QUESTIONS OF RESILIENCE IN MUNICIPAL FINANCE RESPONSE TO A SHOCK EVENT: A CASE STUDY OF THE CAPE TOWN DROUGHT

University of Cape Town

Thesis presented for the degree of Masters in Philosophy in Urban Infrastructure Design and Management
In the Department of Engineering and Built Environment
University of Cape Town
October 2019

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Abbreviations	
Integrated Development Plan	IDP
Medium Term Revenue and Expenditure Framework	MTREF
Financial Monitoring Report	FMR

1. Introduction

The need to be resilient has gained considerable influence in public policymaking and has become an "organizing principle of government action" in cities around the world (Coafee, 2013: 242). In May 2016, Cape Town was selected to join the 100 Resilient Cities (100RC), which is a global network of cities who are committed to resilience in the urban context (Cape Town Preliminary Resilience Assessment (CT PRA), 2018f). 100RC defines resilience as "the capacity of individuals, communities, institutions, businesses and systems within a city to survive, adapt and grow no matter what kind of chronic stresses and acute shocks they experience." (CCT, 2018f: 4).

The gaining prominence of resilience in urban policy has meant that urban decision makers are increasingly being asked to exhibit foresight and preparedness in how the urban system is planned and managed. The City of Cape Town has accepted this principle of resilience as a key means of driving collective understanding and action within the urban system in a time of growing uncertainty. The discussion of resilience in the context of the City of Cape Town, often involves the examining of resource flows to seek out ways to ensure the resources that the city relies on and the infrastructure necessary to deliver it to households and businesses are safeguarded from shocks. A resilient city is one that is "strong and flexible rather than brittle and fragile…. Their lifeline systems of roads, utilities and other support facilities are designed to continue functioning in the face of rising water, high winds, shaking ground and terrorist attacks" (Godschalk, 2003: 137 in Coafee, 2013: 243).

However, there is another crucial resource whose flow yields considerable influence over urban decision makers and which gains comparatively little consideration in discussions around urban resilience. This resource is money. The ability of the state to source funds is critical to its continued functioning and therefore resilience. This lapse is reflected within the City of Cape Town, where the municipal finance system is rarely considered as an important component in building urban resilience. This thesis will show that this resource flow needs to be recognised as central to any transitions in the urban system as greater resilience is sought.

Cape Town recently experienced the worst natural disaster in the history of its city-dom, in the form of a three-year drought. The impact of this drought on the municipal budget has been formidable. In terms of expenditure, considerable adjustments to the planned expenditure had to be made in January 2018 in order to source the funds required for large-scale infrastructure

projects designed to increase resilience within the municipal water supply. In terms of revenue, there is significant concern around the fiscal sustainability of the municipality as more and more households are developing their own water supply in the form of rainwater tanks and boreholes, which is anticipated to decrease the municipal revenue gained from water tariffs dramatically (CCT, 2018f).

According to the City's Preliminary Resilience Assessment (CT PRA), the drought "has shone a spotlight on the sensitivity of the existing revenue model for the City during shock events" (pg. 24). The CT PRA identifies a tension between the resilience- building activities taking place within households and businesses in response to a resource-constrained environment, and the consequent impact on the municipal budget and the associated resilience-building activities of the municipal government (CCT, 2018f: 55).

This thesis will seek to unpack this tension within the context of the 2015-2018 Cape Town drought event, with the aim of exploring how the City's understanding of resilience was applied as the municipality grappled with how the rules and assumptions underpinning how they fund their functions impacted on their ability to respond to this shock event. The research will describe the shifts evident in the City of Cape Town's (CCT) budgeting process during the drought event and the intersection between the City's understanding of resilience and decision-making around its municipal financing model.

1.1 Research Question:

What can the case study of the Cape Town drought event reveal with regards to how the City understands and applies the concept of resilience to its financing model in response to a shock event?

Research Objectives:

a) To explore how the term resilience was used to support decision making as the City sought to respond to the drought

b) To examine the activities undertaken by actors, public and private, in response to the recent Cape Town drought event, focussing on the resulting and unintended consequences on the municipal budget

c) To provide insights regarding the application of the City's understanding of resilience to the municipal financing model for Cape Town

2 Literature Review

2.1 Introduction

With the effects of climate change growing, urban centers are facing more uncertainty than ever with the pressure from natural and man-made challenges mounting. It is in this context that resilience as a concept has taken hold, as cities are required to adapt and thrive in the face of more frequent and diverse threats. Urban resilience is defined as, "the network of structures, processes, infrastructure and community identity that both manages extreme stress and evolves into a more desirable state following a disturbance" (Norris et al., 2007 in Cretney, 2014: 628). This literature review will provide an account of the growing resilience literature relating to cities, which has grown alongside the development of assessment tools to measure urban resilience. It will also present a deeper dive into bodies of literature relating to recurring themes of resilience building in an urban context, highlighting the debates and tensions evident therein.

When considering what greater urban resilience looks like, it is useful to consider what it would take for the urban system to change. The flows of people, money and resources are all important in ensuring the urban system continues to function. The frequency, intensity and severity of natural hazards is growing (Djalante et al., 2011), and the costs associated with responding to and adapting in the face of these hazards is a growing burden for urban centers to bear (Djalante et al., 2013). The flow of money and decision making around financial resources, however, is rarely considered within literature relating to urban resilience. Outside of resilience literature, there is a growing interest in the financing options for changing urban contexts due to climate change, with prevalence given to the financing of the capital investments required for infrastructure transitions.

There is an established literature around municipal financing models and how they came into being which will be described in the literature review, specifically looking at the municipal finance model in place in South Africa. Municipal finance models are a key driver of how urban governments invest in, maintain and preserve the services necessary for the functioning of the urban system. However, there is little literature interrogating how the municipal finance model responds in a time of increased climate shocks and stresses.

This thesis sits at the intersection of the municipal finance and urban resilience bodies of literature and uses the Cape Town drought case study as a means of highlighting how the

response of the municipal finance model in a time of shock is a key determinant of the response and ongoing functioning of the urban system.

2.2 Review of Resilience in Urban planning and management discourse

Resilience as a concept originated in the applied sciences where it describes the "stability of materials and their resistance to external shocks" (Spaans and Waterhout, 2016: 109). Resilience then became established within ecological systems thinking in the 1960s, where it describes, "the magnitude of the disturbance that can be absorbed before the system changes its structure" (Holling, 1996:33 in Spaans and Waterhout, 2016). Since the 1990s, the concept of resilience has increasingly gained traction in urban planning and policymaking discourse (UNHabitat, 2017). The concept of resilience gained further traction within Disaster Risk Response literature after the adoption of the Hyogo Framework for Actions 2005-2015: Building the Resilience of Nations and Communities to Disasters (UNISDR 2007, in Djalante et al., 2013). In the context of disasters, resilience is understood as the "ability of a community or society to resist, absorb, accommodate and recover from disasters timely and efficiently" (UNISDR 2009 in Djalante et al., 2013: 2110).

There has been a rapid adoption of the concept among international donors. In 2013, the Rockefeller Foundation established the 100 Resilient Cities (100RC) Programme with the aim of assisting cities to become more resilient to physical, social and economic challenges they face in the 21st Century (Spaans and Waterhout, 2016). In 2017, Cape Town was included as part of the 100RC network. The definition of urban resilience adopted by the Rockefeller Foundation for the 100 Resilient Cities Programme is the "ongoing capacity of cities to absorb, adapt, transform and prepare for shocks and stresses along the economic, social, institutional and environmental dimensions, with the aim of maintaining the functions of a city and improving response to future shocks." (Figueiredo, Honiden and Schumann, 2018, pg. 10).

Within urban resilience literature there is a focus on governance and policy frameworks that guide decision makers in fostering urban resilience (UNHabitat, 2017: 7). In support of this research, there is an increasing drive towards developing resilience frameworks and associated "quantitative tools, indicators and international standards to measure resilience at the urban scale" (UNHabitat, 2017:7). Schipper and Langston (2015) have provided a comparative study on the various resilience frameworks developed, including their conceptual entry points and approach to measurement. They have found there are two schools of thought following the conceptual roots described above which inform these frameworks. One school focuses on the socio-ecological approach to resilience, which has its roots in ecological systems thinking, whereas the other school focuses on a disaster-risk focused approach to resilience (Schipper and

Langston, 2015). The most rigorous frameworks are able to navigate both of these two conceptual entry points, as measuring the improved livelihoods and well-being of a population will certainly provide an indication of how successful resilience building is likely to be, however it does not assist in assessing the extent to which a population is resilient to a disaster event (Schipper and Langston, 2015).

In a study on Understanding and Measuring City Resilience, ARUP, in partnership with the Rockefeller Foundation (2014), found that there is a large degree of convergence within the various resilience frameworks around the key dimensions of resilience building and these have been captured in the City Resilience Framework, which focuses on the capacity of the urban system to cope with a range of dynamic shocks and stresses. Coming out of this Resilience Framework is a City Resilience Index (CRI), which is quickly becoming the foremost tool in articulating "urban resilience in measurable evidence-based and accessible way that can inform urban planning, practice, and investment patterns" (The Rockefeller Foundation and ARUP, 2014: 11). This is the tool adopted by the 100 Resilient Cities network, which Cape Town is a member. The purpose of the CRI is to offer cities a tool to measure their key strengths and weaknesses and monitor their resilience over time with the intention that the wide range of stakeholders within the urban system are able to enhance their cities resilience through their collective day-to-day practices, behaviors and decisions (The Rockefeller Foundation and ARUP, 2016).

However, resilience is by nature realized through disruption of existing equilibriums, which means that in becoming more resilient, a city may be required to shed its more poorly adapted systems in favour of more resilient ones (Spaans and Waterhout, 2017). The frameworks developed to guide cities toward resilience have been criticized for not offering enough guidance on how to navigate the disruption to existing urban systems that comes with resilience-building and the vested interests inherent in these systems, whilst still safeguarding the continued functioning of the city.

Sharifi and Yamagata (2016) examine the body of literature relating to urban energy resilience with the aim of developing a conceptual framework for assessing energy resilience in urban centres. This study found that often resilience literature takes the form of single-hazard studies focussing on, "hazard mitigation, ecology, transportation, infrastructure, economy, poverty, disease and pandemics, governance and agriculture" (pg. 1655). These authors have noted that a more recent and emerging conceptualization of resilience – termed 'adaptive resilience' recognises that the dynamic and complex nature of cities means that they continuously undergo

change in response to shocks and stresses, and do not necessarily return to an equilibrium state. These systems exhibit adaptive resilience through their ability to engage in "short term coping" and "long term adaptation" (pg. 1660). In short, these systems are able to "bounce back and also bounce forward." (pg. 1660).

There is growing recognition that resilience is both a process and an outcome that takes cities beyond merely being prepared for and able to recover from specific disaster events as is the focus of disaster risk reduction efforts (Spaans and Waterhout, 2016). Rather, urban resilience assumes that at any one time a city faces a multitude of stresses and shocks and the urban system as a whole must be able to cope with a wide range of disruptive events.

A number of tensions and debates around how the changes required for cities to achieve greater resilience practically play out within the four dimensions above have emerged within the literature and these will be discussed further below.

2.2.1 Resilience by Whom and for Whom?

The dominance of governments as the audience for resilience literature is of concern to some, including Cote and Nightingale (2012), Coafee (2013), Cretney (2014) and Kolers (2016) and as this perhaps over-emphasises the role of the state as the custodian of city resilience. There is recognition that the governance culture of a city will influence how City Resilience Frameworks are applied and at what scale resilience-building activities take place and who is responsible for undertaking these activities (Spaans and Waterhout, 2017). ARUP have found that there are many cases where there is dominance by the state in engaging with shocks and stresses facing cities and where the state is viewed as the main actor in building urban resilience.

Stemming from the understanding that cities function as "complex, interdependent and integrated social-ecological systems" (UNHabitat, 2017: 6), there is recognition that building resilience in an urban context requires an integrated, multi-level and multi-stakeholder approach. OECD produced a paper outlining 'Indicators for Resilient Cities' that provides guidance to city governments on how to develop a local resilience strategy and what indicators are useful in measuring urban resilience. This paper asks the important questions of "Are disasters perceived differently by different stakeholders?" (Figueiredo et. al., 2018: 5). Coafee (2013) argues that the resilience lens is unique in its enhanced appreciation of the range of perspectives, objectives and contexts within the urban system which need to be taken into account when building resilience, in contrast to "traditional approaches to urban risk and security [which] relied upon a narrow range of governmental stakeholders" (pg. 243). Resilience discourse has facilitated the involvement of more stakeholders, as well as a shift in the scale of

intervention being invoked (Chandler, 2012 in Coafee, 2013: 248). Coafee (2013) has argued that resilience has "disrupted the traditional relationship between the state and the individual with 'governing from a distance' through decentralized decision-making and authority increasingly encouraged" (Coafee, 2013: 243).

Through a review of resilience literature and an evaluation of how the concept has evolved over time Cretney (2014) depicts how the term resilience is used by different actors for different purposes. This paper asks questions around 'for whom' and 'by whom' resilience is enacted. Cretney (2014) argues that resilience literature, both in the academic and in the popular use of the concept, has not grappled with the elements of power, agency and inequality which are at play within an urban system. Pike et. al. (2010) highlights how due to the state's wide-reaching power it is able to shape how resilience is understood and measured, viewing the need for strong institutions and state resources as key in building resilience (in Cretney, 2014). This questions whether resilience tools and frameworks can be used to reinforce dominant power relations. This concern is highlighted by Welsh (2014) who argues that "exploitative systems can be extremely resilient, favouring certain social groups at the expense of others, implying that resilience is not always a desired state" (in Durban Resilience Strategy (DRS), 2017: 15). There are a number of researchers whom have questioned whether the actions justified in the name of resilience result in, "further marginalisation of disadvantaged populations, threaten democratic processes …." (Coafee and Rogers, 2008; Walker and Cooper, 2011; Cretney, 2014). The popular application of resilience often calls for more responsibility for coping with shocks and stresses to be placed on the individual or community level rather than on the state.

Similarly, Cote and Nightingale (2012) argue that "resilience thinking is a power-laden framing that creates certain windows of visibility on the processes of change, while obscuring others" (pg. 484). Within an urban system, there are competing power, authority and complex rationalities at play, therefore it is important that resilience literature become more critically engaged in questions around whose environments, livelihoods and interests are being protected through resilience activities. Furthermore, Cote and Nightingale (2012) highlight how competing value systems and systems of power are integral to the development of resilient socio-ecological systems (SES). This paper highlights how conflicts in scientific and indigenous knowledge can have considerable bearing on how the concept of resilience is interpreted and effected by different actors, however this conflict has not been engaged with in resilience literature (Cote and Nightingale, 2012). Conflicts around resilience occur not only between interest groups, but also between different systems. It is possible for a system to be environmentally resilient but not socially desirable, and vice versa (Walker and Salt (2012) in Cretney, 2014).

It is evident that resilience is intrinsically conflictual (Kolers, 2016; Harris, Chu and Ziervogel, 2017). Therefore, there is a need for explicit recognition within resilience literature that achieving greater urban resilience does not just require involving more stakeholders but also the recognition and negotiation between the different agendas held by stakeholders (Harris et al., 2017). What happens when the resilience of individuals conflicts with that of the state?

The Durban Resilience Strategy (2017) argues that urban resilience cannot be considered separate from 'politics', given that politics is "the process through which people construct, defend and change the rules and frameworks which inform how they live" (Miller, 1980 in DRS, 2017: 15). True resilience building requires actors to critically engage and negotiate, "the material changes, processes and pathways that lead to more sustainable societies" (DRS, 2017: 15). Resilience therefore needs to be considered in terms of "who benefits, by whom and for what reasons or purposes" (DRS, 2017: 15). Interestingly, this perspective on resilience saw Durban parting ways with the 100 Resilient Cities network (DRS, 2017).

There is a need to consider in the context of a particular city; to what extent the activities associated with resilience building can be effectively undertaken by a range of actors, including non-governmental organisations as well as individual households and businesses (Spaans and Waterhout, 2017). The Cape Town drought event offers an opportunity to interrogate how the concept of resilience is interpreted and negotiated between different actors during a shock event, and how these differing and at times conflicting interpretations can impact on the financial model underpinning service delivery.

2.2.2 Cape Town Preliminary Resilience Assessment:

Over the first half of 2018, the City of Cape Town undertook the City Resilience Assessment using the Rockefeller City Resilience Index (CRI) as part of the 100 resilient cities programme and is in the process of developing a Resilience Strategy. The purpose of this index is to help cities "understand and measure their capacity to endure, adapt and transform" (The Rockefeller Foundation and ARUP, 2016). As part of this programme, a mass survey involving over 11 000 participants was undertaken where persons were asked to identify the most pertinent chronic stresses and Acute shocks facing Cape Town. A Chronic Stress is defined as a phenomenon, which weakens, "the fabric of a city on a day-to-day or cyclical basis, for example, high unemployment and crime." (CCT, 2018f: 5). An Acute shock is a "sudden sharp event that threaten a city, for example, earthquakes and floods" (CT PRA, 2018f: 5).

It is important to note that the City Resilience Framework does not outline a roadmap for how cities are to become more resilient. Instead its aim is to provide a set of critical domains for

resilience, which allow cities to assess, “the extent to which critical functions are capable of adapting to new situations induced by shock or stress” (Spaans and Waterhout, 2017:115).

This Index is based on research conducted by The Rockefeller Foundation and ARUP (2016) and outlines four dimensions critical for resilience, which include:

- “**People [Health and Wellbeing]:** the health and well-being of everyone living and working in the city;
- **Organization [Economy and Society]:** the social and economic systems that enable urban populations to live peacefully, and act collectively
- **Place [Infrastructure and Environment]:** the quality of infrastructure and ecosystems that protects, provide and connect us;
- **Knowledge [Leadership and Strategy]:** the capacity to learn from the past and take appropriate action based on evidence and active participation, including business and civil society” (The Rockefeller Foundation and ARUP, 2016: 10).

Figure 1 below depicts how these dimensions are unpacked into 12 drivers, all of which focus on an aspect of resilience building in the urban context.

The Index also provides seven qualities of resilient systems (ARUP, 2014: 5):

- **Reflective:** the ability to continuously evolve and modify according to emerging evidence
- **Resourceful:** the ability to, “rapidly find different ways to achieve their goals or meet their needs during a shock or when under stress”
- **Robust:** the ability to anticipate and design for potential failures in systems
- **Inclusive:** the ability to consult and engage with a broad range of stakeholders
- **Redundant**: the ability to withstand disruptions and extreme pressure due to built-in spare capacity
- **Integrated:** the ability to ensure alignment between city systems and decisions towards a common outcome
- **Flexible:** the ability to “change, evolve and adapt in response to changing circumstances’”.

Figure 1: City Resilience Framework

Source: City Resilience Framework (ARUP, 2014:9)

Four enablers for Resilience have been identified within the Cape Town Preliminary Resilience Assessment, two of which are relevant for this thesis (CCT, 2018f). One of these enablers and an associated pathfinding question for each are listed below. It is intended that this research will provide reflections on this pathfinding question, drawing lessons from the drought event.

An enabler identified through the PRA is the **improvement of resourcing and funding resilience,** with the following associated pathfinding question: (CCT, 2018f: pg. 55)

> *"How does the City develop a resilient long-term financial strategy? How do we use our data to understand future financing needs based on what we extrapolate for the 'resilience' gates in our strategic business processes and how do we construct a financial strategy accordingly?*

The CT PRA notes the need for Cape Town city government to be reflective and self-aware in order to continuously incorporate the learnings from past experiences in improving strategies and plans to avoid future shocks (CCT, 2018f). Furthermore, the PRA calls for "improved accountability and decision-making around instances of shock" (pg. 53). Thus, documenting and critically reviewing how the municipal budget was able to respond to the Cape Town drought event is an important step in giving effect to the desired embedding of the concept of resilience into decision making relating to the municipal budget.

The following section will briefly outline the regulatory and literature environment determining the structure and processes associated with municipal finance in South Africa. This section also provides a critique of how the current municipal financing model is able to adapt to the changing nature of cities, which includes new and evolving stresses and shocks.

2.3 Understanding Municipal Finance in the South African context

UNHabitat (2015) recognises that municipal finances are under pressure globally, due to the "widening gap between the availability of financial resources and municipal spending needs". One of the driving forces behind this gap is the rapidly growing urban populations and the resultant growth in demand for public services, new public infrastructure and the increasing maintenance burden (UNHabitat, 2015).

In South Africa, the powers and functions of local government are entrenched in its constitution, making it one of the most advanced local government systems in the world (Cameron, 2001). The South African White Paper on Local Government (1998) initiated the policy and legal framework for municipalities as a third tier of government. Between 1998 and 2004 the mandates and focus of local governments were deepened and a classification system was put in place which led to the creation of metropolitan cities, giving them enhanced powers and responsibilities and autonomy. Municipalities fund basic services including water, electricity, refuse removal, fire-fighting and emergency services, selected social services and amenities, as well as a host of urban management services (National Treasury, 2017). These services require both capital expenditure and operating expenditure in order to ensure their continued functioning and the efficiency and effectiveness thereof. Capital Expenditure involves the utilisation of funds to replace, improve or expand infrastructure necessary for these services to be delivered. Operating Expenditure refers to the funds required for the ongoing costs of keeping the services operational, including the remuneration of staff, repairs and maintenance (SACN, 2015).

A City governments ability to function relies on its ability to collect revenue and administer expenditure on both day-to-day operations which ensure the continued functioning of current infrastructure and capital projects which see new services created and infrastructures expanded to accommodate a growing city (SACN, 2015). The fiscal instruments that are available to municipalities to fund their expenditure responsibilities include, "own revenue (property taxes, user charges for municipal services rendered, surcharges on user charges and other local taxes), intergovernmental transfers (conditional and unconditional grants) from national government and municipal borrowing from credit markets (financial institutions) for capital expenditure" (SACN, 2017: 25). Revenue from Electricity sales are the main source of revenue for South African municipalities, accounting for approximates 50% of all city own revenue (SACN, 2014). This is followed by Property rates contributing roughly 20% and thirdly revenue from water sales contributing approximately 15% (SACN, 2014). To ensure that municipal finances are managed lawfully, the municipal financing system is regulated by the Municipal Finance Management Act (MFMA) (Mtwesi, 2016).

The Local Government Fiscal Framework is based on the recognition that certain municipalities have less own revenue raising potential than others (National Treasury, 2017). In 2017, Metropolitan cities were allocated only 4.29% of the total national tax base, the assumption being that cities have the potential to raise considerably more revenue than other government institutions and are expected to be largely self-financing (SACN, 2017).

However, in 2001 it was already apparent that the infrastructure backlogs facing municipalities meant that their ability to fund their needs using own revenue is not sufficient (Cameron, 2001). The model underpinning city financing is circular in nature, whereby the revenue generating potential depends on the expenditures made. It is anticipated that the expenditure of municipalities will lead to improvements in the Quality of Life of city residents, thereby enhancing their ability to prosper and consequently their ability to better afford to pay for municipal services and to pay more tax (SACN, 2016). The effect being that the 'own' revenue potential for municipalities will increase as households and businesses are able to pay property taxes and service charges (SACN, 2016: 46).

The South African Cities Network conducted a study in 2017 investigating alternative financing models for metropolitan cities, in partnership with Tswane Municipality (SACN, 2017). This study took into account the impacts of shock-risks and normal risks on municipal financing and proposed some crosscutting principles and fiscal instruments which could provide for a better fiscal environment for municipalities.

This report outlines the three major risks facing cities and their ability to finance their functions:

- "Climate change and its effects on resourcing, space, habitat, administrative management, infrastructure and planning
- Political and governance regime change or regional / national wars
- Economic crises (specific) and its effects on financing; administrative management and infrastructure" (SACN, 2017: 34).

The report concludes that, "the current financing model is inadequate to meet the medium to long term trajectory of local government and cities" (SACN, 2017: 35). The Local Government Equitable Share has not increased from its flat rate of 9% despite the functions and mandates of local government increasing by 43%. The report advises that metropolitan city revenue sources need to be diversified and a number of the existing revenue sources currently allocated to other spheres of government need to be re-assigned to cities in order for them to sustainably deliver on their mandated responsibilities (SACN, 2017).

One of the crucial questions raised by this report is in relation to the principle of sustainability, where it motivates that consideration be given, "to the extent to which cites are reducing the impact on the environment through their day to day operations and new or refurbed infrastructure investment" (SACN, 2017: 47). The report raises questions around whether the financing model of cities contradicts these objectives and whether alternative revenue raising opportunities associated with more environmentally sustainable growth can be developed (SACN, 2017: 47).

2.3.1 Financing the water services in times of climate uncertainty

There are a number of public finance researchers who have focussed specifically on the logic underpinning the financing model underpinning the water service in different contexts and the challenges which this model is encountering due to climate uncertainty.

Muller (2017) argues, "water could become a lead sector in the process of developing appropriate models for financing the implementation of adaptation" (pg. 111). Water managers are required to make sound decisions regarding infrastructure investments in a time of uncertainty, relying on a thorough understanding of the relative operating costs and lifecycle costs of various water infrastructure options over time (Muller, 2017). The important backdrop to these decisions is climate variability if investments in water infrastructure are to successfully "perform under future climate regimes" (Muller, 2017: 105). The understanding of risk among water managers associated with climate variability will determine water managers' appetite to

pursue more expensive options which deliver a more climate-independent water source. However, it is important to note that these decisions are tied to the financial model linked with these options.

Rusca and Schwartz (2018) describe how cost-recovering tariffs are held up as an important means of achieving the goal of 'water for all' inherent in global strategy like the Millennium Development Goals (2000-2015) and the Sustainable Development Goals (2015-2030). The motivation for this approach being that a water utility needs to be financially sustainable if it is to be able to perform better will be able to provide water more efficiently to its customers. Rusca and Schwartz (2018) outline the business administrative case for cost recovery which is a key informant into how water utilities within Sub-Saharan African have chosen to model their water utility function on. This case purports that by under-pricing services, the financial viability of the water utility will be undermined leading to "low operating performance and underinvestment in infrastructure (pg. 102). Full cost recovery is commonly viewed as a pre-requisite for the expansion of the network infrastructure and therefore growing the access of the poor to drinking water. This paper interrogates how inclusive urban water services can be achieved in the context of sub-Saharan Africa where extensive socio-economic inequalities exist. It finds that the adoption of full cost recovery principles by water utilities can exacerbate rather than enhance access to safe water supply.

A further argument for full cost-recovery tariffs described by Rusca and Schwartz (2018) is that by paying the full environmental and economic cost of the service, consumers are incentivised to reduce their water consumption and limit wastage and misuse. Some researchers have raised the concern that payment by citizens for water services doesn't necessarily reflect a willingness and ability to pay due to water being essential for life (Khunou, 2002 in Rusca and Schwartz, 2018). Rather, the payment of higher tariffs for water may lead to significant implications for lower income households and inhibit their access to other goods or basic services.

Rusca and Schwartz (2018) argue that the, "financial performance of a water provider should not only be measured by the level of cost recovery, but also by its ability to access other sustainable sources of funding" (pg. 107). They have observed that the "existing institutional framework regulating water production and associated tariffs is still geared toward a single utility with a mandate to provide water access to all" (Rusca and Schwartz, 2018:107). However, these institutional frameworks are not able to adapt to the realities of the heterogeneous municipal water systems at play within cities in sub-Saharan Africa. The principles and practices relating to water pricing need to be able to respond to the multitude of ways people meet their water needs

within these complex urban environments, in response to their own financial resource constraints, as well as water supply constraints.

Within the Cape Town specific literature relating to resilience and municipal finance, there is an identified need for analysis and the building of insights relating to how the principles of resilience can be better reflected and applied within the municipal financing model. The final section of this literature review will highlight studies which explore areas of intersection between the municipal finance and urban resilience literature.

2.4 Intersections between Public Finance and Resilience Literature

There are a few examples within urban resilience literature and its associated indices and frameworks where the importance of applying resilience thinking to financing systems is noted. Muller et al. (2007) argue that institutional mechanisms and financial instruments, which allow for greater resilience to climate variability, are essential for the continued functioning of local governments in the face of increasing complexity and uncertainty. The OECD Ministerial Council's statement (2014) motivates that there are four inter-related dimensions of resilience, these being the economic, environmental, social and institutional dimensions, with most disasters requiring the efforts of all four dimensions to overcome. The institutional dimension requires, "clear leadership and long-term vision; sufficient public resources; collaboration with other levels of government; and an open and participatory government" (pg. 17). Within the Risk Governance Process (OECD, 2014) it calls for governments to "plan for contingent liabilities within clear public finance frameworks by enhancing efforts to minimize the impact that critical risks may have on public finances and the fiscal position of a country in order to support greater resilience." (Pg. 20). Djalante et al. (2013) echo this sentiment in their seven pathways for adaptive and integrated disaster resilience. Within this framework they recognize that the provision of adequate financial resources is a crucial part of disaster resilience and as such, one of the seven pathways is 'Finance and Risk' whereby comprehensive disaster risk finance and insurance must be developed using a broad set of private and public instruments. They urge urban governments to seek the diversification of their financial resources if they are to adequately, "deal with complexities and to anticipate uncertain impacts from hazards and climate change" (Djalante et al., 2013: 2122).

Sharifi and Yamagata (2016) in putting together a conceptual framework for assessing urban energy resilience, they recognise the importance of governance and strong institutional capacity to monitor the functioning of the system, as well as strong decision-support environment to

support adaptation. This paper notes the need for urban authorities and utilities to make available the resources and funding necessary for resilience-building actions, however, the question around whether the system which governs the allocation of these resources and funds is adequate to support these activities is never asked. The flexibility, robustness etc. of the financial system will determine whether urban governors are able to perform in the manner called for in this paper, whereby urban governors "experiment with a wide array of carrot and stick measures to reduce energy consumption and encourage technology development" (pg. 1670) or indeed whether they have the incentive to do so from a financial sustainability perspective.

Brugmann's (2011) paper on 'Financing the resilient city' does bring the finance lens into the resilience debate. He argues that resilience upgrading activities with regards to infrastructure should include, "a set of financially justified risk reduction measures that increase the reliability of investment returns and asset values under a wider range of circumstances" (p. 217). This paper highlights the importance of resilience upgrading efforts not solely focussing on the infrastructure design, but also the interdependent sub-systems that inform it. It calls for "a more integrated focus on overall environmental risks, development conditions and local area performance" (pg. 222). With regards to the financing of these projects, Brugmann (2011) cautions that reliance on international adaptation funds should be avoided, and rather resilience upgrading projects should leverage public and private finance. This paper unpacks the importance of financial planning and innovative financing mechanisms with regards to infrastructure upgrading projects, but does not cover the financial planning and mechanisms required to allow for the urban system as a whole to adapt to new challenges. Furthermore, it is increasingly necessary to critically review the assumptions and bias inherent in the current systems and processes at work within urban governance, specifically financial modelling.

2.5 Conclusion

Resilience is an approach adopted by the City of Cape Town, and many other city governments around the world, to ensure that the resources that the city relies on and the infrastructure that distribute these resources are safeguarded from shocks (Ziervogel et. al., 2017). The embeddedness of resources within the urban system means that transformation of that system to one which is more resilient becomes more difficult (Walker and Salt, 2012 in Cretney, 2014). However, within resilience literature, money is a resource not often considered in light of a

resilient urban center. Arguably, an important attribute of a resilient city government should be its ability to plan, allocate and manage funds in a way that ensures reliable and sufficient utility services. A financially robust city is one that anticipates the shocks and stresses of the 21st century and puts in place a financial model that is able to withstand these changes. The bringing together of these two bodies of work offer useful insights which can be applied to the Cape Town context, as we use the drought event as an opportunity to observe how these two bodies of knowledge and the logics underpinning them play out during a shock event.

The Cape Town case study also presents an opportunity to observe how the concept and practice of resilience can be translated from the "natural to the social world" (Davoudi et al., 2012: 305), whereby the systems which urban governments are seeking to safeguard are increasingly able to change and adapt rather than merely 'bounce back' to their original state in response to a shock.

Resilience literature is also lacking in providing guidance to urban governments in navigating tensions between actors with regards to their resilience-building efforts. The role of the state is often the focus of resilience authors and there is therefore a tendency to ignore the complexity of the urban system, whereby there are multiple actors all seeking to build their resilience in the face of increasing shocks and persistent stresses. The actions undertaken by these actors in the name of resilience may conflict, compounding the effects of shocks or stresses impacting upon the city. Furthermore, consideration of the temporal and spatial interactions taking place at various scales, becomes important in understanding the trade-offs being made in pursuit of urban resilience (Chelleri, Waters, Olazabal and Minucci, 2015).

Therefore, although the concept of resilience offers a useful lens through which to assess whether a city is able to cope with a wide range of shocks and stresses, the literature base needs to develop further in its consideration of the trade-offs, interdependencies, unintended consequences and conflicting interests inherent in a complex urban system if it is going to better inform decision-making in this space. This thesis will show how these tensions are evident within the municipal finance system informing the investment, operations and tariffing decisions for the water service during the recent Cape Town drought event.

It is clear from a review of literature that there is a need to explore how resilience can be understood and applied to a municipal finance model in periods of high complexity and uncertainty associated with a shock event.

4. Research Methodology:

The following section will outline how information was gathered in order to provide an account of the various responses to the drought and how this information was analysed to describe the implications of these activities on the municipal budget. The identification of the research question emerged through the Cape Town drought as experienced by the researcher, who is a City of Cape Town employee hired to provide strategic support to the politician tasked with providing oversight over the Disaster Risk Management department during this time (Mayoral Committee Member for Safety and Security).

4.1 Research Approach:

This thesis adopted a pragmatic approach, whereby the research focussed on the systematic study of a particular problem, with the intention of articulating the drivers and contextual elements leading to this problem which could then point to a solution (Creswell, 2013). This research was conducted using a mixed methods approach, whereby many approaches to the collecting and analysing of data, information and insights were adopted (Creswell, 2013). The methods used were selected in order to best achieve the research aim and objectives.

In terms of the gathering of information, a range of techniques were used in order to increase the veracity of this information, particularly in order to confirm the sequence of events and decisions taken throughout the drought event which had implications for the municipal budget (Berg, 2004). The information gathered through written records was checked against the first-hand accounts gained through interviews and the researcher's own experience.

The research conducted a thorough evaluation and synthesis of documentation relating to the City of Cape Town's budgeting process for both the 2017/18 and 2018/19 financial years as well as the planning being conducted for the 2019/20 budget cycle. The evidence reviewed included presentations to political and administrative committees and civic interest groups, Monthly Financial Monitoring Reports, annual Medium Term Revenue and Expenditure Frameworks, meeting minutes and studies. This documentation was reviewed in order to gain understanding as to the impact of the 2015-2018 drought event on the municipal budget development process

within the 2017/18 and 2018/19 financial years. Other forms of written evidence included in this review was media statements made by the City of Cape Town and media articles written which featured quotes from key decision makers within the City.

A **Descriptive Research Methodology** was utilised in order to collect information through observation, as part of the researcher's capacity as a City of Cape Town employee, which meant they were included in many meetings and discussions relating to the drought event as it was unfolding throughout 2017 and 2018. Evidence was reviewed relating to the meetings/ workshops listed below, including the researcher's own personal notes, meeting minutes, documents and presentations:

- City of Cape Town Workshop on the Budget Policies for 2018/19
- Built Environment Performance Plan 2019/20 planning meetings
- Urban Growth Management Meetings August 2018
- Informal Settlement Engagement (organised by Slum Dwellers International) – presentation by Ethekweni municipality on the Durban Resilience Strategy
- Work Session with UNHabitat, National Treasury's City Support Programme and CCT on scenario planning around the financial sustainability of the municipality - 3rd August 2018

Interviews were conducted with key officials involved in the municipal budgeting process, from the following City of Cape Town departments:

- Resilience Unit: Cayley Green (Senior Resilience Analyst – Resilience Unit)
- Strategic Policy Unit: Daniel Sullivan (Acting Manager)

These interviews were in-depth, semi-structured interviews with the intention of gaining a detailed perspective of the interviewees' experience of and opinion on the City of Cape Town's budget development process in light of the concept of resilience.

4.2 Data Analysis:

The purpose of the research is to provide descriptive accounts based on the information captured from the various collection techniques described (Berg, 2014). This research analysis approach enables the researcher to better understand the sequence of events and trajectory which occurred during the drought event, as well as explore the areas of tension and

contradiction which emerged between the assumptions, functional roles and responsibilities within local government.

The researcher's embeddedness within the City of Cape Town meant that the identification of the underlying causes and possible interventions relating to the research question could be collaboratively constructed between the researcher and practitioners, with the shared objective of improving the practice and service delivery of the practitioner (Berg, 2004). The researcher was able to work with practitioners to reflect on the underlying assumptions impacting on the decisions taken during the shock event and challenge these assumptions in light of the City's understanding of resilience (Berg, 2004).

Due to the embedded nature of the researcher, it is likely that a researcher bias influenced the research question and methodological approach (Diefenbach, 2008). The researcher is an employee of the City of Cape Town and was involved in many meetings and discussions where various aspects of the municipal response to the drought event were discussed. This provides for uniquely detailed insights into the complexity of the decision-making process for City authorities, but also means that the research question emerged from the researcher's experience of this time in local government.

However, the researcher has been cautious not to stray from the descriptive mode of analysis, using the Cape Town Drought event to highlight tensions and raise questions around the City's understanding of the principles of resilience and the extent to which the municipal financing model exhibits these principles during a shock event. The intention of this research is not to provide case study findings which can be generalized and applied to other city experiences.

4.3 Conceptual Framework

The Cape Town drought event coincided with the City's growing interest in resilience as a unifying principle which could drive collective understanding and action. As a result, resilience became the dominant discourse of the City during the drought, particularly as a means of articulating the City's understanding of, and response to growing uncertainty brought about by climate change. It was also used as a concept which all facets of local government and society at large were called upon to unite behind, with resilience being expressed by the municipality as a shared objective for all residents of Cape Town.

This thesis will explore the City's framing of resilience together with its underlying principles and make observations around how this framing of resilience is evident in how the drought event was responded to within the municipal budgeting process. The drought disrupted the status quo on both the expenditure and revenue side of the municipal budget for the water service. The expenditure budget for water services over the period of the drought, depicts how the City as the active agent responded in terms of their understanding of what a resilient water service would look like. The revenue budget for water, where service charges are linked to the amount of water consumed, depicts how the residents' relationship with water changed during the course of the drought, and likewise their levels of water consumption. In viewing the drought through the lens of the municipal financial model and in assessing the implications of the drought on both the expenditure and revenue sides of the budget, it is possible to gain insight into the impact of activities undertaken by multiple actors in the pursuit of 'water resilience' on the finance resource base for the water service.

The story of how the municipal budget system was affected by and reacted to the drought provides an opportunity to observe how useful the City's understanding of resilience is when applied to a complex system, where many actors undertake simultaneous and independent activities, and the impact of these activities is evident at multiple levels and across multiple systems and sub-systems. The researcher wanted to test whether the City's understanding of resilience was reflected in how it navigated the tensions and uncertainty brought about by the drought and whether it was useful in re-assessing the assumptions underpinning the water service financing model.

5. The Cape Town Drought Case Study

5.1 Introduction

This section will begin with a brief description of the Cape Town municipal budget and some of the recent concerns around the sustainability of the municipality's major revenue streams. This provides the backdrop for the Cape Town drought case study. This thesis provides a descriptive analysis of this shock event both in terms of the response it invoked from municipal government and from Cape Town's businesses and households. An account is provided around how the contradictions and tensions evident in how the responses from these various actors impacted upon the municipality's finances, and what this case study reveals around the assumptions inherent in the municipal finance model. The discussion ends with a collection of reflections around the application of CCT's understanding of resilience to its municipal budgeting approach in a time of greater uncertainty.

5.2 Cape Town Budget Context:

For the current financial year, 2018/19, the total municipal budget is R47.7 billion with R8.4 billion for capital expenditure and R39.3 billion for operating expenditure (CCT, 2018b). Figure 2 below indicates that the majority of the City's operating budget is allocated to the Energy Directorate, followed closely by the Informal Settlements, Water and Waste directorate in order to provide the basic services of water and waste collection. The third largest tranche is provided to the Transport and Urban Development Authority with the aim of developing and maintaining an integrated public transport system (CCT, 2018b).

Figure 2: Total Operating expenditure for each City directorate for 2017/2018 (CCT. 2018b)

OPERATING EXPENDITURE BUDGET PER AREA

Directorate	North	East	Central	South	City-wide*	Total 2018/19 Budget
Area-Based Service Delivery	184 494 673	48 684 581	86 732 042	61 066 951	195 519 718	576 497 966
Assets & Facilities Management	240 562 745	50 762 065	228 876 183	66 534 776	1 070 811 560	1 657 547 329
City Manager					160 619 482	160 619 482
Corporate Services	517 409 980		42 076 917		1 624 975 364	2 184 462 261
Energy	314 309 288	165 708 150	161 802 862	266 028 846	9 766 133 353	10 673 982 499
Finance	318 025 886	51 889 706	106 074 764	18 707 403	2 652 197 947	3 146 895 706
Informal Settlements, Water and Waste Services	1 903 579 768	1 132 190 298	665 628 363	595 222 709	5 225 142 912	9 521 764 051
Safety and Security	445 085 870	242 316 383	230 722 711	328 674 785	2 069 930 961	3 316 730 710
Social Services	599 229 056	497 852 823	565 859 562	614 211 309	1 340 255 505	3 617 408 254
Transport and Urban Development Authority	255 103 132	253 138 960	411 658 695	197 385 524	3 290 743 688	4 408 029 998
Total	**4 777 800 396**	**2 442 542 966**	**2 499 432 099**	**2 147 832 304**	**27 396 330 492**	**39 263 938 257**

*City-wide includes provision for bulk purchases, external finance charges, bad debt, etc.

Source: CCT, 2018b

The City funds the vast majority of its operating budget from revenue derived from the charges levied for services (48.7%) including electricity, water, refuse and sanitation tariffs, with the second largest revenue stream being property rates (23.8%) (CCT, 2018b). The City also gains an equitable share grant from National Government for the purposes of subsidising the provision of free basic water, electricity, sanitation and refuse removal services for the poor. Figure 3 outlines the major revenue streams received by the City of Cape Town and the amount of funds predicted from each category for the 2018/19 financial year (CCT, 2018b). Electricity charges bring in by far the most revenue for the municipality at almost R12.6billion per annum, which accounts for 32% of the City's total revenue. This is followed by property rates (R9.3billion) which

accounts for 23.8% of total revenue. Water service charges are the third largest source of 'own' revenue for the municipality at R3.5billion per annum, and together with revenue from sanitation charges (R1.8billion), water service related revenue contributes 13.7% of total revenue.

Both the water and electricity utilities and their associated tariff models have been built on a cost-recovery basis, whereby the costs of providing these services is expected to be recouped via service charges, with a degree of cross-subsidisation built in to accommodate the provision of free or subsidised services to the 'indigent' population. It is clear that the willingness and ability of households and businesses to pay property tax and utility charges is a very important factor in ensuring that the Cape Town municipality is able to generate the revenue it needs to meet its commitments. The revenue generation model is also premised on the consumption of services by households and businesses, as the revenue gained from electricity and water services are linked to the consumption of these services rather than availability thereof. A household or business pays according to the amount of water or electricity they have consumed in the past month. This is a second important factor which underpins this revenue model and is built upon assumptions that the demand for these services would remain constant or at least be predictable over time.

Figure 3: Major Revenue categories of the 2018/19 budget

Revenue By Source	**Expected Revenue for 2018/19 Financial Year (R Thousand)**	**Percentage of Total Revenue**
Property Rates	9, 361, 952	**23.8%**
Service Charges – Electricity Revenue	12, 591, 403	**32%**
Service Charges – Water Revenue	3, 574, 755	**9.1%**
Service Charges – Sanitation Revenue	1, 811, 048	**4.6%**
Service Charges – Refuse Removal	1, 202, 059	**3.1%**
Fines, penalties and forfeits	1, 280, 160	**3.3%**
Transfers and Subsidies	6, 803, 608	**17.3%**
Total Revenue (excluding capital transfers and contributions)	**39, 349, 818**	**100.0%**

Source: Adapted from CCT, 2018b

5.2.1 Revenue Sustainability Questions – Electricity, Water and Sanitation Consumption Trends

The City of Cape Town's financial model is referred to as the Medium-Term Revenue and Expenditure Framework (MTREF). The intention of this model is to determine "the appropriate mix of financial parameters and assumptions within which the City should operate to facilitate budgets that are affordable and sustainable at least ten years into the future" (CCT, 2018r:1). In reviewing the MTREF's for the past four years, it is evident that shifts are occurring in both the electricity and water sectors, with regards to how much of these services are being consumed by residents, and consequently how much revenue the City can raise from the sale of these services (CCT 2014-2018). These transitions are due in large part to extreme landscape pressures come in the form of load shedding in the electricity sector and severe water restrictions linked to the recent drought.

In the case of electricity, limitations have been reached in manufactured capital/infrastructure, where power generation plant capacity was rendered insufficient to meet demand due to a lack of asset management by Eskom. As a result, many households and businesses have invested in embedded electricity generating technologies, mainly in the form of Solar PV Panels, in order to secure their supply of electricity during these times. This trend, together with increasing energy efficiencies, has meant that residents are buying less of their electricity from the state, resulting in a persistent decline in revenue being realised from electricity sales by the City of Cape Town (CCT, 2018f). The Medium Term Revenue and Expenditure Framework (MTREF) depict a persistent 1% or 1.5% decline in the consumption of electricity over the past four years up until the 2017/18 MTREF (CCT, 2018s). The current MTREF depicts the rate of shrinkage in electricity consumption doubling to 2.68% for the 2018/19 financial year, and a predicted shrinkage of 2% for the following two financial years (CCT, 2018s). This persistent decline in electricity consumption is a trend that the CCT has recognised and incorporated into its long term budget planning. The City of Cape Town's Integrated Development Plan (IDP) recognises the need to develop a revenue model for the City that reduces its reliance on electricity sales as a key revenue stream (CCT, 2017a).

This slow decline in consumption within the electricity sector provides the backdrop for the revenue predicament brought on by the recent Cape Town drought. Limitations have been reached in natural/environmental capital in the case of water, where rainfall and resulting surface water has been insufficient to meet the city's water needs due to the recent drought.

The drought has given rise to a decline in water consumption being much sharper than that for electricity due to the progressively more stringent water restrictions put in place by the City (CCT, 2018f). These restrictions together with aggressive water-saving communication campaigns have meant that water consumption has decreased by over 50% compared with pre-drought consumption levels (CCT, 2018f, Booysen et. al., 2018).

In the latest MTREF the consumption of water services is predicted to shrink by 20% in 2018/19 financial year, with a similar level of decline for sanitation services as this is aligned to the volume of water used by consumers (CCT, 2018s). The reasons provided in the MTREF for this decline is a combination of water use being curtailed due the water restrictions, as well as the permanent water saving measures implemented in response to these restrictions. From this new base level, the volumetric consumption of water predicted for the next two financial years is predicted to hold constant, with the assumption that the ability of consumers to save water would have 'plateaued out' (CCT, 2018s).

The consumption trends in both electricity and water are calling into question the sustainability of the revenue base for the City of Cape Town, and the assumptions underlying the financial model. The following sections will describe the impact of the drought on the City's financial planning over the past two financial years (2017/18 and 2018/19) and going forward.

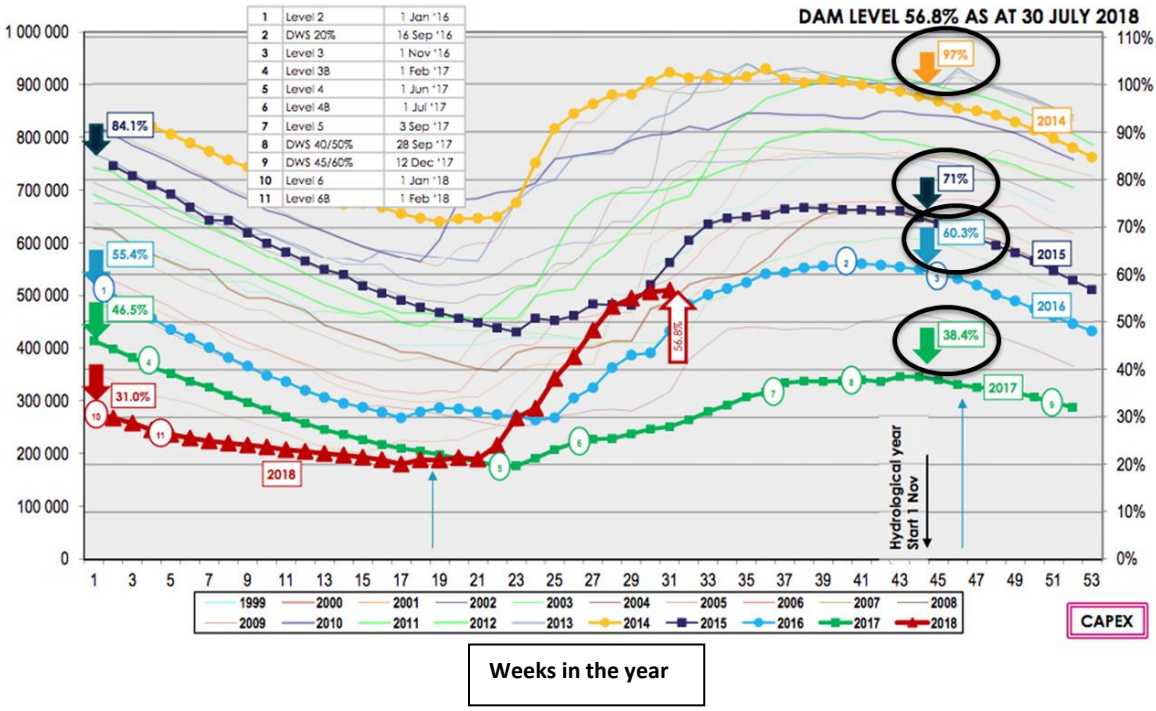
However, it is important to note that 10% of Cape Town's population live in informal settlements where taps are provided on a ratio of 5 households to 1 tap (CCT, 2018u). The average consumption of water per household in informal settlements is below 50 litres per day which is consumption level imposed by the City's at the height of the drought. Therefore, the drop in water consumption was not effected uniformly across the city, and the urban poor were largely unaffected by water restrictions due to their already limited access to water.

5.3 The Cape Town water supply system:

Muller (2017) states that over time assumptions built on climate information have been embedded in how urban infrastructure is designed and operated. This is very true in the Cape Town context, where capturing rainfall was the means by which the city serviced 88% of its water resource needs before the drought. The City of Cape Town (CCT) is part of the Western Cape Water Supply System (WCWSS), which comprises of six dams supplying agriculture and a number of urban areas. Cape Town's water supply was severely depleted after the region experienced three consecutive dry years (2015-2018) with drastically lower rainfall than the average (CCT, 2018a).

Figure 4 depicts the dam levels within the WCWSS over the past 19 years and shows how at the end of the rainy season year-on-year dam levels depleted from being 97% full at the end of the rainy season in 2014 to 71% in 2015, 60.3% in 2016 and finally 38.4% in 2017. The 2017 rainy season was the driest of the three years and saw dam levels fail to reach 40% for the year. The 2018 rainy season has seen rainfall increase again with dam levels reaching over 50% as of July 2018. The graph also indicates at what point in time various levels of water restrictions were imposed by the City of Cape Town on its residents, culminating in Level 6B, which was effected in February of 2018, and limited water use to 50 liters per person per day (CCT, 2018k).

Figure 4: Dam Levels within the WWSS (CCT, 2018k)



Source: CCT, 2018k

The Cape Town drought event and the response it elicited from the various actors within the urban system reflects the growing sense of insecurity experienced by the many facets of society as they were thrust into unchartered territory by a shock event. Muller et al. (2007) recognize that slow onset disasters such as droughts are often more difficult for urban centers to navigate successfully due to the potential for these disasters to "lead to the collapse of the social, political and financial viability of urban settlements" (pg. 100). The decisions required of the City, the business sector and households linked to the 2015-2018 drought were burdened by both uncertainty and complexity. Frensch and Funke (1995 in Djalante et al., 2013) describe complexity as arising when "a problem lacks transparency, is comprised of many variables with

significant connectivity, and there is a time delay between causes and impacts" (pg. 2106). Uncertainty arises when there is incomplete knowledge regarding a complex problem leading to the inability to "predict future dynamics or the likelihood and impact of a decision" (Milliken, 1987 in Djalante et al., 2013: 2106).

The level of complexity and uncertainty brought about by this drought event is evident in the decisions taken by the municipality around the water augmentation programme which sought to diversify Cape Town's water supply and increase the supply of water from sources other than surface water. It is also evident in the financial planning decisions taken and the consequent changes to the water tariff structures. Households and businesses responded to growing uncertainty around access to water by taking measures to secure their own water supply, separate from that provided via the municipal water service. The decisions of each of these stakeholders are unpacked in detail below, with their implications for the Cape Town municipal budget explained.

5.4 Municipal Government Response to the drought

5.4.1 'Resilience' becomes the key rhetoric

As Cape Town got to the end of the rainy season in the second year of the drought, anxiety was building amongst the City's senior politicians and officials. It had become apparent that if consumption levels were to remain as they were, that one more dry rainy season could see the city running out of water completely. It is at this point, from May 2017 onwards, that the concept of resilience starts to feature strongly in all of the City's internal and external communications around the drought. In response to this unprecedented level of uncertainty, the Mayor of Cape Town, Alderman Patricia De Lille, referred to the need for Cape Town to accept its 'new normal' as a water scarce area instead of taking up short term measures with the expectation that rainfall would return to average patterns in future.

"The New normal is an opportunity for us to significantly change our approach to water. It is about building resilience, which is the capacity of individuals, communities, institutions, businesses and systems to survive, adapt and grow no matter what kind of stresses and acute shocks they experience…. We need improved design and innovation with regard to water use and reuse in both public infrastructure, and private households and businesses." (De Lille, 2017a).

During the period of May 2017 to May 2018, the City released over 20 official media statements which emphasized the importance of resilience as a means of overcoming the drought (CCT, 2017i). Below are some key milestones during this period, which provide a sense of the growing profile of 'resilience' as the overarching aim of all the City's efforts in overcoming the drought, as well as becoming the banner under which the City motivated for the collective efforts of civil society and the business community to join in overcoming the drought.

- In May 2017, the Mayor announced the appointment of the City's Chief Resilience Officer whom had a mandate of institutionalizing resilience into the City's administration (CCT, 2017c)

- Later in May 2017, a media statement was released outlining how 'Water Resilience' signified a, "heightened approach to avoiding water shortages and achieving long term water security" (CCT, 2017d). This statement announced the formation of a Water Resilience Task Team established under the Chief Resilience Officer and consisting of senior City officials tasked with the development of a Water Resilience Plan for Cape Town.

- This Water Resilience Task Team was to be supported by a Water Resilience Advisory Committee consisting of external experts.

- On 30th May 2017, Resilience is adopted as one of 6 key principles within the City's 5-year Integrated Development Plan (IDP) for the period of 2017-2022 (CCT, 2017e).

- From June 2017, senior politicians and officials used a presentation entitled, the 'New Normal' Water Resilience Programme (CCT, 2017f), when engaging with the business sector. As part of this presentation, the business sector was encouraged to build long term resilience by considering alternative water sources.

- In August 2017, the City's Water Resilience Plan was launched (CCT, 2017g) which focused on how the City would be augmenting the water supply system by 500million liters per day to reduce the city's reliance on rainfall.

- In September 2017, the City released a statement outlining its 'water resilience projects' as part of a pursuit towards a diversified water supply system. These projects included desalination (marine, barge and land based), water reclamation, spring water and aquifer extraction (CCT, 2017h).

The concept of resilience was used by the City to signify, both internally and externally, a shift in how the water service would operate both in terms of supply and demand for water. This is encapsulated in the following quote from the 'New Normal' Water Resilience Programme presentation:

> *"The opportunity provided by the current water crisis must be maximized to effect a quantum leap' change to the way water is resourced and utilized in Cape Town" (CCT, 2017f).*

Resilience was used as a means of explaining and justifying the City's water augmentation efforts and the need for a decrease in water consumption across all sectors of society.

However, in these communications the decrease in water consumption was framed as a way of stretching the water supply in order to allow time for the City's augmentation efforts to deliver the shortfall of water needed. Changing households' and business' relationship with water and consequently their consumption patterns formed part of the communication messaging at the time, but the major shift towards 'water resilience' was viewed by the City to be the diversification of the water supply system through expenditure on large capital projects.

At the end of 2017 and the beginning of 2018, after the third and driest rainy season, it had become apparent that the City was not going to be able to 'build itself out of the problem' ((Personal communication, Acting Manager Strategic Policy Unit of the City of Cape Town, 2018), as the water augmentation efforts were not going to deliver the water required to meet demand. This is when the communication campaign to reduce water consumption escalated considerably. The following quote illustrates how resilience was used in the campaign to drive down consumption,

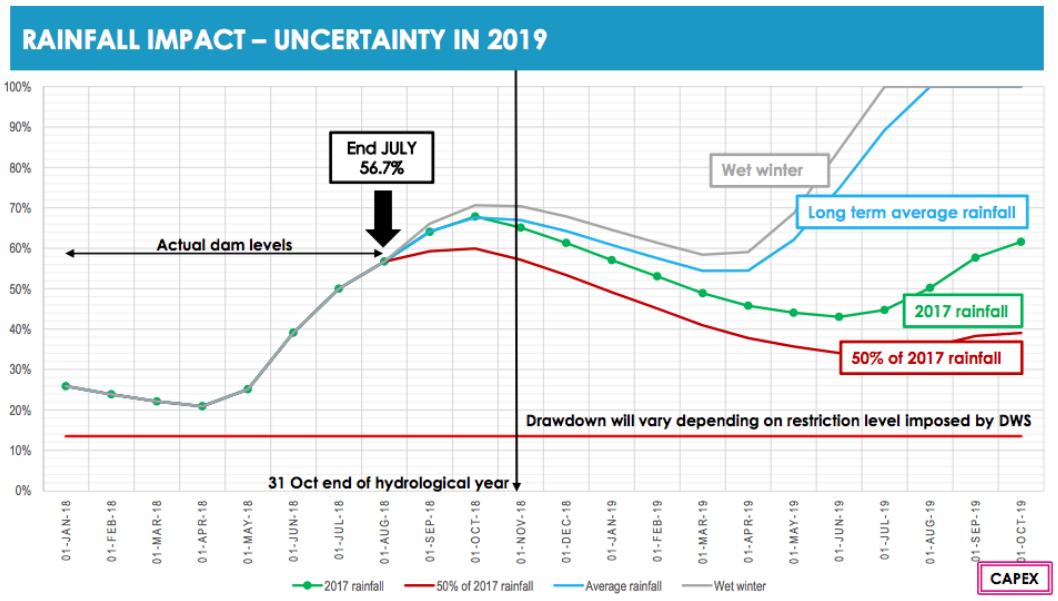
> *"We are in a critical situation and to build resilience to acute water shortages. We need to push even harder and reduce water usage city-wide to 500 million liters of water per day" (CCT, 2017d)*

However, even during this time when the demand side management efforts were being recognized as the key determinant in overcoming the drought, the overall concept of 'water resilience' centered around a diversified supply of municipal water and not long-term changes in water consumption behavior. The following section will explore the shifts in the expenditure budget which occurred to support the City's objective of a 'resilient' water supply system.

5.4.2 *The cost of a 'resilient' water supply system*

Figure 5 depicts the level of uncertainty within the City's water department regarding the anticipated rainfall figures of the next winter rainfall season of 2019 for Cape Town. The rainfall scenarios shown in this graph depict dam capacity as being anything from 100% to just over 30% by the end of the 2019 rainy season, making planning and budgeting for the water supply for Cape Town very difficult to do (CCT, 2018k).

Figure 5: Predicted Rainfall for 2019



Source: CCT, 2018k

The original Water Resilience Plan (CCT, 2017b) outlining the approach to diversifying Cape Town's water supply was founded on the assumption that it would never rain again, in order to account for the levels of extreme uncertainty regarding the regions rainfall patterns. This original plan motivated for 500 mega-liters' extra capacity to be developed, which would supply almost all of Cape Town's water needs without drawing on rain-fed dams. The plan focused on desalination as the only truly 'resilient' water supply option.

The budget requirements for the additional capacity argued for in the Water Resilience Plan (CCT, 2017b) led to a full review of the City's expenditure budget prompted by both the Executive

Mayor and City Manager at the time. The budget adjustment process saw substantial cuts to line department's budgets. One measure taken was to freeze all staff vacancies and the available budget reallocated to the water programme (Personal communication, Acting Manager Strategic Policy Unit of the City of Cape Town, 2018). The three areas most affected by these budget cuts were road maintenance, council rental stock maintenance and new capital projects across all services (Personal communication, Acting Manager Strategic Policy Unit of the City of Cape Town, 2018).

The assumption that it would never rain again was later revised as it was regarded as unrealistic to assume the need to transition Cape Town's water supply mix to one which doesn't include surface water, which is currently the most affordable means of sourcing water for the city (CCT, 2018d). The current plan delineating the City's approach to diversifying its water supply mix is called the New Water Programme (NWP), and a City Water Strategy is in the process of being developed.

It is evident that the City has learnt some hard lessons when it comes to decision-making around water augmentation. When comparing the capital project list of October 2017 outlining the various projects associated with increasing and diversifying Cape Town's water supply, with the revised project list of July 2018, some clear changes in approach are evident (CCT, 2018d). Of the originally proposed 12 desalination plants, only 4 are being pursued. This is because temporary desalination plants have been found to be logistically complex, as well as offering a poor economy of scale. Instead the City has opted to only focus on permanent desalination at an optimum scale in order to bring the unit cost of water down as far as possible. Three smaller water reclamation plants have been removed from the project list for similar reasons.

Groundwater was not incorporated as part of the immediate response to the drought due to insufficient and unreliable information about this form of water extraction. The New Water Plan (NWP) (CCT, 2018c) exhibits a shift to groundwater as one of the most cost-effective and achievable means of increasing water capacity for Cape Town. After further investigation the City has prioritized ground water extraction, with three ground water projects progressing due to their demonstrated yields– namely, the Cape Flats Aquifer, the Table Mountain Group Aquifer and the Atlantis Aquifer (CCT, 2018d). The budget required to realise this additional capacity under this new plan was still substantial however. The cost of the infrastructure transitions which form part of the New Water Programme was calculated to result in a budget deficit of R7.296billion over the 2017/18; 18/19 and 19/20 financial years compared to a R1.732bn shortfall without the NWP (CCT, 2018m).

5.5 Business and Household Response to the drought

5.5.1 Seeking water resilience at the Household and Business level

As described earlier, Cape Town's residents succeeded in dramatically reducing their water consumption, making Cape Town the first city in the world to reduce its water consumption by 50% in just three years, falling from 1.1billion liters per day before the drought to about 600-million liters a day (CCT, 2018a). Cape Town recently was awarded a certificate by the International Water Association acknowledging this accomplishment.

This substantial decrease in consumption was most strongly evident amongst high-level water consumers. In December 2016 there were roughly 117, 000 households using more than 20, 000 liters of municipal water per month. By February 2018, this number had reduced by 90% to 12, 300 households (CCT 2017b). Many of these households and businesses supplemented their water supply requirements with alternative water sources to the municipal supply, with households and business investing in rainwater harvesting, boreholes and grey water systems. Rainwater harvesting tanks were selected as the most affordable and accessible means of achieving water security and resilience at the household level and therefore the most common option (Simpson, 2018). This is evident in the dramatic increase in the sales of rainwater tanks between 2016 and 2018 (Simpson, 2018).

The brand of rainwater tank that is most commonly available in South Africa is the JoJo tank (Simpson, 2018). The cost of a standard 5000litre JoJo tank during 2017/2018 was approximately R4 800 and a 2500litre JoJo tank was approximately R3 800 (Pricecheck, 2018). Given that the costs of each of these tanks is equivalent to more than a month's salary at the minimum wage, it can be assumed that it is mostly higher-income households who are able to afford the cost of purchasing a rainwater harvesting tank. South et. al. (unpublished) encourages awareness around the socio-technical shifts which can lead to growing unevenness and inequality, whereby those who can afford it are able to protect themselves from the uncertainty brought about by climate change. This kind of shift is evident in the context of the Cape Town drought, whereby

high-income households rapidly adopted technologies which enabled them to 'seal' themselves off from the impacts of the drought (South et. al., unpublished). They achieved on a micro scale what the City was battling to achieve on a macro-scale – the diversification of water supply. It is important to note that rainwater-harvesting tanks, boreholes and grey-water systems do not provide households with a more rainfall-independent water resource but rather it allows households to secure their own water source independent of the grid where the supply is controlled by the municipality (Personal Communication, Post-Doctoral Fellow Global Risk Governance Programme, 2018). These actions meant that these households could meet their water needs through a mix of municipal supplied and own-source water systems, which freed them from having to reduce their water consumption to the levels required by the water restriction levels. For these households, the drought did not spur a rapid decrease in water consumption, but rather a rapid uptake in technologies which ensured they were less reliant on the municipality for their water supply.

Furthermore, in the Cape Town context the significant capital outlay which households and businesses had to endure in order to purchase and install a rainwater-harvesting tank or grey-water system means that these consumers are unlikely to return to consuming their full water needs through the City's grid water system (Personal Communication, Post-Doctoral Fellow Global Risk Governance Programme, 2018). The investment in these disruptive technologies will likely change the way households' and businesses' source water for years to come. These shifts in consumption patterns are likely to have long-term implications for the degree to which the water service is provided via a centralized system by the public sector (Personal Communication, Post-Doctoral Fellow Global Risk Governance Programme, 2018).

A key consideration for the City's financial modelling going forward, is the extent to which the actions taken by consumers to reduce water consumption are permanent in nature, and therefore will have sustained impact on the City's ability to maintain pre-drought revenue streams. Beal et al. (2014) have studied rebounding water use in communities that have experienced plentiful water supply after a time of drought. They recognize that understanding the drivers associated with this rebound in water use is crucial for those in government to better predict water use behaviours and plan and budget appropriately. In South East Queensland a rebound in water consumption has been observed which has seen a return to close to pre-drought water consumption levels. This is due in large part to the removal of behavioural cues to conserve water and the absence of marketing campaigns and the removal of water restrictions.

Even after rain returned to the Cape Town region during the winter of 2018, in October of 2018 there was still only a slight increase in water consumption which is up from 507 MLD in April 2018 to 556 MLD (CCT, 2018n). Water restrictions were relaxed from October 2018 to level 5 which allows for 70litres per person per day instead of 50litres (CCT, 2018o). On 29th November 2018, the Mayor announced the further relaxation of water restrictions to Level 3, which increases the daily allowance to 105 litres per person per day (CCT, 2018p). The impact of this relaxation in restrictions on water consumption is yet to be seen.

5.5.2 Enforcing a decrease in water consumption

Not all activities which occurred at the household and business level were as a result of a voluntary decrease in water consumption or shift to alternative water sources. Many were compelled to change their water behaviors in response to the water demand management interventions of the City. The City did not have the staff resources available to compel households and businesses to abide by the water restrictions through enforcement. With only 18 City of Cape Town employees allocated full time to the enforcement of the water restriction levels, the use of communication and awareness campaigns to drive down consumption were essential. However, the City was not consistently optimistic about the impact their communication campaigns would have on consumption levels, and thus sought ways to compel compliance. The installation of water management devices was an enthusiastically adopted technological solution to the problem of compelling compliance in a cost-effective manner. These devices have been part of the City's water management strategy since 2007 and involve the installation of a device which cuts off water flow to a household once it has reached a certain level. They were used as a means of managing water services debt, whereby an 'indigent' households' debt would be written off once a water management device was installed, as it was argued that this device would prevent the household from utilizing beyond the free basic allowance (6000 liters of water per household per month) and also would assist with the detection of leaks (CCT, 2018t).

In mid-August of 2017, a media statement was released informing the public that the City would be using Water Management Devices (WMD) to restrict high consumption households (CCT, 2017j). These WMDs would cut off a household's water after 350 liters per day, in line with the per person water allocation of 87litres per day under water restriction level of 4b (CCT, 2017j). The high consuming household were sent a warning letter and thereafter if their consumption did not reduce to within the allocation associated with the water restriction level, a water management device was installed at the household's expense. The following quote from Mayor

De Lille illustrates how the City was inviting the public to celebrate this more interventionist approach and the increased control the City would have with regards to the amount of water used by households:

> *"The time for asking people to reduce excessive consumption is over and we will now forcibly restrict those households who continue to contravene water restrictions" (CCT, 2017j)*

The installation of WMDs escalated quickly and by the end of September 2017 the City vowed to install WMD on all properties where excessive usage was recorded, "irrespective of the reason for the high usage" (CCT, 2017k). WMDs were planned for 50 000 households who were using in over 20 000 liters per month and all WMDs were to be set to an allocation of 350litres per day. WMD were seen as a low-cost means of ensuring compliance with the water restriction levels and between September 2017 and July 2018, an average of 1 500 WMDs were installed every week by the City (CCT, 2018a).

What is interesting about this approach is this is the first time that the City has restricted the amount of water flowing to a household, irrespective of the household's ability and willingness to pay. The decision to install WMD on high consumption households during the drought was purely motivated by the need to protect the water resource itself and not as a means to reduce the volume of water consumed without being paid for, as was the original purpose of the WMDs. These high consumption households were willing and able to pay for the water they were using, despite the punitive tariffs in place associated with the water restrictions. It is not clear what the role of WMDs was in prompting higher income households to reduce their consumption of municipal water and using their wealth to pursue non-municipal water sources to supplement their water needs. Although, at the time of the drought the City was grateful that alternative water sources were being pursued, this did have disruptive consequences for the financial model underpinning the municipal water service which will likely be felt for many years after the end of the drought.

5.6 A shock within a shock:

The impact of the Cape Town drought on the municipal budget is substantial, to the extent that it could be deemed a shock within a shock. The drought caused a substantial decrease in water consumption and an escalation of the use of disruptive technologies, which in turn caused a sharp decline in the revenue gained by the municipality from water consumption. Revenue from

the sale of water and sanitation services is an important source of revenue for the Cape Town municipality and was predicted to contribute 15.8% of total revenue for CCT in 2017/18 financial year (CCT, 2018e, p. 17). In the City's Financial Monitoring Report in December 2017 (CCT, 2018g), revenue from water sales was down by 24.8% and it was expected that the decrease in consumption would cause an R1.1bn shortfall on revenue for the year. In addition, revenue from sanitation was down by 30.8%, which was expected to cause an R700m shortfall on revenue for the year.

This Financial Monitoring Report offers the following explanation for the decrease in revenue:

> *"The under recovery is due to Level 4b water restrictions and level 5 additional measures that have been implemented as well as the impact of the billing cycle and continuous corrections…. It is important to note that the level 4b restrictions are 'unchartered water' in terms of restriction levels and no previous budget trends in this regard are available." (CCT, 2018g).*
>
> *"This is predominantly due to additional restriction measures implemented flowing from the severity of the drought above what was reasonably expected during the preparation of the 2017/18 original budget." (CCT, 2018g).*

In the original 2017/18 budget the City had budgeted on revenue from tariffs relating to the water and sanitation services being in the region of R6,02billion (CCT, 2018g). This estimate was made at the beginning of 2017 when dam levels were above 40%, and the demand for water was 900 Million Litres per Day (MLD). At this time the City had imposed Level 4 water restrictions only. However, with the 2017 rainy season bringing less than half the expected rainfall, the volume of water present in the water supply system was simply insufficient to raise R6,02billion under Level 4 restrictions. December 2017 is the point at which there was the largest variance between the Year to Date (YTD) actual revenue gained versus YTD planned revenue for water and sanitation services. The CCT had received 24.8% less revenue from water service charges which amounted to a shortfall of R483million and 30.8% less revenue from sanitation service charges, amounting to a shortfall of R316million (CCT, 2018g). This is an unprecedented level of variance within this revenue source which resulted in an unprecedented adjustment to the predicted revenue from these service charges.

During the adjustment budget in January 2018, the revenue expected from water and sanitation services was revised down from R6,02billion to R4.17billion to bring the budget in line with the under-recovery at the time and the projected impact of Level 6 restrictions (CCT, 2018g). This

meant that the predicted revenue gained from the sale of water and sanitation services decreased by 31% and would only be able to contribute 9.6% of the total revenue required by the municipality for the 2017/18 financial year instead of the originally predicted 15.8% (CCT, 2018g). This decreased revenue "necessitated budget reprioritization and immediate internal cost cutting directives on various expenditure items to soften the likely rates and tariff increases in the short to medium term" (CCT, 2018i, p.14).

However, the decrease in the actual revenue received at the end of the 2017/18 financial year (June 2018) was not as dramatic as was anticipated in January of 2018 adjustment budget. The final audited revenue received for water and sanitation services for the 2017/18 financial year was R5.316billion, which is only a 12% shortfall on the originally predicted revenue from these services, rather than the 31% shortfall predicted in January (CCT, 2018r). This discrepancy highlights the complexity of the shifts in consumption and payment behavior brought about by the drought and the consequent water restrictions and punitive tariffs put in place. The reason for this recovery in the revenue generated despite the volumetric consumption of water decreasing by 50%, is the escalation of the billed revenue on account of the punitive tariffs put in place for households and businesses with higher than permitted water consumption (CCT, 2018r).

This trend has continued through to the 2018/19 financial year, with the current over-recovery on the water and sanitation service charges for December 2018 (mid-financial year) of R1.1billion on a planned revenue recovery of R5.37billion for the entire year (CCT, 2018q). The City's Chief Financial Officer has explained that these figures reflect the billed revenue rather than the cash-backed revenue and that due to lower than normal collection rates, it is likely that the actual cash-backed revenue will more closely reflect the budgeted cash-backed revenue amounts (CCT, 2018q). This explanation highlights another shift which has come about as a result of the drought period. The collection rate for water services has decreased from 86% in 2016/17 to 70.1% in the current 2018/19 financial year (CCT, 2018s). This lower collection rate is attributed by CCT to, "non-paying high-water users during the period of water restrictions where tariffs are much higher than the standard tariff" (CCT, 2018s).

The multiple and interdependent shifts evident within the City's MTREF for the 2017/18 and 2018/19 financial years indicates the levels of uncertainty wrought on the budget planning processes on account of the drought. Household consumption and payment behaviours have undergone substantial changes as consumers reacted to the water restrictions and punitive tariffs put in place during the drought period.

5.6.1 *Key municipal finance assumptions questioned by the shock*

An article by Rebecca Cameron (2018) highlights an important assumption underlying the Cape Town municipality's budgeting; she notes, "the structure and pricing of our water system is based on the assumption that there will be a constant supply of available and easily accessible freshwater" (Cameron and Katzschner, 2016).

The CCT's 2018/19 Tariff Policy (CCT, 2018j) still holds the following assumptions with regards to the setting of water and electricity tariffs:

- "Consumptive tariffs will be set at levels that facilitate the financial sustainability of the service" (pg. 6)
- "Reasonable and appropriate cross-subsidization may be applied between consumer categories" (pg. 44)
- "The calculation of all tariffs is based on the general principles of full cost recovery, to protect the basic level of service and to ensure long-term sustainability of the service" (pg. 44)

The decreased consumption of both the water and sanitation services on local government revenue will also yield a considerable impact on the cross subsidization model of the City (Personal Communication, 3rd August 2018. Work Session on scenario planning around the financial sustainability of the municipality). High consumer households would previously have provided the revenue required by the City to provide for 'indigent' households who cannot afford to pay for electricity and water. For 'indigent' households, the City currently provides a 100% subsidy on 6kl of water per household per month and where the electricity received does not exceed 250kWh per month, customers will receive a free basic allocation of up to 69kWh (CCT, 2018j).

5.6.2 *Water Tariff decision making process:*

As a result of the 'shock within a shock' outlined above, the City undertook to rapidly overhaul its tariff structure in an attempt to mitigate the impact of reduced consumption on the municipal account. Cape Town's Deputy Mayor Ian Neilson provides the following rationale for the approach taken by the City in its tariff restructuring:

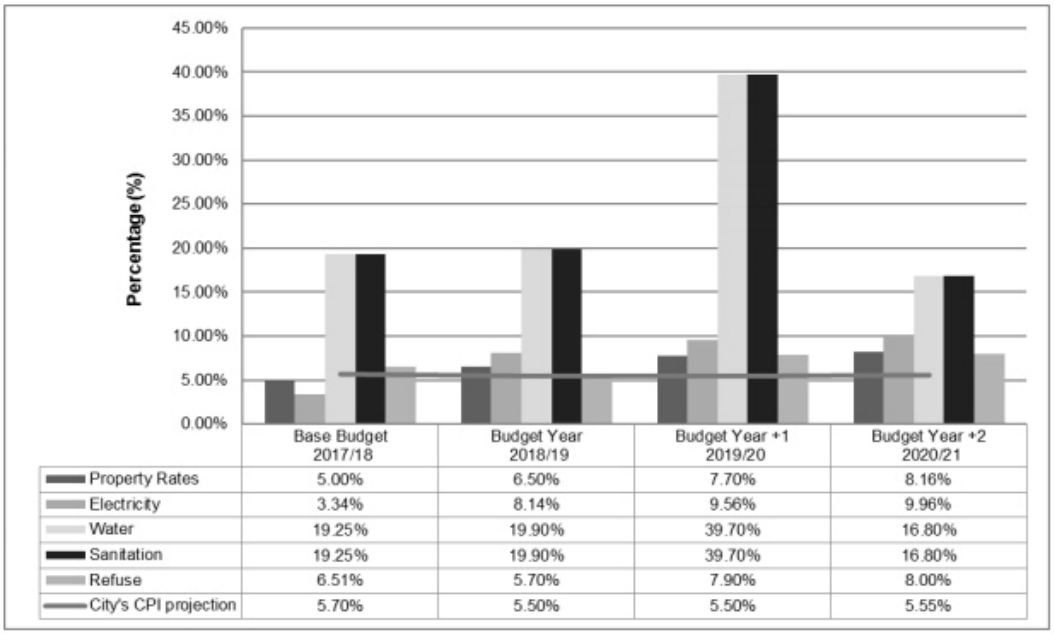
> *"The City has reached a point where it can no longer afford to supply water at tariffs that are unsustainable…up until now, tariffs have been adjusted to recover the revenue deficit primarily from the higher usage consumers. However, given how few people are now*

> *entering the higher steps of the tariff where the price per kiloliter goes up, this methodology is no longer functioning effectively and the city must therefore adjust water pricing more drastically in the lower steps of the tariff"* (Ian Neilson quoted in van der Merwe, 2018, p.2).

The City's MTREF considers what level of tariff increases are required to ensure the financial sustainability of the municipality. One of the informants for how the MTREF is approached, is the guidance provided by the South African National Treasury to municipalities on the setting of tariffs and charges in the form of Municipal Finance Management Act (MFMA) Circulars. Circulars 89 and 91 state that, "National Treasury encourages municipalities to maintain tariff increases at levels that reflect an appropriate balance between the affordability to poorer households and other customers while ensuring the financial sustainability of the municipality" (CCT, 2018s). The circular further acknowledged that "municipal own revenue sources are shrinking due to widespread drought and households opting for alternative sources of energy" (CCT, 2018s), however maintains that electricity services must pursue fully cost-reflective tariffs and water services should pursue tariffs that cover the cost of bulk purchases, ongoing operations as well as provision for future infrastructure. Circular 91 also emphasizes that the full costs of new schemes to expand water service networks will need to be recovered from water users through tariffs.

It is this requirement for cost-recovery that has informed the substantial increases in tariffs for water and sanitation services for CCT residents. Figure 6 below depicts the proposed revenue increases of 19.9% for the 2018/19 financial year with 39.7% and 16.8% proposed for the 2019/20 and 2020/21 years respectively (CCT, 2018s). The justification for these increases is the current and anticipated negative volumetric growth in water consumption which means that if the City is to safeguard current levels of water revenue, the water which is consumed is required to be more expensive per unit. Additional factors cited in the MTREF include the spending required to ensure the sustainability and resilience of Cape Town's water supply, the continued roll out of water demand management initiatives and the lower collection rate (CCT, 2018s).

Figure 6: Average revenue increases per revenue type (2017-2021)



	Base Budget 2017/18	Budget Year 2018/19	Budget Year +1 2019/20	Budget Year +2 2020/21
Property Rates	5.00%	6.50%	7.70%	8.16%
Electricity	3.34%	8.14%	9.56%	9.96%
Water	19.25%	19.90%	39.70%	16.80%
Sanitation	19.25%	19.90%	39.70%	16.80%
Refuse	6.51%	5.70%	7.90%	8.00%
City's CPI projection	5.70%	5.50%	5.50%	5.55%

The 2018/19 budget (CCT, 2018h, p.7) depicts a restructured water tariff, with a revision from the six step tariff to a four step tariff structure, which allows for a higher rate of recovery at the lower usage levels given that the higher usage levels are no longer a reliable source of revenue.

In addition, Cape Town City Council agreed upon the introduction of a 'fixed service charge' for both electricity and water and sanitation services, which is independent of consumption levels (CCT, 2018h). The intention behind this fixed service charge is to recover the cost of maintaining the service connection and the grid infrastructure necessary to deliver the service. Previously this cost was built into the unit price per unit for electricity and water, with the assumption that those using less units of these services were more vulnerable and those consuming more were higher-income households who can afford to contribute more to the upkeep of the infrastructure

(CCT, 2018h). However, it is now evident that the consumption of electricity and water is no longer closely aligned to income, as more affluent households and businesses are able to make the capital investments necessary to generate their own electricity and secure their own water supply (South et. al., 2019). Therefore, this assumption cannot underpin the tariffing structure and a more equitable means of recouping the costs of service delivery is required. The introduction of a fixed service charge is an attempt at creating a more equitable means of distributing the costs of infrastructure maintenance.

This change in how City's revenue is structured shows the impact of the decreases in consumption, either due to more efficient and restrained use of the resource or the adoption of embedded disruptive technologies. This is an important shift if the institutional regime is not to stand in the way of new ways of basic services like energy and water being provided. It also recognizes the technological hybridization occurring at the household and business scale with regards to water and electricity provision, whereby residents do not meet all their energy and water needs through disruptive technologies but rather gain these through a mix of embedded generation technologies and the traditional grid infrastructure. In fact, their connection to the grid offers a convenient back-up/redundancy service. This shift in how electricity and water tariffs are structured requires a shift in how residents think about their payments for these services, as the service that you are paying for is less the resource to be consumed, but more that you are connected to the grid which acts as a back-up should your alternative means of providing these services fail?

However, questions still remain as to whether this choice of tariff structure and the introduction of the 'availability charge' will bring about the revenue required to augment Cape Town's water supply as per the requirements in the New Water Plan (Personal communication, Acting Manager Strategic Policy Unit of the City of Cape Town, 2018).

6. Discussion

Resilience was used by the City of Cape Town as a concept behind which all facets of local government and society at large were called upon to unite behind, with resilience being expressed as a shared objective for all residents of Cape Town. It was used by the City as a convenient means of building shared understanding and action in the face of a climate shock. In purely water resource terms, resilience as a concept was useful in motivating for a more diversified water supply and in motivating for reduced consumption of water. However, when the drought event is viewed through the municipal budget it is clear that these activities were not compatible in ensuring the ongoing functioning of the municipal finance system underpinning the water service.

6.1 Resilience by Whom and for Whom

The Cape Town drought presents an interesting case study as different actors responded in ways that when viewed through the lens of municipal finance, were at odds with each other. The Cape Town drought case study depicts a scenario whereby the water resilience-seeking activities happening at business and household level were compromising the municipality's ability to raise revenue and consequently its ability to fund the transition in the city's waters supply infrastructure and achieve a more resilient mix of water supply.

There is an evident lack of alignment between the assumptions and objectives of water demand management and the water augmentation schemes and the City's budgeting structure. The New Water Programme assumed that it was up to the municipality to bring about resilience in the water supply to Cape Town, and that the associated costs would be paid for by consumers.

This tension points to a wider tension and debate around the concept of resilience and how this can be practically achieved within an urban context (Meerow and Newell, 2016). The OECD paper, 'Indicators of Resilient Cities' provides a review of definitions of resilience noting that each of them makes reference to resilience being a capacity by city governments, communities, households, organisations or businesses. This paper argues that individual and community action is recognized as crucial in resilience building and should not be overlooked (Figueiredo et. al., 2018). In the context of the Cape Town drought, the resilience capacity of households, communities, organizations and businesses had negative implications for the resilience of the state, specifically the ability of the municipal budgeting structure and process to absorb and

adapt to shocks and stresses. In the case of energy and water, shocks in both of these sectors has led to actions which have brought about concerns on the ability of the municipality to "maintain its functions" due to revenue reductions. Many organizations are involved in helping local governments support and drive resilience in their cities (Figueiredo et. al., 2018) but there appears to be a lack of guidance on some of the unintended outcomes of greater community and household resilience on the municipal budget. What happens when resilience of the state is called into question by the actions of those it governs who are trying to build their own resilience? How this tension plays out is crucial to understanding how cities can progress towards greater urban resilience.

Figueiredo et. al. (2018) warn that any actions of the state which may reward or penalize a sector of society in relation to resilience indicators should be carefully considered in case it encourages "any unintended behavior or lead to unintended consequences" (pg. 43). Certainly a concern highlighted by the Cape Town drought case study is that disruptive technologies won't be sufficiently incentivized or supported by municipal governments due to the impact these technologies are having on the municipal fiscus. If left unresolved, the actions of government in trying to maintain the control and funding necessary to maintain its functions may result in undermining the resilience of those it governs. Therefore, the unintended consequences of how households, communities, organizations and governments adapt in relation to a shock or stress must form part of any assessment of urban resilience.

Cape Town is not the only city that is considering these important questions around resilience. The major reason for the breakdown of relationship between eThekweni and 100RC is the question of 'Resilience for Whom'? eThekweni wanted a resilience strategy that built systems of empowerment and support to enable people to take actions for themselves in building their own resilience, rather than building a State focussed system of control and service provision which focussed on building state resilience (Personal Communication, 2018b, Informal Settlement Engagement).

The "shift from equilibrist resilience to evolutionary resilience" (Figueiredo et. al., 2018: 16) is particularly relevant in resolving this tension. More recently, the concept of resilience has focused less on the ability of a system to regain stability in the face of stresses or shocks and more on the system's ability to change and adapt, "considering that the previous state contributed to the occurrence of the shock in the first place, returning to it may not be resilient" (Figueiredo et. al., 2018: 16).

Politics and power are important components for consideration in any pursuit of resilience. There has been an increasing recognition, led by social theorists, of the political context and power dynamics which are inevitably at play within any pursuit of urban resilience (Meerow and Newell, 2016; Davoudi et al., 2012). The Cape Town drought highlighted the differentiated response of households and businesses to the drought in accordance with their means. Some were able to use their wealth to invest in alternative water supplies and thus seal themselves off from the impact of the drought to a large degree. Others were dependent on the municipal grid for all of their water needs and therefore more vulnerable to the weaknesses and vulnerabilities of this centralized system.

It is important to interrogate any narratives, such as the resilience narrative, that appear to justify the exemption of some segments of society from the consequences of climate change and unsustainable levels of consumption (South et al., unpublished).

The question of whether the City understands resilience to be something which individuals attain for themselves or whether the object of resilience is to safeguard state control (Reid, 2002 in Coafee, 2013) is one which the City needs to explicitly engage with. In the case of the water service, the City needs to consider whether strong institutions and secure state finances is required to build resilience. These are definite requirements if 'water resilience' is regarded to be primarily about the diversification of the water supply system feeding the municipal water system, however these are not necessary requirements if the diversification of water sources at the household and business level is accepted as being the primary or even similarly weighted means of achieving city 'water resilience'. During the drought event, the City sought techniques to control the water consumption of residents, such as the installation of water management devices. In responding to a shock or stress the crucial question that the CCT needs to consider, is whether in trying to secure the funding it needs to maintain the provision of services by the state, whether it may be undermining the resilience of those it serves. The application of resilience to the municipal finance decision-making process must seek to consider unintended consequences of municipal financing decisions on resilience of all actors.

6.2 Key Questions for resilience as it is applied in CCT municipal budget process

When considering the application of the City's understanding of Resilience within City's Budgeting process, it is important that the municipal budget structure, particularly what revenue streams are relied upon, adapts to withstand the effects of shocks. This process also needs to demonstrate cognizance of a future where consumption of resources is not assumed to remain static (Figueiredo et. al., 2018).

On the expenditure side, the Cape Town drought event disrupted assumptions around how much capital expenditure was required to ensure the ongoing functioning of the water service. On the revenue side, the drought disrupted assumptions around how reliant residents are on the municipal water supply system to serve their water needs and consequently assumptions around the degree to which water service charges linked to water consumption are a fair, equitable and sustainable means of funding the service.

Although the revenue gained from water sales is not as deficient as anticipated in December of 2017, as despite the dramatic decrease in the volume of water consumed, the punitive tariffs imposed and the restructuring of the tariff bands ensured that revenue recovery from the water service did not reflect the full consequence of this decrease in consumption. However, since the drought event the degree of uncertainty with respects to water service revenue is far higher. This uncertainty is evident the much lower collection rates anticipated and in the lack of accuracy in water revenue predictions since the drought began.

The City needs to recognize and address the major uncertainties relating to its financial model for water and sanitation.

<u>There are two major areas of uncertainty going forward:</u>

1. **Rainfall patterns**

It is clear that Cape Town's water managers can no longer use historic rainfall records to plan and manage its water infrastructure. There is a need to enhance the regions ability to predict rainfall and stream flows going forward, including the likelihood of extreme water flows due to storm events in order that water infrastructure can be designed to cope with these (Muller, 2017). Furthermore, there is a need for much greater data and understanding around the potential changes to groundwater yields linked to rainfall variability (Muller, 2017).

2. **Household Consumption**

The extent to which water consumption rebounds post-drought is a key factor in the municipality's ability to budget for the service going forward. Similarly, the rate of decline in

electricity consumption will also impact the degree to which this service is able to be self-sustainable. Traditionally, how the City structures its budget and finance model is still governed by a system of rules and assumptions, reliant on an environment where residents pay and where the rule of law is upheld. Finance officials are used to 'governing from a distance' whereby tariffs are set at the city-scale and only take into account the lived experience of households and their decision making in very general terms as it relates to their willingness and ability to pay. But this approach is only sustainable when households have no other option but to buy municipal supplied services. Now these officials are being forced to take into account decision making at the household and business level as key assumptions around how they choose to access services are tested.

It is clear that the City's municipal budgeting system is not underpinned by a sophisticated understanding of consumer behavior, particularly given the increased complexity brought about by the recent hybrid water supply systems adopted across Cape Town's wealthier businesses and households. The City has been primarily focused on the need for increased sophistication in understanding and predicting rainfall patterns, if the City is to ensure the ongoing functioning and resilience of the water service. However, when one considers the current financing system upon which the water service is dependent, the uncertainty with regards to consumer behavior becomes a considerable factor in determining the ongoing functioning of the water service and therefore its resilience.

<u>The key questions for the City of Cape Town as it navigates these uncertainties are as follows</u>:

One of the enablers identified through the City of Cape Town's Preliminary Resilience Assessment is the **improvement of resourcing and funding resilience,** with the following associated pathfinding question: (CCT, 2018f: pg. 55)

> *"How does the City develop a resilient long-term financial strategy? How do we use our data to understand future financing needs based on what we extrapolate for the 'resilience' gates in our strategic business processes and how do we construct a financial strategy accordingly?*

One of the qualities of a resilient city is reflectiveness (The Rockefeller Foundation and ARUP, 2016), which is the ability of a system to, "examine and systematically learn from past experiences, to inform future decision making that will enable adaptation and change" (pg. 17). It is important that the City's budget process is reflective as it takes on the learnings from the drought period.

Another key characteristic of Resilience is that it is by nature realized through disruption of existing equilibriums, which means that in becoming more resilient, a city may be required to

shed its more poorly adapted systems in favor of more resilient ones (Spaans and Waterhout, 2017). It is therefore important to identify the assumptions and drivers pertaining to the municipal finance model which need to be challenged and reformed in order to build resilience into municipal financing.

The 'shock within a shock' which occurred during the Cape Town drought, was largely caused by inflexibility and constraints on decision making in a time of shock. The CCT needs to question whether it's finance decision-making process is able to cope with the uncertainties described above and their implications for expenditure and revenue collection?

On the **expenditure side**, whether the City's infrastructure investment plans and frameworks are agile enough to navigate these shifts in customer preference and play a new role in regulating and incentivizing good practice around on-site power generation and water capture/extraction and storage?

Applicable Resilience Principles:

- **Reflective:** the ability to continuously evolve and modify according to emerging evidence
- **Inclusive:** the ability to consult and engage with a broad range of stakeholders
- **Integrated:** the ability to ensure alignment between city systems and decisions towards a common outcome
- **Flexible:** the ability to "change, evolve and adapt in response to changing circumstances'" (ARUP, 2014: 5).

On the **revenue side**, whether the fiscal model of the City able to cope with uncertainty in consumption behavior and the implications for revenue collection and the degrees of subsidization required to deliver these services?

Applicable Resilience Principles:

- **Redundant:** the ability to withstand disruptions and extreme pressure due to built-in spare capacity
- **Robust:** the ability to anticipate and design for potential failures in systems
- **Resourceful:** the ability to, "rapidly find different ways to achieve their goals or meet their needs during a shock or when under stress" (ARUP, 2014: 5).

The story of the Cape Town drought as viewed through the lens of the municipal finance system, highlights how the cost-recovery assumption, which underpins how the municipal water service is funded, managed and delivered, needs to be reviewed in light of increasing resource constraints. The South African Cities Network (2016) argues that "cities are built how they are financed" (pg._) and motivates for the development alternative financing models which do not undermine the environmental sustainability of the city.

Rusca and Schwartz (2018) highlight how the necessary assumption of the cost-recovery logic of water services, is that plentiful and cheap water sources will be available. However, as seen in the Cape Town drought example, with increasing climate uncertainty municipalities are having to consider more expensive water supply options such as desalination which is pushing up the price per unit of water considerably. Rusca and Schwartz (2018) argue that the, "financial performance of a water provider should not only be measured by the level of cost recovery, but also by its ability to access other sustainable sources of funding" (pg. 107).

The Cape Town case study also demonstrates how as municipal water resources both become less plentiful and therefore more expensive, high usage consumers are moving to off-grid technologies which disrupts the current cross-subsidization model underpinning the water service.

The concept of adaptive resilience and the ability of a system to not only 'bounce back' but also 'bounce forward' (Sharifi and Yamagata, date) is an important aspect of resilience within the context of this research. In order for the municipal finance system to successfully navigate the drought, it needed to exhibit both 'short term coping' and 'long term adaptation' if the functioning of the municipal water service is to be safeguarded going forward (Sharif and Yamagata, date). It is questionable, however, whether the City's understanding of resilience assisted it in coping with both the immediate disruption of the municipal finance system whilst still safeguarding the functionality of the system.

7. Conclusion:

The aim of this research was to review the effect of the Cape Town drought event on the municipal budget and to evaluate how the activities undertaken by both public and private actors during the drought have had implications for both the revenue and expenditure components of the fiscus. These activities have been conducted with the intention of making Cape Town more resilient in the face of a more uncertain climate. This thesis explored the extent to which

principles of resilience feature within the city's financing model, using the case study of the drought to interrogate the impact of a shock event on the sustainability of the municipal fiscus.

The level of complexity and uncertainty brought about by this drought event is evident in the decisions taken by the municipality around the water augmentation programme which sought to diversify Cape Town's water supply and increase the supply of water from sources other than surface water. It is also evident in the financial planning decisions taken and the consequent changes to the water tariff structures. This thesis served to unpack the drivers and assumptions leading to these various decisions, and analyze these decisions in light of their impact on the municipal budget during the drought event and their likely implications going forward.

By providing a descriptive analysis of the response to the drought from a range of actors, it became apparent how the resilience-building activities by all actors shared the common objective of securing access to water supply in a time of drought. However, when the impact of these activities on the municipal budget is documented it is clear that the municipal finance model was not able to effectively negotiate these activities in a way that safeguarded the financial resource base required for the ongoing functioning of the municipal government. It is clear that the sustainability of the current municipal financing model relies upon an increase in water consumption, which contradicts the sustainability of the city's ongoing water supply. In navigating this contradiction, the assumptions of the municipal financing model must be questioned in light of the principles of resilience.

The CT PRA calls on the Cape Town city government to be reflective and self-aware in order to continuously incorporate the learnings from past experiences in improving strategies and plans to avoid future shocks (CCT, 2018f). The City Resilience Framework offers a useful means for Cape Town to assess, "the extent to which critical functions are capable of adapting to new situations induced by shock or stress" (Spaans and Waterhout, 2017:115). The drought has provided a learning opportunity around the capability of the municipal budgeting structure and processes, and the finance decision makers in the City, to adapt to new realities brought about by a shock event. The 2016 State of Cities Report articulates the financing dilemma that cities face by stating that 'cities are built how they are financed'. With increasing environmental resource constraints and uncertainty, the sustainability of municipal reliance on consumption of resources in the form of electricity and water as a major revenue stream needs to be questioned. It is evident that the extent to which the municipality is the only player in providing electricity and water supply to households and businesses is changing and therefore the extent to which the municipality can extract revenue from these services cannot remain the same.

The drought event has also lead to learnings with regards to the approach of various functional areas within local government to governance, particularly the extent to which they need to engage with and understand the public they serve in a time of greater uncertainty and complexity. Coafee (2013) describes how building resilience leads to the disruption of "the traditional relationship between the state and the individual with 'governing from a distance' through decentralized decision-making and authority increasingly encouraged" (Foucault, 2007). Both the water services and finance departments within the City of Cape Town have had to adopt far higher levels of cognizance around water consumptions behaviors and decision making at the business and household level. This is reflective of Coafee's proposition that governing through a range of techniques and mechanisms aimed at controlling residents is not an effective means of building resilience, rather governments need to recognize that building resilience is "most effective when it involve[s] a mutual and accountable network of civic institutions, agencies and individual citizens working in partnership towards common goals within a common understanding" (Coafee, Murakami Wood and Rogers, 2008:3 in Coafee: 249).

Finally, we are left with the question of whether resilience was a useful framing for the City in articulating and organizing their response to the drought event. It was certainly useful in assisting the City to articulate the suite of efforts and interventions required across all sectors in overcoming the drought. Resilience was a useful term which featured in almost all internal and external communication material around the drought, and contributed to the effectiveness of the City's communication campaign in driving down water consumption.

However, the usefulness of Resilience as a framing and objective now that the immediate threat of running out of water has passed is questionable. It is now that the City must face the reality that the 'new normal' and the strive for resilience to drought has followed different paths for the City and for individual households and businesses. The City is still pursuing an expensive capital expenditure programme in order to diversify the water supply of Cape Town, whereas households and businesses have sought alternatives to the municipal water supply system in order to safeguard themselves from similar shocks in the future.

The cost-recovery principles embedded in the municipal financing model for water services means that these activities are eroding the financial sustainability of the service. What this 'new normal' means for the cross-subsidization model associated with the water service, and consequently what the poor pay for water going forward, will need to be considered.

It is not believed that the City's understanding of resilience, nor the resilience literature and guidelines available, provides an adequate framing to guide the City in navigating this tension.

This case study provides the opportunity to view the intersection between the logics and knowledge associated with resilience and that of the financial model underpinning the municipal government. Muller et al. (2007) states that Water resource management has the potential to be a lead sector in building urban resilience to climate change, and furthermore "developing appropriate models for financing the implementation of adaptation" (pg. 111). This thesis has provided a descriptive analysis of the Cape Town drought case study and how it has moved the City of Cape Town to recognize the need for adaptation within its municipal financing model and assumptions. The ability of the state to source, allocate and manage funds is critical to the continued functioning of the city, and therefore its resilience.

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