



From drought to desalination: The case of Cape Town

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Abstract

The recent Cape Town drought and fear of a severe water crisis between 2015- 2018 was followed by a fast-tracked crisis management response. In line with a wider global trend, the City of Cape Town adopted a technology called ‘reverse osmosis desalination’ into the water supply mix. This ‘water production’ technology is alluring as it promises to be ‘drought- proof’, preserving a constant flow of water in times of increased climatic uncertainty. Yet, the implementation of water technologies in Cape Town continues to be a highly debated topic. Cape Town suffers from a longstanding legacy of uneven racialized infrastructure development practices, resulting in unequal water access and consumption. In this context of unequal water security across social groups and increased climatic vulnerability, it is important to carefully consider the implications of new water technologies if the desired outcome is a more sustainable and equitable water future.

Drawing on urban political ecology, this dissertation explores the process in which the instalment of three temporary desalination plants and planning for permanent desalination in Cape Town emerged. This, in order to carefully consider its consequences for equitable water security. By utilizing secondary official city documents, reports and news articles from several credible news platforms, supported by a number of personally conducted semi-structured interviews and secondary sourced interviews with City employees, this thesis aims to understand how desalination is constituted as a crisis response. This exploration is organized around analyzing the relationships and dynamics between various actors, the events that signified the processual nature of the adoption and the emergent effects for water access across the City.

The findings reveal that the promise that desalination holds as a technical solution to climatic uncertainty undermines the / contradictions that evolve alongside the instalments. While desalination was pushed by the municipality as a drought relief technology for all citizens, the results show that the emergence of this technology came with frictions, as it was contested, ecologically disturbed and critically questioned by multiple actors. As my findings demonstrate, desalination triggers the emergence of exclusive decision-making processes and financial constraints, especially for vulnerable citizens. This thesis thus argues that desalination implies to only secure water for some, while intensifying water insecurity for the already vulnerable. While the City strives towards a “shared water future”, the high focus on extending its water supply to meet growing demands lacks consideration of meeting existing demands, excluding the socio- political processes within current water decision making. This rather reinforces racialized- spatial and distributional inequities across a diverse range of social groups within the City.

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Acronyms

ANC	African National Congress
AWCC	African Water Commons Collective
'City'	City of Cape Town
CoCT	the City of Cape Town
COVID- 19	Corona Virus Disease 2019
DA	Democratic Alliance
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EPWP	Expanded Public Works Programme
FBW	Free Basic Water
KDF	Khayelitsha Development Forum
MLD	Mega/ Million Litres a Day
NEMA	National Environmental Management Act
PE	Political Ecology
TRA	Temporary Relocation Areas
UPE	Urban Political Ecology
WCWSS	Western Cape Water Supply System
WMD	Water Management Device
WRTT	Water Resilience Task Team
WSD	Water and Sanitation Department

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1. Introduction

1.1 Background

Around the world, changing climate patterns, in combination with an ever-growing urban population, social justice trade-offs and environmental needs puts pressure on the limited availability of fresh water supplies (UN- Water, 2020). Water scarcity already affects every continent, and is only expected to be exacerbated over the coming years (WHO, 2019).

In South Africa, the recent drought over the years of 2015- 2018, shocked the Cape metropole with a 30 per cent– 50 per cent below average rainfall, which led to the worst meteorological driven drought since 1904 (Botai et al. 2017; Wolski, 2018). Within this context, Cape Town announced ‘Day Zero’, counting the days till the dam levels would dip down to a little over 10 per cent, and the City would inevitably have to switch supply systems from the dams towards designated communal water points (CoCT, 2020a; Lavanchy et al., 2018). However, this abrupt water insecurity was experienced and coped with differently across the urban landscape (Millington & Scheba, 2021). An overall increased reliance on limited water supplies resulted in growing tensions around unequal allocations of water, which is rooted in uneven, racialised infrastructural development during colonial and apartheid regimes (Rawlins, 2019). In the City of Cape Town, this translates to the reality that while in the year of 2019, an estimated 20 per cent of the population lived in informal settlements, they used only 4 per cent of the total domestic water supply. This is set against 70 per cent of the domestic supply allocated to middle and upper class households (Enqvist & Ziervogel, 2019; Robins, 2019; UN, 2018). Thus, while the climatic significance of the severe drought in Cape Town should not be disregarded, water scarcity was already a reality for many residents even before the water crisis.

To counter contemporary water scarcity issues, governments are moving towards ‘resilient’ water governance practises, implementing new strategies and infrastructural technologies to secure a constant water flow in times of increased climatic uncertainty. One of the technological promises is reverse osmosis desalination. Seawater desalination can be described as an industrial process which uses heat and pressure for the separation of salt from water, suited for human consumption (Darre & Toor, 2018). The production of desalinated water is expected to play a crucial role in narrowing the ‘water supply- demand’ gap (Jones et al., 2018). Advocates of desalination argue that it has some unique features which other water resources lack; namely being rainfall- independent, its uncontested nature and inexhaustible source (Voutchkov et al., 2018). This makes it an appealing solution and best practice for governments and coastal areas as a means to diversify their water supply, thereby becoming more ‘resilient’ to future challenges (CoCT, 2020a; Wong & Brown, 2009).

Opponents are more critical, foremost because desalination is a high- energy consuming technology and is significantly more expensive than any other water sources. In addition, recent analyses draw attention to the tensions that arise regarding its socially induced consequences, such as water access. In Cape Town, three temporary small- scale desalination plants have been adopted during the recent water crisis and there are plans to include permanent large scale desalination into their future water strategy (CoCT, 2020a).

In this dissertation, light is shed on the discursive and material emergence of the infrastructural intervention that is desalination in Cape Town. This is done through the interrogation of three relational layers that define infrastructures, which are the relations, the frictions and the effects. First, this thesis explores the desalination promises and decisions taken by the City, which is followed up by taking a closer look at the contestedness and push backs of both the discursive and material emergence of this 'new water' supply. Through tracing these socio- hydrological phenomena, a careful analysis then unpacks the underlying tensions that trigger the emerging consequences for water access and distribution. The concern to examine socio-ecological crisis, adopted desalination and the implications thereof, is informed by a political ecology orientation, explicitly concerned with understanding the political processes that shape and redefine water security through the access to infrastructure. This critical lens assists to explore how, by who and why desalination emerged as a crisis response and resilience strategy. Exploring the contested space between the expected process towards the delivery of desalination promises, such as greater water security and unrestricted flow, and the situated realities of unequal access and consumption across the urban landscape, assists to tease out the dynamics that determine water security.

1.2 Problem statement

The recent three year drought was countered with an accelerated crisis management response. This dissertation is concerned with the way in which water governance in the City of Cape Town was structured and how it came to be redefined as a response to the crisis. What can be observed is that demand management strategies such as intensive pressure management, raised tariffs and the rollout of Water Management Devices (WMD's) were introduced to limit the wastage of water (CoCT, 2020a; Enqvist & Ziervogel, 2019). Aligned with demand management, augmentation schemes such as waste- water reuse, groundwater access and sea- water desalination plants were quickly introduced to maximise the City's water supply.

A number of scholars have reflected on the implication of the demand management measures outlined above both in terms of a longer term analysis of post-apartheid water management (Angel & Loftus, 2019; Loftus, 2005; Peters & Oldfield, 2005; von Schnitzler,

2016) and in analysing the specific implications of the drought response (Enqvist & Ziervogel, 2019; Millington & Scheba, 2021; Simpson et.al, 2019; Yates & Harris, 2018), yet a thorough analysis on the augmentation scheme, especially desalination technology in Cape Town and its consequences on the access to water, has not been carefully considered to date. This thesis recognises the significance of demand management and associated instruments as central to the crisis response but focuses specifically on desalination as an augmentation measure that was adopted as an immediate crisis response, and with a consideration for future water resilience. It contends that, in a context of growing uncertainty, it is important to examine more carefully future water alternatives that are being presented as the production of 'new water'. In particular, it explores this gap in the growing crisis response literature through undertaking an interrogation of the dynamics that shape the process of emergence and consequences of desalination, within the context of evolving water governance practises in Cape Town. Importantly, it must be recognised that within the context of Cape Town, there is material scarcity and deep inequality. Recognizing the socio-political implications of infrastructure implementations is crucial for water governance practitioners if the desired outcome is a future of sustainable water practises and equitable water access.

1.3 Aim and Objectives

The aim of this dissertation is to trace the emergence of desalination technology as a crisis response and a recognised future water strategy in Cape Town in order to carefully consider its consequences for water access in the City. The following key questions are central for this research:

- Through which relations and framing is desalination constituted as a crisis response by the City of Cape Town?
- What are the key events through which desalination came to be adopted in Cape Town?
- What are the emergent effects of the adoption of desalination with a concern for equitable water access in the City??

2. Theoretical Framework

This study draws on existing literature which explores the conceptual debates that are relevant to the objectives of this research, which are the constitutive relations, contingent events and emergent effects of the adoption of desalination in Cape Town.

The first section discusses the politics of infrastructure and specifically the utility of an 'infrastructural lens' as a way in to exploring urban processes and politics. In this section the infrastructural concepts of temporality and temporal fragility are explored to understand the important role that infrastructural phases of delay, shutdowns and technical disfunction play in infrastructure development. An important point here, is that infrastructural development is not a linear process, but instead is defined by a temporal incompleteness and fragility. This offers an understanding to investigate how and which constitutive events shape infrastructures to move towards their adoption, but with an explicit interest in how this is a non-linear and interrupted process. Identifying contradictions in this process also opens insights into the emergent future effects of infrastructure development. This is followed by a more focused section outlining the relatively new body of work on the political ecology of desalination. This discussion is briefly fore fronted by a presentation of political ecology more broadly, as a scholarly orientation, and understanding of the implications of situated shifting water governance strategies so as to better understand infrastructural relations and their consequences for life worlds. Overall, this body of work is informed both by urban political ecology and an explicit interest in the politics of infrastructure, understood as more than a technical intervention into crisis.

2.1 The politics of infrastructure

Urban infrastructures have long been perceived as technical mediators between the 'natural' and social environment, as it allocates and transforms ecological services to the needs of the urban population through a well- planned network of cables, pipes and concrete (Kaika & Swyngedouw, 2000; Monstadt, 2009). This 'hard' technology is expected to run smoothly, embody an accepted, neutral motive and is presumed to be invisible to its users.

Infrastructures are then commonly framed or understood as de- politicized, technical objects (Anand et al., 2018). This seemingly well- planned network is therefore often referred to by critical scholars as the infrastructural 'Blackbox' (Latour, 1999).

However, in the fields of critical geography, anthropology and complementary fields, a growing body of literature aims to open up this Blackbox by shifting focus away from the technical towards the power relations that are embedded within the material form (for example, Graham, 2009; Wakefield, 2018). This approach, to thinking with and through

infrastructures as a pathway and material object to apprehend urban processes and relations, is termed an 'infrastructural lens', concerned to undertake more careful analysis around access, distribution, and even the ways in which infrastructure both embodies and mediates state-citizen relations (Lemanski, 2020; Tzaninis et al., 2020). The existing literature on the politics of infrastructure is extensive and focuses particularly on various technological mediators such as water meters, pipes and more recently desalination plants (for example Anand, 2017; Coelho, 2006; Ramesh, 2018; Robins, 2019; Rodina et al., 2016; Von Schnitzler, 2016). These studies show that infrastructures do not merely have a technical function, but can serve as a tool of power to separate politics from nature, technical from political and the human from the non- human, with sometimes disastrous segregating consequences (Anand et al., 2018; Barry, 2006; Foucault, 1991; Harris, 2012; Larkin, 2013; Wakefield, 2018).

Thus, this theoretical foundation of the infrastructural lense is a useful consideration in this dissertation, as through this lense the technical solution that is desalination becomes more than a material object. Urban infrastructures are not simply technological materials, but are better understood as material embedded into a web of social relations, political forms, and environmental concerns (Anand et al., 2018; Graham, 2009; Millington 2018; Venkatesan et al., 2018). This is also referred to as 'infrastructural assemblages'. By centring the infrastructural water supply system of Cape Town as an analytical entry-point, the focus shifts from technology as 'thing', towards the processes that constitute and inform the emergence and the 'actual' effects of infrastructural adoption or incompleteness. The next section dives into this matter more specifically, discussing a useful conceptual guide to put the infrastructural lense, and thus, the analysis of the desalination adoption in Cape Town into practise.

2.1.1. Infrastructural temporality and non-linearity

Recent works, such as that of Penny Harvey (Harvey et al., 2017; 2018) point out that technological interventions do not simply follow a straight, predictable pathway . Rather this complicated 'network of things', involving in particular technological promises and contradictions, power dynamics and the distribution of ecosystem services through urban processes, is curvy and non-linear, processual, and shape the future in unpredictable forms. This speaks to Harvey, Jensen and Morita (2017) who observe that the impacts that infrastructures generate not only arise from the planned, engineered activities wherein infrastructure technology emerges, but also through unplanned activities, which can be triggered by either humans or more- than humans. For example, planned engineering activities can be an expected timeline of when and how an infrastructure development would

look like. Putting this in the context of desalination, this would involve tender agreements, site preparations and expected volumes of production. Unplanned, unintended activities are then the interruptions that cause for example delay, disagreements or breakdowns, the activities that were not taken into consideration while planning for a certain infrastructure, but have a significant influence on the infrastructural outcomes. Following, Harvey (2018) proposes an anthropological approach which assists with conceptualising infrastructures as assemblages (meaning a complicated network of things as discussed earlier), through three 'layers'. i) The first is its 'constitutive relations', referring to the relations that signify the discursive and material realisation of infrastructure. It entails the connective capacity of infrastructure. This is explorable by looking at the materials and design, actors and governance tensions, agreements and its (discursive) promises of progress (Harvey, 2018). li) The second feature is its 'contingent events', which entails the unexpected disruptions that reconfigure its 'planned' activities. This can entail either technological breakdowns, human interruptions such as protests or ecological disturbances. lii) Lastly, is the 'emergent effects', which refers to the ways in which these two layers congregate into evolving consequences that shape social worlds and create new environments.

This thesis draws centrally on this conceptualization, as a guide to explore the relational politics and temporality of infrastructure, with a linked concern to consider the emergent effects of infrastructural development (intended and unintended). Exploring desalination through an attentiveness to these three elements, is a valuable support to this study as it unravels and situate the 'planned' ideal of the adoption of infrastructure guided by a process oriented analysis.

In utilising this understanding, the thesis goes further by drawing on allied scholars interested in examining the temporalities, and incompleteness of infrastructural development, speaking to the second and third 'layer' that Harvey conceptualizes, the contingent events and emergent effects Infrastructure projects are generated by promised improvements of social and environmental worlds, are a result of a certain development vision of progress, and strive towards circulation through linearity, linking ideals of growth and integrative cities (Graham & Marvin, 2001; Larkin, 2013; Mitchell, 2002; Ramakrishnan et al., 2020; Von Schnitzler, 2016). However, in paying attention to infrastructural realities especially in Southern cities, scholars have pointed to the collapse of this 'modern infrastructure ideal' (Graham & Marvin, 2001), showing the uncomfortable mismatch between standardized infrastructure solutions and current Southern, heterogenous realities (Carse, 2017; Linton & Budds, 2014; Ramakrishnan et al., 2020). Contrary to the neutral engineering vision of infrastructure as an invisible circulating system, Southern infrastructures often deal with aging pipes and technologies that lead to wastage, energy intensive processes and maintenance difficulties. Anand, Gupta and

Appel (2018) argue that 'technological breakdowns saturate a particular politics of the present' as it shows the fragility between people, things and institutions that aim to govern them. These studies indicate that disruptions rather than a continuous flow are the norm (Anand et al., 2018; Furlong 2014; Graham, 2009; Harvey et al., 2017; Lawhon et al., 2018; Silver, 2015). As this dissertation is a study on desalination infrastructure situated in the South, it is important to take this point of view into account and focus in the analysis on disruptions as a way to unpack the political layers and relationality between people and the environment.

Following, this thesis draws further on critical scholars such as Akhil Gupta (2018) who, similarly to Anand et al (2018), suggest a need to rethink the understanding of infrastructures and their linear trajectories resulting in 'completion', as this lacks an inclusive view that considers the diverse socio- political and environmental disruptive forces that affect its adoption. In these studies, the life span of infrastructure consist out of diverse phases illustrating the multiple temporalities and trajectories wherein infrastructure develops, which include breakdown, delay, decay, maintenance and repair (Anand et al., 2018; Humphrey, 2005; Ramakrishnan et al., 2020; Simone, 2004). Decisions for infrastructural changes for example can accelerate or be slowed down due to shifting public or political will, ecological disturbances or immediate threats. In this light, infrastructures are thus ever- changing, constantly dependent upon and producing diverse socio- ecological relations, political visions and material conditions (Ramakrishnan et al., 2020). Infrastructures are then mediators of time, as it enables certain temporalities to coexist while foreclosing others (Anand et al., 2018; Barak, 2013; Degani, 2013; Hetherington, 2014). This time dimension of infrastructures can assist to understand water insecurity in post- colonial areas, such as Cape Town, as a 'legacy of the past' but at the same time a result of the constant dynamics between hydro- social and technical systems (Savelli et al., 2021). Situating this knowledge into the context of this dissertation, I am concerned with the role that temporalities played during the desalination adoption by critically analysing the diverse phases to unpack the situated socio- political dynamics, decision making processes and forthcoming effects.

Larkin (2013) builds onto this idea of infrastructure temporality, stating that it not only offers us to look at the present, but also see the aspirations of a modern future, illustrating the dreams and hopes of political leaders or society. These future dreams that are attached to 'future- oriented' infrastructures are, just like its trajectory, not linear but often evolve in heterogenous manners, where different positive and negative visions are ever changing. Differently put, temporalities, the continuous unfolding of infrastructure phases over different moments of time, define 'spatial patterns' and 'spatial extensions' of work, living and entertainment and thereby influences socio- political impacts (Anand et al., 2018). The

importance of thinking of infrastructures in terms of temporality is that it shows the changing nature of the relation between ordinary people, state agencies and the environment (Ramakrishnan et al., 2020).

These phases of infrastructure life as non-linear and continuously unfolding, are conceptualized by Ramakrishnan, O'Reilly and Budds (2020) as 'temporal fragility'. This notion supports an examination of urban infrastructures through paying attention to their shifting political imaginaries, the contingent experiences that inform them, and the process of infrastructure assemblage. Thinking through 'temporal fragility' recognizes the constant flux of the infrastructure assemblage, its forms, relations and effects on social worlds. The acknowledgement of temporal fragility becomes for example evident in the much cited work on post- colonial urban infrastructures of Anand (2011; 2017) and von Schnitzler (2013; 2016) who show that the physical characteristics of water infrastructure, such as leaks, pressure, water meters and flow, become political platforms where marginalized citizens constantly negotiate for water access thereby facing uncertain political and material effects. A valuable addition to this, is the exploration of emerging contradictions touching on 'colonial remains' within infrastructure development projects. Just as Savelli et al (2021) briefly touch on the colonial temporalities that define water security through past and current infrastructure developments, Kimari and Ernston (2020) dedicate their paper on the structural causes that leads to past, present and future temporal fragilities of infrastructures. Kimari and Ernston (2020) observe that not only in the 'executive towers' of government but especially in current infrastructure projects there are 'colonial remains' present, stating that; "What we insist on, is the presence of the colonial, its active remains. What infrastructures are imagined and how they are implemented—indeed who gets to define infrastructure and its benefits—continue to emerge from historically colonial and racialized processes" (Kimari & Ernston., 2020, p.30). These studies are part of a larger body of literature that illustrate the ever contested space of access to safe water within post- colonial contexts (Anand, 2017; Bakker, 2007; Fragkou, 2018; Kooy & Bakker, 2008; Meehan 2014; Robin & Broton, 2020; von Schnitzler, 2016). For the purpose of this dissertation, the awareness of 'colonial remains' can assist to bring in a deepened understanding of the temporal legacy of oppression and violence related to infrastructure development in a post- colonial context like Cape Town.

As this section has shown, literature on infrastructural temporality and incompleteness, challenges notions of the modern infrastructure ideal. It does so by zooming into the fragilities of infrastructural development, bringing into view the underlying processes. This is especially significant in Southern urban contexts where deep inequalities, spatial differentiated citizens and alternative modes of supply are a reality. This shows that, while often thought of otherwise, the development of Southern infrastructures is a dynamic process

where multiple phases such as decay, maintenance and delay are constantly shifting relations which consequently leads to the emergence of unexpected effects. In addition, colonial remains contribute to the temporal fragility of Southern infrastructures. This is important in informing current and future governance strategies regarding water security efforts and the realities of socio- spatial distribution. Connecting this to this dissertation, the data analysis will be structured following the infrastructural conceptualisation by Harvey (2018) which consists out of the three layers which are the constitutive relations, contingent events and emergent effects as discussed above, with consideration of the phases of infrastructural fragility caused by structural and alternative forces. In this way, the political aspects of desalination become clearer, which helps to unpack the emergent effects with concern for equitable water security. The following section will continue to deepen an understanding of infrastructures but situate this theoretical matter into the work of political ecologists on water and urban water governance. As will be more clear, the following section mostly overlaps with the previous section on critical water infrastructures literature, and is mostly a complementary and sometimes overlapping stream as to contextualise the above discussion into the case of the drought management strategy of Cape Town.

2.2 Politics of Water

Thus far, infrastructures have been discussed in relation to their capacity to either connect or disconnect social, political, economic and environmental worlds through mediating technologies. In addition, unpacking of disruptive phases and contestation assists to look behind the engineering and political promises. This section connects this understanding of infrastructures to a specific focus on urban water governance and associated infrastructural interventions, namely desalination. In locating this discussion, I am broadly influenced by the work of urban political ecologists who have contributed a great deal of analysis to examining the politics and actor relations shaping water provisioning and access in cities. Presenting a brief sketching of this work assists to understand the way in which water is influenced by urban water governance practices, I then proceed to discuss urban water governance, with a focus on South Africa, more carefully. This will help to understand which approach is taken to unpack the drought strategies of the City, including the adoption of desalination technology. I then move on to a presentation of the emerging insights from the relatively new scholarship on the 'political ecology of desalination' to gain a deeper understanding of which ways this specific infrastructure technology affects life worlds.

2.2.1 Urban Political Ecology

Urban Political Ecology (UPE) is a theoretical stream aiming to understand the power relations and discourses that are underlying unequal access to urban space, resources and infrastructure (Perreault et al., 2015). This makes Urban Political Ecology a useful lens to interrogate the process of water provisioning and desalination adoption and the consequences for equitable water access in Cape Town.

The essence of Urban Political Ecology is to shed light on the political within environmental governance practices. It suggests that normalised assumptions about existing power imbalances within societies but also between humans and more- than humans are the source of degradation and a deepening of inequalities (Lawhon, 2014). To allow a transition to a more just and sustainable world, UPE invites a re- framing of short- sighted, technocratic 'truths' and imagined, quick 'fixes' to environmental threats into a holistic understanding which will lead to more structural, long- term solutions (Leff, 2015).

One of the significant contributions of UPE is its work on the political visions and engineering solutions to water related concerns. It has offered a great deal of insights into the temporal dimensions and spatial distribution of water insecurity and the emerging effects of reactive water governance practices. One of the defining UPE works on water and infrastructures is that of Boelens, Hoogesteger, Swyngedouw, Vos and Wester (2016) who understand 'water' and 'society' as an interrelated network, instead of two separate worlds. In their article 'Hydrosocial territories', the 'hydro- social networks' are understood as a dynamic process that is shaped around water and its usage, directed via infrastructure and other more- than human entities. It involves actors, strategies, agendas and consequences, (re) defining the boundaries of a certain space, also referred to as 'hydrosocial territories'. Thus, their article shows that water can act as a relational entity that connects different scales of society, from households, to communities to national. It also shows an understanding of water and technology as ecologies with emergent consequences for the way society is organised, both spatially and socially. Because of the variety of actors and scales, hydrosocial territories are then constantly shaped by the divergent interests and emerging frictions through 'hydro- social networks' (Bridge & Perreault, 2009). This corresponds to the theoretical foundation discussed above on the politics of infrastructure, yet adds a more specific dimension on the shaping of water through actors in different scales and boundaries of spaces which impacts life worlds. In a sentence, the concept of hydrosocial territories embody "the political nature of the mechanisms of water access and distribution that are built into hydro- territorial planning, the relations that shape rights and rules regarding water decision making, and the discourses that underpin water policies and hydrosocial territorial reform"(Boelens et al.,

p.10). Water governance strategies are then often a result of the (re)production of dominant imaginaries and knowledge through hydrosocial networks, changing the flow of water. Integrating this knowledge into this dissertation, the importance of all actors involved into the shaping of the drought management strategy, the discourses, imaginaries of desalination and decision making processes should be highlighted in order to understand the way desalination generate emerging (unintended) impacts. These analytical dimensions of water governance are put in the analysis of the 'constitutive relations'. Multiple scholars have engaged with the ways these imaginations of certain prioritised strategies lead to the empowerment of some actor groups, while others are left disempowered. Yet, as these scales of relations are deeply intertwined, contestation is inherent to this process, challenging dominant water politics to claim and negotiate for more just water governance practices (Anand, 2017; Duarte-Abadía & Boelens, 2016; Hoogesteger et al., 2016; Loftus, 2012; Truelove, 2011, 2016; Wilson et al., 2019).

Savelli, Rusca, Cloke and Baldassarre (2021) utilises this insight by questioning the neutral socio-hydraulic understanding of and response to the recent drought in Cape Town. While socio- hydrology offers insights in the relational understanding of water flows through society, it fails to acknowledge the political processes and context specifics that re-shape the imagined outcomes of either environmental threats or water governance strategies. Therefore, Savelli et al (2021) point out that, by acknowledging inequalities and related dynamics of social power within water governance planning, these mechanisms can assist to deepen an understanding of "... what water is secured and what human- water interactions and dynamics will be sustained over time" (Savelli et al., p.1). Savelli et al (2021) concludes that using a UPE approach within water governance identifies how and where water is used by different actors rather than assuming that this will be the same for the whole of society. Moreover, studies on water through an urban political ecology lens focus on the why, by who, how and for who water governance practices are emerging, interrogating the different actors and processes of negotiations and contestation that influence human- water relations.

These discussed examples of Boelens et al (2016) and Savelli et al (2021) are examples of recent contributions to the shifting UPE approach itself. UPE has come under critique from scholars suggesting that the approach tends to universalise debates, contributing to a reproduction of Eurocentric and colonial knowledge within political ecology research (Lawhon et al., 2014; Zimmer, 2010). This has led to the emergence of a more 'situated' UPE, where more attention is given to race, gender, location and everyday practices through which sense-making and theory emerges from local rather than the global (Lawhon et al., 2014; Loftus, 2019; Truelove, 2011). In other words, attention is given towards a more

anthropological, decolonial understanding of the urban. Situated UPE has led to a call for a shift away from the deeply rooted Marxist understanding of the Urban as 'metabolic circulation', which has a tendency to universalise diverse political, material, social, economic and environmental settings. Instead, more attention is given to the everyday practices, shifting focus from the critiquing of the capitalist system, zooming into the everyday dynamics on the ground that trigger either positive or negative impacts for the most vulnerable (Lawhon, 2014). This thesis is influenced by a commitment to a more situated analysis, concerned to trace hydrosocial relations as they unfold in a specific context and shifting water governance strategies so as to better understand infrastructural relations and their consequences for life worlds.

2.2.2 Urban Water governance While the previous section outlines the importance to situate this thesis in the specific context of Cape Town's infrastructural relations and thereby point out the need to focus on local dynamics, the following section highlights similarities across the globe related to urban water governance challenges and emerging tensions triggered by governance interventions. This thesis will make use of both situated and birds eye perspectives to gain a comprehensive understanding of the emerging effects of desalination adoption.

Worldwide, the challenges related to providing urban services such as water and sanitation, are met by a combination of an ever- growing population and increasing climate change variability, which is framed to pose emerging risks for the provision of resources and infrastructure networks (Simpson et al., 2019). This is especially a critical challenge for Southern Africa, where processes of urbanization and climate change are expected to happen faster than other places (Enqvist & Ziervogel, 2019; Grasham et al., 2019; Nagendra et al., 2018). To prepare the future for this new uncertainty, governance approaches increasingly shift towards investments in climate 'resilience', opening up new possibilities for private and public/ private interventions (Coaffee & Wood 2006; ; Luker & Harris 2019; Simpson et al., 2019; Sharifi & Yamagata 2016; Trabacchi & Mazza, 2015). Resilience is often considered as the capacity of systems to withstand, cope, or adapt to risks and shocks within an unchanging variability, while remaining to maintaining key functions or structures (Folke, 2016). Yet, within water governance the resilience discourse is shifting, as it moves away from this conventional 'stationary' approach towards the understanding of hydro- social systems as non- linear and unpredictable which asks for more integrative solutions (Rodina, 2019).

Critical engagements with contemporary (resilience) water governance practices have been strongly advanced by urban political ecologists, who have argued for a political understanding of water systems as a 'hydrosocial cycle' as opposed to hydrological cycle.

These scholars, have been interested in two emerging core tensions: The provision of a stable water supply and the involvement of market logics (Bakker, 2010; Bakker, 2014; Yates & Harris, 2018), and the increasing reliance on technocratic solutions in times of increased climatic uncertainty (e.g., Dunn et al., 2016; Hoffmann, 2017; Milly et al., 2008). The work of political ecologist Karen Bakker (2014) has been particularly instrumental here, as it details and conceptualizes the increased involvement of market mechanisms and capital into existing water governance structures, referred to as 'market environmentalism' (Bakker, 2014). Similarly, in outlining this interest in enrolling water into market relations, Yates and Harris (2018) understand this as "the processes of advocating and implementing policies that emphasize economic markets and related strategies such as privatization, commodification, commercialization, marketization and the re- scaling of governance" (Yates & Harris, 2018, p.3). Importantly, these various principles can occur in many forms, singular or hybrid, balancing risks and benefits. Both Bakker (2014) and Yates and Harris (2018) argue that these neoliberal methods are pursued with the belief that it is most effective and efficient for water provision. It is assumed that the state has failed to provide reliable resource management and thus private actors should jump in and assist, striving for economic growth and environmental resilience (Bakker, 2010). This will ultimately trickle down to affordable rates for all customers, including those who struggle to pay for water.

Yet, this focus on water provision contrasts the human right to water's emphasis on access. Therefore, privatization or commercialization practices to manage resources, such as water, has become an uttermost debated matter among governance practitioners (Bakker, 2013). In many cases, this move towards privatization failed to meet the imagined outcomes (Ahlers, 2010; Anand et al., 2017; Bakker, 2010). Critics of privatization schemes highlight the danger of market externalities, arguing that the inclusion of private entities will have negative consequences on social and environmental life worlds. One of the characteristics of market environmentalism, which starkly contrasts the public sector, is pricing mechanisms such as full-cost recovery, as the prior objective of private actors is to stay financial sustainable, which translates into profit made of its users. This shift from public, to private-public, commercial or private management of environmental resources, consequently changes the 'hydro- social contract' between users and the providers, where access to water is decided upon the customers' ability to pay rather than by the entitlement of citizens (Bakker, 2014; Smith, 2004). Consequently, with neoliberalist ideals injected into natural resource governance, efficiency is prioritized over equity considerations. Thus, market environmentalism changes the valuation of both water and its users, which could lead to critical shifts in the way that access to and the allocation of water is organized across (urban) landscapes.

Situating water governance in Cape Town, South Africa

Cape Town, South Africa presents a unique illustration of water governance challenges as it draws attention to the emerging uncertain dynamics within Southern cities. This study draws on previous analyses of water governance and access in Cape Town, South Africa (Angel & Loftus, 2019; Bakker, 2014; Dugard, 2015; Enqvist & Ziervogel, 2019; Rodina, 2019; Scheba & Millington, 2018; Simpson et al., 2019; Yates & Harris, 2018). The following paragraphs will contribute to the understanding of the historical and current developments of the water system of Cape Town, which are (re)shaped by socio- hydraulic processes that segregates, discriminates and intensifies differentiated levels of water insecurity across the urban landscape (Dugard, 2016; Enqvist & Ziervogel, 2019; Savelli et al., 2021).

During colonial and apartheid regimes, large infrastructural investments were strategically aimed to benefit and provide a continuous flow of water to the specific residential areas of the generally white affluent households, while the outskirts of the City with mostly black residents were left with poor access, only leaving these areas with shared standpipes and yard taps (von Schnitzler, 2016). After Apartheid, the new Constitution prioritised specific goals redressing past injustices, aiming for a more equitable distribution of public services and the engagement of marginalized communities (Beck et al., 2016; Yates & Harris, 2018). The Constitution is binded to two international agreements; To ensure the Social economic rights for all South Africans and to offer equitable access to water for all (ICE-SCR, 1966; UNDHR, 1948 in Dugard, 2016). 'Access' refers here to both physical as economic access. It should be equitable at all times, even in times of scarcity (SAHRC, 2010 in Dugard, 2016). Specific to water, the national Water Act (1998) entitled municipalities as water service authorities, which comes with the responsibilities of ensuring "...efficient, affordable, economical and sustainable access to water services" (Dugard et al., 2017, p. 235). This is when the Free Basic Water policy was introduced which subsidises the first 6kl of water per household per month. Although this seems progressive, concerns on the qualitative aspects of water services are increasing.

With the decentralization of political power from national government to municipalities, Bakker (2014) observes that post- apartheid water governance is marked by the increase of market environmentalist tactics. As municipalities became financially self- sufficient, being cut off national funding, the challenge now was to stabilize the revenues in a situated context where a significant portion of residents rely on subsidized water (Dugard et al., 2017; Enqvist & Ziervogel, 2019). This dual commitment resulted in a shortfall of budgets. To stabilize the cost- recovery scheme, municipalities, including the City of Cape Town, initiated practices of water 'commercialisation' through specific technologies and strategies. An example is the

block tariff billing system, where the first litres of basic water are relatively low in cost, for 'indigent' households for free, while the more water is used, the sharper the increase of costs are. This framework makes sure that the revenue from high usage households subsidises water for low usage households. For the City this means that, the higher the sales the better it can serve water delivery to all of Cape Town (Joubert & Ziervogel, 2019) These commercialization practices turned water into a public good, while at the same time embracing the idea of water as an economic good, fostering policies that encouraged efficiency and growth (McDonald, 2012; RSA, 1998). It has showed that these dual objectives of equity and efficiency has resulted in evolving contested spaces of water supply and access, often indirectly burdening disadvantaged communities (Enqvist & Ziervogel, 2019; Hellberg, 2014; Scheba & Millington, 2018; Simpson et al., 2019; Yates & Harris, 2018). For example, Loftus (2015) shows that the cost- recovery system in Durban, South Africa, deepened race and class inequalities as water meters were installed in households where they were dependent on FBW. While access was limited for these households, the revenue balance of the municipality became more stable, as water consumption was now efficiently controlled. While the Constitutional promise seems advanced, this hybrid responsibility of municipalities translated into a water supply system that has immensely expanded through government investments in large- scale infrastructure, yet this supply has been unable to improve qualitative water access nor consumption for low- income households (Savelli et al., 2021; Smith, 2004). While providing excellent services to meet the needs of unsustainable lifestyles in the wealthy areas, the townships and informal settlements are left with minimal standards to meet the basic right to water access (McDonald, 2012). The City acknowledges the inequitable distribution of financial and physical access to water (CoCT, 2020a), but the continuing introduction of commercialised practises within water governance - such as the instalment of water meter devices, rigid demand management strategies and changes in the financial scheme - only seem to burden the most vulnerable and deepen inequalities rather than achieving distributive equity (Bond, 2000; Dugard et al., 2017). Hence, despite progressive law, systemic issues remain in the qualitative aspects of the access to water. The following section will focus on the shifting of water governance strategies as a response to the recent drought and their emerging effects with concerns to equity.

Drought response Cape Town

During the drought, the City was stopped at a crossroad. Besides the fear of a severe water crisis, the cost recovery structure of the municipality experienced constrains of its design. If the City would encourage water savings, this would mean that there would be loss of income, leading to a tighter budget for marginalized households. This tension that emerged as a

consequence of the drought has been discussed in multiple papers in recent years, exploring the 'lessons learned' for water governance practitioners (Ziervogel, 2019), the emerging differentiating effects of the imposed drought response strategies tool (such as Millington & Scheba, 2021; Robins, 2019; Simpson et al., 2019), investigating specifically the consequences of demand management strategies such as the intensive rollout of Water Management Devices as a conservation and debt management and the effects of increased tariffs, and carefully considering the emerging effects of the imagined resilience trajectory imposed by the City as a way forward (Rodina, 2019; Simpson et al., 2019).

Overall, although the water crisis in Cape Town has been promoted by popular media as an event which sparked 'community spirit', critics argue that the Cape Town water crisis response rather reproduced and intensified existing, uneven power structures and inequities through processes of commercialization (Millington & Scheba, 2021; Robins, 2019). Placing this knowledge into the context of this dissertation, I am concerned with the role that technocratic and market driven narrative and practices played leading up to the realisation of desalination in Cape Town, to understand the ways in which these were prioritised and informed the emergence of desalination as a Crisis response and resilience solution, with concern for equity considerations.

2.2.3 The political ecology of desalination

2.2.3.1. *The promise of desalination*

Following is a brief overview of the relatively new field on the political ecology of desalination which assists this dissertation in a deepening of understanding of the role that engineering discourses play in the actualisation and emergent (in)direct impacts of the desalination adoption. In addition it sketches some possible emergent effects which have been identified across different contexts. Case studies on desalination infrastructure repeatedly highlight the difficulties of disciplining water for profit due to the constraining material characteristics of water as a flow resource (Bakker, 2003; Castro, 2013; Loftus, 2009). Yet, in the context of global water crises, the increasing interest in seawater desalination plants creates a new commercial market. Through the materialities of this technology, water can now be perfectly customized along the lines of production, regulation and commodification through a market-mechanism (Loftus & March, 2016; Williams, 2018). Thus, desalination technology offers an innovative way to commodify ecosystem services, resulting in a product with surplus value. As the climate change projections are looking urgent, the desalination industry is rocketing towards an estimated value of \$20 billion in 2020 (O'Neill, 2020; Swyngedouw, 2013). Therefore, it is stated that desalination is becoming an essential technology in the political

and ideological transition towards a deeper commodification of municipal water supply (Williams, 2018).

Within critical literature, the promotion of the desalination 'fix' is identified through several engineering promises. For one, seawater desalination is presented as an 'unconventional' water infrastructure technology, promising to be able to extend fresh water supplies beyond what is available from the hydrological cycle, providing an infinite, rainfall independent, reliable flow of fresh water (Bernabé-Crespo et al., 2019; Speckhahn & Isgren, 2019; Swyngedouw & Williams, 2016; Williams, 2018). Advocates of desalination argue that contrary to conventional fresh water sources, the salty waters of the ocean offer free, uncontested ecosystem services, with no competing socio-ecological value regimes attached to it (March et al., 2008). Besides, desalination is often viewed as a 'green' technology as it relieves traditional water resources so that there is more water to share with the ecological environment (McEvoy & Wilder, 2012). This is for example the case in Spain, where desalination was promoted as a local, democratic, market efficient and ecologically sustainable solution (March et al., 2014). Desalination also holds the promise to overcome water pollution, as it offers 'produced' water with controlled standards (Fragkou, 2018; Swyngedouw, 2013). Hence, in times of water scarcity and climate change, population growth and urbanization, desalination seems like an appealing engineering solution which serves both as a climate change adaptation strategy and economic growth (Swyngedouw & Williams, 2016; Tubi & Williams, 2020).

2.2.3.1. The emergent effects of desalination

Drought and climatic uncertainty frequently plays a key role in the discursive justification and construction for the adoption of desalination. This is for example the case in Australia where desalination was introduced as an emergency response (Heberger, 2012), in Southern California (Williams, 2018) and in Israel (Marin et al., 2017). As desalination is gaining momentum, critical scholars in the field of political ecology and related disciplines have recently developed a growing interest for desalination and its political agenda. These analyses draw attention to the underlying temporal tensions and emergent effects (Campero & Harris, 2019; Feitelson, 2018; Loftus & March, 2018; March, 2015; Scheba & Scheba, 2018; Swyngedouw & March, 2016; Williams & Swyngedouw, 2018). They reveal that desalination has immediate implications due to the technology's uses but also indirect impacts, which emerges from the way that society and the environment makes use of the technology and its water (Campero & Harris, 2019; McEvoy & Wilder, 2012). The direct environmental impacts of desalination technology are well- documented, such as potential marine degradation due to brine release, the intake systems of water sucking in small marine

life and the significant amount of energy (and thus greenhouse emissions) necessary for the desalting process (Darre & Toor, 2018; Schiffler, 2004). Others have sought to focus more on the economic impediments, such as the energy costs and extraordinary capital costs (Amy et al., 2017; Loftus et al., 2019; Mezher et al., 2011; Williams, 2018). In Australia for example, four out of the six large scale desalination plants which were built as an emergency response have been paused or operating at limited capacity. This is because it has been more cost effective to keep them as an 'insurance policy' to future droughts, then to actively operate them as part of the current water supply. The presentation of desalination as a long-term drought strategy can thus be questioned, as the emergent effects are fluctuating between maladaptive and adaptive qualities (Tubi & Williams, 2020). Besides these technical drawbacks, critical scholars are increasingly engaging with the politics of desalination and its consequences concerning equity. For one, a small body of work points out the potential of desalination as a 'fix' to solve spatial (terrestrial and marine), environmental or social contestations that are disrupting water governance (Fragkou & McEvoy, 2016; March et al., 2014; McEvoy, 2014; Usher, 2018; Swyngedouw & Williams, 2016; Williams, 2018). The noteworthy work of Swyngedouw and Williams (2016) re-politicise the Spanish water governance by outlining six emerging contradictions that appeared as a consequence of the adoption of desalination in Spain. As they observe, the techno-managerial, growth-oriented vision of desalination as a 'fix' for water scarcity was pushed by a consensus of powerful actors. Yet, the identified contradictions refute this, and these concerns seem to be applicable and consistent over various geographies. These include i) a concern over democratic water governance, as public funds are used to serve private interests; ii) a growth-at-all-costs mentality which surpasses the strive for a just society; iii) an emerging demand contradiction, which explores the contradiction of offering increased supply to serve the growing water demands, yet due to the rising costs of water, users have reduced their water demand. This results in desalination plants having to produce consistently below its capacity; v) The ownership contradiction which speaks to the question of who has the legal right to the sea waters and what are its costs? This fits into the broader debate of the commodification of water and the 'accumulation by dispossession' on the ground, exploring the ways in which either capital or service delivery accumulation instigates dispossession of the most vulnerable (Ahlers, 2010; Bakker, 2007; Harvey, 2006; Levenson, 2018; Swyngedouw, 2005).

So far, studies on the socially induced impacts of desalination on the 'host communities' seems limited, and the few that have paid attention to this are primarily analysed through theoretical methods, without any concrete evidence (Fragkou, 2018; Ibrahim et al., 2021). In a study of Jamie McEvoy (2014), the adoption of desalination in Mexico might 'fix' the

scarcity in water volume, yet does not 'fix' perceived water scarcity for its users, as a sense of distrust towards the water quality or water supply network make users continue to refuse tap water. This is echoed in the ethnographic work of Maria Christina Fragkou (2016; 2018) where Chilean residents express their maintained distrust due to historical tensions. As the body of empirical studies on the understanding of the socio- political emergent effects of desalination on the situated context is still small, there is significant space for in- depth studies.

Desalination is at the intersection of shifting governance approaches due to the increasing uncertainty of climate change, concerns over inequality and imaginations of the future, making it an interesting and important topic for further interrogation for this dissertation. The literature has shown that desalination is a suitable example of an emerging infrastructure solution shaped by neutral promises and political visions in the context of increasing uncertainty due to climate change. It provides the framework in which this dissertation is grounded, investigating conceptual debates and tools to unravel the complex processes at play in the context of the emergence of desalination in Cape Town. This study evokes the politics of infrastructure lens in its interrogation of the shifting constitutive relations along the diverse phases of the desalination emergence, thereby focussing especially on the planned and unplanned engineering activities (Harvey et al., 2017; Harvey, 2018). This will gain insights into the course the City is taking in concern of equitable water governance in times of climatic changes.

3. Methodology

3.1 Case Study presentation

This study will focus on a case study of the emergence of desalination in Cape Town as a Crisis response and recognized future water strategy in the context of the recent water Crisis. Presenting the case thus involves both a general understanding of the hydraulic emergence of the drought as well as the specifics of the desalination plants. Below I present a brief sketch of the drought details, followed by the spatial- technical details of the three temporary plants.

From a meteorological perspective, data suggests that the period of 2015- 2018 were the driest years since last century (Wolski, 2018). For three consecutive years, the Western Cape province received less precipitation than needed. Eventually, this meteorological drought triggered a severe hydrological drought. Koopman and de Buys (2017) argue that the situation was especially dire due to the continuous high water demand in some areas of

the City. Climate scientists from the University of Cape Town have determined that climate change tripled the probability of the recent drought (Otto et al., 2018; Wolski, 2018). Climate change introduces high levels of variability and unpredictability, which brings a wide array of uncertainty around rainfall estimates into future planning (Wolski, 2018). While multiple factors determined the extreme circumstances of the recent drought, the City seems to be mostly concerned with the climatic factor (Millington & Scheba, 2021; Savelli et al., 2021; Simpson et al., 2019). In this light, desalination as a rainfall independent water resource is framed by the City as a solution which will bring water security. As part of the City's (climatic) resilience strategy, the City sited three temporary reverse- osmosis sea-water desalination plants in Monwabisi, Strandfontein and at the V&A Waterfront. The sites of the three plants are situated along the segregated lines of a 'white', 'black' and 'coloured' community. In December 2017 the City of Cape Town contracted Water Solutions Proxa JV to build both the Monwabisi with a tendered value of around R260 million as well as the Strandfontein desalination plant worth approximately R240- 250 million (CoCT, 2018a; Evans, 2018). These were expected to produce each 7ML of water a day for 24 months (Greencape, 2018). The Strandfontein came online in June 2018 and produced a total of 3.8 billion litres over a period of 2 years. The site is close to Mitchells plain, where 90.8 per cent of the population is coloured. Right beside the plant, there is a sensitive dune area. This plant was decommissioned on the 17th of June 2020, a month prior to the end of the contract at the contractor's request (CoCT,2020d). The Monwabisi plant came online in September 2018 and produced a total of 4,3 billion litres of water over a period of 2 years. The plant was decommissioned in September 2020 (CoCT, 2020e). This site is situated along the coastline of Khayelitsha, the biggest township of Cape Town, where at least 98.6 per cent of the population is black (DSSA, 2020). Khayelitsha is one of the areas in Cape Town with a significant lower average income per family, which is R20.000 a year compared to the average of a Capetonian family income of R40.000 a year. Also, the unemployment rate is significantly higher than the average of the country, which is at 70 per cent (KDF, 2020). The plant at the V&A Waterfront was contracted by Quality Filtration Systems, and expected to produce 2ML a day for a period of 24 months. The plant started its full production since September 2018, yet halted the production on the 7th of May 2019, when the owner of the plant at the V&A Waterfront, Quality Filtration Systems, ended its contract with the CoCT (Liao, 2019). The V&A Waterfront is an economic hub near the city centre, mostly visited by wealthy tourists and foremost inhabited by white residents. While the temporary plants are decommissioned, there has been an expressed commitment to permanent large- scale desalination as a significant contributor to the future of water in Cape Town. As expressed in the 'new water strategy'; 'the siting, feasibility and water quality investigations are under way

for a desalination plant with a capacity of between 50 and 150 million litres per day' (2020a, p.37).

According to Alan Bryman (2012) a case study is not so much about the case itself. Rather, the emphasis is on the unpacking of the multitude of layers of the setting. Therefore, the case of the instalment of sea- water desalination infrastructure in Cape Town offers a lens which can be used as a unit of analysis. The assumption is that the emergence of desalination did not follow a linear pathway but was rather produced through both planned and unplanned activities. This dissertation traces the material and discursive emergence of desalination technology in Cape Town through the three 'layers', which are the constitutive relations, contingent events and emergent effects (Harvey, 2018). By doing so, this dissertation then allows to investigate matters of environmental and social justice within past, current and future water governance practises in Cape Town. Shedding light on the relational elements between actors that constitute political framings and material designs of desalination, the following unplanned events that trigger tensions then serve as an important guide to explore the potential of direct and indirect consequences for water access. These raise important questions for future research, especially when permanent big- scale desalination plants will be a reality in Cape Town.

3.2 Data Collection

The following sections will outline the rationale behind the aspects of the research methods used. It justifies what data collection approaches were used and why, which and why particular actors were interviewed and how the overall process of collecting and analysing data developed. Lastly, this section concludes with the limitations to this research as well as suggestions for further exploration, and considers ethical questions of this process.

3.2.1 Document Review

The key source of data collection to trace the emergence of desalination in Cape Town is an extensive document analysis of both public documents by the City of Cape Town as well as news articles from various credible news platforms, such as Groundup, IOL and Cape Times. The public documents that are used for this research include Water Outlook reports, online City of Cape Town press releases and water management strategies. These document resources respond to the three main objectives, as it allowed to inform the research with a detailed timeline of the evolving water crisis response, the emergence of desalination as a discursive and material construct and assisted with the identifying of related conflicting rationales that led to tensions. In addition, it offered transcripts of second- hand semi-structured interviews which were shared with me and were used as a supplementary source

of data to gain a deeper understanding of the identified specifics of the processual nature of the adoption of desalination in Cape Town.

As Tim May (2001, p. 183) mentions “documents then may be interesting for what they leave out, as well as what they contain. They do not simply reflect, but also construct social reality and versions of events.” This very much reflects to the context of this study, where document analysis was largely pursued to engage with embedded meanings in the documents themselves, to gain a clear understanding of the water management assumptions relating to desalination and the shifts of framing of desalination over time.

3.2.2 Semi- Structured interviews

The advantage of semi- structured interviews as opposed to structured interviews is that the process is flexible while the more specific issues are addressed. While there is an interview guide with fixed questions, the interviewee holds a flexibility to adapt to the responses of the participant, therefore asking questions which might not be included in the guide or by changing the pattern of questions (Bryman, 2012). During the conversations with respondents, the interview guide was there to explore subjective viewpoints and provide a focus to ensure a certain consistency along the process of data collection. Instead of asking specific interview questions from the interview guide, I asked the interviewee to tell their story of their experiences, based on the topics that were covered in the guide and thus relevant to my research (See appendix 8.2). This allowed for a natural flow of the conversation. I could then ask for further explanation regarding the information they shared. If a certain topic was not covered in the narrative of the interviewee, I used the open- ended interview questions to fill this gap.

The semi- structured interviews and site visit to the Strandfontein plant were a complementary source of data collection for this study, as it allowed to explore certain aspects in more depth. More specifically, while the document analysis offers a great deal of information, particular attitudes and experiences towards shifts within water governance practices regarding to desalination are harder to grasp only through documents, especially those of City officials. In practice, the benefits of using this combination of methods seemed the more fruitful when putting it in practice as the document analysis showed to be mostly consisting out of engineering promises and a dominant political discourse on the process. Only through interviews did I gain more information from City officials on the realities and experiences of the desalination adoption. Without this information, the documents would have given me a very one-sided story of the processual nature of adoption.

The interviews were selected on the grounds of purposive and opportunistic sampling. Purposive sampling was the main sampling method used, as the selected respondents had specific characteristics that would be a relevant addition to the objectives and themes of this research, adding a deepened understanding of the document review (Bryman, 2012). Importantly, as this research focusses on the overall processual nature of the desalination plants, it was important to speak to different actors of City employees across its branches, to gain a broad sense of the experiences from different points of view. In addition, this was combined with convenience sampling, as some of the interviewees could be accessed easily because of my supervisor's network.

In total, I interviewed four mid- and high ranking employees from various sub sectors within the City of Cape Town, including the Engineering and Asset branch, the Bulk Water branch and an official at a relevant sub council in Khayelitsha. Also, I attended a site visit at the Strandfontein desalination plant. In addition, interviews were conducted as part of a larger project. Even though I wasn't present in all of the interviews, those interviews were shared with me. The interviews which I could not attend were conducted with officials at the Demand management and strategy branch, the financial and commercial branch and an additional interview at the Bulk water branch. In addition, notes were shared with me from a roundtable conversation of the African Water Commons Collective, which is a community-based, grassroots organization committed to communicating water-related issues throughout lower-income communities in Cape Town.

The interviews with these various representatives within the City's Water and Sanitation Department (WSD) as well as with the official at one of the sub councils in Khayelitsha, are an important addition to this research as they carry valuable, detailed knowledge on the overall adoption process as well as the several attitudes and contestation that arose within the City and between the City and other actors regarding desalination. Moreover, the sample of a diversity of City officials give this research insights into a detailed perspective, from a multitude of positions, of the experiences with desalination as a 'new' infrastructure. Importantly is the roundtable conversation with the AWCC, which gives a small, but not less relevant, insight into the attitudes that were arising from 'below' towards the overall drought response of the City.

Ultimately, this research engages with transcripts of 7 interviewees, 1 document with notes from the site visit and 1 document with notes from a roundtable conversation (see table 1 and 2). Hereof, four interviews were self- conducted over a time frame of roughly two months. The starting point of sampling interviewees was at the Belville Water and Sanitation Head Office. From there, the respondents sometimes offered to share their contacts that might be relevant to this research, such as the sub council official. Other shared contacts

such as the contractors of the plants and a ward councillor who were unfortunately unavailable due to the busy period and limited time.

Table 1. Number and branches of personally conducted interviews.

SUB CATEGORY	INTERVIEW CODE	DATE	NO. INTERVIEWED
Bulk Water	1 BW	21 November 2019	1
Engineering and Asset	2 ENG	12 December 2019	2
Sub council	3 SUB	22 January 2020	1
Strandfontein site visit	Site visit	13 September 2019	1

Table 2. Number and branches of secondary borrowed interviews

SUB CATEGORY	INTERVIEW CODE	DATE	NO. INTERVIEWED	INTERVIEWER
Bulk Water	4 BW	29 July 2019	1	Koehler, M., Scheba, S. and Kuranananthan, M.
Finance and Commercial	5 FIN	25 September 2019	1	Koehler, M.
Demand Management & Strategy	6 DM	19 August 2019	1	Marie Koehler, M. and Scheba, S.
AWCC	AWCC	18 July 2019	1	Scheba, S.

All the interviews were held in the offices of the interviewees. The interviews with the City of Cape Town officials were all conducted at the Water and Sanitation Department in Belville. Two of the interviews were held with multiple respondents. One of them was an interview conducted with a sub council official, who was accompanied by an Engineer and Asset representative at his office in Khayelitsha. The interview with the two representatives of the Engineer and Asset branch was a combined interview because of their limited availability. The length of the interviews varied from one to two hours. The interview often started with an introduction of myself and my research and a verbal explanation of the consent form. All the interviewees gave verbal and written consent to record the interview, which helped me to fully engage and listen to the interviewee (see appendix 8.3). It was aimed to transcribe the interviews within one week, as the conversation would still be fresh in my mind. After

transcribing, the recording of the interview was erased and a copy of the text was sent to the interviewee for transparency.

3.3 Data Analysis

This research analysed the collected data through a thematic analysis. The method which shapes this work is the foundation of a theoretical framework through a Political Ecology lens. As Political Ecology is part of critical social theory, this orientation aligns with the aim of this research to focus on politics and thereby question conventional governance approaches, in order to gain a deeper understanding of the effects on socio- natural life worlds.

The interview guide used in this research is structured along the thematic 'layers' of Penny Harvey (2018), which are the constitutive relations, contingent events and emerging effects (see appendix 8.2). The questions then were sorted into the following themes:

- Roles and responsibilities of interviewees
- Their story and timeline of the water crisis up to the running of desalination plants
- On desalination and its technicalities
- Process of decision-making regarding the implementation of desalination
- On desalination promises and emerging tensions (non- human and human disruptions)
- On the future of permanent desalination
- On the situated context of the surrounding communities (access, trust, demographics)

Then, this data was transcribed and coded in the program NVivo. After gathering data, transcribing the interviews and coding these into sub categories related to the literature, the emerging themes that came out of this are presented and analysed in chapter 4 and 5.

3.4 Limitations

As this research is specifically based on the situated case of desalination in Cape Town, the results are not applicable to other situations. Besides, the gross of interviews was to be conducted in summer, which appeared to be the busiest season for water officials.

Therefore, only a few actors that were involved with the adoption process were available for interviews, which limited the amount of additional data to the document review. Besides timing, there was a time constraint to conduct the interviews. While I was able to conduct and borrow some interviews with important actors, the constraint of time limited this research to explore a more diverse range of voices, such as those directly affected by the plant projects. What is more, is that the City official respondents don't represent the voice of their branch. Moreover, they cannot be seen as representative for the voice of the 'City'. Another limitation

of building this research foremost on interviews with City officials is that, during the interviews, there could be a certain 'political correctness' within the responses of City officials due to their loyalty and position. This can twist their responses in certain ways that affect the findings. Finally, my own bias as a researcher could implicitly direct the course of the overall research via my preconceived beliefs and assumptions, which can steer the literature I use, the questions I ask and the findings I select..

However, while this research acknowledge these limitations, it aims to contribute to the growing body of literature on the adoption of desalination plants in (Southern) urban contexts. . This research could be taken further by sampling a greater size of actors who were (in) directly involved with the desalination project adoption. This can assists to deepen an understanding in the way that the City can move along a transformational trajectory towards true sustainable and equitable water governance.

3.5 Ethical considerations

Prior to the interviews, I informed each interviewee about the intention of this dissertation and their voluntary and anonymous participation. After the conversations, each participant signed a consent form (see 8.3). To ensure transparency, the interviews were transcribed and sent back to the interviewees, who then had the option to read through the transcripts and request adjustments. Because some of the interviews contain sensitive information, it is important to protect and respect the privacy of the interviewees. The stakes are high, as the possible consequence of revealing names or specific positions could mean that the interviewee loses their job or status within their specific field. Therefore, interviewees are only identified by the their branch or organization to or within the City of Cape Town, such as 'Bulk water". In all cases I aimed to be mindful of my positionality as a European, privileged woman, with little experience of the South African tensions over the ongoing water access struggles.

4. Findings

The following sections of the findings are divided into three parts aligning with the research objectives guided by Harvey's (2018) layers of infrastructure. The first section (4.1) speaks to the first objective and contains an analysis of the constitutive relations of desalination in Cape Town. This section comprises which actors are involved and how certain relations led to the discursive and material emergence of the temporary desalination plants. The first part (4.1.1) explores the key actors within the water management framework and an identified tension that emerged during the drought. The second part of this section (4.1.2) explores the question how the emergence of desalination was pushed in language alongside shifting drought management strategies and actors. Attention is given to the fluctuating, uncoherent framing of desalination from a City's perspective and its contested nature within the public debate.

The following section (4.2) addresses the second research objective, presenting the contingent events, tracing the 'unplanned', disruptive activities from both humans and more-than-human actors which reveal the temporal fragilities of desalination. This section is divided into 4.2.1 which presents timeline of the Monwabisi desalination plant, visualizing the gap between the 'planned' engineering activities encompassing deadlines and an expectation of constant production, and the 'unplanned' activities which halted the construction and production of the plant. This is followed by 4.2.1, exploring the emerging tensions and following negotiations between the City, contractor and the community. The second part (4.2.2) explores the ecological disturbances causing shutdowns of the plant which amplified public contestation over the financial costs.

Lastly, section 4.3 speaks to the third objective of emergent effects, presenting findings on the considerations of current, emergent and future consequences of desalination in concern of equitable water access. These findings are divided into three parts, where these (4.3.1) interrogate the current and emerging financial burden of desalination for both citizens and the municipality, followed by the (4.3.2) future planning and considerations of permanent desalination. Finally, (4.3.3) explores potential consequences of current and future planning for desalination, such as ecological and financial impacts.

Through the presented findings, it becomes clear that desalination was elevated in the context of the crisis. The discursive and material emergence of desalination shows to be all but linear and complete. Rather, its processual nature is signified by moving in a 'back and forth' direction, with break-downs, disputes and struggle along the adoption. The tensions that arise from this dynamic field, hint that the adoption of desalination in Cape Town triggers

differentiating impacts on water access and water security across the urban landscape.

4.1 Constitutive relations

Across water governance, different actors with different interests and visions were, and are involved in the emergence of temporary and permanent desalination projects. Through the tensions, strategies and discursive framings outlined below, desalination was imagined and re-imagined. Overall, this section intends to understand, by who, why and how, desalination emerged.

4.1.1 Actors

Within South African water governance, the actors involved carry overlapping, complementary and distinguishing roles during an infrastructure development process. The drought put enormous pressure on this framework, which shifted some of these relations. The following paragraph intends to outline the important government actors involved in the decision making on infrastructure implementation in Cape Town. This overview assists to understand the roles that these actors played during the adoption process of desalination as a discursive and material structure.

Water management framework

In Cape Town, the ruling party of the African National Congress (ANC) is responsible for water resource management and supply creation, which includes the allocation of certain grants, such as drought relief funds. The Western Cape is the only province ruled by the opposition party Democratic Alliance (DA). The responsibility of provincial government is to offer oversight and support, whereas the City (also lead by the opposition party Democratic Alliance) carries the constitutional and operational responsibility to provide water services (Beck et al., 2016; Enqvist & Ziervogel, 2019). Municipalities, such as Cape Town, fund their responsibilities generally through revenues from service charges and property tax and grants from national governments. The City relies on six dams of the Western Cape Water Supply System (WCWSS) for its main supply, which allocates water to agriculture and a number of urban areas. Three of the dams are owned by the City (Rawlins, 2019; CoCT, 2021). Although the City owns these dams, National Department holds its monitoring and regulatory control, by allocating water through quota's, based on priorities set in the national Water Act. The City's Water and Sanitation Department (WSD) falls under the Directorate of Informal Settlements, Water and Waste Services. The WSD then consists out of several branches, such as Bulk water, who manages the main water supply system for over 4,5 million people (Interview 4 BW), the Engineering and Asset, where engineers operate a system and

manage engineering projects (interview engineers). Other branches are the Reticulation Management, Water Demand Management & Strategy, Finance and Commercial and Engineering and Asset (CoCT, 2021). Ward councillors are there to raise the needs, complaints or demands of the community. Ward councillors are in close contact with the City, mediating between the needs of the community and the wants of the City. In Khayelitsha, where the Monwabisi plant was established, there are 13 wards (interview 3 SUB). Each sub council has around 6 wards under them to manage (Interview 3 SUB). In Khayelitsha, whenever there is a development project, the first thing sub councillors do is to engage with the affiliated stakeholders through the Khayelitsha Development Forum, which includes political parties, civic organisations, religious, businesses, ward committees and others (interview 3 SUB).

During the drought, it became apparent that the relationship between the three central tiers (national, provincial and City) of governance is fragile. While the existing institutional framework regulating water supply is clearly set on paper, the various actors hold different beliefs of what must be done in which situation and face diverse challenges, either overlapping, clashing or diverting from each other. The drought underscored some of the frictions that now were lifted up to the surface. As tensions over water governance responsibilities arose, water governance took on a different shape. A key tension which emerged as the drought evolved was concerning the accountability of responding to the drought. As this tension portrays an important starting point for the emergence of desalination, this will be elaborated on in the following paragraph.

Tension between the three tiers

The key tension that played an important role in the adoption of desalination in Cape Town relates to the managing of the WCWSS. On paper, the City uses about 60 per cent of the dam supply, agriculture 30 per cent and other areas 10 per cent. As a City official says, “Because the farmers need to provide food, we need water to drink, in which the allocation had to played nicely. We had too many times fight with the farmers” (Interview 6 DM).

As the City official at the bulk water branch explains, the City purchases water from the dams, which then has to be treated up to drinking water standards, while “agriculture is taking it raw and using it straight from the system. And they also pay a lower tariff than we do” (Interview 4 BW). During the drought, the unpredicted lower rainfall over a three year period, heated up tensions between the City and the national Department of Water and Sanitation (DWS), as the City felt national DWS was not properly regulating the WCWSS, and lacked the willingness to enforce restrictions on the Agriculture sector (Enqvist & Ziervogel, 2019; Ziervogel, 2019). While the drought began to take its toll on dam levels,

national DWS did little to restrict agricultural water use. More specifically, during an administrative and technical support group meeting on the 12th of August in 2015, it demonstrates that the national Department allocated more water to agriculture than available (DWS, 2015). The bulk water official confirms this, stating that the supply system is ‘over-allocated’ (interview 4 BW). In addition, there has been concerns over the “...vegetation that has been growing kind of uncontrolled for quite a while” (interview 4 BW). Hence, the findings suggest that the City lost trust in the ability of the national department of offering a secured provision of a reliable bulk water supply into the system in times of increased climatic uncertainty and population growth (Interview 4 BW). This is why the City took over this role by planning for augmenting supply itself (Enqvist & Ziervogel, 2019). This shift towards a more autonomous governance approach was significant for the discursive and material construction of desalination. The following section outlines the envisioned City augmentation strategies to counter the drought and the emergence of desalination (both in discourse and implementation).

4.1.2 A City framing of desalination

In this section the variety of discourses of desalination are explored alongside the changing drought responses during the Cape Town water crisis. For this section, I used several data sources, such as municipal documents, news- paper articles, non- profit publications and public statements by the City (for a specific overview of the City’s framing of desalination see appendix 8.1). The findings show that the desalination discourse appeared in multiple forms, as City officials, external advisors, activists and journalists offered different shapes of desalination at different moments during and after the crisis. Here, these were co-created through key actor relations between and within the Water Resilience Task Team, Mayor de Lille, chief resilience officer Craig Kesson, the desalination tenders (QFS and Proxa), the World Bank, activist groups like the Water Crisis Coalition and multiple news platforms. Each of the following sub- sections explore the important shifts within drought management that were aligned to the emergence of desalination.

Pre-drought attitudes

Desalination was barely mentioned till it appeared in the Western Cape reconciliation strategy (DWAF, 2007), where the idea of adopting desalination was first coined and framed to “... reconcile increases in water requirements with supplies” and “to learn lessons for ultimate large scale desalination” (p.8). This was an engineering strategy based on balancing the projected supply against demand (Interview 4 BW). This first framing of desalination thus illustrates a technocratic discourse, as the focus is solely on the technical favours to satisfy a

volumetric balance, the increasing affordability over time due to technological advancements and the “lower environmental and socio- economic impacts” than other supply technologies (DWAF, 2007, p.47). The emergency augmentation scheme during the early phase of the drought was copied from this early strategy (Interview 1 BW). According to the City official at the Bulk water branch, desalination was not a new idea, as it was already planned for to be adopted in the year of 2034 (Interview 1 BW). While the strategy expressed a need to diversify supply, these long- term plans did not align with the City approach at the time. Although a CoCT development strategy (2012) frames desalination as one of the potential “game changer” landmarks (CoCT, 2012), a 2016 press release by the City argues that “interventions such as desalination require massive capital spend which, in the current context of redressing the spatial planning of apartheid, is difficult to justify when a careful attitude to water will be just as effective” (CoCT, 2016). Madonsela, Koop, van Leeuwen and Carden (2019) confirm that although desalination was mentioned a few times, there were no plans of it being supported.

Emergency augmentation

Alongside the disaster area declaration of the whole of the Western Cape province including the City in May 2017, desalination was first coined as part of an emergency augmentation solution to counter the drought. During the beginning phase of the crisis, the need for desalination was amplified by framing the water crisis as nature induced, an emergency that was caused externally. Examples of such statements are; “the most stubborn drought in recent history” (CoCT, 2017a), “the impacts of climate change are being harshly felt” (CoCT, 2017b), “to act in the face of low and unpredictable rainfall” (CoCT, 2018b), “a champion fight against a savagely unrelenting drought” (CoCT, 2019a). This crisis discourse necessitated a “rapid” and serious response to the drought, wherein the emergence of the imagination of desalination as a solution only existed in the context of the water crisis, without considering past and future conditions. Here, desalination was framed as a ‘scarcity fix’, relieving the City of the water crisis. In these beginning months, desalination was framed as an “emergency procurement” (CoCT, 2017f) to “avert a potential crisis” (CoCT, 2017d). To counter the crisis, the City changed their management strategy by shifting responsibilities from the City’s water and sanitation department towards the Water Resilience Task Team (WRTT). This task team was led by the ‘chief resilience officer’ Craig Kesson, and consisted of four members of the Directorate. During the process, the task team worked closely under supervision of former Mayor de Lille. The reason for this was that the WRTT aimed to engage with water in a more inclusive manner, by acknowledging the institutional context of the way that water impacts residents, the economy and the socio- ecological system, thus

taking up a *resilience* approach (Ziervogel, 2019). This shift in approach was exemplified by a City official who states that, “the decisions around moving forward was not only being able to supply for demand, it was resilience, in that you’re not solely dependent on surface water” (Interview 2 ENG). This new formation of the way the City manages water translated into the ‘Water Resilience Plan’ (CoCT, 2017c). The emergency augmentation scheme encompassed the plan to develop 500 Mega- litres of extra water capacity, satisfying almost all of Cape Town’s water demand without using water from the dams. By the beginning of July 2017, the City received over one hundred submissions of proposed augmenting solutions (CoCT, 2017d). The emergency augmentation plan envisioned the production of 350 MI desalinated water from at least eight temporary desalination plants. 300 ML would be produced from ‘ship and barge based’ temporary desalination in the Cape Town harbour (CoCT, 2017c). Moreover, the combination of a crisis discourse, resource scarcity and the promise of technology thus generated an uncontested technocratic desalination narrative (See figure 1).

Technologies	Total MI/day per technology	Locations
Immediate and first tranche		
Groundwater extraction	100	Atlantis and Silverstroom, Cape Flats, Cape Peninsula, Hottentots Holland
Desalination – land-based containers	50	Koeberg, Silverstroom, Woodbridge Island, Granger Bay, Hout Bay, Red Hill, Strandfontein, Monwabisi, Harmony Park
Desalination – barge	50	Cape Town Harbour

Table 3. The envisioned augmentation scheme in the early phase of the water crisis, Cape Town (CoCT, 2017c)

Despite impressions having been created by media reports over the weekend and today that the City's **emergency augmentation** programme has been 'cancelled', this is not true.

The first RFP that has been issued pertains to land-based salt water reverse osmosis desalination plants. The City will aim to issue **emergency augmentation** tenders approximately every two weeks, depending on whether all goes according to plan.

Emergency procurement mechanism will be used to source more water. All procurement will be done speedily and in within the confines the law.

Drought crisis: City working to bring **emergency schemes online**

The drought we are currently experiencing is the **most stubborn** in recent history. It is a significant shock to the fabric our city and accentuates many other underlying stresses such as urbanisation.

'While we are working towards our long-term goal of becoming a more water resilient city, the City is also focusing on averting a potential crisis of running out of water through the introduction of our **emergency schemes**, such as the temporary desalination plants. We have been careful to look at potential sites


We will only get through this **severe drought** together. As a city, we need to do all that we can to get additional water supply on track, but also to continue with water augmentation and saving. We will supply while Capetonians save and by working together, we will make it through the drought.

Figure 1. Visualising reports in support of adopting desalination in the initial sense of emergency.(CoCT, 2017h; CoCT, 2017j; CoCT, 2017k; CoCT, 2017l; CoCT, 2017m; CoCT, 2017n

Push Back and Contestation

In November 2017, the techno- managerial consensus of desalination as a crisis 'solution' was put into question by multiple actors. While the Monwabisi and Strandfontein tenders were already awarded, this desalination discourse became heavily contested from multiple sides, with a variety of attitudes. Foremost, expert party advise, including representatives of the World Bank, steered against the pursuit of temporary desalination, as "providing temporary desalination at scale is not a quick solution, It will take longer than planned and anticipate" (CoCT, 2017e; CoCT, 2018a). There were concerns around the financial side of the emergency investments and the risk of the City wanting to "build itself out of a crisis" (Interview 4 BW; CoCT, 2018a). Instead of pursuing multiple small scale temporary plants, they advised to introduce one large scale plant producing 50 to 150 MLD. In addition to expert party advise, activists, City officials, activists and journalists increasingly contested the assumption that desalination would be the most suitable and needed response to the water crisis (see figure 2 and 3). This contested nature was manifested in various ways. For example, news platform 'IOL' published a slightly critical article titled 'Debunking Desalination' (Weiss, 2018) expressing the fear of over- investing. Another critical news article reviewing Cape Town's plan to adopt eight plants titled 'Desalination "Not a quick fix" ' (Felix, 2017) conclude that "In essence, desalination is expensive, time- consuming and can be a logistical nightmare" which "may well cost Capetonians more in the near future". The news site 'the South African' shared similar concerns over time and costs, yet also questions the potential harm for the marine environment due to brine release (Head, 2017). While several attitudes arose, one of the key narratives involved concerns over the financial costs of the projects, leading to a preference of alternative solutions. This contestation changed the consensus driven, technocratic desalination discourse into a more hesitant, shattered and uncoherent one, concerned with its multitude of consequences.


COMMUNITIES AND WORKERS UNDER ATTACK!



On 17 Nov 2017 the state announced major changes to workers' rights, without consulting with workers and communities. If these amendments come into law in May 2018, it will signal an enormous defeat for the working class.

Increases in VAT and Fuel Levies means paying more for food, electricity, water, housing and transport. Government has FAILED to provide adequate housing!

The working class in Cape Town pays 5 times more for water than before. Water management devices cut off water and rob poor people of their dignity. The water mismanagement crisis is hitting us at home and in our pockets!



These attacks seek to divide and repress workers and communities

We call on all communities, activists, workers and organisations to

UNITE,


DEFEND OUR RIGHTS,

REJECT THE BILLS

&

DEMAND A LIVING WAGE!

CAPE TOWN STRIKE ACTION;
12 APRIL @10AM
MARCH TO CIVIC CENTRE/PARLY
 Gather at Kaisergracht



NATIONAL STRIKE ACTION;
25 APRIL @10AM
MARCH TO PARLIAMENT
 Gather at Kaisergracht

Join these organisations in rejecting the new labour bills:
 Abahlali Base Freedom Park, AIDC, Alex LCMF, APDUSA, Black Sash Trust, BPAC, CWAO, DEMAWUSA, FAWU, Gauteng Community Healthworkers Forum, GIWUSA, Housing Assembly, ILRIG, ISM, Keep Left, Khanya College, Khulumani Support Group, MACODEFO, Maokene Advice & Resource Centre, NUCWOSA, NUMSA, #OMF, PACSA, R2K, SAFTU, SALIPSU, SAPU, SERI, Simunye Workers Forum, SRWP, United Front, UF Youth Arise, WASP, Water Crisis Coalition, WIVP, WWMP

Figure 2. A protest pamphlet to call for a strike action against the privatization of water and labour bill (WCC, 2018).

SOUTH AFRICA

Scientists sound warning over pollutants in treated sea water

04 December 2017 - 06:24

Revealed: The alarming costs behind Cape Town's desalination debacle

#EveryDropCounts: Two multimillion-rand desalination plants have stopped working

Outcry over City of Cape Town's high water tariffs

Cape Town water crisis: Why desalination can't provide water overnight

"The 13500 members of STOP COCT and the wider public feel cheated as they are burdened with extreme water tariffs, but nothing in terms of water security is delivered," she said.

Dirty sea water brings Cape Town desalination plant to a halt

Desalination plant contractor said water was "40 times dirtier" than expected

6 May 2019 | By Kristine Liao

Cape Town's drought: don't blame climate change

People, politics and poor planning are behind most urban water shortages, argues Mike Muller.

LETTER: 'Limberg admitted desalination plants are an absolute disaster'

ALL 3 OF CT'S DESALINATION PLANTS FINALLY UP AND RUNNING

Figure 3. Visualising the push back and unfolding contestation of desalination adoption in the period following the initial sense of emergency (Chambers, 2017; Evans, 2017; Felix, 2017; Head, 2017; Liao, 2019; Mlamla, 2020; Muller, 2018; Noseweek, 2019; Smith, 2018; WCC, 2018; Wydeman, 2019).



The material realisation: A learning experience

While a water outlook report from May (CoCT, 2018e) still states that “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”, the outlook report in July (CoCT, 2018f) states that it “continues to work on augmentation projects but focus shifted to sustainability and cost efficiency”. The City understood now that “desalination rarely provides enough additional supply of water” (CoCT, 2018c; CoCT, 2018f). This fits well into a shift towards a ‘resilient’ approach to desalination (Rodina, 2019; Simpson et al., 2019). The City changed course and decided instead on three small scale desalination plants, with a future possibility of a 50ML permanent large scale plant (CoCT, 2018f). Yet, the contestedness of desalination did not disappear. As the planned trajectories of constructing the plants were delayed, disrupted and challenged by humans, technology and ecological disturbances, the critique on desalination and its implications became intensified (See figure 2 and 3). These discourses vary from critiquing the delayed process of adoption, the emerging effects for marginalized groups, the fragility of the plants, the taste of water and its excessive costs. For example, in April 2018, the Water Crisis Coalition, an activist group, set up a petition and organised a march and strike to ‘tell the CoCT that we reject the budget and privatization of water’ (WCC, 2018; Figure 5). They further elaborate that “if we do not stop the privatization of water, the same high tariffs and poisonous desalination will be forced on more communities in SA and around the globe” (WCC, 2018). Their petition is signed by 3439 people, illustrative for the continuous rejection of desalination ‘from below’. Another example reveals the contestedness of the desalination forms through the continuous disputes between the contractor QFS of the V&A desalination plant and the City. In May 2019, news platform ‘Groundup’ (Liao, 2019) released an article titled ‘Dirty sea water brings Cape Town desalination plant to a halt’. Herein, the QFS contractor states that “the water was 40 times dirtier than expected” , which complicated the technicalities of the plant. Following, he states that “We took our own money, bought a plant, installed it in record time ... And then they turn around and don’t even pay us”. The disputes are still a topic of contention during the ongoing legal process. These examples illustrate the fragile and contested forms of desalination. While desalination was framed as ‘sustainable and cost efficient’, again, journalists and activists politicized the City’s ‘resilience’ framing of desalination, highlighting the embedded emergent effects.

Eventually three temporary small scale desalination plants were constructed which covered a maximum potential production of 16 ML a day. As described in the case study (3.1), the Strandfontein plant was the first plant to inject desalted water into the reticulation system by the 15th of May 2018 and was fully operational, producing 7MLD by the 31st of May 2018.

Following, the V&A plant came online on the 28th of May 2018 yet only commissioned to its full capacity of 2ML a day on the 5th of September 2018. Lastly, the Monwabisi plant delivered its first water on the 25th of July 2018 and was in full capacity, producing 7ML a day on the 21st of September 2018 (CoCT, 2018a). From 2018 till 2020, the desalination plants were producing water to inject into the City's water system. Over the course of these operating months, the City's framing of desalination took on a slightly different form again. Multiple sources, from press statements to interviews with several City officials (Interview 1 BW; Interview 2 ENG) justify the instalment of temporary desalination as a 'learning experience'. For example, a City press release (CoCT, 2020b) states that the City "acquired valuable knowledge through hands- on experience about the operation of this alternative water technology", and is "now confident that we are capable of successfully pursuing the large scale desalination project included in the Water Strategy: our roadmap towards greater resilience and water security in the face of shifting climate realities" (CoCT, 2020a). A statement of a City official at the Bulk water branch illustrates this 'learning experience' narrative:

"The temporary facilities obviously give us experience with the technology, while we might not own the plants they still give us experience with the technology. Also in terms of managing environmental concerns, we have comprehensive managing program looking at the brine discharges etcetera. The impact of raw water quality from the sea. So, you know that kind of information and experience, will help us when we get to the bigger plants, around 2026. So while it does seem expensive, if you weren't gonna have water then anything is better than nothing. So that was the one logic behind the small plants is that they're also gonna be distributed slightly, so in terms of supplying water into networks that is on a distributed basis in an emergency. And then it is also the learning you get from it. And in fact we learned quite a bit, so. I think it's good to start small before you go big."
(Interview 1 BW)

Thus, as these examples illustrate, the City was still holding onto a 'resilience approach', yet temporary desalination is now considered as a learning experience as a preparation for the permanent desalination plant(s).

Concluding, this chapter indicates that there is a wide variety of actors that were involved in the realisation of the temporary desalination plants. Already, the distinction between the variety of discourses on temporary and permanent desalination shows the so called infrastructure temporality (Gupta, 2018). While discourses were shifting over time, various actors became part of this process of constituting desalination. In this process of adopting desalination infrastructure, the relations unfolded into diverse discourses of the crisis and

political imagination of desalination as well as the technical necessity of it. It shows that the desalination discourse was fluctuating and met with consensus and contestation, as the framing of the function of temporary desalination was incoherent and dependent on incoming information. While the discourse was in constant motion, the technological promise of desalination was coherent over time. The overall technocratic ideal of desalination contained the promise to be a ‘sustainable’ approach towards greater water security in the face of shifting climate realities. The City portrays desalination as an engineering technology that promises to lead the City to a resilient future and economic growth. This is a linear, neutral assumption undermining the political consequences. These political implications will be further unpacked in the following chapter on the ‘unplanned’ events that happened during the construction and operating of the plants.

4.2 Contingent events

This section speaks to the second objective of this research, exploring the ‘contingent events’ through which desalination was met while it was constructed, operated and injected into the larger water supply system. While the desalination adoption was planned by the City and contractors within a certain timeframe to produce a certain amount of water a day, these planned engineering activities were challenged by multiple actors, highlighting the limits and constraints of the promise of this infrastructure. In a word, these events thus show the infrastructure phases of interruption across multiple temporalities (Anand, 2018; Gupta, 2018; Ramakrishnan et al., 2020). As my data is mostly centred on the significant disruptive events that emerged at the Monwabisi plant, this chapter therefore aims to explore these cases in more depth. The visualisations below sketches the inconsistency of construction (figure 4 and 5).

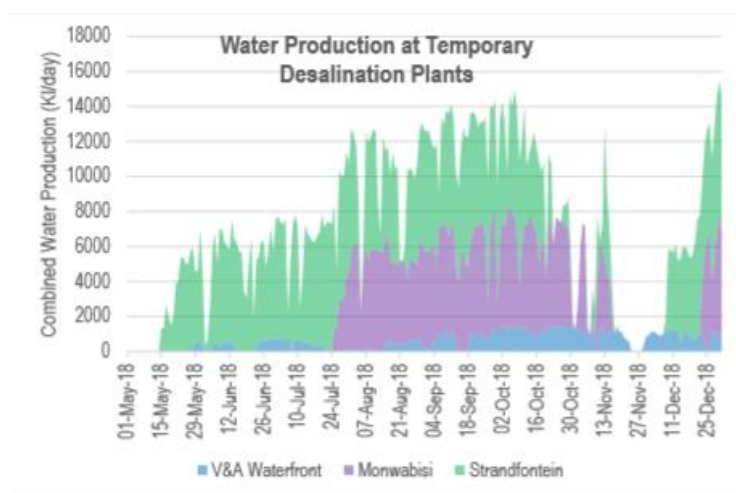


Figure 4. Graph of yield desalination over a time period of 9 months in 2018 (CoCT, 2018a).

The image above illustrates the unpredictable modes of supply of desalted water for the three plants. The purple graph represents the Monwabisi plant. According to the water outlook report of December 2018 (CoCT, 2018a), the gaps can be justified by multiple major impacts on production. The timeline below will zoom further into this, with the data available.

Besides the reported causes of the shutdowns, the report (CoCT, 2018a) also mentioned some unreported cases of electrical interruptions due to cable theft and extreme sea conditions such as the weather and big swell.

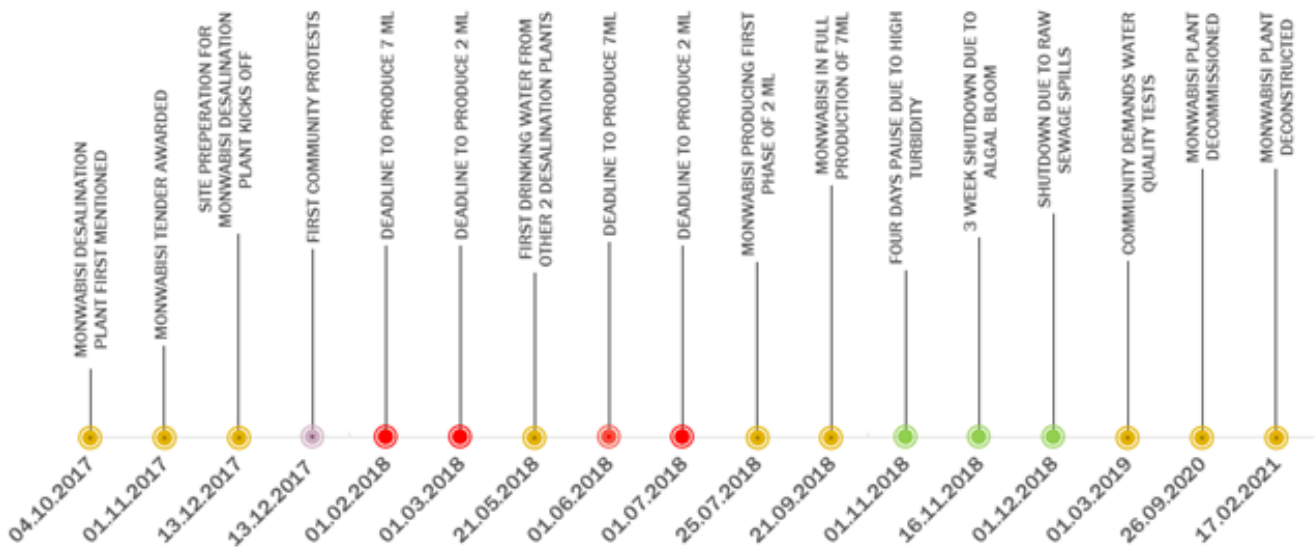


Figure 5. Own construction of the timeline of the Monwabisi desalination plant (CoCT, 2017g; CoCT, 2017h; CoCT, 2017i; CoCT, 2018c; CoCT, 2018g; CoCT, 2018h; CoCT, 2018i; CoCT, 2020e; CoCT, 2021; interview 2 ENG)

This timeline tracks the planned and disruptive features that played an important role in the material emergence of the Monwabisi desalination plant and its emerging effects. On the X-axis the planned and revised dates are lined up, while the Y-axis shows the proposals of construction, operation and unplanned events of disruption. The red dots represent the intended deadlines, which shifts from February to July 2018, yet as the timeline shows, the plant only starts its full production in September 2018. The green dots demarcate the ecological disturbances which caused a shutdown of production. The purple dot of the community protest symbolizes the start of negotiations between the contractor, the City and the ward councillors. These consultations reduced in intensity as the infrastructure took shape. From the protests, the community consultations started on a regular base meeting once every two weeks. This slowly shifted to once every month and eventually to none (Interview 3 SUB). Following, the next two section will explore these disruptive ‘contingent events’ of the Monwabisi plant further.

4.2.1 Negotiations

One of the emerging events which is visualised in the timeline is the community protests, sparked by a mismatch between the rushed attitude of the contractor and the City and the situated realities in Khayelitsha concerning unemployment, poverty, disconnection of public services and historical injustice. Von Schnitzler (2016) points out that due to colonial legacies, it is especially in these spaces of infrastructure procedures where marginalized residents seek out democratic participation. In line with this, the following sections explore the political aspects of the desalination development. As the emergency augmentation scheme had to be implemented in a rushed manner, the legal environment of conventional water governance changed into new shapes. The execution of this 'planned' efficiency was met with dissatisfaction from the community, which emerged as protests, demands for job opportunities and verifying the water quality. This will be discussed in the following paragraphs.

Dissatisfaction over public consultation

For the City, there were a few important criteria which enabled the possibility of a rapid construction. It was important that the plant location 'criteria were mostly focused on quick implementation and minimal infrastructure in terms of an emergency situation' (Interview 2 ENG). This emerged in several forms. One of such is explained by a City official, who explains that 'we specifically did City owned ground to implement it a lot faster, so you don't have to go negotiate with somebody' (Interview 2 ENG). A key transition to enable quick implementation was that the City changed its legal environment. As the City was declared a disaster area, the Water and Sanitation Department requested to exempt the 30A Directive of NEMA. (Interview 2 ENG). One of the City plant managers mention: "Especially for the 30A directive, if we didn't have that thing we could have might as well not. So we don't have to do our EIA before it but you need to mitigate ..." (Interview 2 ENG).

The exemption of the 30A Directive relieved the City of the Environmental Impact Assessment (EIA)- commitment as well as the commitment of public participation. This means that under the veil of Emergency where time is a factor, desalination wasn't realised in the conventional way. Instead of having to go through the main aspects of an EIA before construction which can take up to six years, the City mitigated the environmental impact assessments through specialists parallel to the construction (Interview 2 ENG). Yet a City official argues that "we considered everything that you would consider with EIA when we implement it" (Interview 2 ENG). At the same time, under the exemption of the 30A Directive, the City official explains that "we didn't have public

participation in normal fashion, but there was public engagement” (Interview 2 ENG). A City engineer illustrates this need further:

“I mean in an emergency you don't even consider that [public participation] as a [governing] criteria. Your considerate is you will find it okay. You don't have a choice, this is for the bigger public” (Interview 2 ENG).

Instead of public participation, which includes an appeal period for the public to comment, the City communicated with stakeholders through ‘public engagement’ which entails a more “informed session”. One of the interviewees mentions:

“So the public participation is when people have opportunity to give comments. Public engagement is more informing the public of what you're going to do. They went to specific sub- councils and anyone that's affected and gave them the presentation of what's gonna happen, where it is going to happen” (Interview 2 ENG).

As a consequence of this shift in consultation procedures, the engineers bumped into emerging tensions. This is exemplified by an interviewee: “ So the engagement with the public, obviously, in the context of South Africa, it's a very touchy subject”. Those factors have to be considered when approaching the engagement”. However, as he continues, “during emergency, again, time is a factor” (Interview 2 ENG). In Strandfontein, the public engagement process followed this new procedure without any queries. Presentations were held to the community leaders, who then communicated this information to the community (Interview 2 ENG). This was not the case in Monwabisi, as residents refused to be consulted through the new procedure of public participation. As an official at a sub- council explains: “The community demanded that any issues of common interest has to be discussed through the local ‘Khayelitsha Development Forum (KDF)’”, even in times of emergency. KDF is a very active, all inclusive, community stakeholder structure established because of the “history of violence” right after the post- apartheid elections (Interview 3 SUB). This is further described by the City official:

“Now that we are in a democratic dispensation, we want to have a forum where everybody can be part of irrespective of political affiliations so that we discuss issues of common interest. So we established KDF so that [is] the structure we consult when everybody is going to be in development.” (Interview 3 SUB)

Within the KDF, civil organisations, women, religious groups and ward councillors are all part of the decision making (Interview 3 SUB). While the City said to have informed the

Khayelitsha community before construction through presentations, the community showed dissatisfaction and demanded the KDF- structure to be used. The protests were visible and heard by the contractor and City, as consequently the public consultation process changed shape again. The attitudes of some City officials towards the consultation processes of the Monwabisi plant show a certain underlying claim of the residents not understanding the emergency of the situation (Interview 2 ENG; Site visit). Yet, this judgement might also show a lack of understanding from the City official himself, not seeing the socio- economic and historical factors that sparked the community to rise up. This is admitted by one City official, stating that:

“This specific project [Monwabisi] that wasn't as successful. And we had to have a lot of engagements after that... This was sort of, we've been going in and doing that without this [public participation up front]. And that was probably mistake from our side, I think.”
(Interview 3 SUB).

As the community demanded the democratic KDF- structure to be used instead of the autocratic public engagement structure, the City had to mitigate this “specific” on the spot. The community consultation process of the Monwabisi plant adjusted into slightly more democratic forms. During the construction of the plant, the City organised meetings with the ward councillors every second week. Then it was changed to each month, once a quarter and eventually the meetings were stopped. (Interview 2 ENG; Interview 3 SUB). The next section unpacks the emergent effects that arose from the decision to exclude the public from participating in the development negotiations before construction.

Protests over labour requirements

As the consulting process took off, the main requirement of the community was the local involvement of constructing and maintaining the site, through the allocation of sufficient employment vacancies. The normal procedure is that in the contracts “there is a minimal percentage that needs to go to local labour which is normally EPWP workers”. The City official continues that “with this project in the community you uplift the community” (Interview 3 SUB). While the contract agreement between the City and Proxa entailed a certain percentage allocated to EPWP (Expanded Public Works Programme) labour, the community demanded more. One of the officials at the engineering and asset branch acknowledged the ambiguity between rushing a water project in a community where many don't have the financial resources to pay for sufficient access to water:

“Just say it's a challenging environment, it's an environment where people don't have work. In an emergency project, you don't always have the time to consider labour requirements, because it needs to be implemented quickly.”(Interview 2 ENG)

This shows a deliberate decision to not engage properly with the community. The need for water for the City seemed to trump any other struggle. Whereas the community consultation processes dismissed the community from negotiating power, the design of the plant limited the access of the community through its minimal labour requirements. The City officials at the engineer and asset branch explained that the emergency of the situation determined the temporary nature of the plant (interview 2 ENG; site visit). The instalment needed to happen “Quick” , “very fast” to get the water (Interview 4 BW, interview 2 ENG; site visit). A consequence of this rushed nature is that the design of the plants had to be “pre- fab” consisting out of “containers” that could be “picked up by a truck and go” (site visit). Following, as a lot of the design is prefabricated, the project required mostly highly skilled workers that were “fit for purpose” (Interview 3 SUB). A City official explains further:

“It depends on the contract, so this one was really high skills so the local names were actually on the lower side because you couldn't, a lot of it is prefabricated, entire amounts, so you can't really do a percentage for work like that“. (Interview 2 ENG)

This relatively low employment percentage was not acceptable to the residents near the site. In addition, “in two to three weeks [after signing the contract], the contractor was moving or decided even though he didn't have his construction permit yet” (Interview 2 ENG). Not long after, community protests halted the construction of the site. A news article by ‘Eyewitness news’ (Smith, 2018) state: “There've been many delays at the Monwabisi desalination plant because of a dispute between the City and the local community. Residents were demanding that more of them be employed at the facility”. One thing that seems to exacerbate the delays is the mismatch of the City's reality and that of the residents near the Monwabisi site. This is further exemplified by the contrast between the City officials framing of this community engagement as a ‘showstopper’ to their planned, fast-tracked trajectory (Interview 2 ENG, Interview 3 SUB). Whereas the official at the sub council explains the drive behind the protests of the residents in Khayelitsha:

“Here is the thing, when you have or you're going to have few opportunities for work from a ‘sea of poverty’, in Khayelitsha. Now, when the people start seeing some bulldozers and so on, see that something is going to happen. Then they develop hope that they are going to work”.

(Interview 3 SUB)

Through the KDF- structure and EPWP labour procedure, the labour benefits of any project development is only allocated to those who are from the directly affected wards within the community. In this case, the protests were not only around employments but also about who was employed. It was agreed upon that the staff commitment of the contractor would be divided over the wards that are opposed to the coast, that is ward 95, 97, 98 and 99 (Interview 3 SUB). Especially Ward 99, the host of the project, claimed a higher per centage of employment than other wards that were involved (Interview 3 SUB). The sub council interviewee states:

“Well we agreed with them. And we also informed them that they should also remember that the sea is a national competitor.... The project we were going to do there, would have to benefit everyone. What are we getting from the sea, is going to be able to taking the water reticulation system for the whole city of Cape Town. So it's everybody's water. And they demanded, they agreed but demanded several things.” (Interview 3 SUB)

Other demands were about subcontracting local businesses instead of hiring subcontractors outside of the community. In the end, the different wards, contractor and City came to a negotiated agreement wherein the driving of sand trucks, electrical works and the full time employment of a Khayelitsha based security company were locally hired (Interview 3 SUB).

The planned extraction of sea water through desalination technology created a platform for political engagement. The negotiations over employment requirements and public consultation processes illustrate particular 'politics of the present' (Anand et al., 2018). The prior dismissal of community voices into the decision making symbolises the little effort of the City to recognize the implications of the racialized demographics and continuous institutional neglect of proper service delivery to especially low income black communities.

Distrust over water quality

The above signify the tense relation the City has with many communities, as the City fails to redress unjust policies of the past and conserving those by failing to address these in the present (Enqvist & Ziervogel, 2019). The desalination adoption in Monwabisi which came with a top- down approach of the City only deepened this mistrust. This became the more visible when, in parallel to the construction of the plant, the quality of water was questioned by concerned residents.

More than six months after the first water was produced at the Monwabisi plant, Ward 99 demanded another public engagement process because of complaints concerning the taste and quality of the water. In parallel to the operating of the plant a City official says that “we

had to do another consultation when the project had started because people were complaining about the taste of water” (Interview 3 SUB). According to a City official at the sub council in Khayelitsha, a strong group of community leaders from ward 99 claimed that desalted water only targets their ward, while other areas within and around Khayelitsha wouldn't receive this water”(Interview 3 SUB). As exemplified. “They said this water is not the same as the water that we are drinking” (Interview 3 SUB). This distrust was not only faced towards the City, but also to their allies inside of the community. As the interviewee at the sub council explains, the ‘group of strong leaders’ turned their back towards their ward councillor. This while “the ward councillor is supposed to play a center role in informing the community about projects and so on” (interview 3 SUB). They centred around the local ward councillor and did not believe his statements. He goes on, saying that “I think it was after implementing the construction phase onto the operational phase. I think those dynamics then crept in” (Interview 3 SUB).

One of the City managers explains that the City then had to convince the community that there is no problem (Interview 3 SUB). Consequently, a full study was done by ‘Environmental Health Services’ by the City, monitoring the quality of water before inserting it into the system and also using sampling sites to test over the whole of Khayelitsha (Interview 3 SUB). While the quality of drinking water in Khayelitsha was proved to be safe, the taste can still be different due to the mineral composition of the specific mix households receive. At times, some households close to the plant only receive desalinated water, which is a new taste people have to get used to (Interview 3 SUB).

Overall, CoCT officials seem to understand the value of community consultation processes as they acknowledge the already tense and complex water governance landscape they work in. However, this understanding contrasted the urgent need to get more water into the system. For this desalination project, the Crisis context shaped infrastructure strategies to offer ‘the City’ a short-term solution to the restricted flow of water. Yet at the same time, it downscaled the ongoing struggles that is facing the Khayelitsha community, who are in need of a long- term solution to receive that same continuous flow of water. This is illustrated by the clash between the City and the community. Whereas desalination promises a continuous flow of water, a large part of this community prefers to be relieved from the financial constraints that prevents them of gaining access to a non- restricted flow of water.

4.2.2 Ecological disturbances

Besides human interaction, the production process of desalinated water was paused several times by what the City claimed to be “extreme ecological disturbances” (Interview 2 ENG).

These shutdowns appear a few times a year and became a contested space over financial costs.

All three of the plants faced ecological disruptions that led to a pause in construction and production. According to the officials at the engineering and asset branch, the most common ecological challenges that were faced by the Strandfontein and Monwabisi plants were a naturally occurring algal blooming in False Bay and extreme sea water turbidity during big storm events (Interview 2 ENG). The official at the Engineering and Asset branch explains that “the algae blooms is so fine that the pre-treatment can’t pick off, so we could not run the plants” (Interview 2 ENG). This might occur once or maybe twice a year. Besides algae bloom, another challenge is the extreme turbidity, “which would be now and then”. In both cases, the plants have to stop its production as their temporary design is not capable to treat the murky waters without it being damaged. Other challenges the City engineers mentioned were more of technical nature, such as “pump failure and electrical failures”. When asked about the emerging costs as the purchase contract continues while the production is stopped, a City official explains:

“It is important to consider the context of the emergency of the time frame. Temporary versus permanent. So with the cost of being able to treat during the algae bloom period, you could have a treatment system that actually manages it. But is it cost effective? When you have a permanent plant, you wouldn’t actually shut down the plant. There is no shutting down. So you need a system in place to actually deal with that” (Interview 2 ENG)

The costs that come with the ecological disturbances stirred a broader discussion on the seeping of the price for the public. In the situation of Monwabisi and Strandfontein, the contract between the plant owner and the City mitigated for the ecological events, meaning that the City continued to pay for water, even though the production was halted. This was confirmed in an interview with Proxa director Elspeth Grahn mentions that “Its contract prescribed that the plant would shut down during extreme events, such as last year’s algae bloom, and [the contractor] continue to be paid fixed cost [by the City]” (Liao, 2019). While the contractor was financially secured by the City through the set-up of the contract, the public contested this. ‘IOL’, headed a news article stating ‘Two multimillion-rand desalination plants built to help avert a now forgotten Day Zero scenario have stopped working’ (Felix, 2018). In the same article, an interview with the leader of civic group STOP COCT, shared her concerns: “The 13.500 members of STOP COCT and the wider public feel cheated as they are burdened with extreme water tariffs, but nothing in terms of water security is delivered” (Felix, 2018). This conflict over accountability of costs, was taken further during a

roundtable session of the civic organisation African Water Commons Collective (AWCC). Here, it was critically questioned what the true benefits are of “the white elephant desalination”. Specifically, the framing of desalination as an exclusive, expensive technology was set against the ongoing struggle of marginalised people to access sufficient water on a day to day basis. How is it justified to build desalination technology while people in areas with aging infrastructure, such as Khayelitsha, suffer from the City’s pressure management, leaving them “on the drip system”.

These findings further highlight the continuous contestedness of desalination infrastructure. While the City of Cape Town put a remarkable focus on the positive process of adoption and outcomes of desalination, the outlined disruptions above are highlighting the underlying tensions and fragility that exist between and within multiple stakeholders.

4.3 Emergent effects

While we are in the early part of being able to understand what the implications of adopting both temporary and permanent desalination might be, the two sections above as well as the political ecology of desalination literature can assist to illustrate this imagination of what might come. The following sections will discuss the potential socio- environmental effects and the current and future financial rearrangements and implications. Specifically, it explores the emerging impacts of desalination infrastructure on the financial resilience of the municipality and linked governance shifts. This section draws on Millington and Scheba (2021) and Simpson et al (2019), as recent scholarship that has specifically begun to grapple with the relationship between the drought resilience and financial resilience of the municipality, and the implications of this on current and future water governance strategies.

4.3.1 A financial burden

The findings of the section 4.1.2 on the ‘City framing of desalination’ explored the diverse discourses of the Crisis, political visions and technical necessity regarding desalination. The interpretation of the drought as an external ‘natural’ threat, justified a drought response that merely focussed on the hydrological necessities of bringing ‘new water’ in the system while reducing spilling of water as much as possible. While attitudes towards desalination were fluctuating and incoherent, the technical promise was an overall stable ideal that desalination will lead the City towards greater resilience and economic growth. Yet, as shown, various actors question this promised benefit. One of the main contestations that was amplified is the extensive costs that come with this new infrastructure, which became the more clear when the plants sat idle due to ecological disturbances. As this section will explore, these costs

trigger emergent, accumulating effects for both the municipality as well as for vulnerable residents.

When the 2015-2018 drought intensified, a tension arose between municipal and household level adaptation actions, which had effects on the municipal budget and funds needed to provide resilience building strategies (Simpson et al., 2019). While the City was intensifying its control on public water allocation, affluent households shifted towards off-grid supply to maintain their flawed water consumption practices. While the level of consumption was already below average due to the little volume of supply, on top of that, high- end users were and continue to engage in decentralization efforts. This is exemplified by an official at the demand management and strategy branch, stating that “people have been using less water and still in the aftermath of this drought, the people are still in shock and they have implemented certain mechanisms“. He continues, saying that “we had more than 26.000 boreholes that were registered. Private boreholes. We don’t encourage it. We want people to drink our tap water, not their borehole water” (Interview 6 DM). Thus besides the fear of facing a severe water crisis, the municipality experienced an additional shock within their budget scheme (Interview 5 FIN). Accordingly, the drought amplified the fragility of the existing revenue model of the municipality. With the reduced revenue and planned expenditure on resilience building efforts, such as the adoption of desalination through private- public partnerships, the tariff structure was forced to change shape. An official at the Finance and Commercial branch exemplifies this further:

“Okay, so, where normally you would have had quite low tariffs at the bottom end and high tariffs at the high end. Because there’s none [water] left, you need to immediately start bringing your step 1 and 2 much closer to your actual cost of what it costs you to produce that. No more cross-subsidization. Now, obviously, that immediately has impact for your poorer people. And the people that previously paid more, you know, they can probably absorb it, but your lower middle class is also struggling. So, that whole thing is something that has been pushing on us.”(Interview 5 FIN).

Moreover, this ‘potential funding crisis’ within the department needed to be stabilised by the City through radically changing the tariff structure, bringing the tariffs closer to the actual costs, meaning that water became more expensive (Interview 5 FIN). Consequently, there was decided upon *three major changes* which re-valued and raised the price of water, triggering emerging consequences with concern for water access.

Firstly, a *stepped tariff framework* was introduced to align restriction levels and bring the tariffs closer to the costs and encourage water conservation. If dam levels would be below a

certain per centage, the water tariffs would rise. during the height of the crisis in February 2018, this translated into customers paying R30/kL under level- 6B (CoCT, 2020a).

Secondly, the *fixed price* was introduced to cover for infrastructure costs, such as desalination. This will remain (post-Crisis) an additional fee (interview 5 FIN). The total costs of desalination for the City is several hundreds of millions of rands for two years (rough estimation of R650 million), despite the actual amount of water produced (interview 2 ENG). With this, the price of water increases from around 5 Rand to an estimated 40 Rand per kL (CoCT, 2020a), which is almost a 100 per cent increase. The City official at the Finance branch states that the fixed price will increase over time, dependent on the imagined design and function of permanent desalination (Interview 5 FIN). An additional uncertain cost which comes with desalination is further explained by one of the interviewees:

“The issue is, is if that [plant sitting still] is part of the contract, it’s part of what I need to pay for. It’s going to be part of my fixed cost. It’s going to have to be recovered from the tariff ... Whether we’re ever going to get the fixed basic charge up to that level, in a country like South Africa with a big Gini Coefficient with the people’s income and stuff, I doubt we will ever get there.” (Interview 5 FIN)

The quote of the City official prevails that halting production of a large scale plant steepens the fixed costs, further stressing the commitment of the City to provide equitable water access.

Thirdly, whereas the cross- subsidization model was no longer sustainable due to a steep decline of high- end users, the universal provision of Free Basic Water was re-vised into a limited, *targeted provision* (Interview 5 FIN). Each non- registered indigent household now has to pay for its first 6 kL a month (Interview 5 FIN). As indigent registration is experienced to be a complicated administrative process, some households might be eligible to be registered as indigent yet being unable to register for various reasons, such as the inability to proof that a household is larger than calculated for (Millington & Scheba, 2021). Some households thus might fall in between, as they are not able to register for indigent and can’t afford the raised tariffs either, accumulating the risk of water insecurity of vulnerable households. Another consequence of this shift towards a more targeted provision is that the indigent registration appears only as a dubious ‘package deal’ (Interview 5 FIN). As further clarified by a City official:

“With the indigent, you’re actually saying ‘this is the offer we’re making to you’ because the offer was ‘okay, we’ll come and fix the leaks on your property. We will write off your debt. And we will put this meter [Water Management Device] in to give you the opportunity

to manage your water going forward that we don't get in the same situation again'.”
(Interview 5 FIN)

The City official promotes the complementary WMD- instalment as an offer ,justified by the promise to be free of debts. However, Savelli et al. (2021) argues that it risks to restrict the use of water till lower than needed volumes. Critics argue that the WMD's are actually there to safeguard the revenue of the municipality and decreases the loss of water to leaks, yet it increases water insecurity for vulnerable residents (Roeland, 2018). A City official at a sub council in Khayelitsha points out that the indigent registration to apply for the provision of Free Basic Water might seem to be voluntarily on paper, yet he experiences “there is a real political push to get people registered as indigent” (Interview 3 SUB). This shows through an intensive advertisement campaign in townships and a requirement for the managers to monthly report about the program's progress to politicians (Interview 3 SUB; Interview 6 DM). Since the drought, the sub council City official identifies a “very strong project of installing WMD's in Khayelitsha” which causes a lot of commotion within the community (Interview 3 SUB).

Concluding, as the revenue model became unsustainable, the municipality had to find new ways to balance their budgets. The revisions of the tariffs as a consequence of the recent drought might stabilise the municipality budget and enable to pursue desalination, it can be questioned for who desalination is imagined as a resilience promise. From the data above, it seems that the alterations of the tariff structure implicate unintended negative effects for water access in Cape Town. Vulnerable residents lost their universal free basic water provision, have to deal with water price increases and are pushed to install a water meter device, reducing the volume of water to restricted amounts. Desalination already raised the costs of water and is considered to raise the tariffs even more when permanent desalination will be realised.

4.3.2 Into the future: Imagining permanent desalination

Although the temporary plants experienced “setbacks” (Interview 2 ENG), the future of desalination in Cape Town is still being pursued and supported. As communicated in the new water strategy (2020a, p.7), “in the medium and longer term, desalination is very likely to become an increasingly significant share of the mix because it is scalable and not dependent on rainfall. The City will aim to prepare desalination sites, allowing for rapid deployment if needed”.

Aligned with a global trend, Cape Town is working towards desalinated water covering eleven per cent of the total supply of water by 2040 (CoCT, 2020a; Interview 4 BW). As the City official at the Bulk water branch explains, the pursuit of future permanent desalination is important “to get a percentage of our water use off the traditional climate driven system” (Interview 4 BW). As an interviewee describes:

“We understood now what can actually happen, we planned for certain risks quite substantially, but it actually exceeded that. So now obviously, you can't continue on that same path. And that's where desal and reuse and all of those aspects actually fit in... It is strategic decisions that are being made with resilience in mind, as well as with supplying future demand”. (Interview 2 ENG).

Thus, according to the officials at the Engineering and Asset branch, desalination is one of the bullets that will lead to a secured water future in times of increased climatic risks, while at the same time ensuring growth. When asked what desalination means for the City, a City Official even states that “Our water future is gonna be in the longer term, is gonna probably be dominated by waste- water reuse and desalination, in terms of additional capacity” (Interview 1 BW). He goes on, saying that:

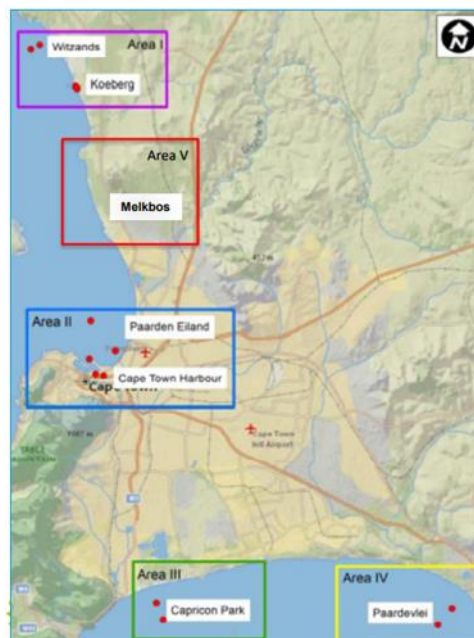
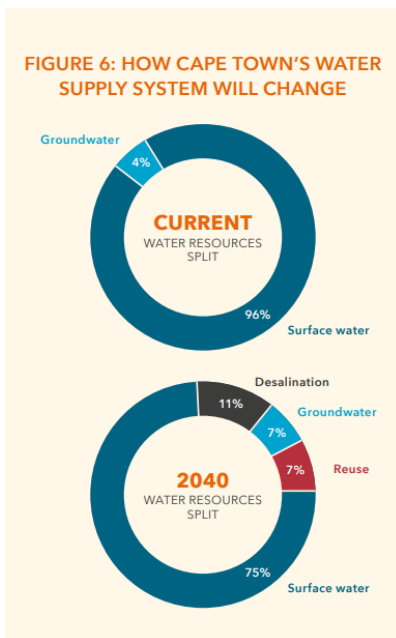
“Our population is expanding, our economy is expanding, so, we need to build for growth and that is really what it [augmentation] is covering, it's growth. And, it was always contemplated, we just brought it forth. So we're building a little bit extra for resilience as well”. (Interview 1 BW)

An interviewee at the Engineering and Asset branch mentions that it is likely that the future plants might not operate all the time or at full capacity, as it depends on the rainfall seasons (Interview 2 ENG). Because of these features, some City officials refer to permanent desalination as if “buying insurance policy” (Interview 1 BW; Interview 2 ENG; interview 4 BW). While the costs are significantly higher than surface water, a City official at the Bulk water branch states that “we aren't in the era of cheap water. We don't have many more surface sources of water in Cape Town for growth. So, this is our future” (Interview 4 BW). As the table and figure (4 and 6) below portrays, the City aims to produce an additional 50MLD through permanent desalination at a (revised) cost of R1800 M by the year of 2026. It is expected for the feasibility studies to be completed towards the middle of 2021, which will be followed up by a full EIA assessment of the project later in 2021 (CoCT, 2020c). The report (CoCT, 2020c) further acknowledges that due to COVID- 19, the implementation augmentation scheme might be delayed up to three years, as financial resources are ever

scarce. Yet, Covid- 19 does not diminish the priority to transform water governance in Cape Town. By 2040, the City envisions to be “a ‘water- sensitive city’ that optimises and integrates water management resources to improve resilience, competitiveness and liveability for the prosperity of its people” (CoCT, 2020a, p. 10).

Table 4. A revised table of the water scheme ‘phasing and costs’, showing increased estimated costs for desalination for the year of 2026 (CoCT, 2020c).

Description	Water Strategy Completion Date / First water (Nov 2018)	Revised Completion Date / First water (Feb 2020)	Water Strategy Capacity (Nov 2018) MLD	Revised Capacity (Feb 2020) [ML]	Water Strategy CAPEX 2018 (R million)	Revised CAPEX 2020 (R million)	Water Strategy 2018 R million /MLD	Revised 2020 R million /MLD	Water Strategy 2018 Operating Cost (R/kl)	Revised 2020 Operating cost (R/kl)	URV (R/m3)
Table Mountain Group Aquifer - Steenbras Wellfield	2020	Jul-20	15	25	375	468	25	18.7	5	5.5	9.3
Table Mountain Group Aquifer - Nuweberg Wellfield	2022	Jul-23	15	15	335	523	22	34.9	5	5.5	12.5
Table Mountain Group Aquifer - Groenlandberg Wellfield	2022	Nov-23	20	12	326	376	16	31.3	2	2.2	9.1
Cape Flats Aquifer - Strandfontein Wellfield	2020	Jul-21	45	5	1060	378	varies between 18 and 31	75.6	5	6.5	22.5
Cape Flats Aquifer - Hanover Park Wellfield	2021	May-22		4		158		39.4		8.5	17
Cape Flats Aquifer - Strandfontein North and East Wellfield	2021	Dec-22		15		772		51.5		6.5	17.7
Cape Flats Aquifer - Philippi Wellfield	2021	Dec-24		6		434		72.3		8.5	24.7
Cape Flats Aquifer - Mitchells Plain Wellfield	2021	Jul-25		20		673		33.7		8.5	16
Atlantis Aquifer Rehabilitation and Expansion	2021	Jul-22	10	16	290	314	29.0	19.6	8	8.5	12.7
Berg Voelvlei River Augmentation Scheme (BVRAS)	2023	Jul-23	40	40					3-5	4.62	4.62
Water Reuse - Faure New Water Scheme	2024	Jul-25	70	70	1360	1882	19.4	26.9	5	5.7	11.7
Desalination	2026	Dec-26	50	50	1650	1800	33-40	33-40	9	9	17.3
Alien Vegetation Clearance						372					1.2-2.4
Improved Supply System Management (WCWSS)											To be confirmed once more detailed information becomes available
Water Conservation/Demand Management											To be confirmed once more detailed information becomes available



- Scoping and Pre-Feasibility Studies on sites completed.
- Feasibility studies in progress
 - Detailed investigations
 - Conceptual designs
 - Preferred site selection
- EIA process to be followed
- Committed to first water by 2026

Figure 6. Visualizing the City’s imagined future desalination plans, showing the committed mix of water supply for the year of 2040 and possible sites for permanent desalination (CoCT, 2019b).

4.3.3 Considering consequences

As the findings have shown, the temporary desalination plants in Cape Town were met by multiple forms of contestedness and push-backs which demonstrate to have emerging (in)direct effects, especially for the most vulnerable residents. Yet, as desalination is 'very likely' to be pursued in the future, it is important to build onto these tensions, considering the potential (long term) consequences for the wider environment and society. Previous scholarship on desalination has shown the most prevalent implications, as explored in section 2.2.3 on 'the political ecology of desalination'. Placing these in the context of Cape Town, the following paragraphs aims to start considering the emerging, unplanned impacts of permanent desalination in Cape Town.

Climate implications: Embedded energy

The first consideration is the indirect effect of the embedded coal-fired energy required to produce desalted water. For many regions, desalination plants are the biggest energy consumer within their local district (GreenCape. 2018). An example of DWS (2017) shows that a 450MLD plant in Cape Town would possibly use around 7 per cent of the City's total electricity demand. With this, water supply will become more sensitive to energy price fluxes. Although desalination is often introduced to mitigate an unreliable supply, the effect can be to transfer the crisis of water scarcity to the energy sector (Williams, Bouzarovski & Swyngedouw, 2014). Indirectly, the large carbon footprint contributes to air pollution, which has significant effects on many natural thresholds such as ocean acidification and sea level rise. These consequences fuel the very cause desalination has recently been so popular for, namely unreliable rainfall patterns due to climate change leading to water scarcity (March, 2015).

Ecological implications: Brine and pollution

The second concern regarding the instalment of desalination plants is the management and disposal of brine pollution. The risk of brine pollution depends on pre-treatment processes, the type of desalination technique and the percentage of water recovery (Xu et al., 2013). Brine is a highly saline concentrated waste product associated to be harmful for the natural environment and human health (Greencape, 2018; Roberts & Johnston, 2010). Cape Town has various marine protected areas and sensitive dune areas, which may be affected by the marine works and disposal of brine (Greencape, 2018). Brine is usually situated as an underflow as it is denser than the intake water (Darre & Toor, 2018). As a result, hypersaline brine spreads across the ocean floor and depletes dissolved oxygen in the ocean. This can lead to habitat degradation. Cape Town has various marine protected areas and sensitive

dune areas.

Another concern regarding brine pollution is the chemicals which might be used in the pre-treatment process. The metals can build up in coastal sediments and exposure can eventually have a drastic impact on marine organisms (Alshahri, 2017). Chemical pollution might already be present in the intake water due to external pollution. In a recent case study in Cape Town, researchers found the potential site near Greenpoint to contain different types of chemicals, caused mostly by raw sewage disposal. The pollution included pharmaceuticals, household products and microbial pollution (Green et al., 2017). The microbes and pollution has the potential to bioaccumulate in marine organisms. Thus, besides this being a threat to the aquatic environment, bioaccumulation is an additional danger as it works up the food chain, eventually risking human health (Green et al., 2017). Other environmental concerns have to do with marine organisms getting trapped or disoriented because of the desalination plant.

Social (equity) implications

As my findings suggest, desalination implicates unexpected social costs. Importantly, in Cape Town a significant amount of people is reliant on subsidized water services or might not even be connected to the supply system. The adaptation strategies of the City, private businesses and affluent households to regain water security were uncoordinated but aimed for the same goal, namely securing and maintaining their water usage patterns. Yet, the cost recovery model of the municipality is not resilient to sudden shocks, like a decrease of volume of supply or revenue. As desalination is an expensive water infrastructure which has to be covered by the tariffs, the price of water for users increased, through the introduction of a fixed price. While desalination is adopted for 'the bigger public', the shifts in water governance practices that allowed for this project to be rapidly implemented, have shown to have implications to water accessibility for the most vulnerable. These shifts systematically oppress and exclude marginalized households, through top-down interventions, increased tariffs and the new FBW limitations. Therefore, it can be said that the desalination assemblage is intensifying segregated practices of water security in Cape Town, whereby affluent households are secured of a constant flow while marginalized residents are experiencing even less secured forms of water . In a word, desalination thus risks to deepens existing socio- spatial inequities.

Finance implications

While the costs of desalination is set in a contract between the private contractors and the City, the increase of the price of water can lead to emerging indirect impacts on the budget of the municipality. As recent work (Millington & Scheba, 2021; Simpson et al., 2019) demonstrate, the cost recovery of the municipality is an outdated framework developed around the reliant supply of traditional sources assuming a stable, predictable usage of high-end consumers. As the future of water is uncertain, and alternative supply is preferred, the department will struggle to sustain a stable budget. The long term effects that the recent tariff restructuring will have on the adaptation efforts of residents are still uncertain, but can imply even more uncertainty. A possible consequence could be that private resilience strategies might increase, which will cause a shortage of revenue from high- end users. This in turn can have consequences for the cross- subsidization, degrading subsidized water schemes even more. Another implication might be that the municipality will seek out external funders to keep their tariff structure in balance. This can trigger similar negative impacts for those who can't afford, all to secure a capital flow to sustain growth and a stable budget.

5. Discussion

My findings demonstrate that the emergence of desalination technology as a crisis response and recognized future resilience strategy in Cape Town involves dire consequences for equitable water access and sustainable governance in the City. While desalination is promised by engineers, contractors and government officials to increase water security and economic growth, this only seems to be true for those who have the ability to pay for it.

The mismatch between the rushed attitude of the contractor and the City and the situated realities in Khayelitsha concerning unemployment, poverty, disconnection of public services and historical injustice instigated existing structural tensions. Through contestation from activists and journalists, push back from the community and ecological disruptions, tensions over the absence of public participation, low employment percentages, and the rigid tariff restructuring practices show the continuous institutional neglect of the need for qualitative, proper water security in especially low- income, mostly black communities. While the City strives towards a 'shared water future' (CoCT, 2020a), the lack of acknowledgement of political processes within current water governance practices reinforces existing racialized spatial and distributional inequities across the urban landscape. Yet, Khayelitsha residents actively recognize this and detoured the 'planned' activities via their local, inclusive democratic governance structure. This push back demonstrate the alternative possibilities for true transformational water governance.

The next section discusses how desalination as an 'imagined' solution by the City is (re)shaped by a wide variety of actors through the dynamics of consensus and contestation. Here, the voices that contest this engineering 'ideal' already engage with the possible embedded implications of desalination as a material construction.

5.1 The 'imagined' solution

The 'imagined' solution of desalination by the City embodies the promise of a resilient future with an insurance on a reliable, unlimited flow of water in times of increasing climatic uncertainty. Yet, my results suggest that this vision of desalination, where the process of emergence and effects are planned on a linear timeline, undermines the socio- political implications which assembles into emerging 'unexpected' consequences for equitable access to water.

In the context of increased water insecurity due to climate change and the urgency to rapidly 'solve' the crisis, the imagination of desalination came into being. As the prolonged drought was framed as an external threat, implying an a-political narrative, this technology was

believed to eradicate uncertainties. Yet, the discursive emergence was triggering contestation, shaped and reshaped in a dynamic process of constituting a wide range of socio- technical relations, constantly going 'back and forth' between the multitude of agendas. Thus, whereas the City's vision of desalination as an emergency procurement first arose in consensus, over time it was shattered and criticized by multiple actors. Looking at this from an infrastructural lens (Lemanski, 2020; Tzaninis et al., 2020) it can be said that these push backs exemplify the political aspects of the material and discursive construction of desalination. An example of contestation is the multiplicity of journalists who critically question the massive costs funded by public tariffs, the fragility of the materials, the taste of desalted water and its true benefits. As Gupta (2018) and Anand et al (2018) point out, these forms of contestation highlight concerns over emerging and existing tensions as a result of infrastructural temporalities, and question the City's a-political promise of desalination. In this case, the overall concerns touched on issues over water access and affordability, exposing governance tensions, contractor and community disputes and the increased costs. Foremost, it put the generalized, engineering promises of desalination into a situated and political understanding of the segregated urban landscape, placing the modern infrastructural ideal of desalination into a Southern context where different phases and structural temporalities co-shape the planned and unplanned activities which come with the adoption. This is not new, as many scholars have pointed to the fact that disruptions, rather than a continuous flow, seem to be the norm in Southern urban contexts (for example, Graham, 2009).

From the results it becomes visible that through contestation, the desalination discourse was, and still is constantly (re) shaping the initial planned activities. The findings suggest that the City has framed desalination among others as emergency augmentation, a resilience strategy and learning experience, encompassing various (contested) material designs, shifting from 8 plants of different sizes to 1 permanent large- scale plant. While desalination is profiled by the City in their strategies and reports as an infrastructure which is planned along a linear trajectory to deliver an expected outcome, the contestedness of the plants show the inconsistencies and rather 'messy' phases wherein infrastructures and their effects come into being (As exemplified in the Monwabisi plant timeline). The temporal fragility (Ramakrishnan et al 2020), which refers to the shifting political imaginaries, contingent experiences and effects on social life worlds, thus already starts to be unpacked before the actual material construction of the plants. The case of desalination in Cape Town demonstrates that the fragile phases of infrastructure development already starts at the framing of 'to be constructed' plants, which is contested over time, challenging the various idealizing forms of desalination and its planned outcomes. While desalination is thus 'imagined' as a solution to drought related water insecurity, the embodied tensions can

generate unplanned, yet contested consequences. The next section will explore the emerging contradiction relating to insertion of market principles within water governance.

5.2 Financing resilience

The legacy of Cape Town's hydro-social territory is one of segregation, contestedness and uneven water access, reflected in the differentiated geography of water (in)security (for example, Dugard, 2016; Rawlins, 2019). While the water crisis affected the water security of each citizen, this then happened in differentiating manners. The following analysis reflects the notions of Millington and Scheba (2021) and Simpson, Simpson, Shearing and Cirolia (2019), who both argue that the recent drought disproportionately affected vulnerable households as a consequence of the Crisis management response.

As described in the section on 'situating water governance in Cape Town', the financial structure of the municipality of Cape Town is signified by increasing commercialized practices, which has shown to complicate the dual commitment described by Dugard et al (2017) to provide equitable access and being financially self-sustainable (Enqvist & Ziervogel, 2019; Hellberg, 2014; Scheba & Millington, 2018; Simpson et al., 2019; Yates & Harris, 2018). As the results show, the drought amplified this tension, where water scarcity shifted multiple aspects within the way society is organized. This in particular, speaks to Boelens et al (2016), showing that water flows are interrelated to social aspects, creating 'hydro-social networks' between humans and more than human entities thereby affecting 'hydrosocial territories'. In Cape Town, this meant that the scarcity of water amplified a fragile cost recovery structure. As the municipality risked a 'funding crisis', the City took three significant decisions that shifted the tariff structure to secure revenue and rebalance the budget. These, as is shown in the results, have consequences for water access to especially those who are already vulnerable. Critical scholars such as Bakker (2014) and Yates and Harris (2018) have highlighted this emerging contestedness within water governance practices between having to ensure the right to access to water and at the same time having to be financially self-sufficient. Specifically the unequal impacts of the revised tariff structure are typical for the externalities of what Bakker (2014) refers to as 'market environmentalism', the injection of neoliberal ideals within public water governance. The most illustrative case to exemplify this dynamic of market environmentalism is the raised price of water, combined with the revised FBW as a universal right to one that is only accessible through (complex) registration as indigent. These both demonstrate that the drought intensified the need to follow market logics that redefine access to water from a rights based understanding to one which centres the ability of households either to pay, or to register as indigent. Moreover, the

results carefully suggest that the City prioritized a sustainable budget balance over equity considerations.

Temporary desalination plays an important role in the restructuring of the tariffs and hydro-social networks, as the infrastructure is, relative to other infrastructures, very expensive, and the fixed price is introduced to cover these excessive costs. Simpson et al (2019) point out that, considering that affluent households are increasingly involved in private resilience tactics, such as the drilling of boreholes, then the promise of desalination as a 'public' resilience strategy can be questioned and must be carefully considered. The loss of revenue from those affluent households who switch to off grid supply, have a significant adverse impact on the cost recovery structure of the municipality. This loss in revenue will most likely again be stabilized through neoliberal tactics, prioritizing concerns of efficiency and growth over equity considerations. This effect of desalination accumulates negative consequences for the most vulnerable. The concerns over increasing neoliberal tactics with adverse consequences for water access by Simpson et al (2019) speaks to the work of Joe Williams (2018) who asserts to desalination technology as the optimal tactic for the 'commodification of water', the re-assembling of social relations with water, governance practices and life worlds to please the needs of the market.

Related to Cape Town, the introduction of desalination has shown to do exactly this. Through the extensive costs of desalination technology, the fixed price was introduced as a governance tactic, raising the tariffs, financially restricting access for the most vulnerable. Thus, while desalination is pursued as an infrastructure that promises a climate resilient future for its citizens, it has troubling consequences for both the municipality as the most vulnerable. First, desalination (in)directly affects the budget of the municipality, both through the extensive costs and through the need to find new revenue schemes to ensure that these costs will be covered. Furthermore, desalination assembles emerging effects differently across the urban landscape. For middle and upper class households, as well as private businesses, desalination ensures an 'unrestricted' flow of water. However, for the most vulnerable, the desalination adoption unfold in an uncomfortable combination of an increasing price of water and involuntarily indigent registration, increasing water insecurity for the most vulnerable. Desalination as a 'solution' in Cape Town thus preserves the enabling of certain temporalities while foreclosing others (Anand et al., 2018).

5.3 Dispossession through infrastructural delivery

The new water strategy (2020a, p.1) suggests further that "we must make decisions that have the community in mind. Everything the City does must help every citizen, especially the most vulnerable." However, as my findings and the section above suggest, this may not be

the case with the adoption of desalination. In addition to the increasing commercialised practices, the tensions that arose during the construction of the Monwabisi plant reveals additional exclusionary practices, intensifying the water insecurity of the most vulnerable rather than delivering an unrestricted flow of water.

The City understands the investment in desalination technology as an important contribution to 'greater water security' and 'insurance of growth'. It is imagined as a public venture which relieves the whole of the City from water insecurity. The notion that desalination provide water security for the whole of the City was illustrated by a City official, stating that "this is for the bigger public " (Interview 2 ENG). This understanding of the municipality resonates with a wider, normalised assumption that investing in public services, in this case water infrastructure to enhance water delivery, turns into benefits for those who are hit hardest by a violent history and the neoliberal system (Levenson, 2018). Under this belief, certain governance shifts emerged to fast track the adoption of the plants. Nevertheless, as the unanticipated disruptions and push backs during the construction of the Monwabisi site illustrate, marginalized communities may experience this large investment as a governance tactic that degrades their situation. The findings suggest that the construction of the Monwabisi plant was met with community protests resisting the minimal allocation of employment, the public engagement scheme and the different taste of water. These push backs show a 'mismatch' between the City's expected delivery benefits and the actual community expectations of the impact of this infrastructure on their daily lives (Carse, 2017; Linton & Budds, 2014; Ramakrishnan et al., 2020). It is the assembling of socio- technical relations of desalination that materialize in the dispossessing of marginalized communities, reinforcing existing hegemonic power relations between the municipality and marginalized communities.

There were multiple examples in which certain top- down decisions from the City led to the dispossessing of the directly affected residents. For example, the City treats 'City owned land' as theirs, which gives the municipality a certain power to do as it likes, as the statement of a City official illustrates: "we specifically did City owned ground to implement it [desalination] a lot faster, so you don't have to go negotiate with somebody" (Interview 2 ENG). In times of emergency, this 'ownership claim' shift governance practices from inclusive towards more exclusive governance. For instance, the right to public participation was substituted for public engagement and the allocation of labour was minimised to very low numbers due to decisions made about its design, taking away the right of democratic participation in decision making and leaving them with little more. Zachary Levenson (2018) references to the existing of a wide range of 'technologies of delivery' that, unintendedly, facilitate dispossession. While Levenson (2018), explores the dispossessing through the

TRA- housing delivery in informal settlements in Cape Town, some similar effects emerge from infrastructure delivery, in this case desalination. Unlike the TRA- housing scheme, desalination is not specifically adopted and does not promise per se to relieve marginalized communities from their day to day struggles over water scarcity. Rather, it promises water for the 'bigger public'. While it might be unintended, desalination mostly seems to 'take' from the marginalized communities, without delivering much.

The political tactics that facilitate the construction of the desalination plants, instigate dispossession as the City and private contractor 'extract water from a sea of poverty', leaving residents stagnant in their socio- economic position, living far away from job opportunities and locations with a constant flow of water access. In addition, as the findings 4.2.1 explored, desalination instigated distrust within the community, threatening existing stable political structures. Whereas the political ideal of desalination certainly enhances deprivation of the most vulnerable driven by exclusionary governance strategies, it is the economic tactics that complicates and deepens these disparate dynamics of exclusion as described in the section on financing resilience (5.2). One of the significant economic dispossessing strategies which came out of this is the excessive costs for desalination infrastructure, affecting the Free Basic Water policy and led to the introduction of the 'fixed price' within the tariff structure. The rising costs are ever more dispossessing the most vulnerable, as their only way to access water now is through an uncomfortable combination of indigent registration and the instalment of a restrictive water meter device.

In short, it can be argued that while desalination serves accumulation of capital for the contractor and accumulation of water for affluent households, the desalination assemblage extracts the most vulnerable from their right to citizenship, taking away their voice within decision making processes, taking their job opportunities through technological designs and further restricting them from access to water through the indigent policy implying obligatory instalment of WMD's. Moreover, as a consequence of desalination, the community is left with a deepening of their ongoing crises, related to poverty, limited access to basic services and systematic injustice.

5.4 Resisting colonial remains

Within a situated understanding of UPE, it is especially the heterogenous, situated relations and movements between contradictions that are of importance to the shaping of infrastructure (Loftus, 2019; Williams, 2018). In this light, more- than- human and human actors are not solely seen as receivers of 'political tactics' but as 'power brokers' as they can negotiate and trigger new pathways of capital, materials and its products (Meehan, 2013;

Wangui & Ernston, 2020). While a growing body of literature on the politics of desalination focus on the hidden socially induced impacts of the adoption of desalination (Fragkou, 2018; March, 2015; Scheba & Scheba, 2018; Swyngedouw & Williams, 2016; Williams, 2018), often these studies focus on the negative impacts on social life worlds. Yet, some negotiated outcomes forge new connections that benefit those who are at the receiving end and the wider environment. As these outcomes are also of importance to the understanding of political infrastructures and its indirect social impacts, the following paragraphs explore the negotiations that took place at the case of the Monwabisi plant.

While the desalination assemblage displaces tensions instigated by the crisis to marginalized communities, residents in Khayelitsha actively re-politicized that what was meant to be a-political. As Antina Von Schnitzler (2016) has clearly described, throughout South African history, infrastructures have historically been imagined as technology to fragment some from others, instigate white supremacy, aiming to provoke and limit movement instead of enabling circulation in terms of spatial patterns and access. Zooming into the case of the Monwabisi plant, the 'colonial remains' within water governance became visible as tensions arose (Kimari & Ernston, 2020). It can be claimed that alongside the emergence of desalination, historical power dynamics between the governing institution and people of color were instigated to ensure efficient implementation. As explored in section 5.3, the exclusion of especially the most vulnerable emerged in various forms, as a consequence of specific criteria from the City. The most significant example is that of the exempt of the 30A directive, which relieved the City from any friction with those directly affected by the construction. Instead of an open dialogue, residents were now cut out of the conversation. Arguably, the assemblage of desalination thus conserves this historical status quo, disempowering, mostly black, marginalized residents by extracting 'their' water and disclosing access through indirect price and governance measures.

However, residents continue to act as 'power brokers' (Kimari & Ernston, 2020). By disrupting the planned differentiating strategies towards 'greater resilience' through examination and protests, they impose the City to re- imagine the 'imaginary' solution that is desalination into one where they, too, take part in. As Anand et al (2018) and Von Schnitzler (2013; 2016) observe, infrastructure materialities become a site to negotiate rights for those who are unable to/ left out of access to political engagement through formal procedures. In Monwabisi, this was visible through push backs from residents near the Monwabisi plant, who used this infrastructure as a platform to come to negotiated terms of citizenship, political belonging and rights to infrastructure access. Instead of the public engagement procedure of the City, the residents compelled the City to engage in their local, democratic and inclusive

'KDF' governance structure which is specifically set up to collaborate with development projects along equitable and just lines (interview 3 SUB). Through negotiations via the local, democratic KDF- governance structure, residents agreed upon a new negotiated outcome, whereof one example is the fulltime hired Khayelitsha based security company. Assumably, resisting the initial project development tactics of the City, the community activates an alternative imaginative trajectory towards what Kimari & Ernston (2020) consider an alternative 'decolonial future'. A future where those on the receiving end of the technology have as much to say about its development as those who initiate the project. Even though development might be hard to argue against when one has no control over it, this example shows that disruption can alternate set pathways, creating micro- gains for residents.

6. Conclusion: Towards a shared water future?

The aim of this dissertation is to trace the emergence of the adoption of three temporary desalination plants and planning of permanent desalination as a crisis response and recognized future water strategy in Cape Town, in order to carefully consider its consequences for equitable water access. By utilizing secondary official city documents, reports and news articles from several credible news platforms, supported by a number of personally conducted semi-structured interviews and secondary sourced interviews with City employees, this thesis explored by the use of Harvey's (2018) three layers of infrastructure how desalination is constituted as a crisis response, the contingent events through which desalination came to be adopted as a crisis solution and the emergent effects for water access in the City.

This dissertation has shown that the use of an infrastructural lens benefits the analysis of the adoption of desalination in Cape Town, as it assists to unpack the unplanned emerging effects through a focus on actors and relations, contestation and disturbances and emerging socio-political, financial and ecological effects. By tracing the discursive and material emergence of the adoption, it is revealed that the materialities and imagination of this water production technology are political and in a constant movement. The main message that came out of the findings is that an infrastructure development project such as desalination won't follow a planned trajectory within Southern contexts, if it does not take into account the uncertainties over environmental and socio-political concerns and tensions. More importantly, the adoption of new infrastructure won't generate the expected effects. As the discussion exposes, desalination in Cape Town as a solution might provide an unrestricted, secured flow of water for middle- and high-income households as well as private businesses, however, due to specific governance shifts, desalination increases water insecurity for the most vulnerable.

Looking into the near future, the new water strategy called 'Our shared water future' (CoCT, 2020a) envisions permanent desalination to take up an important role in its future water supply. The strategy further promises to lead the City towards a 'water sensitive city' that "optimises and integrates the management of water resources to improve resilience, competitiveness and liveability for the prosperity of its people" (CoCT, 2020a, p.10). The strategy is said to be developed in the context of a 'whole society approach', highlighting collaborative relationships built on trust as key to transformative water governance. Yet, the above discussion on the emergent contradictions of desalination on water accessibility illustrates a different picture, where the current state of affairs is rather one of distrust and preservation of an unequal, differentiating status quo of water security. The emergent effects

amplifies the need to take a more careful approach to the adoption of alternative water sources, especially in times of increasing water scarcity. The unequal trajectories across diverse social groups towards greater water security matter, and should not be singularized as one 'shared' response. Moreover, technical solutions like desalination will not be sufficient to counter water insecurity across the urban landscape. If the City is committed to strive towards more equitable and sustainable water governance, then the focus of governance tactics should shift towards the recognition and understanding of the consequences of the conflicting intentions of the City that trigger friction and hinder true transformational water governance. To withstand future climatic uncertainty and other shocks, it is crucial for the municipality to reflect on and take an active stand to counter these inner tensions, such as the focus on the cost recovery scheme of the municipality, conserving normalized, segregated extremes in terms of water consumption patterns and the preservation of 'colonial remains' within governance practices.

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8. Appendices

8.1 City framing and strategies regarding desalination

Key attitudes towards desalination from early phase of the drought to 'post- crisis'

Date	Early phase attitudes (emergency)	Date	Shifting attitudes
19 March 2017	Disaster declaration to accelerate small- scale emergency water supply schemes. ¹	17 January 2018	Desalination was never going to be enough to stop Day Zero Will make CT more resilient in future ²
9 May 2017	"increase proportion of non- surface water as rapid as possible" ³	22 January 2018	Desal <i>will not provide sufficient supply to help us avoid Day Zero</i> this year. They will, however, help us to <i>become more resilient</i> in

¹ Source: CoCT (City of Cape Town). Drought crisis 18.6 percent of usable water left'. URL: <http://www.capetown.gov.za/Media-and-news/Drought%20crisis%2018,6%20percent%20of%20usable%20water%20left>

² Source CoCT. 'Day Zero is now likely to happen' – new emergency measures. URL: <http://www.capetown.gov.za/Media-and-news/Day%20Zero%20now%20likely%20to%20happen%20%E2%80%93%20new%20emergency%20measures>

³ Source: CoCT (City of Cape Town). De Lille released a statement on engagement with businesses to manage the crisis. URL: <http://www.capetown.gov.za/Media-and-news/City%20committed%20to%20working%20with%20businesses%20and%20residents%20to%20manage%20water%20crisis%20effectively>

			weathering our next dry season.’ ⁴
31 May 2017	Desalination plan for 100mL in first tranche (9 sites) 50mL in second tranche (Cape Town harbour), and 200mL for extreme tranche ⁵	28 February 2018	‘Regardless of rainfall or water supply augmentation, need to continue striving to reduce average daily consumption to 450 MLD ⁶
23 August 2017	Estimated augmentation costs at R2 billion in capital funding and R1,3 billion in operating costs ⁷	9 April 2018	Augmentation ensure we are ready to act in the face of low and unpredictable rainfall. ⁸
31 August 2017	first tender proposals for land based ‘emergency scheme’ desalination ⁹	20 May 2018	To ensure <i>resilience</i> against drought, the WCWSS needs diversified supply sources. <i>strong argument that desalination should be a component of future water supply</i> ¹⁰
19 October 2017	City received over 100 submissions ¹¹	21 May 2018	<i>efforts to make our city more resilient to future drought shocks and to ensure that we thrive despite climatic uncertainty</i> ¹²
29 October 2017	“V&A commissioned, 8 other desalination plans will come online in	28 June 2018	reassessing New Water Programme: in particular our focus

⁴ Source: CoCT. Deputy Mayor Ian Neilson released a statement. URL: <http://www.capetown.gov.za/Media-and-news/Non-water%20savers%20urged%20to%20join%20Team%20Cape%20Town%20water%20savers%20as%20Day%20Zero%20moves%20forward%20to%2012%20April%202018>

⁵ Source: CoCT (City of Cape Town). De Lille presents IDP of 2017-2022.

URL: <http://www.capetown.gov.za/Media-and-news/Water%20resilience%20a%20heightened%20approach%20to%20avoiding%20water%20shortages%20and%20achieving%20long-term%20water%20security>

⁶ Source: CoCT (City of Cape Town). Cape Town water crisis update.

URL: <http://www.capetown.gov.za/Media-and-news/Cape%20Town%20water%20crisis%20update>

⁷ Source: CoCT (City of Cape Town). receiving 20.8 million grant from National Government for drought relief. URL:

<http://www.capetown.gov.za/Media-and-news/City%20to%20receive%20R20,8%20million%20grant%20towards%20drought%20relief>

⁸ Source: CoCT (City of Cape Town). Deputy Mayor Ian Neilson 20 million litres being saved. URL: <http://www.capetown.gov.za/Media-and-news/50%20million%20litres%20being%20saved%20through%20pressure%20management>

⁹ Source: CoCT (City of Cape Town) Drought crisis: private sector interest in City’s water supply tenders soars’.

URL: <http://www.capetown.gov.za/Media-and-news/Drought%20crisis%20private%20sector%20interest%20in%20City's%20water%20supply%20tenders%20soars>

¹⁰ Source: CoCT. Water Outlook report May 2018.

¹¹ CoCT (City of Cape Town). The City hosts a large group of business leaders.

URL: <http://www.capetown.gov.za/Media-and-news/City%20hosts%20close%20to%20600%20business%20sector%20representatives%20calling%20for%20greater%20collective%20action%20in%20response%20to%20drought>

¹² Source: CoCT. First drinking water from desalination a step toward greater resilience’ mentioned the following.

URL: <http://www.capetown.gov.za/Media-and-news/First%20drinking%20water%20from%20desalination%20a%20step%20toward%20greater%20resilience>

	the next few months.” ¹³		on role of permanent desalination in future mix ¹⁴
22 November 2017	On track with first set of augment. plans: Monwabisi, Strandfontein, V&A Waterfront, and Cape Town Harbour plants ¹⁵	5 October 2018	**Avoided Day Zero teaching us valuable lessons about how to possibly one day have a permanent desalination plant for Cape Town. **Monwabisi plant fully online
12 December 2017	World Bank Advisory – discontinue procurement of new desalination Plants	14 February 2019	Increasing available capacity by >300 MLD over next 10 years The build programme will reduce the likelihood of severe water restrictions in future. ¹⁶
		30 May 2019	Transform into a more resilient and water-sensitive city. This is to safeguard and to foster the health and prosperity of all Cape Town residents.’ ¹⁷
		22 June 2020	City acquired <i>valuable knowledge</i> through <i>hands-on experience</i> about the operation of this alternative water technology. We are now <i>confident</i> that we are <i>capable</i> of successfully pursuing the large

¹³ Source: CoCT (City of Cape Town). ‘Drought crisis, moving forward together’.

URL: <http://www.capetown.gov.za/Media-and-news/Drought%20crisis%20moving%20forward%20together>

¹⁴ Source: CoCT. ‘No Day Zero for 2019 if appropriate water restrictions are maintained’.

URL: <http://www.capetown.gov.za/Media-and->

[news/No%20Day%20Zero%20for%202019%20if%20appropriate%20water%20restrictions%20are%20maintained](http://www.capetown.gov.za/Media-and-news/No%20Day%20Zero%20for%202019%20if%20appropriate%20water%20restrictions%20are%20maintained)

¹⁵ Source: CoCT. City launches the water dashboard to give transparency over dam levels and water usage.

URL: <http://www.capetown.gov.za/Media-and->

[news/City%20launches%20new%20weekly%20water%20dashboard%20to%20track%20supply,%20savings%20and%20Day%20Zero](http://www.capetown.gov.za/Media-and-news/City%20launches%20new%20weekly%20water%20dashboard%20to%20track%20supply,%20savings%20and%20Day%20Zero)

¹⁶ Source: CoCT. City’s draft water strategy opens for public comments’.

URL: <http://www.capetown.gov.za/Media-and-news/City's%20Draft%20Water%20Strategy%20opens%20for%20public%20comments>

¹⁷ Source: CoCT. ‘City’s water strategy approved by council’.

URL: <http://www.capetown.gov.za/Media-and-news/City's%20Water%20Strategy%20Approved%20by%20Council>

			scale desalination project ¹⁸
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¹⁸ Source: CoCT. Mission accomplished for Strandfontein temporary desalination plant.
URL:[https://www.capetown.gov.za/Media-and-news/Mission accomplished for Strandfontein temporary desalination plant](https://www.capetown.gov.za/Media-and-news/Mission%20accomplished%20for%20Strandfontein%20temporary%20desalination%20plant)

8.2 Questionnaires

i. Guided Interview topics and questions for City Officials

Introduction: Job related

Please introduce yourself;

What is your name (f/m, etc.), where did you grow up?

What is your job description?

What is your background education ?

What is your role in the bigger picture of water management in Cape Town? (When did you start, gain general idea of his/her power/ worldview).

Has this changed over the years (pre-crisis-post)?

On Desal and (post) crisis

We will start off with talking about the water crisis and the adoption of desalination into CT water infrastructure. Can you briefly summarise your answers on the following questions: (bullet points)

1. Can you share with me your view on the crisis? What happened, why did the City almost run out of water?
2. Can you tell me how desalination in CT came about? (promises)
3. Do you think desalination was a necessary addition to the City's water supply during the crisis? (What was your point of view at that time regarding desalination?- Has this changed?)
4. What were some disruptions in the process of construction and maintenance of the plants? (How did you overcome these and what lessons can we learn from this?)
5. In the new water strategy, the City mentions that desal will be very likely to become a significant share in the water supply mix. What lessons from the implementation of the temporary plants can we apply to the planned permanent plants?

Post- crisis: City and the future of desalination

The next section we will discuss is the new water strategy which links to the transition from the water crisis towards post- crisis. With this comes a transition from temporary desal plants to permanent desal in CT.

6. Now the crisis is over, and the dams are filling up.. How significant is desalination now?
7. Although Cape Town escaped Day Zero, the drought has now been declared as 'the new normal'. The new water strategy states that we can't move back to 'business as usual' and therefore strives to become a 'water sensitive City'. What does the city mean with this? Can you share your thoughts on this? (Does this 'new normal' strategy also include improvements for those who don't use much water? In what way?)

8. The City promotes/ talks about (permanent) desalination as an insurance. Can you share your thoughts on what the City means with this? For who is it an insurance?
9. As is shared in the new water strategy, the City is planning on one or multiple permanent desalination plants. What can you share about the future plans for permanent desalination? What are the possible locations, who will be the contractor, the contract period, the amount of water produced? (Is planning aligned with legislation (on sustainability etc.)?)
10. In an interview with Xanthea (source: Drought response initiative), she spoke about the new tariff structure to cover for the new augmentation scheme, including desalination. First, there would be a drought levy based on property value, however, this plan got discarded and instead a 'fixed charge (pipe charge) is set in place. Why the change?

On Desalination and fragmentation (interconnectedness across scales)

By implementing desalination into Cape Town's water mix, other governance spheres had to adjust, such like the tariff structure and relationships with other spheres on different scales of CT water governance, such as provincial/ national government, farmers.

11. Which adjustments can you identify? (We can think of changes in tariff, private/public, provincial and national level, farmers).
12. Do you have an idea of how the adoption of desalination fits into legal legislation/ policies? Is it aligned with any national, provincial or local legislation/ policies? How was this during emergency and how will this be for future desal? (on energy efficiency, climate change paris agreement, NDP etc.// In which way is desalination aligned with the overall NDP (the 5 year strategy) of the city?)
13. Could be said that desalination is, for CoCT a way to become more self- sufficient and independent, moving away from the reliance on national government? (Some city officials mentioned in interviews (source: drought response initiative) that national government was not acting on non-compliance regarding water usage quotas during the crisis.)

On Desal and Citizenship (trust, inequality, disputes)

Besides other governance spheres, changes in the water infrastructure can affect the social spheres of the City. We'll focus on the role of infrastructure in relation to water access.

14. In your brief opinion, what is the role/function of water infrastructure in Cape Town? (summarise)
15. What are the current and future key challenges CT is facing regarding water infrastructure and governance?
16. The City is still coping with the legacy of extreme inequality. One of the key issues remains to offer access to water for all. How does desalination fit into this?
17. As stated in multiple articles as in the new water strategy, the City acknowledges that the water crisis drew attention to a lack of trust and partnerships between the City and civil society groups, public authorities and others. How did you experience this? How can the City include this/improve this in relation to desalination?
18. The dispute/ lawsuit on the V&A plant site with the CoCT caught much attention in the media, and shows an example of distrust between the City and its stakeholders. How do you look back on this dispute, is there anything that the City could have done to avoid the situation

they are in now?

19. In a recent report of the South African Water Research Commission (2019), they state that 'expensive water is a political hot potato'. What is your thought on this?

(extra.. If you could decide, how do you imagine the future of water management and supply for Cape Town?)

On Desal and the Environment

This final section we will talk about climate change and desalination in relation to the natural environment.

20. What is your take on climate change? How does it impact water management in Cape Town?
21. What is the role of desalination in the broader picture of climate change? (What is the environmental and social cost of taking ocean water to still the thirst of Capetonians?)
22. How sustainable is desalination? What is the impact of desalination on the environment? How does the city regulate to minimise this impact?
23. The cost of desalinated water is closely tight with electricity costs. This is coal fired energy, supplied by eskom. What happens if there is load shedding? Will future tariffs change when the carbon tax bill will be introduced in 2020?

ii. Interview Schedule for City officials at engineer and asset branch

0.Introduction: Job related

- 0.1)Please introduce yourself;
- 0.2) What is your background education ?
- 0.3) What is your job description?
- 0.4)What is your role in the bigger picture of water management in Cape Town?
- 0.5)Has this changed over the years (pre-crisis-post)?

1. Decision making on implementation and maintenance:

- Crisis
- In between
- Future

- 1.1) Do you think temporary desalination was a necessary addition to the City's water supply during the crisis?
- 1.2) Can you tell me how the decision to implement desalination came about? (promises)
- 1.3) At some point, the City decided to switch from implementing 12 desal plants, to 1 big desal plant to 3 temporary smaller ones. I was wondering how this switch came about?

1.4) Now, the City is not in an emergency state anymore. I'm curious about how desalination during the crisis evolved into planning for permanent plants. Can you give me an idea of how this decision has been made?

1.5) How significant is desalination now?

1.6) In the new water strategy, the City mentions that desal will be very likely to become a significant share in the water supply mix. What lessons from the implementation of the temporary plants can we apply to the planned permanent plants?

1.7) Desalination is not new in South Africa. Do you share your experiences with other cities that also have desalination plants?

1.8) In what way do you think the implementation of desal fits into the City's future vision?

1.9) What can you share about the future plans for permanent desalination? (What are the possible locations, who will be the contractor, the contract period, the amount of water produced? Is planning aligned with legislation (on sustainability etc.)?)

specific topics

1.10) The dispute/ lawsuit of the V&A plant site with the CoCT has caught much attention. Can you share anything about the situation? How do you look back on this dispute, is there anything that could have been done differently to have avoided this?

1.11) As is shared in the new water strategy, the City is planning on one or multiple permanent desalination plants. What can you share about the future plans for permanent desalination? What are the possible locations, who will be the contractor, the contract period, the amount of water produced? (Is planning aligned with legislation (on sustainability etc.)?).

2. Localities

We can see a more global trend towards the use of desalination. How does Cape Town fit into this?

2.1) Comparing Cape Town with other countries that implemented desal, what are some similarities and what are some differences for the reason to adopt desalination?

2.2) The City promotes/ talks about (permanent) desalination as an insurance. Can you share your thoughts on what the City means with this? For who is it an insurance?

2.3) What makes these two contractors (Proxa and QFS) stand out from other desalination contractors that have been considered? What was the reason to choose these specific sites? For future desalination, will other sites be considered or will the same ones be used? Why?

3. Technicalities:

- What were some disruptions in the process of construction and maintenance of the plants?
(How did you overcome these and what lessons can we learn from this?)

- What is the nature and cost of the agreements with the contractors?

- Is the city purchasing water?

- What is the cost of the produced water?

- What are the capital, operating and maintenance costs? How are these covered?

- What does that cost account for?
- Where will funding be sourced from for future desal plants?
- What is the energy consumption per L of water produced?
- Do you have an idea how much energy one plant uses on a daily base?
- What if load shedding occurs? What does the contract states?
- How much water is produced as a percentage of the intake water?
- Could you provide more information on plant operations?
- What was the reasoning informing the location of the 3 temporary plants?
- What is the current status of the plants?
- What will become of the plants following the contract period?
- What contributes to the overall cost of the water per litre? (Deal structure, financing model, economies of scale, temporary status, electricity costs)

4. Human Access:

- 4.1) How much water do the plants produce separate and together on a daily basis? (If we divide this evenly over 4,5 million people, how much water would everyone receive? Is this a reality?)
- 4.2) Keeping in mind the continuous load shedding, how secure and accessible is desalinated water?
- 4.3) How did the consultation process with the surrounding communities of Monwabisi and Strandfontein go?
- 4.4) The City supplies over 4,5 million people with water. A large group cannot afford to pay for water. How are these voices represented in the decision making regarding desalination?
- 4.5) In a recent report of the South African Water Research Commission (2019), they state that 'expensive water is a political hot potato'. What is your thought on this?

5. Environmental thresholds:

- 5.1) What is the city's vision for sustainable water management?
- 5.2) How does this relate to an understanding of water and its management as a public or economic good?
- 5.3) What is the role of desalination in the broader picture of climate change?
- 5.4) How can desalination become more sustainable?
- 5.5) What is the relation between desalinated water and the production of coal fired energy? Is this relation also integrated into the decision making and aligned with policies in order to regulate this?
- 5.6) What does the City's vision of a 'water sensitive city' mean to you? Does desalination contribute to that?
- 5.7) How does the city regulate the environmental impact of the process of desalination? What is the

responsibility of the contractor and what is the responsibility of the city? Which department is responsible? Is there alignment with national legislation?

8.3 Consent form

DEPARTMENT OF ENVIRONMENTAL AND GEOGRAPHICAL SCIENCE



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Informed Voluntary Consent to Participate in Research Study

Project title: From drought to desalination: The case of Cape Town

Invitation to participate, and benefits: You are invited to participate in a research study conducted with employees of the City of Cape Town. The study aim is to critically analyse the introduction of sea water desalination as part of the New Water Strategy in Cape Town. I believe that your experience would be a valuable source of information, and hope that by participating you may gain useful knowledge.

Procedures: During this study, you will be asked to answer my questions.

Recording: We may record audio as part of the study. These will be used to transcribe the interviews afterwards and analyse the results. If you object to this, please indicate below.

Risks: There are no potentially harmful risks related to your participation in this study.

Feedback: You will receive feedback about the results of this research by e-mail.

Disclaimer/Withdrawal: Your participation is completely voluntary; you may refuse to participate, and you may withdraw at any time without having to state a reason and without any prejudice or penalty against you. Should you choose to withdraw, the researcher commits not to use any of the information you have provided without your signed consent. Note that the researcher may also withdraw you from the study at any time.

Confidentiality: All information collected in this study will be kept private in that you will not be identified by name. Confidentiality and anonymity will be maintained as pseudonyms will be used.

What signing this form means: By signing this consent form, you agree to participate in this research study. The aim, procedures to be used, as well as the potential risks and benefits of your participation have been explained verbally to you in detail, using this form. Refusal to participate in or withdrawal from this study at any time will have no effect on you in any way. You are free to contact me, to ask questions or request further information, at any time during this research.

I agree to participate in this research (tick one box) Yes No _____
(Initials)

I agree to be audio-recorded Yes No _____ (Initials)

I agree to the use of properly anonymized audio recordings as a way to transcribe the interview Yes No _____
(Initials)

I agree to associate the data with my expertise

Yes

No

_____ (Initials)

(Initials)

Name of Participant

Signature of Participant

Date

Name of Researcher

Signature of Researcher

Date