Chapter 2

Building water resilience into strategy: The Cape Town drought

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ABSTRACT

The Cape Town drought captured the world's attention at the beginning of 2018 with the announcement of Day Zero: the day that Cape Town's taps would run dry. In the eye of the storm a host of factors contributed to the panic, and rapidly falling dam levels. Politics was exceptionally conflictual, interaction between spheres of government responsible for various aspects of water supply far from perfect, with public perception and media frenzy driving a focus on matters which played a very small part in the effort not to run out of water. During this time, Cape Town was building a water strategy, specifically aimed at making Cape Town more resilient against future droughts by addressing all possible factors contributing to the drought crisis. With dams close to overflowing in 2020, the next challenge is to ensure that the strategy is implemented according to plan.

Keywords: Water scarcity, water shortages, urban water supply, drought strategy.

2.1 INTRODUCTION

Regions reliant on water supply from rainfed dams have always been vulnerable to the impact of drought. This is exacerbated by the uncertainty of future rainfall which is never guaranteed, and reliance is placed on modelling using historic data. While weather has always been variable, climate has been generally reliable. With

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anthropogenic activity causing changes in climate, the validity of modelling based on history is currently not fully trusted. Unless the storage capacity is sufficient to carry through numerous seasons of poor rainfall, even with water restrictions to match demand and supply in times of depleted rainfall, the risk of reservoirs running dry remains a threat.

Cape Town experienced its worst drought on record, with climate statisticians estimating a return period of one in 590 years for the low rainfall between 2015 and 2017. The regional water supply system was designed to operate at 98% reliability, resulting in urban users theoretically accepting the risk of severe water restrictions once every 50 years. Agricultural allocations from the regional water supply system are at a lower level of assurance, reflected in lower pricing and higher restrictions being implemented. Despite the levels of assurance having been deemed an acceptable risk within hydrological bulk water planning, how the drought played out proved the system to be less than sufficiently resilient given the uncertainty of the impact climate change.

Through the regional supply system, Cape Town had been served almost exclusively by surface water, which is reliant on runoff from rainfall. Part of the plan to achieve greater resilience thus had to include diversification of water resources away from surface water:

- Groundwater supply is more resilient to drought, although many aquifers need to be recharged to avoid wells running dry and thus even if lagging surface water, groundwater is not fully resilient to drought.
- Water re-use results in better valuing of water by maximising retention of the volume of treated water in the demand cycle. In water scarce regions, flushing potable water down the toilet seems unconscionable, and re-using wastewater, either as treated effluent or directly potable requires consideration. To be able to re-use water, there first has to be sufficient water in the system, thus re-use is also not fully drought-proof.
- Desalinated water is virtually limitless in volume and independent of rainfall. Approximately 97% of the earth's water is saltwater found in oceans and seas. Whilst more expensive, desalination provides supply assurance irrespective of rainfall and drought.

Water supply augmentation is necessary to bring into balance demand and supply, but a number of additional focus areas are critical to render a system resilient. Water scarcity evokes strong emotion, and management of water resources is prone to conflict and politicisation. The protection of rights to water of the most vulnerable is crucial and has historically often been overlooked. Even where relationships are formalised through legislation and regulation, in times of crisis extraordinary collaboration is generally required, spanning all sectors of society. Furthermore, to fully internalise the possible impact of climate change, a long-term view must be taken to having a new relationship with water supply, which inevitably will result in the increased cost of water.

2.2 CONTEXT

South Africa falls into the World Bank categorisation of upper middle-income, based on a per capita gross national income (GNI) range of USD 3996–12,375. The per capita GNI for South Africa in 2019 was calculated at USD 6040, 96th in the world (World Bank, 2020). While inequality has improved slightly since peaking in 2005, South Africa retains the unfortunate top position in the world, with a Gini coefficient (the Gini coefficient is a statistical measure of the degree of variation of income inequality where 0 signifies perfect parity and 1 expresses maximum inequality) of 0.63.

By population, Cape Town is the second largest metropolitan municipality in South Africa, after Johannesburg and covers an area of nearly 2500 km^2. Cape Town is also second to Johannesburg in high net wealth held by private persons. Perhaps counterintuitively, Cape Town's Gini coefficient is the lowest of the metros in South Africa, and lower than the national average at 0.61. In terms of the UNs human development index, Cape Town scores higher than other metros in South Africa, at 0.73 (United Nations Development Programme, 2020).

The City of Cape Town is funded mainly from own revenue from rates (taxes) and utility tariffs, as well as grant funding from the National Government. Rates and tariffs are structured so that higher income households subsidise lower income households that cannot afford to pay. Property values in Cape Town are high compared to that of the rest of the country, and the basic property value used as cut-off for blanket indigency is revisited frequently. In 2020 that value was set at R 300,000 while the monthly household income to qualify as indigent was R 7000. Approximately 40% of households in Cape Town are indigent and thus subsidised by revenue from the balance of households, commerce and industry. These indigent households do not pay for an allocation of 10.5 kl/month or the related sanitation costs. For a household of four, this translates to 87 litres per capita per day (lcd) delivered free of charge. Water tariffs are ring-fenced and cost reflective, and annual increases have historically been kept artificially low, leading to erosion of service standards. In recent years increases have been higher and services are provided at closer to actual cost.

Cape Town has one of the highest levels of biodiversity worldwide. Urban sprawl and high population growth has resulted in encroachment of many ecosystems resulting in threatening many plant species. In response, the City of Cape Town has been at the leading edge of environmental protection for many years, often creating conflict between environmental protection and human habitation. Land invasions typically result in sensitive ecosystems such as wetlands being occupied by informal structures. Once communities are settled in place, eviction processes are lengthy and often unsuccessful, resulting in permanent biodiversity loss.

With a myriad of socio-economic problems in South African cities, there is always a tension in competing for scarce resources. Trade-offs therefore need to

be made at every level; government does not have the financial resources to fund all the infrastructure required countrywide. In 2020 in South Africa, it is common cause that all utilities and shared infrastructure in most regions are in need of investment not only to provide new infrastructure but also to maintain that which exists. In most metropolitan municipalities road infrastructure is crumbling, and rates income cannot afford replacing extensive road networks. The national electricity grid is under supplied due to decades of poor maintenance or renewal, and lengthy delays in commissioning of new power plants further hampered by momentous corruption. As a result, the country is subjected to frequent periods of load-shedding where load is reduced through sequentially switching off areas for a couple of hours at a time. Solid waste services are woefully under-resourced, with many rural municipalities having virtually no capacity to manage and dispose of waste. As a result, illegal dumping abounds with detrimental consequences on the environment. Similarly, the condition of both bulk and reticulation water and sanitation infrastructure has been eroded over decades, while new infrastructure has been targeted at providing access to those most in need. With an estimated one in eight residents of Cape Town living in informal settlements, in need of affordable, well-located housing opportunities, the total lack of resilience in the infrastructure space is unmistakeable.

The water supply system serving Cape Town has had a 98% level of assurance, and compared to other services, was generally deemed to be sufficiently resilient prior to 2017. Water supply was reliable, at good quality, and droughts were managed by imposing restrictions while local government worked with the National Department of Water and Sanitation (NDWS) on reconciliation of the system. By the middle of 2017, the City's political leadership assessed the risk of climate change accelerating faster than compensating infrastructure could be built to be unacceptably high. Water, being such a core component of *all* life, demands special priority in building resilience, and with full focus on the drought, water held centre stage in the Western Cape for many months.

Worldwide, infrastructure development programmes have for decades been seen as the path to economic growth and social upliftment, and since 1994, the South African government has embarked on numerous programmes to do exactly that. From the Reconstruction and Development Programme (RDP), the Growth, Employment and Redistribution strategy (GEAR) through the Accelerated and Shared Growth Initiative for South Africa (ASGISA), New Growth Path (NGP), National Development Plan (NDP), and in 2020, South Africa's Economic Reconstruction and Recovery plan developed to counter the disastrous economic impact of the extended coronavirus disease 2019 lockdown.

Despite the series of laudable customised programmes, poverty, high unemployment, low economic growth and austere inequality prevails in South Africa. An unfortunate culture of corruption resulted in severe erosion of the country's development, and only in 2020 are perpetrators finally being brought to book. The damage done is incalculable, but the past cannot be changed and the

country's best chance at moving forward is to transform the culture to one where rules are respected, and to do so without delay. The new economic recovery plan not only aims to invest in infrastructure thereby stimulating the economy and creating jobs, but also to fight corruption and build a capable state. Furthermore, the intent is clear that obstacles to private sector-led employment and economic growth need to be removed with a focus on local production and consumption to stimulate industry. Planning and budgeting for new bulk water infrastructure is key to the country's water security, and being recognised at the highest level, there is hope that implementation will follow and value for money achieved through the elimination of corruption.

Over and above the risk to resilience posed by degraded infrastructure in the country, relying solely on rainfed dams adds significantly to the risk of inadequate water supply. With rainfall becoming less reliable over time, consideration must be given to diversifying water supply sources.

2.3 INSTITUTIONS

Democratic South Africa is a parliamentary republic and has three spheres of government – national, provincial and local. The South African Constitution (Act 108 of 1996), prescribes that everyone has a right to have access to sufficient water, amongst other basic needs, and that the state has responsibility to progressively realise these rights (Republic of South Africa, 1996). NDWS is responsible for formulation and implementation of policy governing water resources management, which covers protecting, managing, using, developing, conserving and controlling the country's water resources. In terms of the National Water Act, Act 36 of 1998, National Government is responsible for and has authority over water resources, including allocation, protection and use of water (Republic of South Africa, 1998).

Provincial government has no direct responsibility in provision of water, but as a minimum practice oversight through a number of departments. These include:

- The Department of Local Government aims to support and strengthen the capacity of municipalities to manage their own affairs. This department is also responsible for disaster management, and as such participated actively subsequent to the local and provincial disaster declarations.
- The Department of Agriculture stimulates regional economic growth through research and support to the agricultural sector, a major water user in the province. With extreme restrictions on water during the drought, support was required in managing job losses and improved efficiency in agricultural practices.
- The Department of Economic Development and Tourism visions a vibrant economy in the Province and supports business and industry to grow the economy and employment. The threat of literally running out of water

alarmed many businesses to halt expansion plans and invest in alternative water supplies and efficiency measures.

- The Department of Environmental Affairs and Development Planning safeguards the natural environment as custodian of various approval processes while supporting sustainable development through regulating development. Their role in the drought was amplified through approvals related to new augmentation schemes in terms of emergency drought conditions.

Figure 2.1 The WCWSS and dams.

In terms of the Water Services Act, Act 108 of 1997 municipalities are defined as Water Services Authorities, responsible for ensuring access to water services (Republic of South Africa, 1997). Part B of Schedule 4 to the Constitution lists water and sanitation services limited to potable water supply systems and domestic wastewater and sewage disposal systems as a local government matter. The City of Cape Town's Water By-law defines the terms of provision of water within the municipal area (City of Cape Town, 2010).

Whereas most municipalities in South Africa purchase bulk water from water boards, the City of Cape Town is also responsible for provision and treatment of bulk water, and owns three of the six dams which comprise the Western Cape Water Supply System (WCWSS). The WCWSS supplies the urban demand of Cape Town as well as several local and district municipalities, agricultural users and irrigation boards. Cape Town annually utilises around 64% of water from the system, with agriculture using 29% and smaller municipalities making up the balance.

The extent of the WCWSS is shown in Figure 2.1. Most of Cape Town's water comes from the Riviersonderend-Berg River Water Scheme, which makes up the biggest part of WCWSS. This scheme captures the flow of three main rivers: the Sonderend River, Berg River and Eerste River, which feed into six major dams. The long-term sustainability of water resources in the WCWSS is achieved through the provision of flexibility of City infrastructure to shift the demand among various water sources within the system, to the benefit of all users.

Over and above legislative prescripts amongst different spheres of government, the relationship between the City and the NDWS in managing the system collaboratively is defined in the Raw Water Supply Agreement. This agreement was finalised to facilitate funding of the last large dam to be constructed in the system, that being the Berg River dam. The system is premised on operating rules, which when adhered to results in the system being in balance, with assurance of supply reconciled with growth in demand. The operating rules are

2.4 MINIMISING SPILLAGE

As Cape Town is the largest water user consistently throughout the year, the City's demand is shifted to those dams more likely to spill during winter, while other dams still have storage capacity available. The City provided additional treatment capacity at its water treatment plants, and spare capacity in conveyance infrastructure to provide this flexibility. While it is beneficial for the City to utilise water from its own dams thereby avoiding pumping costs for water transfer, by shifting the demand to any of the dams in the system, yield can be optimised.

2.5 MINIMISING WASTAGE

Through the City's Water Conservation and Water Demand Management (WCWDM) programme, the City monitors monthly urban demand and implements strategies to continuously reduce water wastage. Similarly, the agricultural sector has management structures in place to manage water use, and the responsibility for managing and enforcing responsible use falls on the NDWS.

2.6 RESTRICTING DEMAND

At the end of the hydrological year on 31 October every year, the system is evaluated to determine whether restrictions need to be implemented for the coming year. The evaluation model considers available storage, demand and forecasts different inflow scenarios to determine the appropriate level of restriction, if any, to be imposed.

The WCWSS is represented by urban and agricultural water users as well as the NDWS in overseeing the supply and demand reconciliation strategy. The strategy was first developed in 2007, and thereafter updated regularly with actual demand and supply statistics.

Located in a winter rainfall region, around 90% of runoff occurs between May and October. During the balance of the year, November to April, around 70% of water is used: urban demand varies only marginally over the year while agricultural use occurs mainly over the summer months. The system was designed to rely on reasonable rainfall every winter, with average runoff sufficient to fill all but the largest dam every year. The storage capacity of the largest dam, Theewaterskloof, is such that approximately 2 years' of average rainfall is required to fill it from scratch, thus 50% of storage capacity provides carry-over in times of drought.

On the supply side, the impact of climate change, including reduced rainfall and increased evaporation was considered as one of the scenarios, together with, for example, the reduction in yield due to spread invasive alien vegetation. The eradication of these species has been problematic as much of the catchment areas are difficult to access, and land ownership both private and in the hands of various different state departments in the different spheres of the government. Even with programmes such as the much lauded Working for Water under the Department of Environmental Affairs which started in 1995, where job creation went hand-in-hand with catchment management, progress has deteriorated and the calculated impact of the reduction in yield during the drought had a significantly negative impact on dam levels.

Legislation in South Africa is progressive and comprehensive, and governance is highly regulated. Despite the complicated responsibilities assigned to the three spheres of government, there does not seem to be a policy deficit in the ambit of bulk water management which aggravated the impact of the drought. Rather, common to South Africa is the ability to remain on-track with strategy

implementation. This is compounded by politics negatively impacting with frequent changes in leadership at ministerial level, which inevitably results in new strategies and implementation plans being developed, budget re-prioritisation and changes in professional staff especially in leadership positions. Combined, these not only delay implementation but also reduce value achieved in the continuous re-drafting of plans and strategies.

2.7 TIMELINE

The capacity of the major dams in the WCWSS is close to 900 million cubic meters (MCM). The unrestricted urban allocation in 2016 was 415 MCM, and agricultural allocation nearly 200 MCM, comprising 68% of stored capacity. With unrestricted demand, capacity can provide sufficient water for only one and a half years. Restricted by 25%, the storage volume can supply demand for nearly 2 years.

From the supply side, with average runoff from rainfall of 711 MCM, dams would spill at a starting level after summer of 20%. Average rainfall is thus more than sufficient to provide secure supply – between 2000 and 2015, dams spilt eight times. Slightly higher than average rainfall in the three years preceding the drought had dams spilling in the winters of 2012, 2013 and 2014.

The 2015 winter rainfall season heralded the first year of the drought (see Figure 2.2). With the highest urban demand in 15 years, dam levels fell from full to below 50%. The low rainfall in 2015 resulted in dams recovering to only 74% at the end of the rainy season. With Cape Town restricting demand by 10%, reduction in dam levels was ~7% less than the previous year, and reached a minimum average of 29% before winter 2016. Rainfall and thus runoff in 2016 was slightly better, resulting in dam levels rising by nearly 33%. With harsher

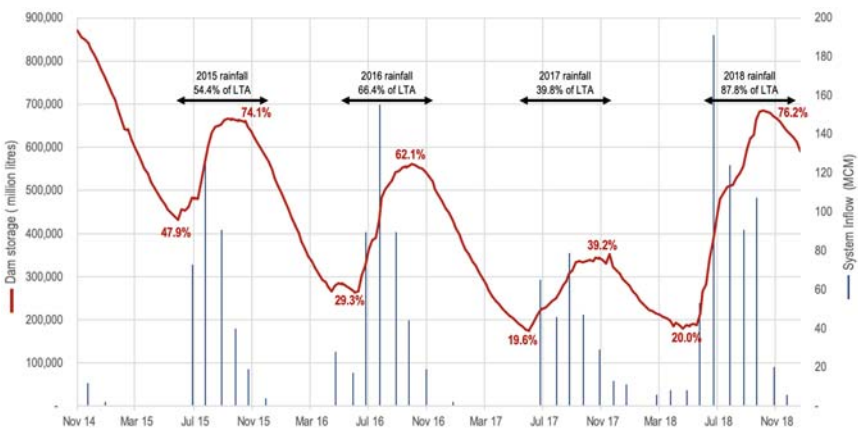

Figure 2.2 WCWSS dam levels and seasonal inflow 2015–2018.

restrictions in place (but not imposed) in the summer of 2016/2017, dam levels reduced by more than 40%, ending just below 20% full. Lowest rainfall on record in 2017 resulted in dam levels peaking just below 40% by the end of the rainy season. The impact of the disaster declaration and various restriction measures is evident in a reduction of less than 20% in the summer of 2017/2018. Due to the dramatically reduced demand, lower-than-average rainfall in 2018 had dam levels rise to 76%, an increase of 56%.

Much happened in the City administration during the period depicted in Figure 2.2, creating significant political instability, whilst the impact of the drought increased to a peak late in 2017 and only started to calm down towards the end of 2018. Local government elections were held in August 2016 and the new city leadership, with a restructured administration was appointed from January 2017. In January 2018, oversight of the drought was moved from the Mayor to the Deputy Mayor. A number of votes of no-confidence failed early in 2018 before the Mayor eventually reached an agreement to step down and leave the ruling political party.

2.8 DESCRIPTION OF ACTIVITIES

The strategy to practically navigate the drought had three main components: managing dam storage in reducing drawdown as far as possible, managing Cape Town's demand, and accelerating sources of additional water.

2.8.1 Managing dam storage

The first element was to retain the remaining water in the dams for as long as possible. Cape Town gets its water from the WCWSS, which is controlled by the NDWS. During the previous summer months of 2016/2017, both urban and agricultural users were restricted by 20%. Urban users made a saving of 17% while agriculture used 3% *more* than their unrestricted allocation. Figure 2.3 shows the planned demand for both Cape Town and agriculture for the 2017 hydrological year, with a 45% urban and 55% agricultural restriction.

The graphs in Figure 2.3 were made public by the City to ensure broad awareness of why dam levels were dropping so rapidly in summer 2017/2018. Urban demand is shown on the left. The usage target was established by reducing the City's allocation by 45%, to just below 175 MCM. By the end of January 2018, the City was tracking marginally above planned demand. Releases to agriculture started earlier than they should have at the end of 2017, and continued at the rate that the 55% restricted target of 58.2 MCM would have been exceeded by February 2018 whereas usually allocations were made through April. As Cape Town had no control on physically stopping releases to agriculture, the City repeatedly alerted NDWS to the need to stay within the restrictions required by the operating rules.

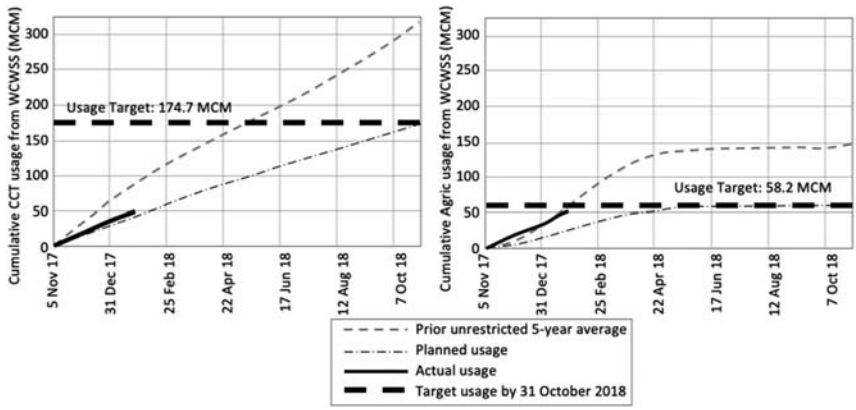

Figure 2.3 Demand tracking to January 2018.

2.8.2 Managing demand

The second component of navigating the drought managed by the City of Cape Town was to ensure that our urban demand was reduced to an absolute minimum to use less water from the system. Demand had already reduced dramatically by the end of 2017, and with an increase in tariff and threat of Day Zero in January 2018, the daily demand finally broke the demand threshold of less than 500 million litres per day (MLD). This was a significant achievement as peak summer demand was in the region of 1200 MLD. Cape Town was widely recognised for the significant achievement, such as a certificate of excellence received from the International Water Association for reducing demand by 55% without resorting to intermittent supply.

As a standard response to drought, restrictions had been imposed in the region since water records were kept for Cape Town since around 1834. Reasons for restrictions historically included inadequate water resources to meet demand, droughts and insufficient infrastructure to treat or convey water. Often, restrictions had to be imposed in the periods immediately prior to completion of major infrastructure such as Wemmershoek Dam, Voelvlei Dam and Faure water treatment plant. Restrictions due to drought were most recently imposed in 2000 and 2004. Between 2004 and 2014, dam levels always exceeded 85% by the end of winter, and exceeded 100% in 6 of the 10 years.

Reducing demand so dramatically in the years of 2016/2017/2018 relied on a multi-pronged strategy:

(1) **Communications:** To engage more than 4 million people in saving water required simplifying complex messages to have broad appeal. All media channels were employed, from print, to radio interviews through to personal interactions to targeting information at the right level of detail in an attempt to soothe the tumultuous political environment.

(2) **Pressure management:** The existing pressure management project was accelerated during the drought. Division of the city into hundreds of discrete pressure zones was finalised, to allow for management of pressure within each zone to be automatically regulated and remotely controlled.
(3) **Restrictions and punitive tariffs:** Water restrictions were increased progressively as the drought unfolded. At the start, three restriction levels were defined, each with behavioural restrictions and tariffs to ensure revenue balancing on reduced demand. This was increased to seven restriction levels by the end of the drought, with each restriction level defining six steps of volumetric use. Only at level 6 were tariffs sufficiently punitive above 6 kilolitres per household per month to result in decreased usage.
(4) **Flow limiters:** Through its indigent support programme, which was first implemented in 2007, the City repaired household leaks and installed a water management device at households which could not afford to pay for water. The device provides 10.5 kilolitres per household per month, as the meter physically restricts water supply to 350 litres per day. During the drought, such meters were installed to limit flow at delinquent households with excessive consumption. These households were charged for the cost of the meter as well as installation. Over 50,000 flow restrictors were installed in the summer of 2017/2018.
(5) **Adaptation measures:** Demand was further reduced by a number of citywide and household adaptation measures, including increased use of treated effluent, retrofitting public buildings with water-efficient fittings, encouraging rainwater harvesting and greywater usage at private households, water-sensitive urban design and so on.

2.8.3 Accelerating augmentation

The final component of navigating the drought was to accelerate additional water from diverse augmentation schemes into the system. It was recognised that these would not be sufficient to significantly increase supplies in the short-term, but the urgency with which projects were undertaken was to set the tone for the augmentation schemes which were later approved in the water strategy. The city had been working on groundwater, potable re-use and desalination projects for decades, which provided a sound base for the accelerated work.

It is accepted in engineering practice that it is seldom feasible to build one's way out of a drought. Water augmentation projects at scale are well regulated and complex, and regionally in the Western Cape, virtually all development and management experience was from surface water. The scale of the volume of water to be produced also means that small inefficiencies can have a significant impact on cost. Therefore, procuring to obtain best value for money while meeting specifications is critically important.

Groundwater projects were expected to be quicker to implement to first water than either desalination or direct re-use. Infrastructure for groundwater projects are naturally more geographically spread out than dams for example, and easier to accommodate in existing reticulation schemes. The Cape Flats aquifer is a shallow sandy aquifer, located within the urban area and was prioritised to be the quickest project for additional water. A variety of delays meant that first water into the system was only available after the worst of the drought. Delays were due to, inter alia, lower than expected borehole flow-rates, poorer than expected water quality, limited accessibility to suitable sites, vandalism of construction site establishment and environmental objections.

Exploratory and pilot drilling work on the Table Mountain Group aquifer project had been underway since 2003. The best areas of accessibility and anticipated yield is located in environmentally protected areas, many of which are close to existing dams. Although the drought disaster declaration excluded these projects from requiring full environmental authorisation, the City followed a conservative approach to ensure long-term sustainability and optimisation of the volumes of water to be finally extracted from this aquifer. The project provided the first *new* water into the WCWSS from production boreholes drilled at Steenbras Dam. Water from the aquifer is of good quality requiring treatment only to remove iron and manganese.

Desalination contributed half of the target of 500 MLD of the initial drought response, in three projects which were fortunately never implemented: 50 MLD from a fast-tracked land-based plant and 200 MLD from ships and barges. A host of small-scale temporary containerised desalination and wastewater re-use projects were initiated in mid-2017 with a total yield just over 100 MLD. Of these, three desalination plants with a combined yield of 16 MLD and one re-use plant with 10 MLD capacity were implemented. The desalination projects provided water in May 2018, as winter rain started falling. The re-use plant suffered some delays and provided water only a year later, at which point the social acceptability concern resulted in water not being injected in the reticulation system. Instead, water was used for utility purposes on site, and as collectable water for purposes such as street cleaning. The cost of water from the temporary plants varied between R 30 and R 35/m^3 compared to that from surface water of R 5.20/m^3 at the time.

As work progressed on the three-pronged approach to navigate the drought, a strategy was taking shape towards building resilience. This evolved over time, but as a starting point, the need for a comprehensive water strategy was built upon a combination of the following objectives:

- Don't lose the lessons learnt during the drought! Value water. Build better social cohesion and equity in access.
- Consider, plan and mitigate shocks (drought, tariff increase, localised flooding, storm surge, protest action) and stresses (inward migration,

informal settlements, poor hygiene and sanitation, sub-optimal institutions, ageing infrastructure).
- Diversify supply by reducing reliance on rainfall; introduce redundancy.
- Maintain water conservation and demand management, support household resilience.
- Resolve better management of catchments requiring cooperation between all spheres of government.
- Price water appropriately.
- Entrench water-sensitive design by managing the entire urban water cycle.

2.9 ANALYSIS OF IMPACT

While the drought was underway, it was recognised that a more formalised strategy was required to ensure long-term water resilience. At the time, Cape Town was also developing a broad municipal resilience strategy. This strategy defines resilience as 'the capacity of individuals, communities, institutions, businesses and systems in a city to survive, adapt and thrive no matter what kind of chronic stresses and acute shocks they experience' (City of Cape Town, 2019a). Chronic stresses include those occurring perpetually such as food insecurity, high unemployment and substance abuse, which weaken society continuously. Droughts are included under acute shocks, with sudden events such as fires, floods and pandemics.

Through the water strategy, Cape Town has a vision of becoming a water-sensitive city by 2040, where management of water resources are optimised and integrated to improve resilience to the benefit of all people in the city (International Water Association, 2019).

Cape Town's Water Strategy is built on five commitments, which if implemented, will result in Cape Town being more resilient to future droughts which will inevitably occur (City of Cape Town, 2019b). As a starting point the City wanted to prioritise rebuilding of trust as this was very much eroded in misinformation and political arguments in the media during the drought. For this reason, the word 'commitment' was chosen to underscore the administration's willingness to give time and energy to the promise of building a water-resilient city.

Ten principles guided the content of the strategy, emphasising that a new relationship with water is required. Water has historically been under-priced, and in times of abundance, not valued. With a focus on people, the strategy recognises that people have different requirements and cultural needs in their relationship with water. Inclusivity and trust will be built by transparency in engaging broadly with stakeholders across boundaries and party politics. Utilising water to create natural connections with nature for the enjoyment of citizens will benefit ecosystems, and build on the knowledge base of local culture.

The commitments provide the backbone of the water strategy and were carefully selected to provide a holistic strategy, covering all the major actions required to build resilience in Cape Town's relationship with water.

2.9.1 Safe access to water and sanitation

Safe access requires municipal potable water supply to meet stringent quality standards, while being available to all inhabitants, business and industry. In unequal societies this is particularly important, where much of the population lives in rudimentary accommodation without direct service connections, and share water points and communal toilets. A commitment was made to engage with poorer communities to develop appropriate service standards that could improve the lived experience, even if not offering permanent formal housing with individual service connections as an option. In the drought, much noise was made about water wastage in informal areas, but in reality, 15% of people in the city accounted for less than 5% of water usage. Decreasing social inequality and prioritising the dignity of all people needs to be a major consideration for all cities.

2.9.2 Wise use

With the dramatic reduction in consumption achieved by 2018, it was evident that the average person could use much less water than before 2015. Rather than demand bouncing back to pre-drought levels, demand should remain supressed, recognising that water must be respected and used wisely to build future resilience. To attain wise use, in the first instance water needs be priced correctly. Municipalities do not make a profit on sale of utility services, but need to cover the cost of providing services. This means that the cost of additional infrastructure needs to be covered by an increase in tariff, while still maintaining a progressive and affordable tariff regime. The second aspect within a local authority's control to influence wise water use is to amend planning regulations, bye laws and green building incentives. Thirdly, with customer complaints escalating exponentially in the drought, on top of increased tariffs and delays in answering queries, the relationship with the customer base had to be dramatically improved, by adding capacity to the support and back office staff. The final component of wise use is to ensure that infrastructure is well maintained and pressure appropriate to minimise leaks and reduce water losses below Cape Town's achievement of 15%.

2.9.3 Sufficient, reliable water from diverse sources

Building on the augmentation projects identified in the reconciliation strategy and accelerated in the drought, the timing and additional yield required over time, with due consideration of cost, resulted in proposed additional volumes in the finalised water strategy as shown in Table 2.1. Modelling anticipated water demand together with impacts of climate change, such as lower rainfall and more frequent drought, the most likely requirement for new, additional water supply over a 10-year period was calculated to be ~350 MLD. Together with the existing surface water resources in the WCWSS, this provided a level of assurance of 99.5%, equating to serious restrictions being required only once in

Table 2.1 Water strategy committed 10-year build programme.

Intervention[+]	First Water	Effective Yield		Total Capex	Unit Capex[++]	Operating Cost[+++]
		MLD	*MCM pa*	R million	Rm /MLD	R/klitres
Demand management	2019	*70*	26	410	6	3
Alien vegetation clearing	2019	55	20			~1–2
Management of WCWSS	N/A	27	10			~0.2–0.5
Cape Flats Aquifer P1	2020	20	7.3	610	31	5
Table Mountain Group P1	2020	15	5.5	375	25	5
Cape Flats Aquifer P2	2021	25	9.1	450	18	5
Atlantis Aquifer	2021	10	4	290	29	8
Table Mountain Group P2	2022	15	5.5	335	23	5
Table Mountain Group P3	2022	20	7.3	326	16	2
Berg River Augmentation	2023	40	15			~3–5
Water Re-Use P1	2024	70	26	1360	20	5
Desalination Phase 1	2026	50	18	1650	33–40	9
Total including WDM		417	154	5806		
Total new supply		347	128	5396		

Notes:
[+]Timing, and the capital and operating costs are best available engineering estimates. All schemes subject to outcomes of ongoing investigations (to determine optimal yield, siting and timing) and relevant approvals.
[++]Rounded to nearest million Rand.
[+++]Rounded to nearest Rand.

200 years, translating to a fourfold increase in reliability. Over and above the new supplies, renewed demand management interventions resulted in an additional availability of 70 MLD in the system. This would result in new, and affordable supply to 2030, providing a springboard for further incremental augmentation thereafter.

The system information would be monitored annually, providing for adaptation of the build programme to retain balance should either demand or supply assumptions change. Given the size of the system, dramatic rapid changes that could not be mitigated by adapting the build programme were not anticipated.

2.9.4 Shared benefits from regional water resources

Responsibility for bulk surface water schemes had been the responsibility of the national DWS since the promulgation of the Water Act in 1956. Although the impact of the new water programme had not been resolved with DWS, Cape Town decided to proceed, to improve resilience to anticipated future droughts. Aspects such as existing allocation, level of assurance and cost of raw water had not been resolved. However, to have paused until legal agreements were concluded would have exposed Cape Town to further risk.

Woking in partnership, and collaborating with stakeholders on water was not generally a priority prior to the drought, but during, many valuable relationships were established. It was recognised that virtually everyone could be significantly impacted should water supply run dry, and collaboration was key to protecting the other commitments in the strategy. The intention thus was to build on this level of transparency and collaborate across business, customers, civil society and spheres of government.

2.9.5 A water-sensitive city

Integrated urban planning and design aimed at achieving a water-sensitive city requires integration of the total urban water cycle, which includes bulk water supply, stormwater, groundwater, reticulation networks and wastewater. Infrastructure systems designed purposefully to facilitate water sensitivity provides for *valuing* every part of the water cycle, for example that stormwater is slowed and stored to recharge aquifers rather than being guided out to sea. Much of Cape Town's urban sprawl has occurred in low-lying areas prone to flooding while summer months are hot and dry. Mechanisms for flood control and utilisation of water for aesthetic and recreational purposes will change the landscape, and the commitment is for all city-led development to follow water-sensitive design principles while encouraging private development to do the same.

2.10 CONCLUSION

It can be argued that the region and Cape Town was technically still resilient to multi-year droughts at the time of the drought between 2015 and 2018, but practically, failures in adhering to the operating rules and lack of cooperation had exacerbated the level of drought disaster significantly. It has been calculated that dams would have had an estimated 18% more water had the operating rules been followed. This would have meant that levels were at 56% rather than the actual 38% at the start of summer 2017/2018. Restrictions would still have been required, but the panic around running out of water would have been averted.

Bulk water planning and the demand and supply reconciliation strategy provided a sound base to deal with a multi-year drought at the level that the world has experienced climate change to date. There is no guarantee that future droughts won't be more severe or that rainfall patterns may change significantly and suddenly, and there for the best way to build resilience in water supply is to diversify and provide some redundancy in the system, even if financial resources are limited.

Having a municipal Council-approved strategy in place provides a solid foundation for building resilience. Commitment is required by the utility department to ensure that sufficient resources are made available and that the necessary support is provided to implement the strategy. Only once all the commitments of the Water Strategy have been met will Cape Town be resilient to future droughts.

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