening with high users, were implemented in earnest. In George, the municipal water manager had a regular radio spot to share the latest news about the drought. In Mossel Bay, a siren went off at noon every Wednesday to remind people to pray for rain and the head of Municipal Income gave her husband a rainwater tank for Christmas. In Plettenberg Bay, trickle devices were installed in the mansions along Millionaire's Mile, where warnings to reduce water consumption had been ignored. However water demand management was definitely seen as the 'soft' route, as something which could hold the disaster at bay for a short time, while the technical infrastructural projects were being put in place to increase supply for the longer term. In fact, the water demand management interventions were extremely effective, and the most cost-effective approach by far. At a fraction of the cost, they achieved as much or more in terms of water saving as the largest desalination plants achieved in terms of extra supply. And yet, in the words of one of the municipal water managers I spoke to, 'You can't rely on water restrictions in the long term, people just get used to them and go back to their old ways (Geldenhuys 2010)'. Another admitted that 'water education only works in the wealthy areas. We do not know how to work in the townships' (Basson 2010).

Municipal water managers are on the front-line of protecting us from climate change induced water scarcity, but they can't do it alone:

It is not easy to be a municipal water manager. They are most often engineers, tasked with the challenging job of getting water to everyone who needs it, but with limited political power over the decisions that influence water availability. In the case of the southern Cape, it appears that their opinions about the insecure state of their water supply were not taken seriously by the politicians until it was too late. It is also very difficult for water managers to turn down new developments. In Knysna for example, new investments in development are necessary to subsidise the building of low cost housing, and so if the water manager were to say no to new development due to water scarcity, it would amount to saying no to low cost housing – which is not an option, from a political perspective.

As discussed above, they favour technical responses; this is not very surprising, given that they are technical specialists. Each manager has their own strengths and passions, but most don't have the affinity, experience or skill for community building, social empowerment and human development. It is, therefore, no wonder that quantifiable technical solutions were prioritised over the vagaries of behavioural and consciousness changes. This is an important reality to grapple with. If resilience to climate change requires the building of social relationships and citizen agency, we need to think carefully about whom we are asking and relying upon to lead our collective responses.

In closing, this research has provided new and valuable insights into the kinds of scenarios, responses and impacts we can fully expect to see in other municipalities as climate change is increasingly felt. The research is just the beginning. These findings will now be used to inform our engagement with policy makers, municipalities, and in the building of a movement of civil society determined to ensure that climate change and its responses are dealt with equitably, sustainably and timeously. Specifically, this research has opened up new areas of potential research, into for example the impacts of desalination, the long term impacts of water demand management, and building healthier relationships between municipalities and the communities they serve.

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