

To: City Council of Cape Town
From: Griffin Bassett
Date: 12/12/20
RE: Engineering for Sustainable Water Use in Cape Town

The city of Cape Town, South Africa is expected to see significant population growth in the coming years. This will put further strain on the city's already limited supply of fresh water, which will make it significantly more difficult for Cape Town residents to comfortably live. In order to alleviate this issue, direct action must be taken to ensure fresh water access in an equitable manner. This can be achieved through a combination of infrastructural expansion and progressive zoning policies on the part of the Cape Town City Government.

2017-2018 drought and future water shortages

From mid-2017 to mid-2018, the city of Cape Town faced a severe shortage of fresh water. As dam reserves plummeted to levels as low as 15 percent capacity, the city's residents braced for a seemingly imminent "Day Zero," at which point the city would become the first major urban area in the world to run out of water (Cassim 2018). Eventually, through a combination of both water usage restrictions and conveniently-timed rainfall, Day Zero was avoided: dam reserves returned to near full capacity, and the city's access to fresh water was more or less restored to previous levels by 2020.

The issue of Cape Town's access to fresh water is far from over, though - in fact, it will likely be recurring at an increasingly greater frequency in years to come. The ongoing process of global climate change will produce more droughts, an especially exigent problem for the already arid area around Cape Town. Additionally, steady local population growth in the Western Cape will place further pressure on existing infrastructure. The population of the province is expected to increase from 5.83 million to 7.36 million in the period between 2011 and 2040 (Western Cape Government 2019). Without a stable plan to provide water for these new residents, existing socioeconomic inequities will only deepen, and lower-income communities will be put at further risk of the spread of disease.

Urban and agricultural engineering in the Cape Town area

The Cape Town urban area is serviced in its fresh water needs by the Western Cape Water Supply System, a complex and interconnected system of dams, tunnels, and pipelines. The largest component, the Theewaterskloof Dam, itself makes up around 41% of the storage volume of the entire system. Throughout the 2017-2018 drought, the dam was reduced to 12% of its total capacity (Bohatch 2017). Additionally, the hydrological environment surrounding the Theewaterskloof has seen a worrying increase in salinity levels, especially in the Vink,

Kogmanskloof, Poesjenels, and Breede Rivers. If this trend continues, the dam's supply could be used to make freshening releases, which would place further strain on the supply going to urban districts of Cape Town (Department of Environmental Affairs and Development Planning 2011).

An increased frequency of drought periods, as is predicted to come with the trend of global warming, will also have a marked effect on Cape Town's food supply. The agricultural sector around the city relies on heavy, careful irrigation, due to fluctuations in temperature and aridity. Further water shortages would necessitate a shift in farming practices and the implementation of macronutrient fertilization, which, though effective in reducing water deficit for crops, may not be an immediately readily accessible practice for farmers in Western Cape (Nieves-Cordones et al., 2019).

Social and economic inequalities deepened by water shortage

Cape Town's water shortage is occurring within a context of deep socioeconomic inequality. The city is starkly divided by income level: neighborhoods of luxury hotels and 10 million dollar homes lie only fifteen minutes away from neighborhoods where the average income is less than \$2,000 per year (Sieff 2018). Dwindling municipal fresh water supplies will have a far more pronounced impact on lower-income communities, who have already had to resort to rationing during the 2017-2018 drought. If water supplies are completely severed, such as in the event of a severe drought or dam malfunction, these communities will have to reckon with a host of new issues - notably, the spread of diseases such as cholera. Meanwhile, residents of higher-income neighborhoods will be far less affected, as many have the money or existing infrastructure available to stockpile water bottles or drill fresh water wells (Sieff 2018).

The issue of fresh water is also deeply rooted in South Africa's complex racial history. Inequality in Cape Town, as in all of South Africa, often follows racial lines, as the country continues to recover from the white supremacist era of Apartheid. Racist segregationist policies were instituted and carefully maintained throughout the country by the white-minority government, and Black South Africans were systematically denied access to economic privileges offered to white South Africans. In Cape Town, nonwhite people were effectively barred from living or working in the city center, instead having to commute in from distant townships on the Cape Flats. This is reflected in the current economic divide of the city: white Capetonians are, on average, more wealthy than nonwhite Capetonians, and predominantly white areas of the city have far easier access to city services (Polgreen 2012). Water shortages in the future will deepen a racial economic divide and hamper progress towards racial equity and justice in post-Apartheid South Africa.

Ethical and moral considerations

The aforementioned inequality of water security raises a number of ethical and moral concerns in devising a solution to this issue. While many wealthy neighborhoods in Cape Town have a fresh water pool in almost every yard, residents of lower-income neighborhoods further from the city center have struggled to secure enough fresh water to conduct basic lived necessities, such as bathing or preparing meals. In some neighborhoods, such as Gugulethu, just over half of homes have toilets (Sieff 2018). Any truly equitable solution that addresses Cape Town's water insecurity cannot let such a fragrant inequality in water usage persist.

Private pools outside, disparities in income also create much different stakes in preparing for a hypothetical Day Zero. Communities where residents are wealthy enough to stock up on water bottles have a far lesser incentive to reduce their personal consumption of water in comparison to residents of low-income communities. Ultimately, a substantial proportion of the city's population cannot afford to prepare for a Day Zero event (Sieff 2018). The geographical inequality of Cape Town must be comprehensively addressed in order to see that all residents have at the very least an incentive to manage their usage of fresh water for the sake of their community.

Engineering and policy recommendations

There is no single preparation that can be made to solve Cape Town's water crisis, but a combination of infrastructural engineering and government policy could make significant progress in alleviating the impact that this issue will have on the city's residents in the future.

From an engineering perspective, the combined capacity of the Western Cape Water Supply System should continue to be expanded through the construction of more dams and reservoirs, linked to the rest of the system through waterways and pipelines as needed. The effectiveness of this action would be further enhanced by a zoning policy that increases density and allotments for mixed-income housing within residential neighborhoods near the city's core. A diversity of income in inner-city residential areas would ensure that everyone has a more equal stake in curbing water usage, and would also reduce the stress placed upon current freshwater transportation infrastructure in properly servicing informal settlements outside of the city's core.

It would also be prudent to pursue a housing policy that limits the excessive use of freshwater for recreational purposes. Private pools in houses and hotels should have a stricter limit on their maximum volume as well as the amount of water they are allowed to use. Enthusiasts of diving or more thorough swimming could still have their wants met by visiting public pools in their respective neighborhoods. The supply of freshwater that is currently diverted to the sustenance of these private pools would be far better suited to expanding sanitation networks in lower-income communities on Cape Town's periphery, as well as in the hypothetical expanded mixed-income communities mentioned above.

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