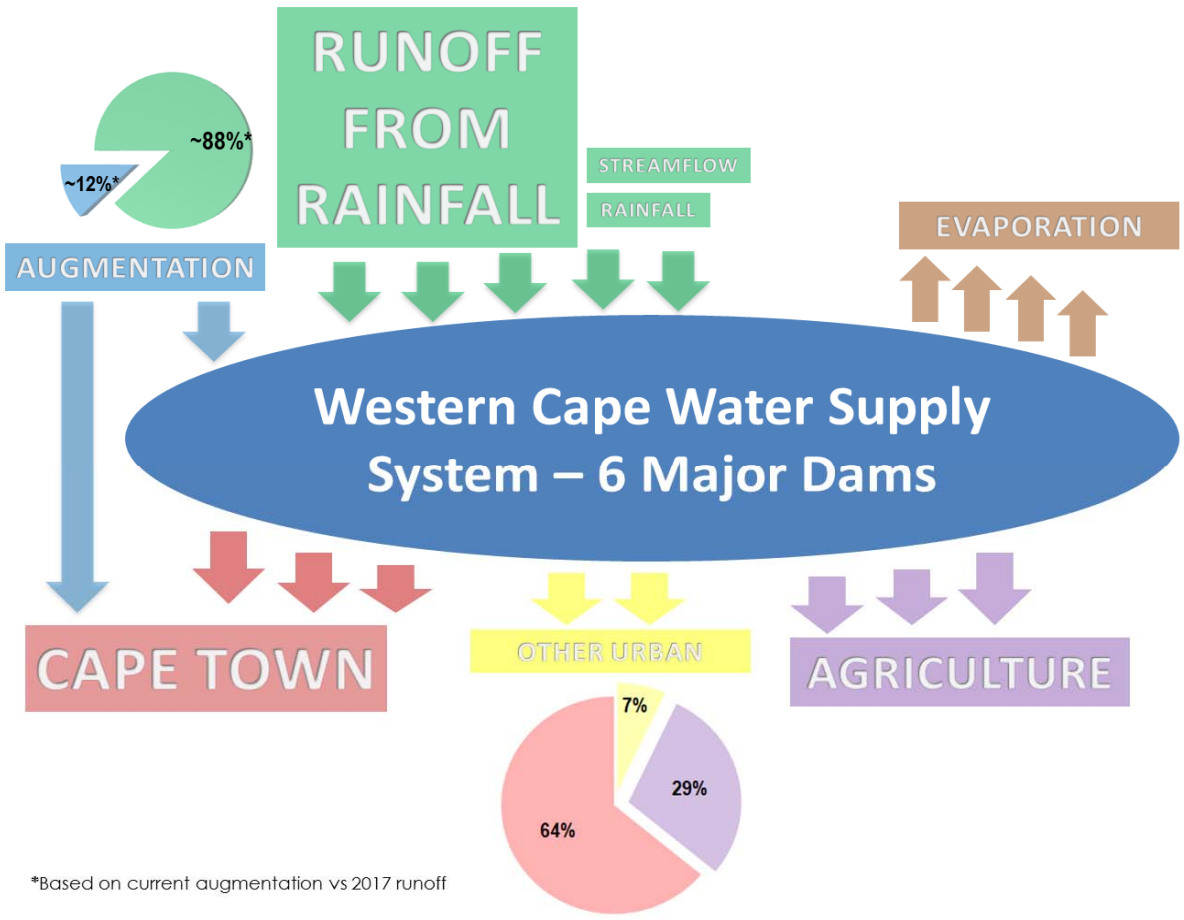
INTRODUCTION:

The City of Cape Town (CCT) is part of the Western Cape Water Supply System (WCWSS), which gets its water from a system of dams that supply agriculture and other urban areas. The current system is almost entirely dependent on rainfall. The National Department of Water and Sanitation (DWS) manages the 3 largest dams in the system and is responsible for planning and implementing water resource schemes to meet water demand for cities, industries, mining and agriculture. DWS plans at a 1 in 50 year level of assurance. This means that during droughts with a severity of 1:50 years or more, restrictions need to be imposed to reduce demand.



Dam levels rise principally from runoff from rainfall in catchment areas, and to a far lesser degree from streams flowing into the dams, and rainfall over the dams. Some augmentation will enter the system (such as groundwater from aquifers).

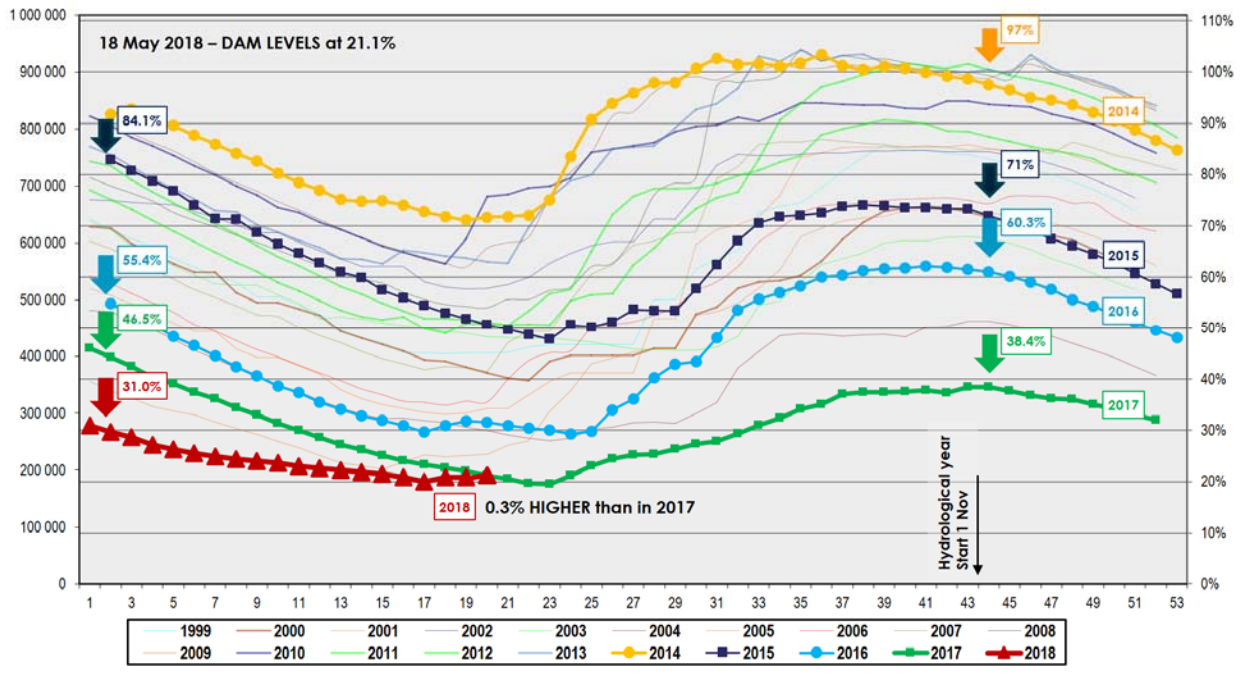
With climate change, worldwide weather patterns have changed and our catchment area has seen the worst drought on record. The current drought is much more severe that a 1 in 50 drought event. *The best estimate of the return interval of the meteorological drought in the region of WCWSS dams is 311 years, with 90% confidence that it actually falls between 105 and 1280 years.* The existing augmentation schemes will provide only about 12% of total available supply during 2018 while the poor rainfall of 2017 contributed 88%.

The next augmentation scheme for WCWSS was planned for 2022/3 and is being accelerated by the national Department. This scheme (surface water augmentation from Bergriver to Voelvlei Dam) is unlikely to be ready before 2021 and will provide about 60 million litres per day (MLD).

Global climate models are in agreement, that while simulations have very different outcomes, that it is not reasonable to plan for a scenario in which it does not rain in the future or in which it *only* rains at 2017 levels.

The capacity of the 6 dams is approximately 900 million m³ (Mm³). The unconstrained system allocation is ~570 Mm³ which provides an unconstrained daily demand of nearly 1,350 MLD to the supply system which includes CCT, agriculture and other urban areas. With current restrictions, this has been limited to an annual daily combined average of 680 MLD. To get through the drought, the DWS introduces restrictions to maintain dam levels above 15%, although water can be extracted to 10%, and with more difficulty, even lower.

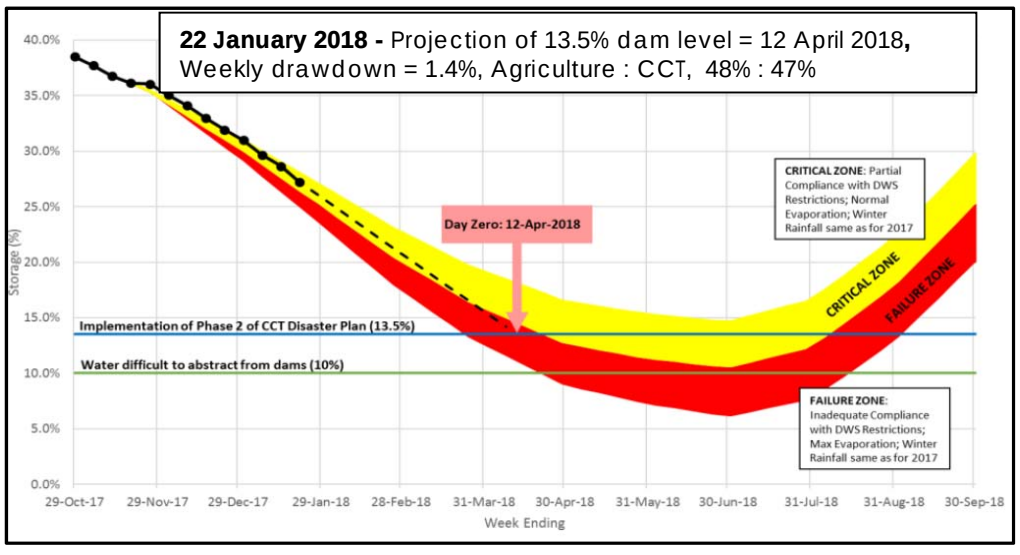
WCWSS Yield	Unconstrained Allocation Mm³	Unconstrained daily demand MLD	Restricted allocation Mm³	Average restricted daily demand MLD
Cape Town	324	888	178	488
Agriculture	144	395	58	158
Other Urban	23	63	13	35
Total	**570**	**1,346**	**248**	**681**

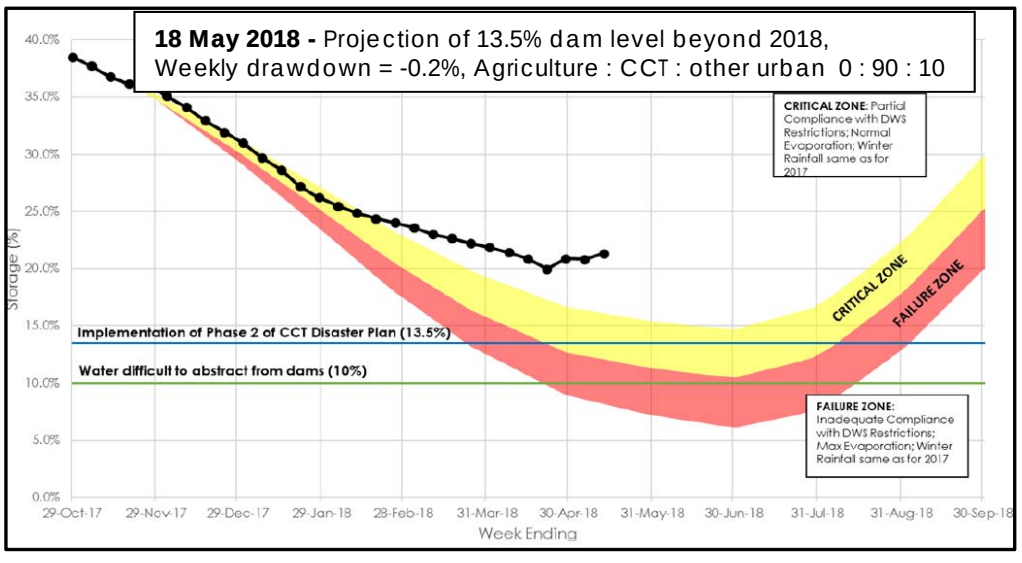


Dam levels have been tracked for many years – for the first months of the year (summer), levels drop, and increase again once the rainy season starts. The 2018 dam behaviour can be seen plotted against that of the past 20 years. Tracking 2018 dam levels indicates far better control as evidenced by the flattened slope compared to previous years. At the beginning of 2018, dam levels were 15.5% lower than in 2017. By the middle of May, the gap had closed and dam levels are now slightly higher than on the same day a year ago.

To meet the DWS restriction target, CCT in turn has to implement restrictions on all consumers. The current restriction level is 6B, requiring savings of 45% for urban users. For non-residential customers monthly consumption needs to be reduced by 45% of unconstrained demand while individuals are restricted to 50 litres per capita per day (lcd) and households to 6 kilolitres (kl) per month.

The severity of the drought prompted CCT to develop a disaster management plan if dam levels drop to the extent whereit is no longer possible to provide water to the metropolitan area. The current drought restriction is part of Phase 1 of the disaster management plan. Phase 2 will be triggered in the event that dam levels become critically low, requiring major disruption. This provides a contingency plan premised on much of the city being disconnected from the the reticulation system and households having to collect a volume fo 25 liters per person from designated points of distribution. Based on consumption scenarios, the Day Zero dam level was set at 13.5%, which would provide 3 months' worth of water at a reduced volume supplied of 350MLD.





On 22 January 2018, Day Zero was modelled to 12 April 2018, with weekly dam level drawdown at 1.4%, and agriculture exceeding CCT's daily demand. By 22 March 2018 the weekly drawdown had reduced to 0.4% with agriculture using only 4% of water from the system, resulting in 13.5% dam level being projected into August. The Day Zero calculation is based on conservative assumptions of consumption beyond the City's control, including releases to agriculture, urban demand, evaporation and rainfall. The projected Day Zero date was publicised weekly, based on the previous weeks' average volume extracted from the system, extrapolated into the future to the intersection point of 13.5% dam level without adjusting for potential rainfall, reduction in demand etc. Unlike previous years, DWS stopped releases to irrigation boards once allocations were reached late in January onwards thus dramatically reducing drawdown from the system. Furthermore, a sizeable transfer was made by an adjacent catchment area in February, also reducing the drop in dam level. These two aspects, as well as a reduction in urban demand led to the Day Zero date moving well beyond the anticipated start of the rainy season in 2018.

Keeping in mind that a significant rise in dam levels will only eventuate from rainfall, the WCWSS thus remains vulnerable to severe water scarcity should rainfall be very late or runoff be similar (or lower) to 2017 volumes. Demand management not only protects the dams in the current year but is crticial to 2019 dam behaviour if rainfall is poor.

STRATEGY TO OVERCOMING THE DROUGHT: Getting through to the rainy season requires **A:** managing the remaining water in the dams, **B:** managing demand down as much as possible and **C:** bringing on-stream water from other sources (ground, re-used and desalinated).
Modelling dam behaviour indicates that:

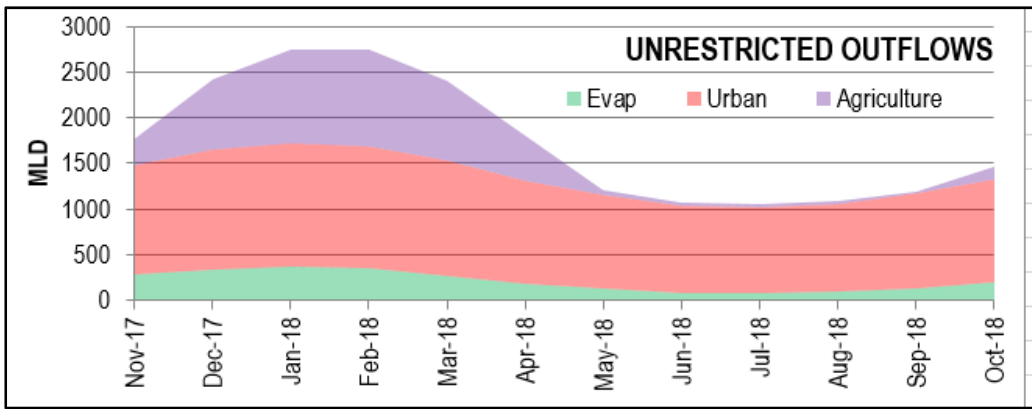
- Getting through the drought in 2018 requires that demand be reduced;
- Augmentation will not add sufficient water to carry the system through to the next rainy season but is critical to summer 2019 if 2018 winter rainfall is poor;
- CCT cannot reasonably go off-grid from the Western WCWSS.

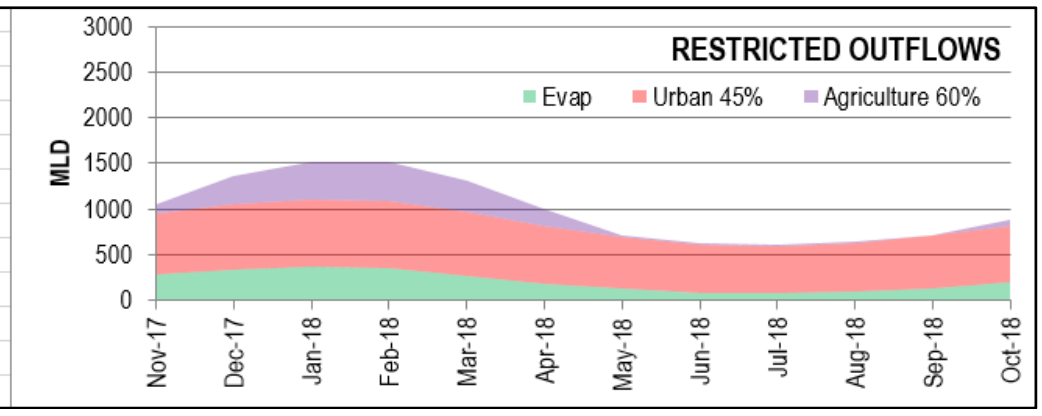
A: MANAGING DAM LEVELS

Dam behaviour is modelled conservatively on 2017 runoff data. Dam levels drop from use by Agricultural, CCT, other municipalities, and through evaporation. Although we have progressed exceedingly well in curtailing our urban consumption and fast-tracking augmentation schemes, the poor rainfall of 2017 leaves us exposed to dams emptying too quickly.

CCT together with DWS monitors dam levels, and publishes change in dam levels and consumption every week. Tracking urban and agriculture demand against allocations has been included on CCT's water dashboard. Decisions around further restrictions will be made based on how dam levels are tracking against the anticipated behaviour. For every day that the 450 MLD target is exceeded it becomes more critical to use less as the over-use needs to be recovered by future reduced demand, while implementing augmentation projects to further reduce drawdown.

Out-flows from the system are shown below (based on maximum calculated evaporation, Urban and Agricultural allocations). Unrestricted, the system demand peaks in summer at over *2,500 MLD*. Under the current restrictions the seasonal peak is at approximately *1,500MLD*. Daily demand varies seasonally, specifically for agriculture. Urban demand fluctuates very little compared to historic patterns, with demand typically increasing slightly on hot days.

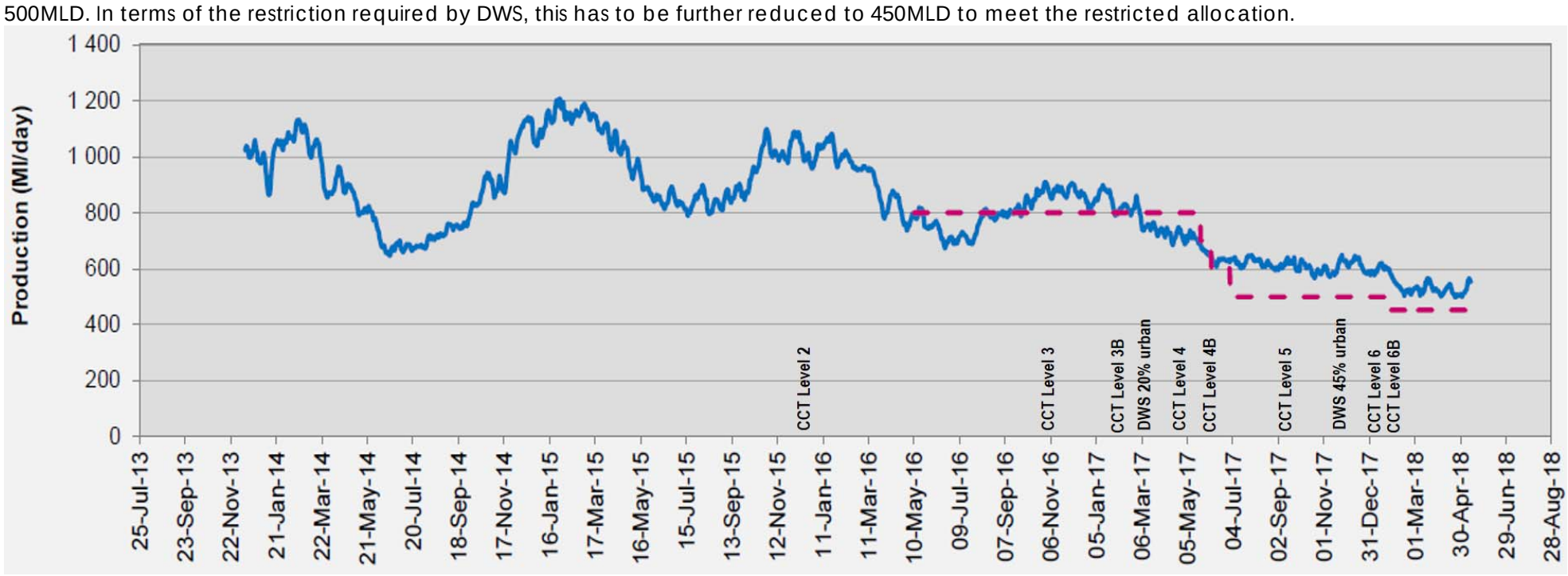




- WCWSS covers West Coast district municipality and local municipalities of Drakenstein, Stellenbosch and Witzenberg, all urban restricted by 45%. CCT provides bulk water directly to parts of Stellenbosch and Drakenstein municipalities. The dams operate as a system, connected by pipelines, canals & tunnels;
- CCT manages 3 of the 6 dams in the WCWSS: Steenbras Upper & Lower and Wemmershoek. Of these, Steenbras Upper is kept as full as possible as it provides for distribution over a wide area. From its elevated location, it can feed either Faure water treatment plant via the lower electricity pumped storage dam at Firlands, or Steenbras water treatment plant via the Lower Dam. Some water is held for the efficient operation of the Steenbras hydroelectric power station;
- CCT also has a number of small dams in its control such as those on top of table mountain, with storage capacity of ~4.4Mm³
- Domestic use ~ 70% of CCT use so demand management has been focussed on reducing domestic consumption.
- Informal settlement in Cape Town use ~4% of water for approximately 15% of households.

B: MANAGING DEMAND

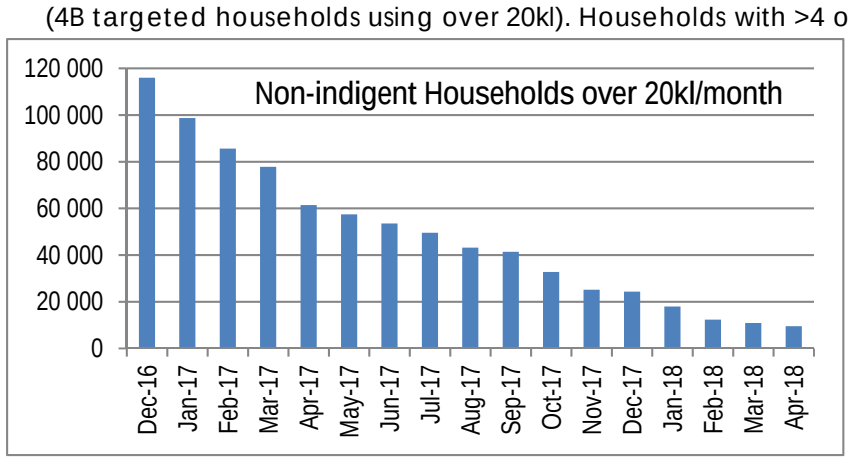
To manage daily demand requires that each person should use no more than the defined volume per day, whether they are home, at work or elsewhere. Reaching the overall demand target is only possible if individual use is curtailed. The peak summer consumption in Cape Town in 2015 was ~1200MLD. In summer 2015/16 under level 2 restrictions this reduced to a peak of ~1100MLD. By summer of 2016/17, a peak of ~900MLD was achieved under Level 3 restrictions. Between June and December 2017 demand stabilised at ~600MLD. Since January 2018, the City has managed to reduce demand to closer to 500MLD. In terms of the restriction required by DWS, this has to be further reduced to 450MLD to meet the restricted allocation.

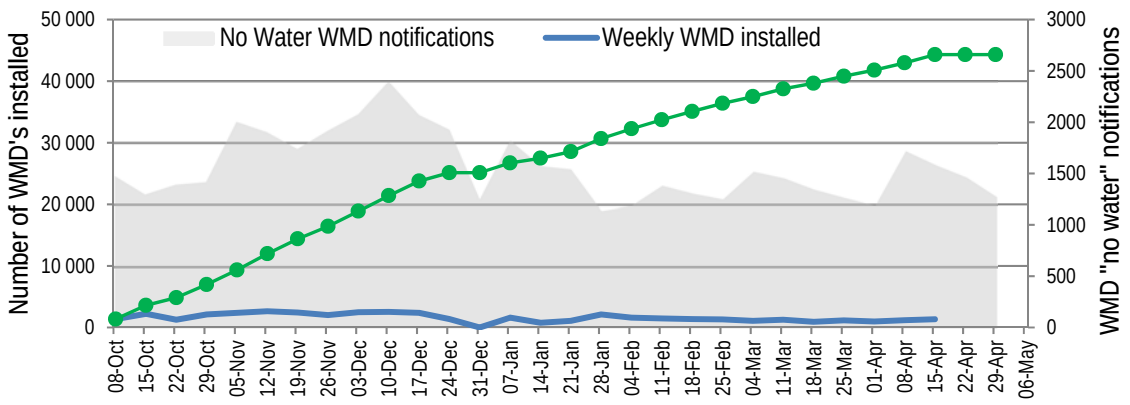


What the City is doing:

- **Restriction Level 6B:** Level 6 was enforced from 1 January 2018, and 6B from 1 February 2018. The target has been reduced to 450MLD. Daily individual consumption must be limited to a maximum of 50 lcd to be aligned with Level 6 tariffs. 4 million people at 50 litres per day = 200MLD. Approximately 150MLD is consumed by industry, commerce, government etc. This results in 100MLD less than the daily target of 450MLD. The inability to adhere to restrictions thus far means that a stretch target of 50 litres is appropriate to ensure that the 450MLD target is reached

- **Communication campaigns:** Every person in the city needs to realise that this is a crisis. The city has launched numerous communication campaigns to assist people in reducing their consumption, such as household leak detection & repair and how to use 50 litres, and continues to use radio, print and social media to reach every citizen and mobilise to reduce consumption to 450MLD, aligned with 6B restrictions.
- **Pressure reduction:** Pressure reduction was initiated more than a decade ago and has been accelerated to automate zones across the city to optimise the system and reduce demand - especially the impact of leaks. Pressure zones are being used to force down consumption by throttling zones to the extent of partial supply if user behaviour in the zone is high in an effort to meet the daily water budget. Average savings of 55MLD have been affected so far.
- **Household flow regulators:** The city has been installing water management devices to manage debt for many years. The programme has been dramatically ramped up to households who have not reduced consumption to restrict daily household consumption and safeguard against the impact of leaks. In many cases this was due to undetected leaks, but under level 6 restrictions, the city will install these where consumption is higher than 10.5kl/month. A household of 4, each person using 50 lcd results in a monthly consumption of 6,000 litres per household. The allowance is per day, whether at home, work or school. Note also that the average household size in Cape Town is 3.2 people. While 6B restricts to 50 lcd, devices will only be fitted above 10.5kl, targeting highest users (4B targeted households using over 20kl). Households with >4 occupants need to register with CCT to increase the allowable monthly use.





CCT ideally would have preferred to manage household consumption through smart metering – similar to electricity, using pre-paid metering or remote monitoring and control – due to low cost of water this has not been viable. The city has installed nearly 300,000 water management devices over the past decade. Household demand has declined significantly with under 10,000 non-indigent households exceeding 20kl/month at end April 2018, a +88% reduction in a year. Since acceleration in installation from beginning October 2017, CCT installed 46,171 at high use households, and dealt with concomitant increase in no water service requests.

- **Punitive tariffs:** Restrictions go hand-in-hand with stepped tariffs, charging more for water use at higher volumes. Progressively more punitive tariffs have been introduced on inclining blocks so that higher use of volumes come at an increased cost. Level 6 tariff was introduced on 1 February 2018 where punitive tariff applies to all use over 50lcd. Water is still cheap compared to other goods and services, and is supplied to every formal household. As households are now required to dramatically reduce consumption, the volumes in higher usage steps have shrunk considerably. Step 1 & 2 (up to 10.5kl per month) will still be provided as free service to indigent households at Level 6. Please see Annexure B: Drought Tariff Increase, for full details.
- **Adaptation:** The city has engaged with large and small business with possible solutions and is working to incentivise reduced consumption. Avenues still to be evolved include usage of private boreholes in the system.
- **Information to drive behaviour change:** Examples include the Star rating tool for buildings, and making visually available household consumption data to incentivise all households to stay within usage limits (dark green & green dots).

What is happening with Agriculture? Agricultural restriction is currently set at 60%. DWS is responsible for regulating and controlling use, including releasing water for agriculture. CCT has been working with DWS and the Western Cape Provincial Government to ensure that releases are controlled – as at the end of February, DWS stopped releases to those irrigation boards who had reached their allocation increasing confidence that the agricultural restriction target will be met;
And other urban areas? Similar to managing agriculture, DWS is responsible for managing other urban use. The outflow to other urban is relatively small. Cumulatively other urban centres are meeting restrictions and being monitored to prevent exceeding targeted consumption.

To reiterate, to make it through the drought and into the rainy season, we need to ensure management of releases out of the dams, reduction in demand that drives these releases, while maximising water flow into the system. The third component is augmentation of supply.

C: AUGMENTATION

Non-surface water augmentation schemes are a much more expensive source of water compared to rain-fed dams. Even under very poor rainfall conditions such as that experienced in 2017, the volume of water added to the dams was the equivalent of ~720MLD. For practical reasons Cape Town will continue to rely significantly on surface water dams supplied by rainfall. Reliability of the system will be increased by adding ground water, re-use and desalination. The costs of these schemes must be compared to the cost of water from dams which is **R5.20/kl** to ensure financial sustainability.

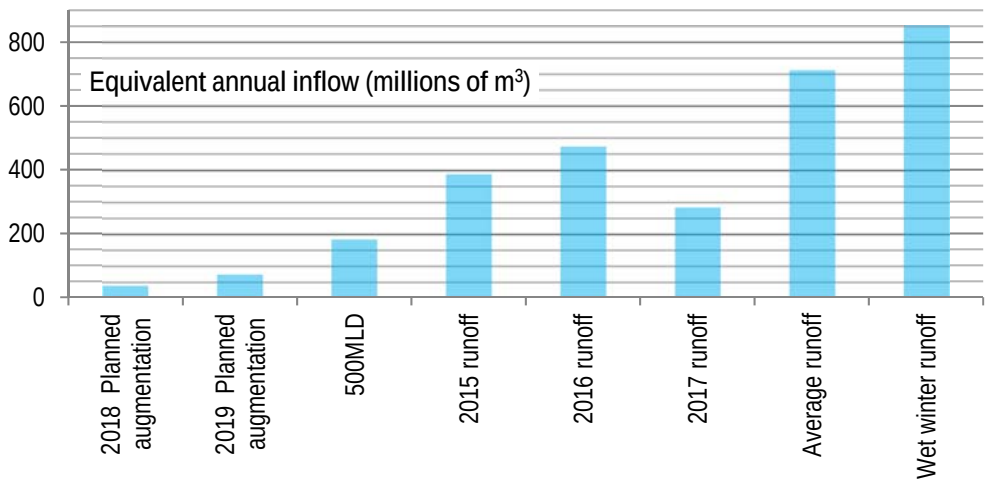
The augmentation programme has evolved significantly since introduction of the Water Resilience programme in May 2017 (for more comprehensive background information please see Annexure A: *Cape Town New Water Augmentation Programme*). In summary, to ensure resilience against drought, the WCWSS needs diversified supply sources. Details of implementation and cost apportionment are still to be resolved but it is agreed that resilience requires diversification:

- **Prioritise groundwater extraction:** Fast-track extraction of water from Cape Flats Aquifer (CFA) and Table Mountain Group (TMG) Aquifer. Both these aquifers have significant storage volumes. The water use licences provide for yields of only a fraction of the available storage, and yields will be maximised in the short-term within the annual allowable volumes. Groundwater is also subject to the impact of drought but with significant time delay. The CFA license requires recharge from treated wastewater to replenish the aquifer and improve water quality in some instances.
- **Pursue permanent desalination at optimal scale.** Plan and execute permanent desalination at an optimum scale, at a plant size or in modules of 120-150 Ml/day. Do not build desalination plants of capacity larger than 200 MLD. Explore alternative procurement such as competitively bid turnkey approach, using the private sector and with a water purchase agreement, will yield the lowest cost per unit of water compared to the alternatives and be quicker to implement provided regulatory processes are fast-tracked as part of the emergency. Decisions around desalination must not be delayed. Desalination provides the only "new" source of water, and other than technical and financial constraints, has unlimited augmentation capacity.
- **Implement water re-use:** As the cost of desalinated (and to a lesser extent ground) water is significantly higher than surface water, it is logical to re-use the water to maximise the benefit. The optimal location for a large plant has been identified at the Faure Water Treatment Plant.
- **Further surface water augmentation:** DWS is implementing the Bergriver Voelvlei Augmentation Scheme (BRVAS) which is expected to add 23 Mm^3 (60MLD) into the WCWSS in 2021.

Existing augmentation volumes include springs & rivers, Atlantis aquifer, and the three small scale temporary desalination plants. The impact of alien vegetation in the WCWSS is substantial and the next update of this outlook will include details of alien eradication.

Indicative target volumes from diverse sources

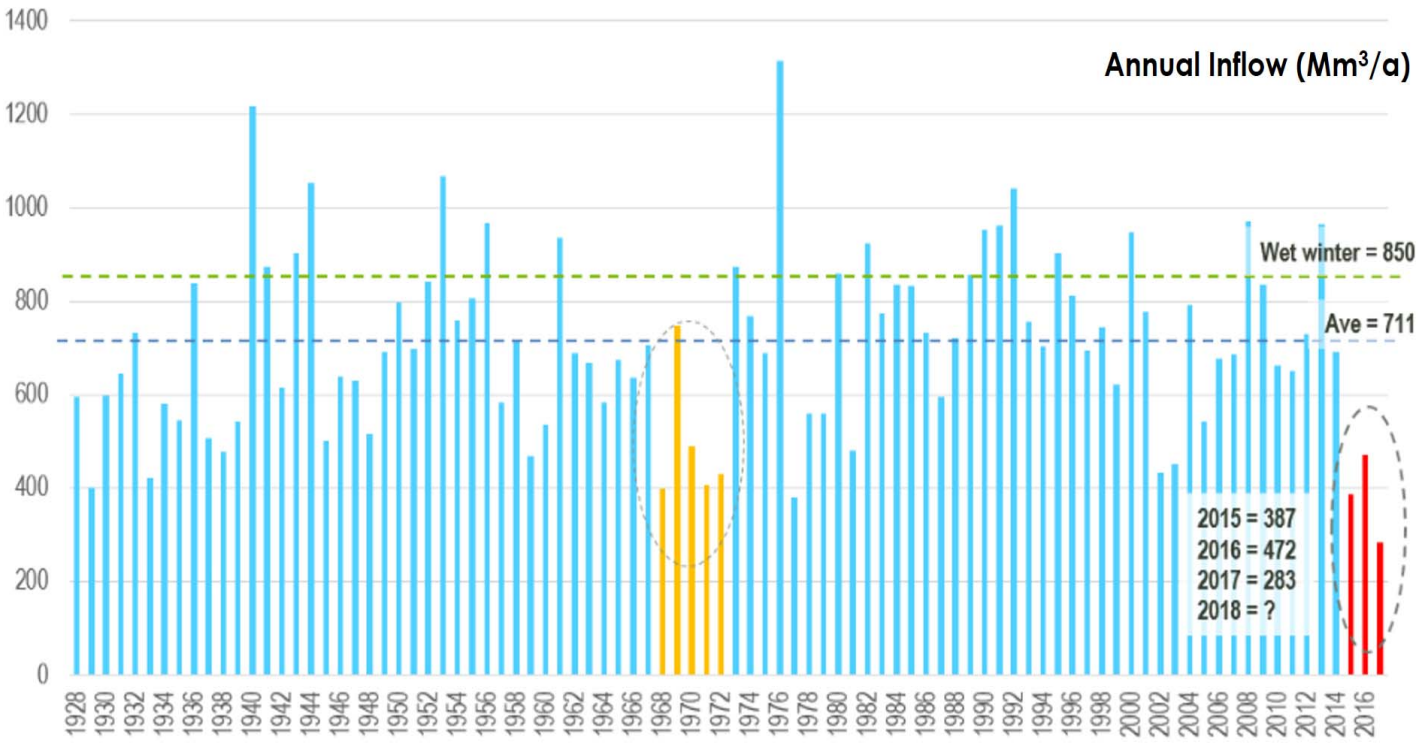
Cost considerations have to factor in the calculation of the yield from diverse water sources together with the level of assurance. Augmenting from sources not reliant on rainfall is evident from the equivalent inflow of augmentation yields versus that from runoff. The City is currently in the process of optimising the extent of the build programme as increasing the yield from the diverse sources will also increase the cost of water. An appropriate balance between assurance of supply and the cost of water will have to be found. Current calculations indicate a requirement in the region of 350MLD which would provide assurance to 2028. The programme will be contiunally reassessed in response to rainfall variability, augmentation progress and demand fluctuations. The City is working towards a water secure position which is resilient to external shocks as soon as possible.

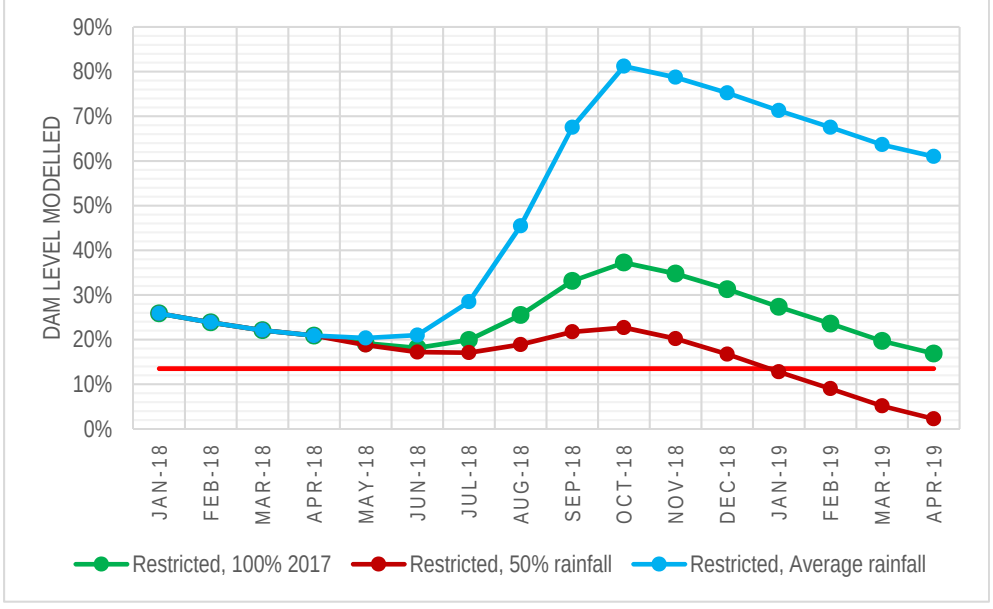


CONCLUSIONS:

Inflow from runoff from rainfall:

Moving from a system of total reliance on surface water to a diversified supply is neither quick nor inexpensive. The three components to getting through the drought will remain in place for as long as is required. Rainfall records from 1928 indicate the variability of annual inflows. It is evident that 2017 had rainfall of only a third of an average year's rainfall. All modelling has been done based on rainfall equivalent to 2017, which has been taken as worst case. This is shown in green below, and will result in dam levels recovering to ~37% at the end of October. If runoff from rainfall equates to an average year, dam levels will be just over 80% at end of October. However, should only half of 2017 runoff from rainfall flow into the system, dam levels will be just below 23% at the end of October, and drop to 13.5% early in 2019. For the system to recover, rainfall at least equivalent to 2017 is required, while restrictions remain in place. Rainfall will be carefully monitored throughout winter.





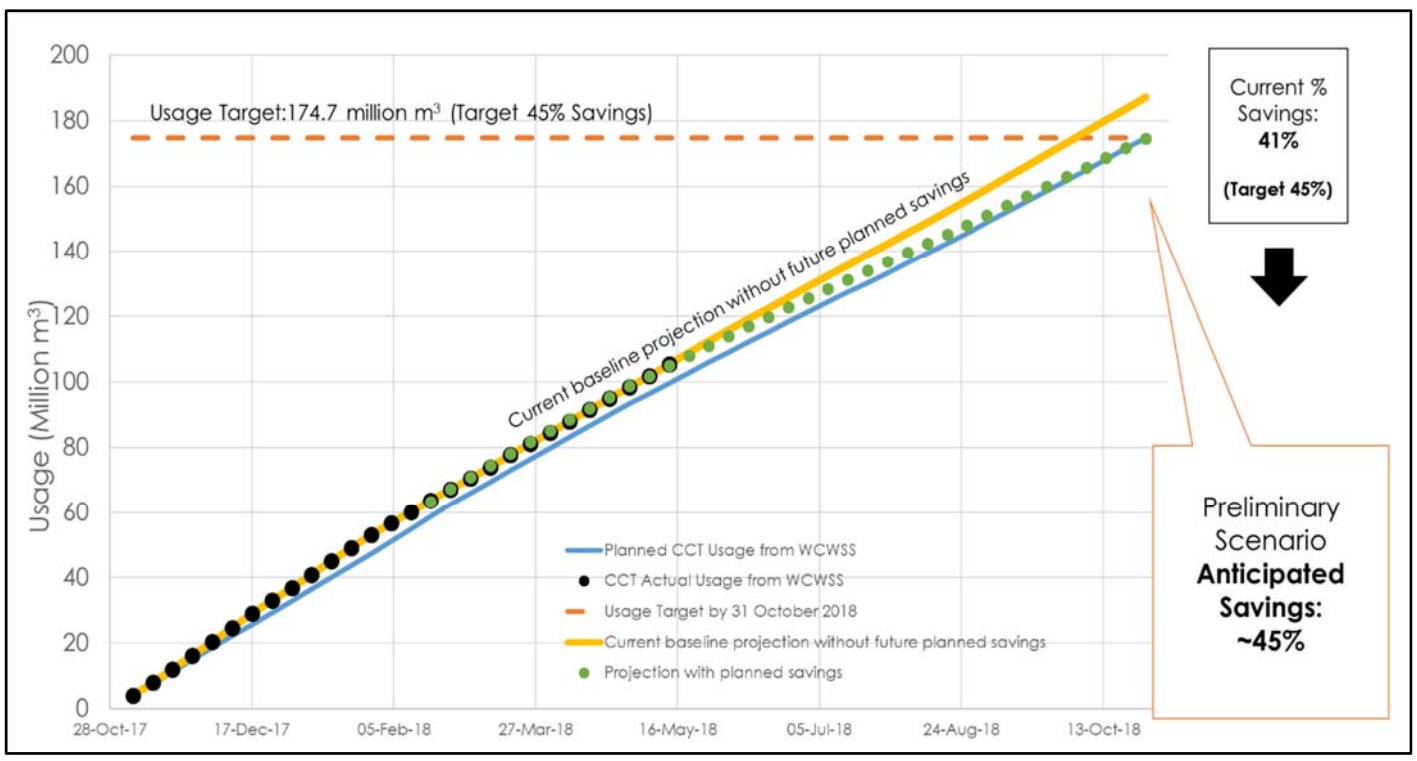
Meeting urban restrictions:

In terms of the unrestricted five-year allocation, a 45% restriction translates to an annual allocation of 174.7 million m³ to CCT. CCT has to adhere to the imposed restriction and has been warned in a pre-directive from DWS that the 45% saving is not currently being achieved. In terms of the restrictions gazetted in December 2017, water restrictions will be lifted should the WCWSS recover to above 85% before the next decision date on 1 November 2018. As levels increase, it is anticipated that DWS will amend restrictions; modelling into the future beyond a single rainfall season is not particularly useful, given the impact of rainfall on the model.

Based on projections of further reduction in demand due to tariffs, installation of water management devices and pressure management as well as some success in the augmentation projects, CCT is programmed to achieve the 45% saving towards the end of the hydrological year as shown on the green dotted line. The increased demand trend is of concern as the City's ability to meet this target relies on individual consumption. As the major drawdown is now related to urban consumption with agriculture releases having virtually ceased, achieving the CCT restriction target, will work in favour of managing the WCWSS system at safe operating level. Communication efforts in ensuring demand is minimised remain urgent. The assumptions of achieving the target include incremental savings due to tariff increases, installation of WMDs, and pressure management progress.

We are also considering the longer term surface water storage situation which is wholly reliant on rainfall. Assumptions in dam behaviour need to be conservative and thus we assume extreme evaporation, While the focus on Day Zero has softened in the current year, it is fully dependent on winter rainfall to safely get through next summer.

As we progress into autumn and winter, more certainty will be achieved in terms of where dam levels are likely to be at the end of winter. This will inform restrictions imposed by DWS, while the City will continue in its efforts to manage demand and fast-track sustainable augmentation.



In summary, the City will:

1. Continue **demand management** initiatives to reduce dam drawdown (in line with NDWS restriction 450MLD required);
2. Manage and monitor **dam behaviour;**
3. Fast-track **augmentation**:
   - **Decisions** under consideration by the City on **optimal augmentation** types, volumes, methods;
   - **Groundwater** projects (Atlantis, Cape Flats and TMG Aquifers) have been prioritised;
   - **Aquifer recharge** projects from treated wastewater under development;
   - **Long-term Permanent Re-use** project under development;
   - **Long-term Permanent Desalination** under evaluation in terms of siting, optimum yield & procurement method;
4. Manage financial impacts through appropriate adjustments to the **tariff structure** and level. There remains a high degree of uncertainty related to future tariff revenues as a result of significant shifts in demand patterns and a steeply inclining block tariff;
5. Endeavour to improve
   - **coordination** and leadership within and between spheres of government;
   - information flows and consistency of messaging; actively **engage citizens** and stakeholders to encourage active citizenry and stakeholder partnerships to jointly solve problems.

For additional information, please see:
Annexure A: New Water Augmentation Program
Annexure B: Drought Tariff Increase

ANNEXURE A

Cape Town's New Water Augmentation Programme – an overview

Updated 20 May 2018

1 INTRODUCTION

1.1 Purpose

The purpose of this document is to present an overview of the City of Cape Town's programme to develop additional water supplies to increase reliability and to avoid the severe restrictions experienced in 2017 and 2018. This program is called the New Water Programme.

1.2 Responsibility for water resource augmentation

It is the responsibility of the national Department of Water and Sanitation to manage water resources and to plan for and ensure a sufficient and reliable water supply to all urban areas. The Department's planning is based on a 98% level of assurance, that is, restrictions on the system are only imposed in the case of a drought that is more severe than a 1 in 50-year event. The Department's next planned augmentation scheme is a surface water scheme, dependent on rain, to provide additional water supplies from the Berg River into the Voelvlei Dam and is called the Berg River Voelvlei Augmentation Scheme. This scheme is due to be implemented in 2021. The risk of delay in the implementation of this scheme could be high.

1.3 A rare drought event or early evidence of climate change?

Cape Town has experienced three low rainfall years in a row. Rainfall in 2015 and 2017 were each individually the lowest rainfall recorded in the last 100 years and the combination of the three years represents a 1 in 400-year event, or worse, based on historical records. This prompts two obvious questions: Is the recent rainfall pattern evidence of climate change? Is Cape Town likely to face more frequent and more severe episodes of low rainfall in future? While it is not possible to answer these questions with any certainty, most (though not all) global climate models predict lower rainfall for Cape Town with more drier years and fewer wetter years. A 2015 study on the overall economic impacts of climate change for South Africa considered a wide range of global climate models and concluded that the majority of climate scenarios for the Western Cape indicate a drying with the change in runoff by 2050 of between -2% and -17%. A reduction of 15% in the mean annual run-off would result in a reduction in the Western Cape Town System yield of around 160 million litres per day (MLD) by 2050. Climate change could happen through a gradual decline in yield or through a step change as a result of a threshold change in the regional climate.

1.4 Getting through the drought by managing demand

Cape Town was able to get through this summer by managing water demand down from 1200 MLD in February 2015 to 500 MLD in February 2018, a saving of 700 MLD (68%) during peak summer usage and a reduction in average usage from 900 MLD in 2016/7, a saving of 400 MLD (45%) on average over the year. The very low rainfall in 2017 contributed about 680 MLD (on average over the year) into the dams. In contrast to this, the total amount of new augmentation into the system achieved from January 2017 to date is about 20 MLD, less than 3% of the low rainfall contribution.

1.5 The impact of the drought on future demand

Experience with previous drought events in Cape Town and elsewhere show that droughts cause a structural downward adjustment in water demand over the medium and long term. It is anticipated that demand will readjust (after the end of the drought) to approximately 80% of the demand prior to the drought. Thereafter demand is projected to grow at the rate of 3% per annum to cater for population and economic growth. These growth forecasts have been taken into account, and tested for sensitivity, in the modelling of water requirements discussed below.

2 CREATING A RESILIENT CITY THROUGH DIVERSIFYING WATER SOURCES

Cape Town is committed to becoming a resilient city and is part of the 100 Resilient Cities Initiative. It is therefore both prudent and appropriate for the City to take climate change risks into account in its planning. In line with international best practice thinking for coastal cities, Cape Town's resilience will be increased through the diversification of water supplies away from dependence on surface water only towards a situation where the city also obtains a share of its water from ground water, wastewater reuse and seawater desalination. Consequently, a resilient city will be able to both optimise and sustain water use through integrated management of four sources of water – surface water from rainwater (including urban storm water runoff) managed in dams and wetlands, ground water (with recharge), reused wastewater and desalinated sea water.

2.1 How much water is available?

Cape Town is fortunate to have good availability of water resources. Cape

Western Cape Water System Yield	Unconstrained daily average demand MLD	Average restricted daily demand MLD
Cape Town	888	488
Agriculture	395	158
Other Urban	63	35
Total	**1,346**	**681**

Town's 6 major dams store about 900 million cubic meters (Mm^3) of water. The Cape Flats Aquifer has above sea-level storage capacity of more than 600 Mm^3, and the Table Mountain Group Aquifer more than 1 000 Mm^3. Total ground water storage, which is not affected by evaporation, is therefore much larger than the total storage of surface water dams.

The firm yield of the Western Cape Water Supply system (comprising the major dams) is 1 500 MLD, and Cape Town's allocation is about 900 MLD. The augmentation of Voelvlei Dam would add another 60 MLD. The sustainable yield (with recharge) of the ground water sources far exceeds 200 MLD. In addition, Cape Town could produce over 200 MLD of potable water from wastewater. The quantity of water available from the sea is only constrained by the high cost that would be incurred in desalination. Of the three 'new sources' of water – ground water, wastewater reuse and seawater desalination – only desalination is totally independent of rainfall.

2.2 How much additional water is needed?

The quantity of additional supplies needed to achieve a secure supply depends primarily on a decision on risk appetite and on assumptions related to the future probability of rainfall distribution. Detailed modelling has been undertaken based on the available historical rainfall records, hydrological modelling and climate change forecasts.

The modelling, and analysis of scenarios based on this modelling, shows that, using a stochastically-generated set of rainfall patterns based on past rainfall records, and assuming a 1 in 200 level of assurance, an augmentation of 50 to 100 MLD would *currently* be sufficient (to meet demand and then growing at 30 MLD per annum thereafter). As we do not have current augmentation of this scale in place, we are working on the medium term, requiring augmentation of 300 to 350 MLD to keep dam levels above restriction levels at the end of summer, providing a margin of safety. Any augmentation over and above this would increase levels of assurance and result in 'surplus water' through more frequent dam spillages during winter. Further modelling, using rainfall predictions from global climate models, is currently being undertaken to inform the City's decision making, taking into account the combination of climate change impacts with natural variability, that is, a combination of the climate change risk assessment with stochastic time series generation of rainfall. In the interim, Cape Town's augmentation plans are based on a long-term augmentation of 350 Ml/day. This is a risk averse view that will give the City of Cape Town a very high level of assurance of supply and will prevent the kind of restrictions currently being experienced from being implemented again in the foreseeable future.

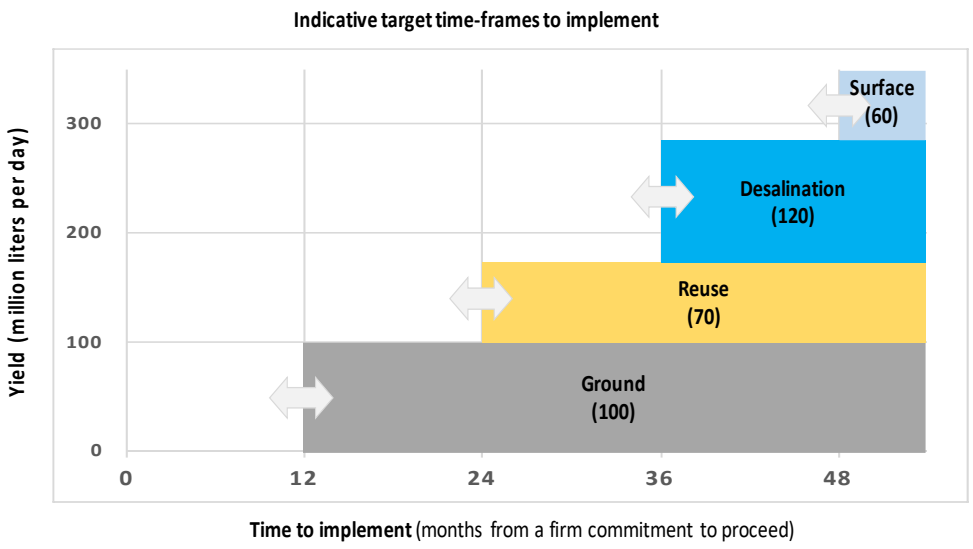
3 HOW MUCH WATER FROM EACH SOURCE AND WHEN?

The available sources exceed Cape Town's needs by some margin. What is an appropriate amount of water to be obtained from each source?

3.1 Cost considerations

The actual costs and yields of any water augmentation scheme is only accurately known after the project has been commissioned. Until that time, reliance must be made on comparable experience with similar projects elsewhere, together with engineering estimates for the specifics of the proposed project.

Desalination costs are primarily a function of scale, water salinity quality and temperature, marine works requirements, network integration costs and procurement methodology. The optimum scale for sea water desalination is in the range of 120 to 150 million litres per day. Both smaller and larger plants suffer from diseconomies of scale. Expensive marine works involving tunnelling increase costs substantially and should be avoided where possible.

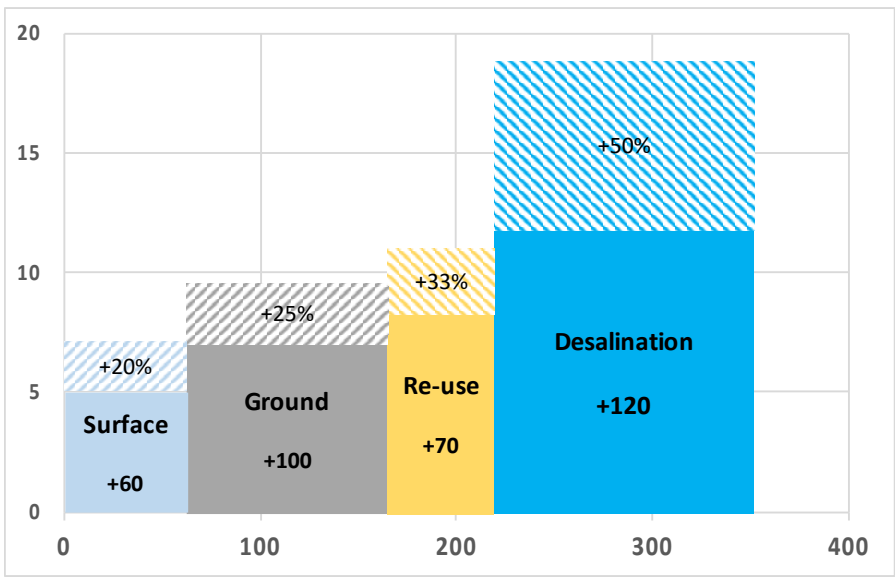


Project costs are also a function of procurement method. Well-managed procurement, attracting reputable international companies, and contracted through a build-operate-transfer contract has delivered desalinated water at less than US$1 (R12) per thousand litres in many places. In contrast, projects contracted through an owner-engineer design-build model are exposed to cost escalation and have proved to be more expensive, with costs in the range of $2 to $3 per thousand litres. An appropriate comparison for an understanding of the different cost outcomes between these two procurement models is the difference in the cost outcomes between the owner-engineer model Eskom adopted for the Kusile and Medupi power stations (both of which experienced massive cost escalations) and the Renewable Energy Independent Power Procurement Programme (REIPPP), which has delivered cost-efficient coal, wind and solar power through competitive bidding processes linked to power purchase agreements. In the case of a 150 million litre per day desalination plant, the difference in cost outcomes between $1 (R12) and $2-3 (R24-36) per thousand litres results in additional "inefficiency" costs of R0.65-1.3 billion per annum, or R6.5-13 billion over ten years. Achieving cost-efficient outcomes for the development of desalination capacity is therefore very important.

Wastewater reuse is expected to be less costly compared to desalination because the capital costs are lower (no expensive marine works are needed) and energy costs are about half of that needed for desalination – 2 kWh for reuse compared to 3.5-4 kWh for desalination per thousand litres. The latest engineering estimates for treating wastewater reuse to a potable standard in Cape Town is about R7.50 per thousand litres, just more than half the cost of efficient desalination. Scale is reasonably important for wastewater reuse too. For example, a single wastewater reuse treatment facility for 50 million litres per day is about 15% cheaper than a 20 million litres per day facility, and a single combined facility of 70 million litres per day is strongly preferred for operational reasons and is cheaper compared to two separate facilities.

Ground water. Ground water is cheaper than wastewater reuse because both the capital and operating costs are significantly lower. The technology required is much simpler and the energy requirements are much lower. Costs are sensitive to water quality (and hence the required treatment costs) and the infrastructure costs are related to borehole depth, yields and location. Cape Town has successfully developed a sandy aquifer ground water scheme, with recharge, in Atlantis and Silverstroom, with a yield of 12 million litres per day. Plans are in place to extend this. While drilling is in progress in both the Cape Flows Aquifer and the Table Mountain Group Aquifer, accurate estimates of the full cost of development of these aquifers, including the associated infrastructure, treatment and recharge, is still awaited.

Surface water. Surface water schemes are cheaper than the other sources of water. The average cost, including bulk infrastructure and treatment, is about R5 per thousand litres. For this reason, preference has been given historically to surface water schemes. In fact, the Western Cape Water System is almost exclusively dependent on surface water.



3.2 Timing considerations

The complexity and logistical implications of project implementation differ depending on the source of water and technology employed. This affects the implementation time frames from the time a decision is made to proceed. Indicative target timeframes are shown, based on international experience. In principle, ground water projects should be fastest to implement, then re-use and then desalination, based on project complexity and logistical requirements. However, the actual timeframes are dependent on regulatory requirements as well as the approach to procurement that is adopted. In South Africa, the regulatory requirements are both complex and lengthy. This, together with stringent public procurement regulations, means that a moderately large infrastructure project that is procured in the standard way (through an owner design-build model) is more likely to take four to five years to implement rather than the two to three years shown for re-use and desalination in the figure.

3.3 Environmental and social considerations

The development of water resources, no matter what the source, has some environmental impacts. Large surface water schemes involve the construction of dams (often in environmentally important or sensitive areas such as mountainous wilderness areas) and associated infrastructure, including long pipelines, pump stations etc. Desalination is energy intensive, with a large carbon footprint if reliant on coal-based electricity, and the discharge of brine (and the related marine works) may affect sensitive coastal areas. The treatment of wastewater for reuse also uses energy (though less than desalination) and will involve infrastructure development (treatment works and pipelines). The flow of wastewater to riverine environments and wetlands will be reduced. Groundwater abstraction, provided it is not over-abstracted, has the least environment impact compared to the alternatives. The terrestrial impact is low, with a very low footprint, especially compared to surface water schemes. Sustainable ground water yield is regulated through a licencing system, together with monitoring, and can be managed through groundwater recharge from rainfall, stormwater systems and treated wastewater.

Health risks related to drinking water sourced from wastewater or ground water that may be polluted are readily managed through the implementation of appropriate tertiary treatment technologies and processes, including multiple protection barriers. Cape Town is already operating a sandy aquifer ground water abstraction and recharge system that is being used for drinking water. The City of Windhoek has treated its wastewater for reuse as drinking water for many years without incident. Nevertheless, negative social perceptions related to these two sources of water may exist and need to be managed.

3.4 What is an appropriate mix and sequencing of 'new water'?

Because desalination is the only truly climate resilient source of water that is independent of rain, there is a strong argument to be made that desalination should be a component of Cape Town's future source of water supply. However, desalinated water is the most expensive and is likely to take longer to implement than the alternatives. For these reasons, Cape Town should not rely on desalination as the only alternative source of water. Ground water is faster to implement, compared to permanent desalination (at scale) and is also much cheaper. Ground water has a lower environment impact compared to the alternatives. Importantly, groundwater can be managed as a form of water storage through recharge and without evaporation losses. This means ground water is a very sustainable source of water that can help mitigate drought events. On these grounds, the prioritisation of ground water as a means to diversify Cape Town's water supply is compelling. In this light, Cape Town has already committed itself to developing the Cape Flats, Atlantis and Table Mountain Group aquifers to the level of at least 100 million

litres per day. Reuse is both cheaper than desalinated water and should be quicker to implement because the logistical requirements are less onerous and complex. There is therefore a compelling argument to include reuse as part of the diversification of Cape Town's water sources.

It is accepted that it is appropriate to get water from all three sources – ground water, wastewater reuse and sea water desalination – to ensure Cape Town is resilient to future water climate change or shocks. The volume of how much to obtain from each source is dependent at least in part on how quickly significant yields can be abstracted into the system.

Because desalination is the most costly, it is important to procure this efficiently. This means that desalination should be procured in modules of 120 to 150 million litres per day. The analysis above suggests that 120 million litres per day will be sufficient for the medium term.

The optimum arrangement for reuse augmentation has been identified as a single reuse treatment plant with a capacity of 70 Ml/day (expandable thereafter) at the Faure water treatment works, taking wastewater from Zandvliet and possibly Macassar wastewater treatment works.

Source	Target yield MLD	Notes
Ground	100	More could be abstracted from ground water sources in dry years.
Re-use	70	One large re-use reclamation plant (economies of scale)
Desalination	120	Optimal scale for desalination is 120-150 MLD
Surface water	60	Lower Berg River Voelvlei Augmentation scheme
Total (diverse sources)	**350**	

Working backwards from the 350 Ml/day augmentation target, and taking into account a future surface scheme of 60 million litres per day, the 120 from desalination and 70 from wastewater reuse, leaves a requirement of 100 million litres per day from ground water. The current plans for groundwater exceed this for the reasons discussed in the next section.

4 INTERNATIONAL REVIEW

An international review of the program facilitated by National Treasury's Cities Support Programme, started during November 2017 advised the following:

- **Manage demand and dam draw-down**. Assuming it will not rain again is not realistic. Augmentation will not make a significant difference to dam levels this summer and there is therefore no alternative but to ensure effective demand management during this summer. Ensuring agriculture is restricted is very important and the city should also pursue opportunities for water transfers from agriculture. The critical point for dam levels is June 2019 if there is poor rain in the winter of 2018.
- **Prioritise ground water**. Ground water is much quicker to exploit and is cheaper. There is a large resource available. It is possible to over-exploit the groundwater resource in the short-run as part of the emergency, taking future recharge into account.
- **Do not pursue temporary desalination and reuse**. Temporary desalination and reuse is very expensive. Multiple small plants are logistically complex, and are not sustainable. Providing temporary desalination at scale is not a quick solution, It will take longer than planned and anticipated.
- **Do not use ship or barge-based marine desalination plants.** Current experience shows that such plants are very costly and have a poor track record of producing target fresh water quantity due to the source seawater challenges when the plant is docked in ports located in an urbanized or industrial area.
- **Re-use is cheaper than desalination and may be faster to execute**. Pursue the most promising opportunities for re-use in a cost-effective and time-effective way, in parallel to permanent desalination.
- **Pursue permanent desalination at optimal scale.** Plan and execute permanent desalination at an optimum scale, at a plant size or in modules of 120-150 million litres per day. Do not build desalination plants of capacity larger than 200 million litres per day.
- **Procure time and cost-effectively**. A competitively bid turnkey approach for reuse and desalination, using the private sector and with a water purchase agreement, will yield the lowest cost per unit of water compared to the alternatives and be quicker to implement provided regulatory processes are fast-tracked as part of the emergency.
- **Make decisions on the long term now and implement**. Do not delay decisions on permanent reuse and desalination, and implementation.

The experience during this summer has demonstrated the fact that augmentation will not make a difference to dam levels this summer. The New Water Program is aligned to the recommendations from the International Review.

SUMMARY OF KEY OBJECTIVES FOR THE NEW WATER PROGRAM

Water from agriculture
- Explore short-term opportunities for trade / transfer (achieved)
- Ensure agriculture restrictions are enforced
- Explore opportunities for trade in summer of 2018/19

Prioritising and scaling up ground water and recharge
- Maximise potential of Cape Flats in short term (and arrange for recharge to maintain sustainable yield)
- Take Atlantis off surface water *(achieved)* and add 20 Ml/day additional capacity
- Continue with the sustainable development of TMG aquifer (up to 50 million litres per day)

Identifying and implementing a least cost permanent re-use project at appropriate scale:
- Develop one 70 million litres per day water reuse treatment plant (an appropriate scale), fast tracking procurement, ensuring cost-effectiveness (competitive turnkey procurement?), with indirect use (managing perception) and avoiding reverse osmosis (to reduce cost).

Permanent desalination
- Agree on the volume (120 to 150 Ml/day), decide on preferred site/s, Decide on procurement model and implement.

5 NEW WATER PROGRAM PROJECT STATUS

5.1 Progression of projects

The persistent drought has led to fast-tracking of a variety of projects with the aim of augmenting supply as quickly as possible, at reasonable cost to the City. Projects can only be initiated once funding is available on the budget, and typically large capital projects enter the project pipeline on the three-year budget in the outer years. Such projects follow a lengthy process - for example this includes procurement of consultants, feasibility studies & basic planning, design & detail design, procurement of contractors and construction. In this instance, the urgency did not allow for the normal process to be followed. Projects funded by the budget apportioned on the Section 29 report in November 2017 were in various stages of planning & design. As planning progressed, new information came to light which further influenced priorities and decisions.

The drought disaster requires project development to provide additional water in as short a space as possible. For example, on new groundwater projects exploratory boreholes inform the quality and quantity of water. If both the quality and quantity are acceptable, then production boreholes are drilled and the necessary infrastructure designed and installed to route the groundwater into the reticulation system. If not, additional sites are identified for further exploratory boreholes to be drilled until the required yield is obtained.

The scope of the augmentation projects continues to evolve and in so doing, become better defined. Costs and yields may be expected to change until projects are finally commissioned. The provisional system augmentation scenarios indicated in the bar chart can thus be expected to change further over time.

5.2 New water projects

Water demand in Cape Town will continue to grow as a result of population and economic growth. Providing water from diverse sources in the region of 350 MLD will increase the system's resilience to periods of drought at the same time as provide for future growth. This volume should be sufficient to provide water security to 2028. The increased resilience provided from these diverse sources, with the ability to extract more from aquifers during droughts and to re-charge with other water sources during wet periods, is significant. The impact of climate variability will be continuously assessed and the planned augmentation volume may be increased in future years, in consultation with DWS.

5.3 Permanent augmentation projects under the new water programme

The impact of alien vegetation in the WCWSS is substantial and the next update of this outlook will include details of an alien eradication programme.

5.3.1 Atlantis aquifer, ±20MLD additional capacity underway, 12MLD already into system

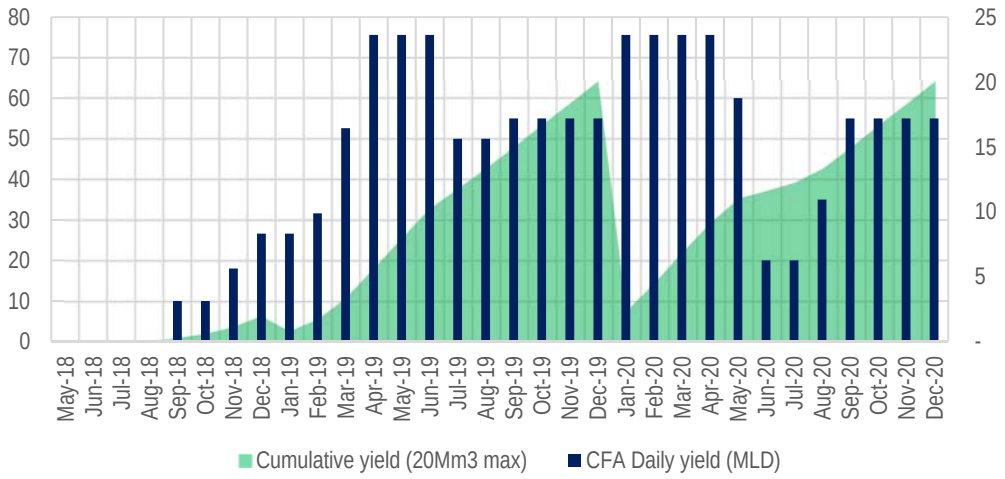
Artificial recharge of Atlantis aquifer began in 1979 when it was recognised that the naturally recharged groundwater yield of the aquifer was insufficient to meet the area's long-term needs. Atlantis is currently operating "off-grid" (separately from the wider western cape water supply system) at approximately 12MLD. The aquifer consists of unconsolidated dune sands with an average thickness of 25m, natural recharge is augmented by artificial recharge through storm water runoff and treated waste water. Planning and design on the additional yield of 20MLD is underway to determine the infrastructure requirements to absorb the additional water into the system. The augmentation programme reflects constant yield of 12MLD with the additional yield entering the system at 3MLD in July, ramping up to 20MLD in January 2019.

5.3.2 Cape Flats aquifer ±80 MLD underway.

Exploratory drilling has progressed to the point where we have achieved some certainty on the location and number of clusters, to provide a maximum yield in the order of 80MLD. Overall, it has been more difficult to extract water than expected, and experience has shown that where yields are good, quality is poor and vice versa. Options to supply additional non-potable water from this aquifer are also under consideration. Locations were prioritised where good yields were expected, on vacant land under public ownership and in close proximity to infrastructure.

The water use license allows for an abstraction limit of 20 Mm^3 per annum in phase 1 (and 25, and 30 Mm^3 per annum in phases 2 & 3 respectively). 20 Mm^3 translates to a daily yield of 55MLD spread over the year, but infrastructure is designed to provide a peak yield of ~80MLD to allow for higher abstraction over the summer months during periods of drought.

CFA will start producing potable water for augmentation in September 2018. The yield is expected to ramp up from 10MLD to 76MLD by April 2019. Extraction volumes will be managed to stay within the 20Mm^3 per annum required by the license conditions. The augmentation chart volumes thus vary over the year, with lower volumes during the winter months and peak volumes during summer. Actual volumes will be adjusted according to prevailing water requirements.



Note: The cumulative yield is reset to zero at the beginning if each year. A maximum of 20 Mm3 is allowed by the licence per year.

The licence condition further provides for an annual recharge requirement of 12 Mm^3 which forms part of the re-use projects. See 5.3.5 below.

5.3.3 TMG aquifer ±50 MLD underway

The City is making considerable effort to ensure environmental sustainability in providing water from the TMG. Borehole placement has been under review following environmental inputs which threatened to reduce the yield in the medium term considerably. The license covers a variety of different sites, and the City is prioritising sites to minimise environmental impact while optimising yield. Current planning includes Steenbras, Wemmershoek, Bergriver, and Theewaterskloof while Cape Peninsula and Helderberg are being re-assessed.

The nature of the TMG aquifer is such that artificial recharge is not required. The optimal locations for abstraction and input to the WCWSS lie close to dams and in other environmentally sensitive areas. The City has established an environmental focus group with representation from Cape Nature, SANPARKS, DEADP, SANBI, as well as academics, consultants and other interested parties. The focus group developed a screening tool to assess borehole locations to ensure environmental impact is minimised at the various sites covered by water use licenses.

In terms of the license conditions, the allowable annual extraction for Phase 1 is shown below.

Site	Phase 1 (Mm^3/a)
Cape Peninsula	8
Helderberg Basin	3.6
Berg River Valley	3.6
Steenbras	12
Theewaterskloof	10
Wemmershoek	2
Voelvlei	3
TOTAL	**42.2**

Steenbras has been prioritised as the Steenbras dams are owned and operated by the City, and drilling is proceeding in the utility zone. The 12Mm^3 translates to a sustainable daily extraction of 33MLD, ramping up from 2MLD in June 2018 to 33MLD by September 2019, depending on resolution of environmental matters. The national DWS has commenced drilling at Theewaterskloof (which falls under their control). The augmentation graph currently considers only water from Steenbras given uncertainties at other locations. In combination of Steenbras and Theewaterskloof, a yield of approximately 50MLD is possible towards the end of 2019.

5.3.4 Zandvliet/Macassar to Faure Re-use scheme ±70 MLD

The introduction of more expensive water such as ground and desalinated water necessitates maximising value by re-use. Having assessed all the available capacity at the City's waste water treatment plants alongside the Cape Flats aquifer injection requirements, a plant of between 70 – 90MLD is being assessed for injection at Faure water treatment plant at an attractive cost with first water in the second half of 2020.

Detailed design work is proceeding on a 70 MLD wastewater reuse plant to be sited at Faure Treatment Works, taking water from Zandvliet and potentially from Macassar to scale to 90MLD. Concept designs have been developed for water reuse from Athlone (75 MLD) although this is unlikely to be triggered in the medium term.

5.3.5 CFA managed aquifer recharge project ±70 MLD

Work is proceeding on options for recharge of the Cape Flats aquifer. Optimal treatment requirements are being assessed based on water quality, cost and infrastructure required for injection for the final CFA license conditions. Phase 1 requires 12Mm^3 or 33MLD while Phase 3 requires 25Mm^3 or 68MLD. Recharge is planned from wastewater treatment works at Cape Flats, Mitchell's Plain and Borcherd's Quarry. Recharge is not immediately required for the aquifer to remain sustainable but is planned to be fully operational within 24 months.

5.3.6 Permanent desalination ±120 MLD

The optimum site for a 120-150 MLD permanent desalination plant is being explored and a pilot plant at Koeberg (20 MLD) is being implemented which will inform the design for a potential larger desalination plant at that site in the future

5.3.7 Additional surface water ±60MLD confirmed

DWS is undertaking preparatory work for the augmentation of Voëlvlei Dam from Berg River catchment (winter flow) downstream of the Berg River Dam. Preliminary designs are complete and the EIA started in November 2015. The project is due for completion by the end of 2021 (with construction to commence in 2019).

- The following other surface water augmentation options are under investigation by the DWS:
  - Michell's Pass diversion weir (upper Breede) to augment Voëlvlei Dam;
  - Raising the structure of the Lower Steenbras Dam;
  - Building a new dam in the Molenaars River (Worcester side of the Huguenot Tunnel);
  - Raising the structure of Voëlvlei Dam.

6 CONCLUSIONS

- Creating new water supplies from diverse sources of about **350 million litres per day** is sufficient to secure Cape Town's water supply, more is not necessary.
- Water with a high level of security costs more than surface water. This will require a re-negotiation of arrangements with the national Department of Water and Sanitation on water allocations from the system, security of supply and cost allocations between urban water users and agriculture.
- This document, together with supporting documents and presentations, will be used as a basis to develop a consensus on the New Water Program within and beyond the City of Cape Town municipality.
- It is challenging to budget in a context of uncertainty with respect to both the timing and costs of projects. This is the case for ground water, reuse and desalination in light of the fact that these projects have not been implemented before at scale by the City. Processes to allow for adjustments to the budget line items within the year need to be developed to cater for this uncertainty;
- While re-use and desalination will take longer to implement, decisions on these need to be made as soon as possible and implementation initiated.

7 RECOMMENDATIONS

- It is necessary to continue to **implement demand management** initiatives effectively through communications, stakeholder management, roll-out of the pressure management programme and acceleration of WMDs;
- It is important to **investigate opportunities in agriculture for transfers** /trade next summer, depending on winter rainfall;
- It is imperative that the **ground water program is fast-tracked** to bring additional water at scale into the system soon. Failure to implement this program timeously creates significant risk to the city with serious economic consequences.
- A **decision** on proceeding with the Faure semi-indirect **re-use plant** needs to be made, including investigating ways to expedite the project.
- A **decision** on the procurement a 120MLD **permanent desalination** is needed, including a decision on the approach to procurement.

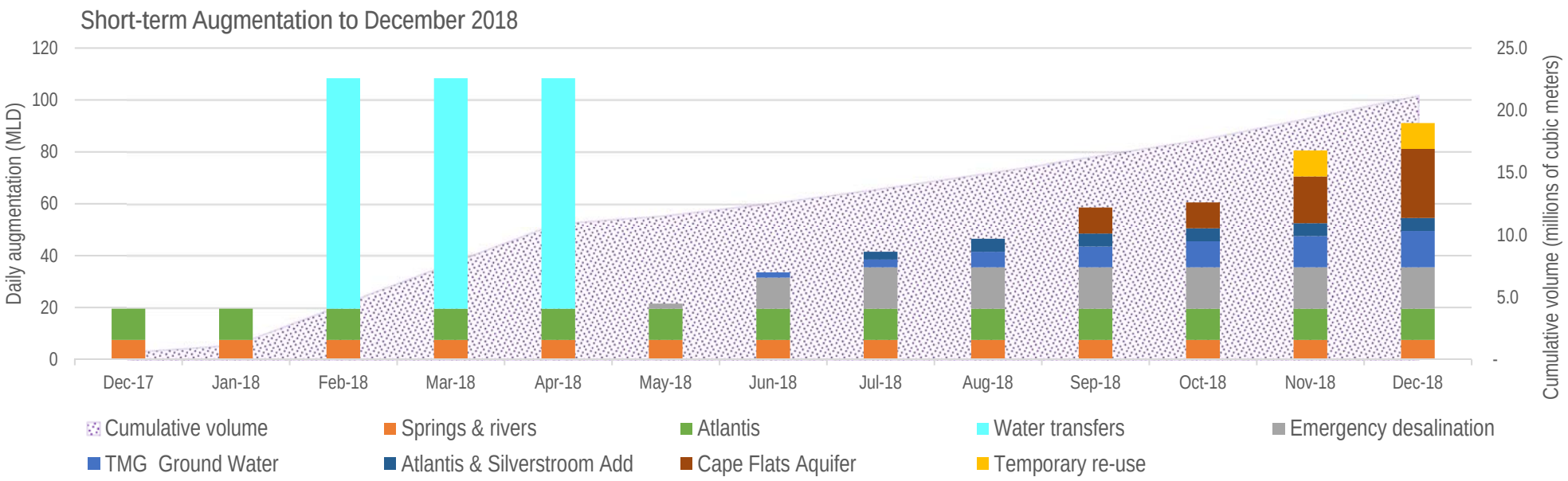
AUGMENTATION SUMMARY: SHORT-TERM (CURRENT TO DECEMBER 2018)

Groundwater (variable, permanent augmentation)
- Cape Flats aquifer ±26MLD by year end
- Atlantis aquifer, ±5MLD additional capacity by year end, 12MLD already into system
- TMG aquifer ±14 MLD by year end

Temporary Desalination (16MLD fixed yield over ~ 2 years)
The temporary desalination projects are generally progressing well and will be introducing new water into the system as per the program.
- Strandfontein, 7MLD, full production mid-2018
- Monwabisi, 7MLD, full production mid-2018
- V&A, 2MLD, full production mid-2018 (could be converted to a permanent yield of 5MLD by the V&A. Off-take agreement not yet finalised).

Temporary Water Re-Use (10 MLD fixed yield over ~ 2 years)
- Zandvliet, temporary re-use scheme - full production in late-2018.

Springs & Rivers Existing, sustainable into the future (7.5 MLD)
- Newlands – Albion spring in operation at ~3MLD. We aim to add all feasible springs into the reticulation system which will increase the volume;
- Oranjezicht – routed 1MLD into the system, looking at other springs to enter into system where possible to increase volume;
- Lourensriver – injection of 3.5MLD into system.



AUGMENTATION SUMMARY: FUTURE (January 2019 onwards)

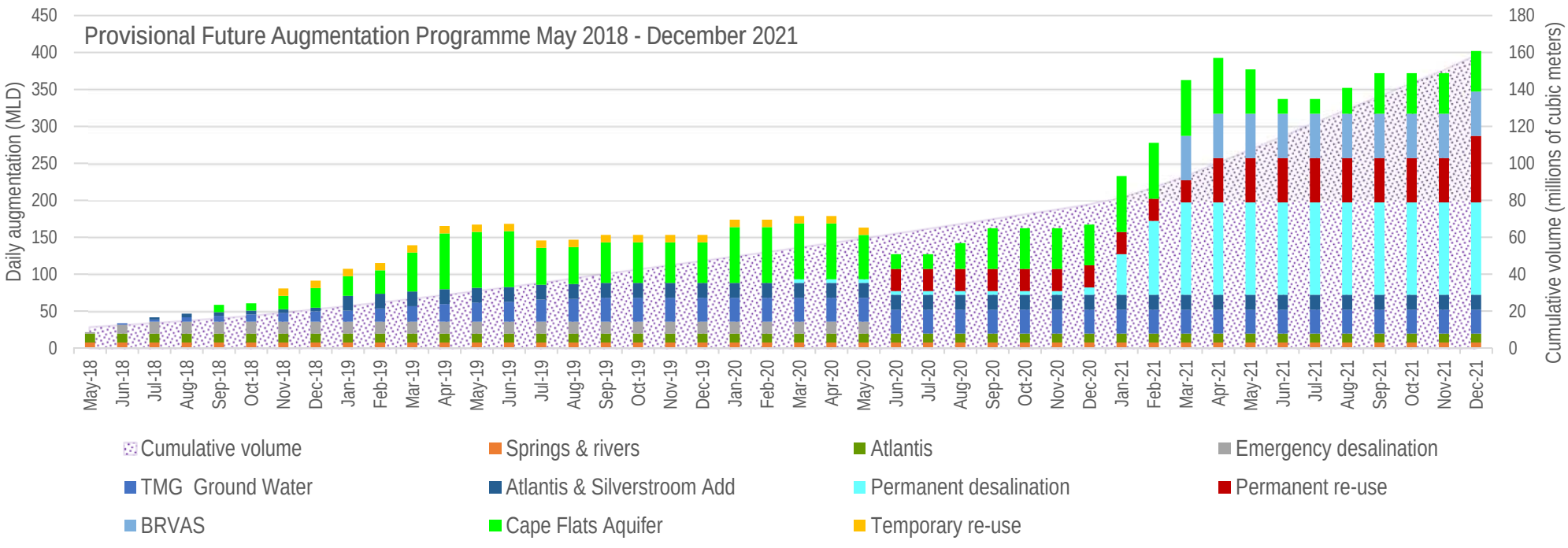
Groundwater (variable, permanent augmentation)
- Cape Flats aquifer ±55MLD sustainable year-round yield (Phase 1)
- Atlantis aquifer, ±32MLD final yield
- TMG aquifer ±50 MLD year-round yield (well within phase 1 license conditions)

Water Transfers
- ~8 Mm³ from Groenland Water User Association, based on a release of ~10Mm³ (assuming approximately 20% losses) was completed between February and April 2018.
- 2018 rainfall will determine whether similar transfers are necessary and/or possible next summer.

Permanent Desalination
- The City is currently contending with the decision of the right volume, location, timing and procurement method of permanent desalination. At the current stage of evaluation, this appears to be optimal between 120 – 150MLD at a single plant, with delivery of first water possible in 2021. In parallel work is continuing at the pilot site at Koeberg which is planned to produce ~20MLD in 2 years' time (March 2020);

Permanent Re-use
- The introduction of more expensive water such as ground and desalinated water necessitates maximising value by re-use. Having assessed all the available capacity at the City's waste water treatment plants alongside the Cape Flats aquifer injection requirements, a plant of between 70 – 90MLD is being assessed for injection at Faure water treatment plant at an attractive cost with first water in the second half of 2020.

Additional Surface Water
- The long-term outlook for additional augmented water into the WCWSS needs to be balanced with water provision from DWS such as the additional 23Mm³ or 60MLD from Berg river to Voelvlei surface water augmentation scheme.



ANNEXURE B
Drought Tariff Increase
Updated 20 May 2018
(Updated from the tabled budget & aligned with tariffs to be proposed to Council)

PURPOSE

The purpose of this document is to provide context to the proposed 2018/19 water and sanitation tariffs and to explain why significant changes in both the tariff levels and structure are necessary to keep water flowing in the taps and wastewater treated in the years to come.

BACKGROUND

Under-funding. Water and Sanitation operations have been underfunded for a number of years due to approved tariffs being at levels insufficient to cover costs. This resulted in pressure on operations, lower than acceptable collection ratio, concern regarding expenditure on asset renewal and maintenance, and postponing planned augmentation. Sanitation tariffs have been linked to volume of water sales on the assumption that 70% of water used entered the sewerage system and were too low to fund operations (i.e. water subsidised sanitation). National Treasury holds that water & sanitation is a trading service that should be ring-fenced and recover full costs of these services.

Drought resilience. The current tariff structure is not resilient to drought. Having the tariff linked exclusively to the volume of water sold results in revenue falling sharply when water has to be restricted (the impact in 2017/18 is approximately R1.7bn anticipated under-recovery). A stepped volume-based tariff structure was introduced in the early 2000s to manage water demand as the cost of water increased with each step of higher use. Anticipated sales volumes in each step were balanced with the overall required revenue based on an assumption of sensitivity to pricing in steps of higher consumption where water was more expensive. To date water sold in the lower steps have always been below cost and subsidised by consumption in higher steps. Where restriction necessitates the City to sell less water, volumes in the lower steps increase resulting in most of the sales being subsidised with no revenue at higher steps available to cover the costs.

Fixed costs. While some of the costs in providing water is volume related, much of the cost is not. Allowing for users to vary their demand and pay accordingly has always been a principle of municipal service provision. With scarcity of resources, more customers make alternative service arrangements and move towards being off grid. These are generally more affluent customers which then impacts on the ability to subsidise poorer households. Losing income at the high end results in a loss of ability to subsidise the poor, thus requiring a fixed charge that is unrelated to consumption.

Subsidies. Municipal charges are generally progressive, i.e. poorer households are subsidised by more affluent customers. Losing income at the high end results in a loss of ability to subsidise the poor, thus requiring a fixed charge that is unrelated to consumption.

SUMMARY

While the proposed tariff adjustments are very significant, these are necessary to sustain the service. The alternative of not making these adjustments is far worse – an unsustainable service that would hurt poor people more than the wealthy. The reasons for the necessary large tariff adjustments (in both level and structure) are set out in summary below, and expanded in more detail in the sections that follow.

Reduced volumes. During a drought, the water usage needs to reduce but a large portion of the costs of providing the service are fixed. (The only significant costs that reduce are chemical costs and the cost of pumping – these are a small share of the total costs.) To cover the total costs of providing the service, the price of each unit of water sold must increase. The size of this adjustment is significant. For example, average water usage by the city reduced from 900 million litres per day (MLD) in February 2017 to 500 MLD in February 2018, a 45% reduction. To compensate for this reduction in the volume of water sales, the price of water sold must increase from an average of R18 to R32 per thousand litres (an 80% increase) to maintain the same revenue. Because sanitation tariffs are based on the volume of water used, large adjustments to sanitation tariffs are also necessary.

Additional costs. In addition, the city is incurring additional costs to respond to the drought in four key areas: (1) pressure management, (2) the accelerated roll out of water management devices, (3) water loss reduction, and (4) the building of the capacity to supply additional water from diverse sources. These additional costs greatly exceed the modest reduction in expenses resulting from reduced water sales.

Maintaining assets for the future. The city must also ensure that it maintains and replaces its existing assets. A recent study showed that the city needed to spend an additional R1 billion per annum on asset rehabilitation and replacement to improve the sustainability of the service which is currently threatened. This represents an increase of about 16% on the 2017/18 water and sanitation budget.

Reducing costs through improved efficiencies. The city already has much lower water losses compared to its peers in South Africa. The investments being made in response to the drought are further reducing real water losses (leaks) and accounting losses (meter faults, incomplete metering etc.). The roll out of water management devices will result in a significant improvement in cash collection efficiency over time although the short term situation is likely to worsen as a result of increasing levels of non-payment in response to the punitive drought tariffs. The increase in costs substantially outweigh the planned and potential efficiency gains to reduce costs.

Increase in the average tariff. The above factors show that very major adjustments to the <u>average</u> tariff level for both water and sanitation are necessary to maintain and sustain the service.

Changes in consumption patterns. Cape Town has a very progressive tariff structure with steeply inclining blocks. This means that households who use more water pay much more for the water than those who only use a little water. This has enabled the city to subsidise water for the majority of people living in Cape Town. All households who consumed less than 20 000 litres per month (667 litres per day) in the period 1 July 2016 to 30 June 2017 (FY2017) were subsidized, paying on average R8 per thousand litres, which is less than half of the actual cost of the water supplied. During that same year, the average tariff for household consumption above 20 000 litres per month was R66 per thousand litres (more than seven times the tariff for use below 20 000 litres), generating a revenue of R1.5 billion for the year, more than double the revenue from households using less than that amount.

Changes in tariff structure. The tariff structure worked well when there were no restrictions (and when restrictions were modest), but does not work in the context of severe restrictions. When households are <u>not allowed</u> to use more than 200 litres per day (6 kℓ per month) for a four-person household, then ***all*** of the revenue for higher levels of consumption disappears. The only way to compensate for this it to increase the tariff for lower levels of consumption. These adjustments have to be very significant to compensate for the very high loss of revenue from the higher tariff bands. A fixed charge increases revenue stability, reduces subsidies to high income households and reduces the impact of the adjustment on the volumetric tariff.

Alternative revenue options. A proposal to soften these very significant tariff impacts for water and sanitation by applying a property-based drought levy was retracted by the City in response to strong negative public reaction. Similarly, a proposal to soften the sanitation tariff impacts by shifting the basis for charging for sanitation away from water volume is under consideration. (There is a compelling argument to be made that the provision of sanitation services is a public good and therefore it is appropriate for the costs of sanitation to be recovered on the basis of a property rate which is used to

fund other public goods. Many cities around the world apply this method of charging for sanitation.)

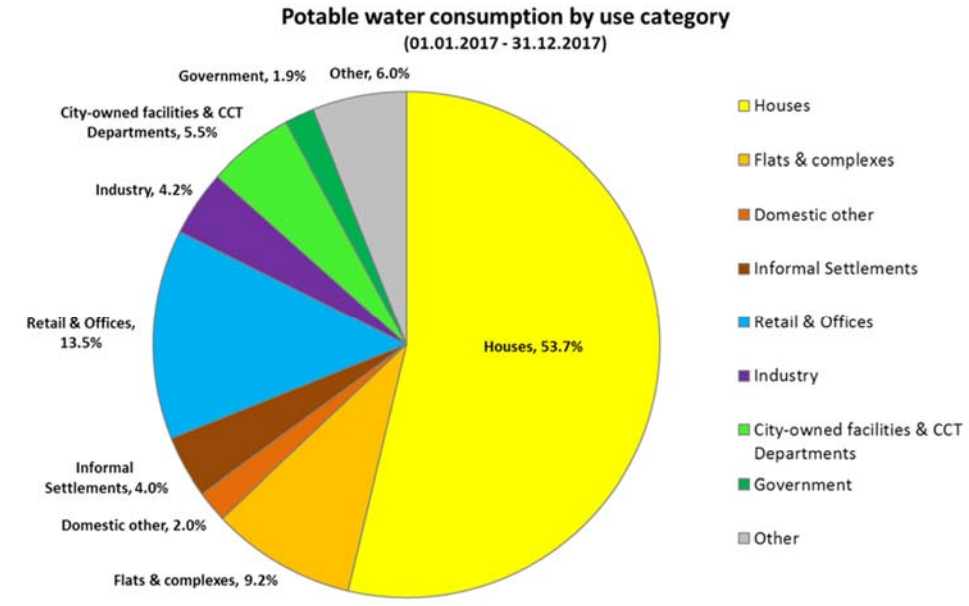
Short-term savings. The city has implemented measures to shift expenditure priorities to achieve and reallocate savings during this financial year. However, these short term measures are not sustainable and cannot be relied upon going forward.

A balanced budget. The City is legally required to balance its budget. Its only options are reducing expenditure, achieving savings, improving efficiencies, increasing rates and/or adjusting tariffs. The scope of these have been briefly described. Because of the size of the required adjustments, the City has no choice but to make major adjustments to the water and sanitation tariffs. These adjustments, although painful in the short term, will support the long term sustainability of the service.

1. SECTION 1: CHANGES IN THE VOLUME OF WATER SALES

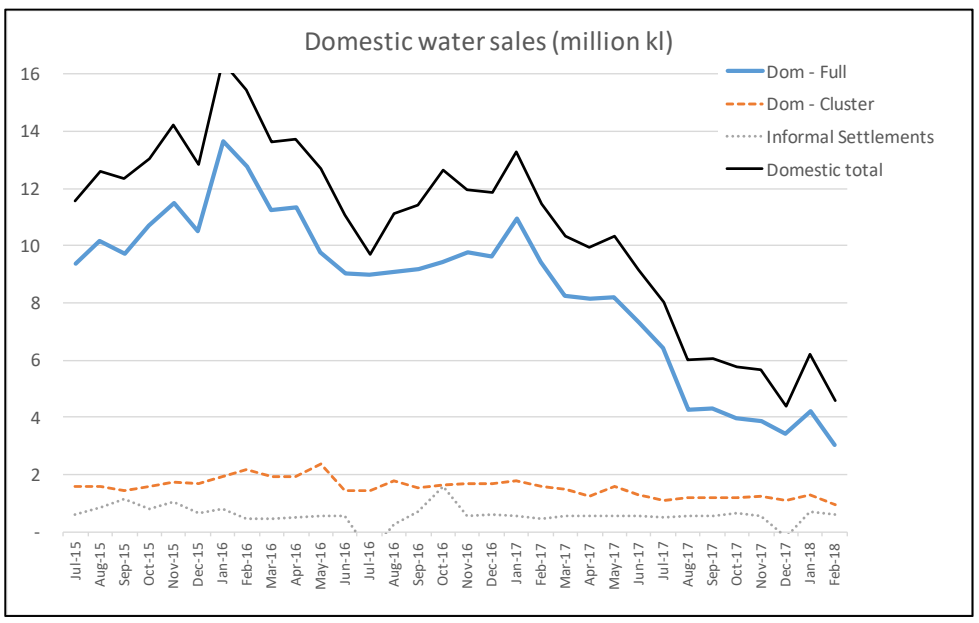
1.1 Structure of demand

Domestic use accounted for 70% of water use during 2017, commercial use 13.5% and industry 4.2%. The major scope for demand reduction therefore lies with domestic customers.



Massive reduction in usages achieved by domestic customers

The reduction in water use by domestic customers has been remarkable, reducing from a peak of over 15 million kilolitres in February 2016 to below 5 million in February 2018, a reduction of over 66%. Most of this was achieved by households with a metered house connection. (The spike in consumption in January 2018 is a result of estimations based on the previous year's average and is corrected in the February figures.)



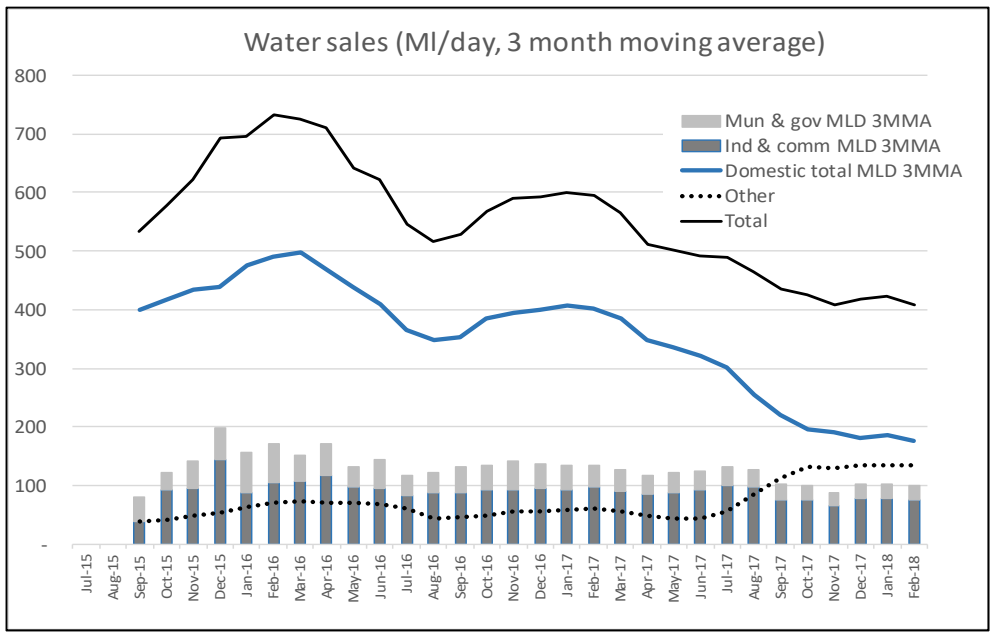
Informal settlements accounted for only 4% of use during 2017, whereas the number of households living in these settlements was more than 12% of the total households living in Cape Town. The demand reduction is all the more impressive in the context of the ongoing growth in the number of people living in Cape Town.

	2013/14	2014/15	2015/16	2016/17	2017/18
Estimated **population**	3 889 237	3 949 164	4 012 441	4 070 910	4 127 052
Estimated number of **households**	1 150 662	1 189 507	1 230 810	1 272 160	1 289 703
Est. households **Formal Dwellings**	921 591	958 168	997 093	1 036 436	1 050 729
Est. households in **Informal Settlements**	151 400	152 620	153 893	154 901	157 037
Est. Households Informal **Backyard Dwellings**	77 671	78 719	79 824	80 823	81 937

Source: Mid-year population estimates, 2011 Census and 2016 Community Survey data from Statistics South Africa, as reported by the City to National Treasury

1.2 Large overall reduction in demand

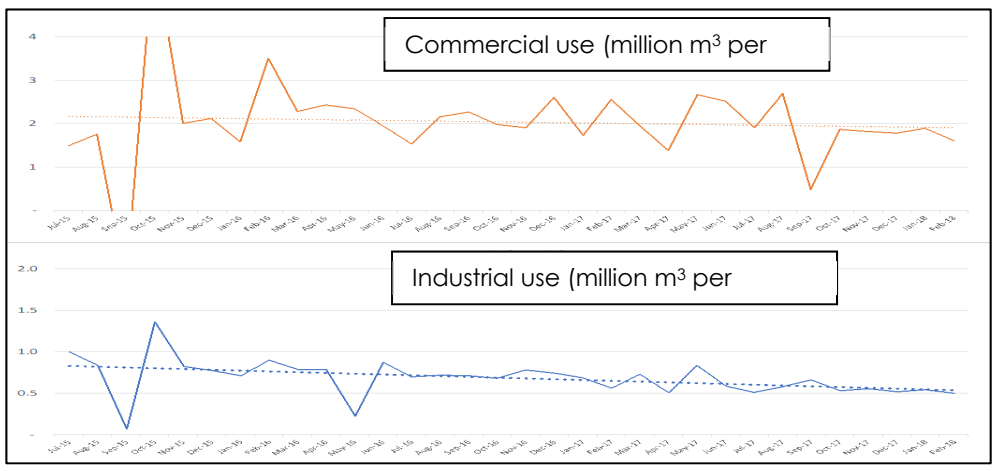
The contribution of domestic demand reduction on overall demand reduction is shown below. The seasonal variation is evident in summer 2015, less so in summer 2016 and virtually non-existent in summer 2017. While the



peak in summer 2015 was at ~750MLD of sales

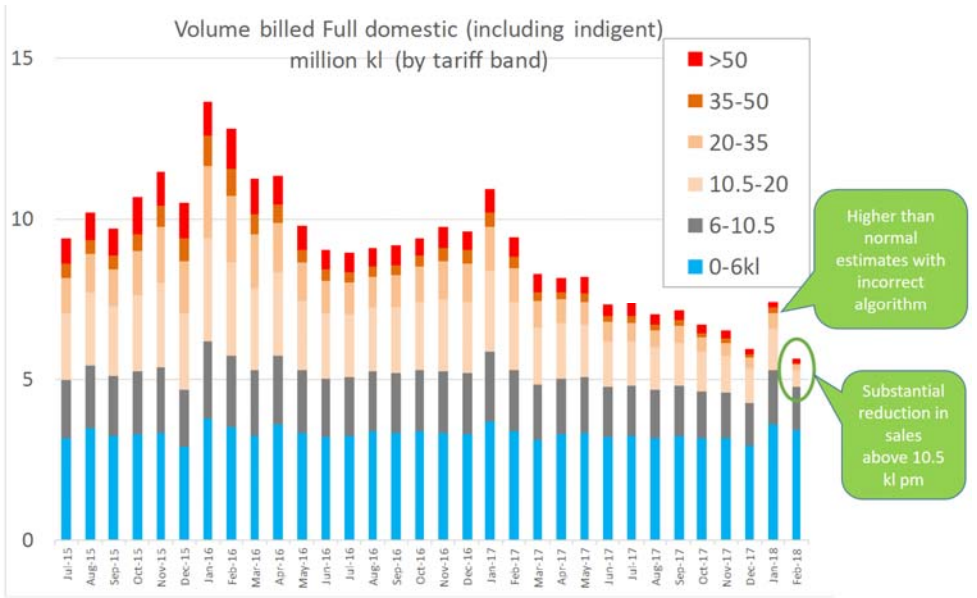
1.3 Commercial and industrial use

Reduction in usage in commerce and industry has been more modest. Consumption in commercial and industrial use have followed an overall downward trend since July 2015. (The spikes are due to billing corrections.)



1.4 A change in the structure of water usage by domestic customers

Water consumption by tariff band for domestic users is shown next. There has been a very substantial reduction in the volume of water sold in the tariff bands above 10.5 kℓ per month from over 7 million kℓ per month in February 2016 to below 1 million kℓ per month in February 2018.



2. SECTION 2: ADDITIONAL COSTS

Additional expenditure is required to implement demand management, ensure the sustainability of the assets and increase the availability of diverse water supplies.

Demand management. While demand management has been very effective, this has required significant investment and additional expenditure. Budgeted expenditure for 2018/19 is in the region of R300m.

Maintaining assets. The city must also ensure that it maintains and replaces its existing assets. A recent study on the Financial Sustainability of Utility Services showed that the city needed to spend an ***additional*** R1 billion per annum on asset rehabilitation and replacement to improve the sustainability

of the service which is currently threatened. If this investment does not occur, the asset conditions will move past the critical tipping point on the deterioration curve and cost to ensure renewal will exponentially increase. This represents an increase of about 16% on the 2017/18 water and sanitation budget. The study also concluded that maintenance is currently under-provided for by Water and Sanitation and must be increased.

New Water Program. The purpose of the New Water Program is to make the city more resilient to drought by making available water from new and diverse sources including ground water, wastewater reuse and desalination.

New Water Program: Capital programme for additional water 18/19:
The current planned augmentation programme will provide more than 20 million cubic metres (Mm^3) of water in 2018/19 (additional to the current restricted annual allocation to CCT is 175Mm^3);

- **Groundwater:** sandy aquifers (Atlantis & Cape Flats) and TMG aquifer capital budget R950m and operating budget R163m. This covers the cost of drilling, connecting infrastructure, electricity and treatment into the water reticulation system as well as operating the system at each site;
- **Water re-use:** budget provision of R560m capital and R93m operational for the year which includes the temporary plant at Zandvliet, design of permanent long-term re-use as well as recharge to Cape Flats aquifer from Borcherd's Quarry, Mitchell's Plain and Cape Flats wastewater treatment plants;
- **Desalination:** The temporary desalination plants including Strandfontein, Monwabisi, V&A and universal sites require an operating budget of R415m for the year, with no capital investment. Long-term desalination costs will be incurred in future years.

A significant capital programme to provide for growth and maintenance of water and sanitation infrastructure is included in previous years' medium term revenue and expenditure framework (MTREF). A number of projects have previously been postponed due to prioritisation and affordability but are critical to implement to provide a secure water future. Significant projects in the bulk water branch include the Bulk Water Augmentation scheme (BWAS) as well as the Contermanskloof reservoir. Wastewater upgrade and expansion projects include Bellville, Borcherds Quarry, Cape Flats, Macassar, Potsdam, Scottsdene, Wesfleur and Zandvliet.

In addition to this, augmentation to the system to diversify water sources in response to the drought under the new water programme adds R2.412 billion to the 2018/19 capital requirement. This will cover the cost infrastructure of groundwater extraction from the Atlantis, Cape Flats and Table Mountain Group Aquifers as well as re-charge of Cape Flats aquifer and permanent re-use from Zandvliet wastewater treatment plant. Augmentation from desalination will only incur operating expenditure in the next year.

In 2018/19, the additional operating expenditure due to the augmentation projects include R163m for groundwater extraction form the three aquifers, R93m for temporary re-use at Zandvliet and R415m for the temporary desalination plants at Monwabisi, Strandfontein and the V&A Waterfront.

CAPEX	R (million)
Bulk Water Program	
BWAS	R117
Contermanskloof Reservoir	R52
Subtotal	*R169*
Wastewater Treatment Program	
Upgrades and extensions	R740
Sludge Facility	R21
Subtotal	*R761*
Asset Replacement Program	
Capital Replacement Programme (Provision)	R555
Future Replacement Programme	R165
Acceleration in Maintenance Programs	R90
Other	R329
Subtotal	*R1 138*
WATER & SANITATION CAPITAL PROGRAM	***R2 068***
New Water Program	
Ground Water/Aquifers	R950
Water Re-use & aquifer recharge	R560
Subtotal	***R1 511***
TOTAL CAPITAL PROGRAM	**R3 579**

3. SECTION 3: REDUCED COSTS AND IMPROVED EFFICIENCIES

3.1 Reduction of non-revenue water and water losses

There is a difference between the volume of water "produced" (treated) and that sold. The water balance is analysed each month in line with international best practice to determine non-revenue water and water losses. The successful implementation of water demand management has resulted in a reduction in the volume of water produced. This has contributed to a slight increase in the percentage non-revenue water although the actual volume of non-revenue water has decreased.

Non-revenue water in the City was calculated to be 24.89% at the end of March compared to the national average of around 41%. Non-revenue water includes unbilled water (for example, to informal settlements) as well as real and apparent losses (also known as unaccounted-for water). Water losses in the city were 16.85% for the 12 months to March compared to the national average of 36%. Water losses include water losses through leaks, as well as water lost through theft and meter inaccuracies. Although the water loss percentage has increased slightly over the past year, this is the result of a large reduction in the denominator in the formula. The actual volume of water losses has reduced significantly due to improved management of the water network.

3.2 Anticipated improvements in cash collections

The roll out of water management devices is expected to have a positive impact on cash collections over time. In the short-term however, the punitive level 6 tariffs may reduce payment levels.

3.3 Staff productivity and other efficiency improvements

As part of the water and sanitation strategy development, the efficiency of the department will be benchmarked with international best practice with a view to identifying and implementing efficiency improvements.

4. SECTION 4: CHANGES IN TARIFF LEVEL AND STRUCTURE

4.1 Average tariff level

Due to the very large tariff increases in February affecting consumer behaviour, the Level 6 increases proposed are not significantly adjusted. The average tariff level is dependent on the volume of water sold – the average tariff is determined by dividing the total cost of providing the service by the volume of water sold. To recover the cost of providing water of ~R3.35 billion, the required average tariff is approximately **R21/kℓ** with sales of 178 million kℓ (Level 1 restrictions) and **R32/kℓ** with sales of 93 million kℓ (Level 6 restrictions).

4.2 Level 6 restrictions are the likely starting point for tariffs in 2017/18

The current drought is unprecedented. The drought has been estimated as a 1 in 311-year meteorological event, with 90% confidence that it falls between 105 and 1280 years[1]. There is no guarantee of when it will start raining or how much it will rain this winter. New tariffs must be in place from 1 July 2018. It is highly likely that at that time, Level 6 restrictions will remain in place unless rainfall is unusually early and substantially higher than the long-term average. Restriction levels will be reduced as soon as dam levels and DWS restrictions allow. ***As restrictions lift, tariffs will reduce***.

4.3 Changes in the tariff structure

The following changes in the tariff structure are necessary in the light of the structural changes in demand and to make the tariff more resilient to drought events:

Domestic tariffs

1. The number of tariff steps are reduced from 6 to 4 in order to reduce complexity.
2. Subsidies for indigent households (approximately 268,000 households) are maintained. Indigent households do not pay for water where usage is maintained at a basic level (below 10.5 kl).
3. Tariffs need to recover costs in the first two steps (0-6, and 6-10.5kl) for all customers except the indigent.
4. The third step is based on the average incremental cost of providing water to ensure sustainability.
5. The fourth step is there to strongly encourage water conservation.
6. A fixed charge based on meter size is introduced to cover approximately 25% of fixed cost.

Non domestic tariffs

7. have now been consolidated into a single tariff covering industrial, commercial and all other non-domestic use, at a fixed rate per kilolitre plus the fixed charge depending on meter size.

Sanitation tariffs

8. Other options for charging for sanitation will be explored to reduce the volatility in the tariff due to its link to water volumes.

Accounting

9. Revenue from the water & sanitation tariffs are now to be separately accounted for.
10. The cost of the subsidy for indigent households will be funded through a transfer from the rates account. Accounts for the cost of supplying indigent households will not be raised – a zero tariff will be applied to indigent use below 10.5 kl per month.

4.4 Basis of calculation of water tariffs

Domestic water tariff will be calculated as follows:

***New* 4 Step Tariff Structure (Water)**	**Tariff set at:**
Basic Usage Water = 0 – 6kℓ Sanitation = 0 - 4.2kℓ	a function of the *average cost of water* (cost/volume)
Basic Usage Water = 6 – 10.5kℓ Sanitation = 4.2 - 7.35kℓ	a function of the *average cost of water* (cost/volume)
Above Basic Usage* Water = 10.5 – 35kℓ Sanitation = 7.35 - 24.5kℓ	a function of *future incremental marginal cost* (additional cost to expand output from additional water sources)
Use jeopardising water conservation Water = > 35kℓ Sanitation = 24.5 - 35kℓ	*Conservation Charge* to deter high water usage

***At Level 6 restrictions, Step 3 is also a conservation tariff to restrict use in this block.

The proposed Level 6 consumptive tariff for 2018/19 is shown below, compared to the tariff of 2017/18.

POTABLE WATER:	2017/18	2018/19	% Increase
Domestic Full - Non Indigent per kl	R ex VAT	R ex VAT	
Step 1 (0 ≤ 6kl)	26.25	28.90	11.06%
Step 2 (>6 ≤ 10.5kl)	46.00	46.00	0%
Step 3 (>10.5 < 35kl)	N/A	120.27	
Step 3 (>10.5 ≤ 20kl)	100.00	N/A	
Step 4 (>20 ≤ 35kl)	300.00	N/A	
Step 4 (> 35kl)	N/A	1 000.00	
Step 5 (>35 ≤ 50kl)	800.00	N/A	
Step 6 (>50kl)	800.00	N/A	

4.5 Basis of calculation of fixed charge

A fixed charge has been introduced which is linked to the size of the metered connection which translates to the demand put on the system. The revenue has been calculated to cover ~a quarter of fixed costs. The formula for calculation of the monthly charge is based on the square of the radius of the connection (the volume supplied is directly related to the area where: Area = π x radius^2 or = π x (diameter/2) ^{2}

It should be noted that there are very few large meters in the network – 95% of meters are 20mm or less, 98% are 25mm or smaller and 99% of meters are 40mm or smaller.

Size (mm)	Number of meters	% of meters	Monthly Charge (incl VAT)
15	367,516	56.0 %	R 64.40
20	254,025	38.7 %	R 115.00
25	20,388	3.1 %	R 179.40
40	4,516	0.7 %	R 460.00
50	4,986	0.8 %	R 718.72
80	1,843	0.3 %	R 1,840.00
100	2,344	0.4 %	R 2,875.00
> 150	471	0.1 %	varies

4.6 Monthly account for Steps 1 and 2 Water & Sanitation

ACCOUNT FOR WATER & SANITATION (+ Domestic connection, incl. VAT)
The monthly increase at Step 1 & 2 at Level 6 is substantial, given the need to cover the actual cost based on the low volumes. Remaining at **Level 6** restrictions, the increase will have the following impact:
6kl Current: R 290 6kl from **1 July**: R 383 (15mm) or R 434 (20mm)
10.5kl Current: R 669 10.5kl from **1 July**: R 763 (15mm) or R 813 (20mm)

If restrictions are reduced during the year, significant relief will be provided by the tariffs at lower levels. For example, should we return to **Level 4,** indicative monthly costs are:
6kl Current: R 290 6kl from **1 July**: R 222 (15mm) or R 272 (20mm)
10.5kl Current: R 669 10.5kl from **1 July:** R 410 (15mm) or R 461 (20mm)

4.7 Sanitation tariffs

In the current tariff structure, revenue from water and sanitation is combined to cover the costs of both services. Over time, the revenue from sanitation tariffs fell short of covering costs to the extent that water revenue buffered sanitation costs. With the drought reducing water volumes so dramatically, it is necessary to separate water and sanitation costs and revenues. It is therefore necessary that individually each service is cost reflective i.e. revenue equals expenditure.

The proposed Level 6 consumptive sanitation tariff for 2018/19 is shown below, compared to the tariff of 2017/18.

SANITATION CONSUMPTION:	2017/18	2018/19	% Increase
Domestic Full - Non Indigent per kl	R ex VAT	R ex VAT	
Step 1 (0 < 4,2 kl)	22.50	24.72	10.83%
Step 2 (>4.2 < 7.35 kl)	39.00	39.00	0%
Step 3 (>7.35 < 24.5 kl)	N/A	108.07	
Step 3 (>7.35 < 14 kl)	86.00	N/A	
Step 4 (>14 < 24.5 kl)	105.00	N/A	
Step 4 (>24.5 < 35 kl)	N/A	108.07	
Step 5 (>24.5 < 35 kl)	105.00	N/A	

The sanitation tariff has thus also been increased in the proposed budget although the tariff structure has changed less substantially than that of water. The tariff is still charged on 70% of water consumption to a maximum of 35kℓ of sewerage per month. The sanitation tariff structure is not resilient as the tariff is linked to the volume of water metered to a property. With the drought, many households have moved to using ground water to flush toilets for example. This means that the volume of water entering the sewerage system is not necessarily linked to the volume of municipal water supplied.

4.8 Level 6 Tariff – An Extreme Tariff

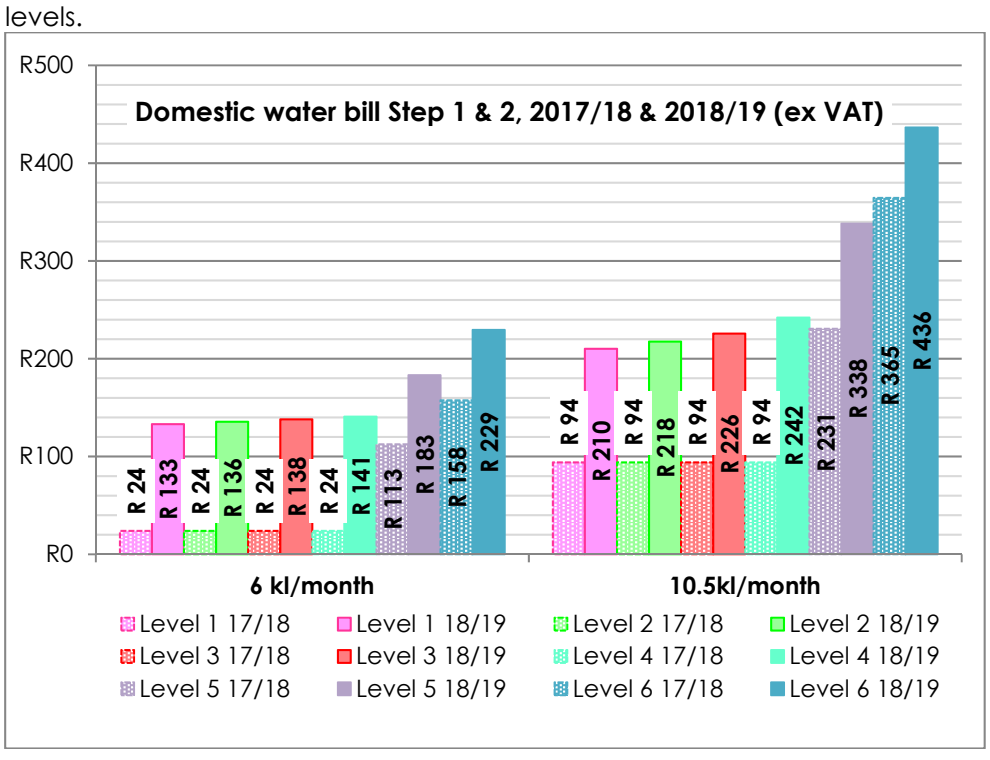
Restriction tariffs are part of managing demand in times of drought. For many years, the City had 3 restriction levels, providing for a saving in consumption of 10%, 20% and 30% (or Level 1, 2 & 3). In the 2017/18 budget process, the City added Level 4 restriction tariff to be introduced from 1 July 2017. At the time it was not foreseen that further restriction tariffs would be required. As the rainfall of 2017 was at a record low, further restriction tariffs proved to be required and Level 5, 6 & 7 were introduced at Council at the end of January 2018 in line with a special directive from the Minister of Finance.

When Level 4 was introduced from 1 July 2017, the first 6kℓ was priced at a subsidised cost of R4 across all restriction levels. Prior to this, all households received 6kℓ at no cost. Now the average household of 4 should use no more than 6kℓ, with the result of there being a deficit in higher step tariff income to subsidise the bulk of domestic consumption. The increase at Levels 1-4 would have resulted in a far smaller shortfall if 2017 had seen average rainfall but the persistent drought has resulted in structural change to the tariff being urgently needed, specifically having the first step (0-6kℓ) cost reflective. The increase by volume (including the fixed charge for a 15mm connection) is shown in the graphs.

At excessive volumes of water use (>35kℓ per month), permanent behaviour change is expected to reduce volumes sold even if dams reach levels sufficient to return to restriction Level 1. This can be attributed to fixing of leaks, installation of alternative water sources at domestic level and overall awareness amongst others.

Under Level 6, households may be restricted from using more than 10.5kℓ/month. Using 6kℓ (ex VAT) currently costs R157.50, which will increase to R229.40 while 10.5kℓ will increase from R364.50 to R436.40. The percentage increase is necessary to cover the cost of provision of water.

Level 6 tariff is essential now to ensure that the region manages to stretch the available water through winter. The City is obligated to achieve 45% savings due to the DWS restriction. DWS has indicated that restrictions will be lifted if dams should reach 85% before 31 October 2018. The City will continue to work with DWS throughout the year to assess restrictions with changing dam levels.



While the drought persists, everyone will need to contribute not only to water savings but also towards the sustainability of the service by paying more for water to be available, and the volume used. Indigent households will still receive Step 1& 2 water and sanitation at no charge.

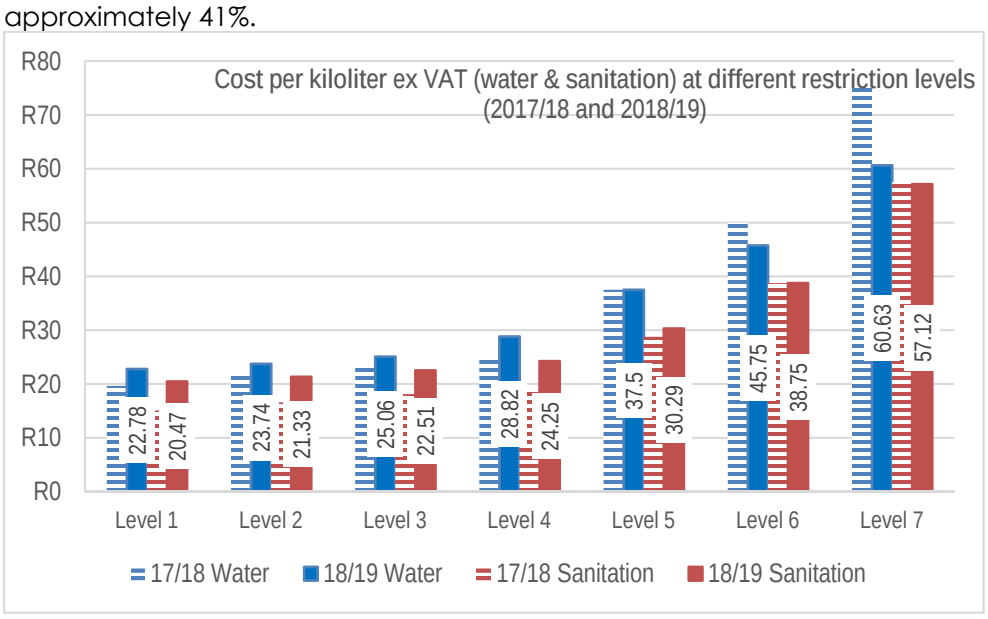
4.9 Section 6: Non-Domestic Tariffs

Non domestic tariffs have now been consolidated into a single tariff covering industrial, commercial and all other non-domestic use, at a fixed rate per kilolitre plus the fixed charge depending on meter size. The proposed tariff for supplying water at restriction Level 6 to premises predominantly of a commercial or industrial nature is R45.75 per kℓ (R52.61 incl. VAT) while for

sanitation it is R38.75 per kℓ (R44.56 incl. VAT). Current tariffs ex VAT are R50.00 for water and R38.75 for sanitation.

Level 7 tariffs have been increased to balance the volume of sales anticipated as people are likely to increase their consumption at work once supply to households has been curtailed. Non-domestic customers will need to ensure that the volumes consumed do not jeopardise the disaster plan which is premised on a volume of supply of 350MLD for an extended period. Domestic users no longer provided with household water supply will be charged a flat monthly rate in an effort to provide financial sustainability to the water service.

Without the fixed connection charge added (as meter sizes & costs vary from premises to premises), the account for non-domestic use increases at Levels 1-4 and decreases beyond that. If, due to DWS and good rainfall, restrictions should be reduced for example to Level 4, water accounts will reduce by approximately 41%.



ACCOUNT FOR WATER & SANITATION (non-domestic, ex VAT)
The monthly increase at Level 6 is substantial, given the need to cover the actual cost based on the low volumes. Remaining at **Level 6** restrictions, the increase will have the following impact:

50kl Current:	R 3,856	from 1 July:	R 3,644 (-6%)
100kl Current:	R 7,713	from 1 July:	R 7,288 (-6%)

If restrictions are reduced during the year, significant relief will be provided by the tariffs at lower levels. For example, should we return to **Level 4,** indicative monthly costs are:

50kl Current:	R 3,856	from 1 July:	R 2,290 (-41%)

4.10 Comparison with other metros

National Treasury benchmarks the 8 metropolitan municipalities budgets annually, which includes tariff increases and the costs of basic services as well as free services provided to indigent households. In scale, Cape Town is comparable to Johannesburg, Ekhurleni, Tshwane and eThekwini. All cities operate in accordance to their personal circumstances and direct comparisons are often not possible. For example, the City of Johannesburg has established Joburg Water as a municipal entity responsible for provision of water and is not included in the comparison of the large municipalities below. The comparative tariffs for the 2017/18 budget year is shown here in cents per kilolitre.

2017/18 Domestic Water tariffs	Ekurhuleni	Tshwane	eThekwini	Cape Town
Water usage - flat rate tariff (c/kl)	13 429.00			
Water usage - life line tariff			1 619.24	
Water usage - Block 1 (c/kl)	1 489.00	954.00	1 913.90	400.00
Water usage - Block 2 (c/kl)	1 824.00	1 362.00	2 548.56	1 557.00
Water usage - Block 3 (c/kl)	2 269.00	1 789.00	3 929.80	2 278.00
Water usage - Block 4 (c/kl)	2 798.00	2 070.00	4 323.63	3 832.00
Other	2 798.00			

The blocks do not directly correspond to our volumetric steps but reflect similar inclining block tariff structure. The prevailing restriction level is used in budget calculations thus Cape Town figures correspond to the Western Cape drought restriction levels whereas other metros may not be restricted. Gauteng water restrictions were lifted in March 2017). Municipalities vary their structure and tariff according to individual circumstances, but what is evident from the budget figures is that CCT is reasonably aligned in their domestic tariff with other metros despite the severe drought. 2018/19 figures will be compared when data becomes available.

GLOSSARY

LEVEL: **Restriction Levels** refer to the saving required in reducing volume to meet DWS restrictions in times of drought. When a Level is approved in the budget, the city can move between the levels as required by the restriction imposed by DWS in response to the drought:
Level 1: requires a saving of 10%;
Level 2: requires a saving of 20%;
Level 3: requires a saving of 30%;
Level 4: allows for an urban demand of 600MLD
Level 5: allows for an urban demand of 500MLD
Level 6: allows for an urban demand of 450MLD
Level 7: allows for an urban demand of 350MLD (collected at PODs)
No higher restriction levels are foreseen.
This document does not include analysis for domestic households at Level 7. Level 7 tariffs will only apply to those households which are still provided with piped water due to their location with respect to points of distribution.

STEP: The tariff consists of a number of consumption steps which are provided for each restriction level. Using a certain volume of water results in a certain price to be paid for each unit. The historical structure had 6 steps:
Step 1: 0-6kℓ,
Step 2: 6-10.5kℓ,
Step 3: 10.5-20kℓ,
Step 4: 20-35kℓ,
Step 5: 35-50kℓ and
Step 6: over 50kℓ.

In 2018/19 we are reducing the number of steps to 4:
Step 1: 0-6kℓ,
Step 2: 6-10.5kℓ,
Step 3: 10.5-35kℓ,
Step 4: over 35kℓ.
The steps were reduced in line with recovering costs, providing resilience and to simplify the tariff to what is necessary.

SUMMARY SHEET: significant tariff increases were proposed in the 2018/19 draft budget (which have subsequently been amended) for two reasons:

1) Dramatic reduction in revenue
2) Substantial increase in costs

1) Dramatic REDUCTION IN REVENUE is driven by:

- Substantial drop in water sales by volume (average city demand down from 900 million liters per day (MLD) in Feb 2017 to 500 MLD in Feb 2018 – reduction of ~45%) and needs to reduce further (Level 6 restrictions). This translates to a shortfall in revenue of nearly R2 billion in the current year. The City has cut other programmes and services to cover the gap in the current & next year but cannot afford to cover an even larger anticipated shortfall of revenue in 2018/19;
- The stepped tariff structure has always subsidized use at lower volumes of consumption (tariff far below cost) through high costs at high volumetric use and must be changed to be more resilient to drought.

Level 6 restrictions & the Drought:

- The current drought is unprecedented – not only do we need to reduce demand, but the tariff requirement is vastly inflated due to the lower volumes of water available;
- *The best estimate of the return interval of the meteorological drought in the region of WCWSS dams is 311 years, with 90% confidence that it actually falls between 105 and 1280 years[1];*
- There is no guarantee of when it will start raining or how much it will rain this winter. New tariffs must be in place from 1 July 2018. It is highly likely that at that time, Level 6 restrictions will remain in place;
- Restriction levels will be reduced as soon as dam levels and DWS restrictions allow.

Change in structure:

- Tariff based on recovery of cost in the first two steps (<10.5kl), additional water sources costs included in step 3, and punitive in step 4;
- Maintain provision to indigent households (~268,000 households) at no charge;
- Introduce a fixed charge based on meter size to cover ~25% of fixed cost;
- Simplify from 6 to 4 volumetric steps;
- Revenue from Water & Sanitation tariff has previously been accounted for combined – in future they will be individually accounted for.

Water: Fixed charge based on meter size (95% of households R115/mth or less):

Size (mm)	Number of meters	% of meters	Monthly Charge (incl. VAT)
15	367,516	56.0 %	R 64.40
20	254,025	38.7 %	R 115.00
25	20,388	3.1 %	R 179.40
40	4,516	0.7 %	R 460.00
50	4,986	0.8 %	R 718.72
80	1,843	0.3 %	R 1,840.00
100	2,344	0.4 %	R 2,875.00
> 150	471	0.1 %	varies

Domestic water tariff simplified to 4 steps, with tariffs calculated as below:

***New* 4 Step Tariff Structure (Water)**	**Tariff set at:**
Basic Usage Water = 0 – 6kℓ Sanitation = 0 - 4.2kℓ	a function of the *average cost of water* (cost/volume)
Basic Usage Water = 6 – 10.5kℓ Sanitation = 4.2 - 7.35kℓ	a function of the *average cost of water* (cost/volume)
Above Basic Usage* Water = 10.5 – 35kℓ Sanitation = 7.35 - 24.5kℓ	a function of *future incremental marginal cost* (additional cost to expand output from additional water sources)
Use jeopardising water conservation Water = > 35kℓ Sanitation = 24.5 - 35kℓ	*Conservation Charge* to deter high water usage

***At Level 6 restrictions, Step 3 is also a conservation tariff to restrict use in this block.

ACCOUNT FOR WATER & SANITATION (+ Domestic connection, incl. VAT)
The monthly increase at Step 1 & 2 at Level 6 is substantial, given the need to cover the actual cost based on the low volumes. Remaining at **Level 6** restrictions, the increase will have the following impact:
6kl Current: R 290 6kl from **1 July**: R 383 (15mm) or R 434 (20mm)
10.5kl Current: R 669 10.5kl from **1 July**: R 763 (15mm) or R 813 (20mm)

If restrictions are reduced during the year, significant relief will be provided by the tariffs at lower levels. For example, should we return to **Level 4,** indicative monthly costs are:
6kl Current: R 290 6kl from **1 July**: R 222 (15mm) or R 272 (20mm)
10.5kl Current: R 669 10.5kl from **1 July:** R 410 (15mm) or R 461 (20mm)

2) Substantial INCREASE IN COST driven by:

- The tariff must reflect the value of water & sanitation accurately while the Collection ratio must reflect actual payment patterns – it has historically been underfunded resulting in an annual shortfall;
- Funding capital program for diversified water sources (New Water Program extra R1.511bn Capex, R671m Opex);
- Water Demand Management initiatives must continue for the supply system including Cape Town to get through the drought;
- Assets must be protected through proper renewal and maintenance investment.

Accurate value of water & sanitation service

- The tariff is determined by dividing the total cost of provision by the volume sold. To recover the cost of providing water of ~R3.35bn, the anticipated sales volume at Level 1 determines a cost of **R21/kl** while the reduced volume under Level 6 determines a cost of **R32/kl.**

Need to DIVERSIFY WATER SUPPLY

- "Surface Water only" no longer viable option to prevent repeated disaster management scenarios;
- Impact on economy / business / tourism/ etc. – reliance only on surface water is stifling economic growth.

Funding capital programme for ADDITIONAL WATER 18/19:
The current planned augmentation programme will provide more than 20 million cubic metres (Mm^3) of water in 2018/19 (additional to the current restricted annual allocation to CCT is 175Mm^3);

- **Groundwater:** sandy aquifers (Atlantis & Cape Flats) and TMG aquifer capital budget R950m and operating budget R163m. This covers the cost of drilling, connecting infrastructure, electricity and treatment into the water reticulation system as well as operating the system at each site;
- **Water re-use:** budget provision of R560m capital and R93m operational for the year which includes the temporary plant at Zandvliet, design of permanent long-term re-use as well as recharge to Cape Flats aquifer from Borcherd's Quarry, Mitchell's Plain and Cape Flats wastewater treatment plants;
- **Desalination:** The temporary desalination plants including Strandfontein, Monwabisi, V&A and universal sites require an operating budget of R415m for the year, with no capital investment. Long-term desalination costs will be incurred in future years.

Demand management & protection of assets

- Demand management initiatives such as investing in the reticulation network, reducing pressure and rapidly fixing leaks;
- Investment needs to continue for growth, renewal and asset replacement over and above specific drought-related infrastructure.

SUMMARY FACTS:

- We need to increase the tariff substantially to be able to continue supplying water & providing sanitation service;
- We do not make a profit on sale of water but we have to recover the full cost;
- We must have a balanced budget, and ensure provision of basic services;
- Level 6 is extreme to respond to the drought crisis, at Level 7 households will be disconnected and have to collect water;
- The required *revenue* increase is 19.9%. The revenue increase results in different percentage increase at the different steps, depending on the volume of water & sanitation likely to be sold to achieve the required revenue;
- Due to the major impact of the drought, we need to invest in other water sources due to low (and unreliable) rainfall;
- Cost of supply has greatly increased over the years due to growth in city, aging infrastructure etc. and the tariff has historically been too low;
- The old stepped tariff structure is not resilient to drought: all water sold below 10.5kl/month has been heavily subsidized (which means middle and high income households have been subsidized). Now we nearly *ONLY* sell water below 10.5kl, with no other revenue to subsidise the shortfall;
- Indigent households are and will always have to be supported;
- We will want to reduce the restriction as soon as possible, depending on winter rainfall and DWS;
- The cost of operating water and sanitation networks does not decrease in proportion to the amount of usage. The fixed charge covers only about a quarter of reticulation costs;
- Even during times of reduced water consumption the same operations and repairs and maintenance programmes are necessary to keep water & sewerage flowing reliably;
- Tariff structure requires higher level of "certain" income not dependant on volumetric usage i.e. a fixed charge component.

GreenCape

Industry brief
03/2018

Why making your **business water resilient** makes financial sense

Main insights

Businesses are investing in water efficiency solutions and alternative water sources due to the drought. However, there are solutions that will make financial sense even when the drought is over and tariffs have been relaxed. Investing in water efficiency and alternative water sources can reduce your business's reliance on municipal water by up to 70% and in some instances save 60% in water related business costs.

- The current drought is the 'new normal' and water will be a scarce future resource.
- Under either the current (strict) tariffs or relaxed tariffs, it makes business sense to invest in solutions that improve water efficiency and provide alternative water sources.

This brief highlights:

- The wide range of water efficiency and alternative water sources solutions available to businesses – the choice of which would depend on cost and complexity, and the size and type of business.
- The estimated cost of solutions, water savings and financial payback periods of different types of interventions using two restriction tariff levels (Level 1 and Level 6, L1 and L6 hereafter)*.

*Per kilolitre (kl) cost assumptions: L1 - consumption (R26.20), sanitation (R20.47); L6 - consumption (R52.61), sanitation (R44.56).

The brief presents modelled scenarios for three business contexts: (1) a medium-sized office, (2) a medium-sized manufacturing facility and (3) a large manufacturing facility. The solutions are selected along a water resilience framework, illustrated below.

Figure 1: Solutions businesses can explore to be drought resilient

1. Understand water uses and risks	2. Reduce consumption	3. Re-use outside water	4. Find an alternative water supply
• Water audits • Meter and monitor, (incl. leak detection) • Water quality requirements (fit-for-purpose) • Set water targets	• Efficient processes and behaviour • Efficient fittings and technologies • Efficient cooling systems	• Use of greywater • Treat water for re-use • Divert water for re-use	• Ground water production • Rainwater/Stormwater harvesting • Use of treated municipal effluent

Increasing cost and complexity

1) Medium-sized office

- **Context:** office of 200 people using 5 kl of water per day
- **Solutions:** smart water meters, retrofit taps and toilet units and harvest rainwater.
- **Other potential options:** ground water extraction

Smart water meters
A basic smart metering solution is enough to provide a comprehensive consumption report, which can help offices identify leakages and track water use. For this modelled scenario, we assumed that 1 main meter and 1 sub-meter would be installed. We also assumed that the office would achieve a 5% reduction in consumption after installing the meters through better awareness or the elimination of leaks. (Research suggests that 15% is a typical saving with some offices achieving 70%).

Retrofitting taps and toilets
Taps and toilets use approximately 50% of all water in office buildings and retrofitting is an excellent opportunity and easy way to save. For this scenario, we based the retrofitting costs on 20 taps, 10 toilet cisterns and 4 urinals.

Rainwater harvesting
Harvesting rainwater is the most financially viable alternative water source solution for most office-type businesses. For this scenario, we assumed a storage capacity of 40 kl, average monthly rainfall patterns for Cape Town, a standard roof size of 2000 sqm, and rainwater to be used for flushing (and possibly irrigation). The model showed that in the rainy months (April – August), toilets can be flushed using only rainwater from the harvesting system.

Table 1:
Cost of solutions and savings for a medium-sized office

Solution	Cost	Reduction in municipal water usage (per solution)	Net Savings per year (Level 1 restrictions)	Net Savings per year (Level 6 restrictions)
Metering	R14 900	5%	R2 250	R8 000
Tap and toilet retrofits	R23 300	39%	R18 700	R43 200
Rainwater harvesting	R166 500	44%	R35 300	R84 400

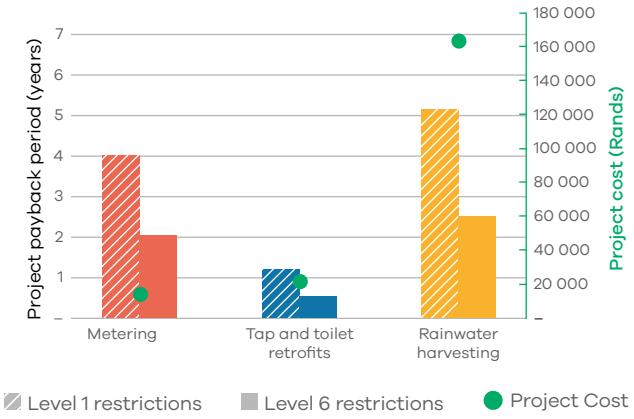


Figure 2: Selected water solutions with costs and payback periods: medium-sized office

Key takeaways
- All solutions pay for themselves in under six years under L1 and L6 tariffs.
- Tap and toilet retrofits payback periods are 6 months (L6) and 1 year (L1).
- Rainwater harvesting can provide greater savings and a shorter payback period if the site gets more rainfall than the average for Cape Town.
- Smart meters in this context take longer to pay back (2 years, both L1 and L6) but larger offices that use more water could pay back meters in less than a year.

Case study
JG Afrika reduced their water consumption by 67% through awareness and water efficiency measures and achieved cumulative savings of R33 424.

2) Medium-sized inorganic manufacturing facility

- **Context:** textile company using 200 kl of water per day.
- **Solutions:** smart water meters, inorganic effluent reuse, treating municipal effluent to potable standards, and rainwater harvesting.
- **Other potential solutions:** retrofitting taps and toilets and groundwater production (see medium-sized office).

Smart water meters
Since industrial sites have more complex reticulation systems and larger land areas, smart metering solutions are more complex and expensive relative to office-type buildings. For this scenario, we assumed that 2 main meters and 4 sub-meters would be needed and that a 5% reduction in consumption would be achieved after installation of the smart water meters.

Reusing inorganic effluent
There are many solutions for the reuse of industrial wastewater depending on the quality of wastewater and the intended purpose of use. The scenario modelled here is for the full-scale treatment of inorganic effluent to potable standards [1]. The data shown in Figure 3 assumes 70% water recovery from the treatment of the inorganic effluent.

Treating municipal effluent to potable standards
For textile manufacturing companies or similar industries that do not have to adhere to very strict health and safety standards when it comes to their process water, upgrading treated effluent to potable standards presents a viable option as an alternative water source. The cost of purchasing municipal treated effluent varies depending on the municipality. In the City of Cape Town, treated effluent costs R6.79/kl (including VAT). For this scenario, we assumed 100 kl/day production capacity (i.e. 50% of the facility's consumption).

Harvesting rainwater
Given the large roof areas of industrial facilities, rainwater harvesting is a viable option for most manufacturing plants and is a 'low hanging fruit' for accessing an alternative water source. For this scenario, we assumed a roof size of 20 000 sqm, storage capacity of 400 kl and that rainwater would be used for toilet flushing and industrial processes that do not need high water quality.

Table 2:
Cost of solutions and savings for a medium-sized manufacturing facility

Solution	Cost	Reduction in municipal water usage (per solution)	Net Savings per year (Level 1 restrictions)	Net Savings per year (Level 6 restrictions)
Smart water metering	R156 000	5%	R145 000	R330 000
Inorganic effluent reuse	R4 060 000[2]	70%	R1 213 000	R3 770 000
Treated effluent	R2 102 000	50%	R883 000	R2 713 000
Rainwater harvesting	R2 260 000	44%	R353 000	R 844 000

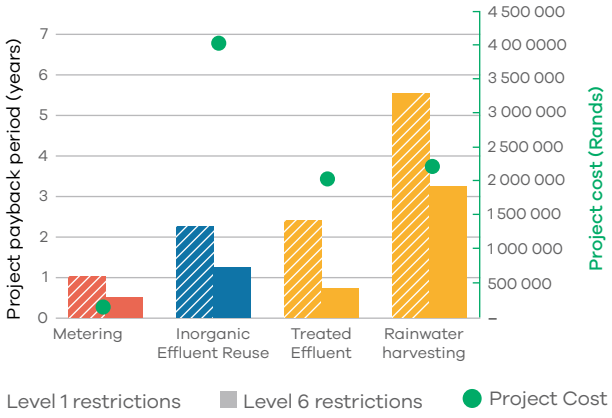


Figure 3: Selected water solutions, costs and payback periods: medium-sized manufacturing facililty

Key takeaways
- All solutions can be paid back in less than six years under both L1 and L6 restrictions.
- The best business case is for smart metering, with a payback period of 1 year (under L1) and 6 months (under L6).

Case study
ACA Threads managed to reduce their water consumption by 70% between 2012 and 2017 through equipment automation and process adaptation and managed to achieve R1.9 million annual savings.

1 It was assumed that the effluent would not contain any metals or toxic elements
2 The capital cost includes the cost of evaporation ponds needed for brine handling.

3) Large organic manufacturing facility

- **Context:** food and beverage company using 1 000 kl/day.
- **Solutions:** smart water meters, reuse of organic effluent and boreholes.
- **Other potential solutions:** see previous two scenarios

Smart water meters
Large manufacturing facilities have relatively high water consumption and larger land areas. The capital costs for implementing smart water metering are therefore higher, but so is the potential for water savings. We assumed 4 main meters and 8 sub-meters would be needed, and that a 5% reduction in consumption would be achieved after installation of smart water meters.

Reusing organic effluent
The costs to treat and reuse the wastewater vary widely, are site specific and subject to change depending on the effluent characteristics. For the modelled solution we assumed the use of anaerobic digesters and used a 70% water recovery rate. We assumed that the final reduced volume discharged would not have organic loads exceeding the maximum allowed limits and that the sludge from the anaerobic digester will be dried and taken to a landfill[3].

Boreholes
Most high water users opt to invest in boreholes to secure an alternative water source. We assumed a 200kl/day groundwater production capacity. The capital costs presented include costs for consulting and drilling, water treatment and brine handling (the groundwater quality was modelled as saline).

Table 3:
Cost of solutions and savings for a large food and beverage facility

Solution	Cost	Reduction in municipal water usage (per solution)	Net Savings per year (Level 1 restrictions)	Net Savings per year (Level 6 restrictions)
Metering	R430 000	5%	R730 000	R1 644 000
Organic effluent reuse	R60 000 000	70%	R7 070 000	R23 800 000
Groundwater production	R3 616 000[4]	20%	R1 500 000	R5 200 000

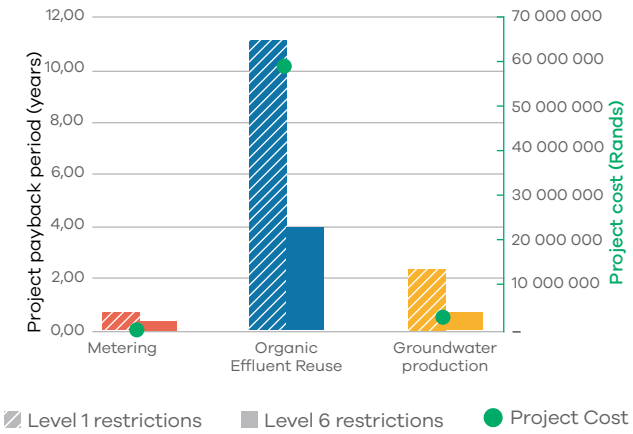


Figure 4: Selected water solutions, costs and payback periods: medium-sized manufacturing context

Key takeaways
- Organic effluent reuse is the most expensive and have the longest payback period, but can save the most water.
- The costs of treating organic effluent for reuse are very site specific.

Case study
Quality beverages reduced their water use by 27% through a staff water-saving campaign and by reusing water from bottle rinsing processes. They achieved cumulative savings of R870 000 from 2016 to 2017.

3 The costs for handling the waste sludge have not been included in the financial model.
4 Included in the capital cost is the cost of the evaporation ponds needed for the handling of the brine remaining after treatment.

Next Steps
For more information and support, contact GreenCape's water sector desk: water@greencape.co.za or call 021 811 0250.

Additional resources on improving water resilience are available from: https://www.greencape.co.za/content/focusarea/drought-business-support

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*The analysis presented in this industry brief is generated from a financial model of water efficiency and alternative water sources projects. The information used to generate the model was sourced from an in-house database of water technologies gathered through engagement with technology providers, desktop research and expert engagements.

CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD