Whose water crisis? How government drought responses widen inequality

by

Olivia R. David

A thesis submitted
in partial fulfillment of the requirements
for the degree of
Master of Science
(Environment and Sustainability)
in the University of Michigan
April 2022

Thesis Advisor:
Dr. Sara Hughes

Acknowledgements:

First, thank you to my advisor, Dr. Sara Hughes, whose support since the beginning of my time at the University of Michigan School for Environment and Sustainability has been unwavering and unmatched. My thesis, and my experience as a master's student more broadly, benefitted incalculably from her gracious guidance and mentorship – I cannot think of a better advisor for my continued work as a doctoral student!

Thank you to Dr. Michael Moore for reviewing this thesis, and to Dr. Kelly Askew and doctoral candidate Lotte de Jong for providing valuable feedback on earlier versions of parts of this work. I owe thanks to many others at UM whose generosity in sharing their knowledge with me shaped my work on this thesis, including Dr. Shobita Parthasarathy, Yazier Henry, Dr. Omolade Adunbi, and Dr. Sam Stolper. I also could not have done this work without the support and encouragement, and sometimes commiseration, of the friends I have made during my time at UM thus far. I also thank my interview participants who kindly lent their time to me for this research, and many others who provided advice and general encouragement.

Thank you to my family for their support, which this work reflects. This of course includes my dog, Alice, who cannot read but whose companionship was immensely helpful for writing – and for taking much-needed breaks.

I must also acknowledge the two places I call home, which inspired this project: California and Cape Town. Growing up within and between them shaped my worldview in ways that undertaking this research helped me better understand and recognize, and I could not have completed a project of this magnitude without the inspiration drawn from the affection I have for these places and my experiences of them.

This material is based upon work supported by the National Science Foundation Graduate Research Fellowship Program under Grant No. DGE 1841052. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

Table of Contents

List of Tables ..... **iv**

List of Figures ..... **v**

List of Acronyms ..... **vi**

Abstract ..... **vii**

1. Introduction **1**

2. Theoretical framework: Understanding water injustice through the lens of hydraulic citizenship **5**

3. Research design and methods **10**

3.1. Case study regions: selection and descriptions *10*
Units of analysis: levels of government decision-making 13

3.2. Mechanism-based process tracing *14*

3.3. Data collection and analysis *15*
Data collection: Semi-structured interviews 15
Data analysis: Interview coding 16

4. Results I: Using the hydraulic citizenship spectrum to identify widened inequalities **19**

4.1. California *19*

4.2. Western Cape *24*

5. Results II: Characterizing mechanisms of widened inequality **31**

5.1. Values-reinforcement mechanism *31*

5.2. Strategic communication mechanism *34*

5.3. Pertinence of decisions around groundwater *39*

6. Discussion and Conclusion **40**

6.1. Practical implications *40*

6.2. Areas for further research *42*

References **44**

Appendices **54**

Appendix A: Interview participant information *54*

Appendix B: Interview codebook *55*

List of Tables

Table 1: Summary of key policy responses in each region by intervention type. 4
Table 2: Definition of factors that determine place on the hydraulic citizenship spectrum. 6
Table 3: Characterizing the severity and association with anthropogenic climate change of the California and Western Cape drought events. 11

List of Figures

Figure 1: Gerring's (2008) basic mechanismic understanding of causation. 7
Figure 2: Hedström and Swedberg's (1998) typology of social mechanisms (Figure from Hedström and Ylikoski 2010). 8
Figure 3: Proposed causal-mechanismic process linking government drought responses to widened inequality. 9
Figure 4: Deriving high-level codes from initial research question. 17
Figure 5: The spectrum of hydraulic citizenship in California under baseline circumstances (unshaded areas), evincing how it widened post-drought (shaded areas). 19
Figure 6: The spectrum of hydraulic citizenship in the Western Cape under baseline circumstances (unshaded areas), evincing how it widened post-drought (shaded areas). 24

List of Acronyms

DWR	Department of Water Resources (California)
DWS	Department of Water and Sanitation (South Africa)
EO	Executive Order
EPA	Environmental Protection Agency (USA)
FBW	Free Basic Water (South African policy)
HRTW	Human right to water
LADWP	Los Angeles Department of Water and Power
SGMA	Sustainable Groundwater Management Act (California)
SWRCB	State Water Resources Control Board (California)
UN	United Nations
WCWSS	Western Cape Water Supply System
WMD	Water management device

Abstract

Recent severe droughts in California, USA and the Western Cape Province, South Africa attracted global attention as water scarcity challenged cities, rural communities, agricultural industries, and ecosystems in varied ways. Governments responded to these conditions by setting and ultimately achieving water conservation targets, and scholarship evaluating the causes and consequences of both droughts from diverse perspectives emerged. This study extends existing scholarship by comparing drought responses in terms of their effects on water (in)justice, or social inequality as evinced in relationships to water access networks. In so doing, I explain how and why the drought responses materialized and manifested in widened inequalities, using information from previous research on the droughts and drought responses, policy documents, and interviews with key informants in each region about their perspectives on the droughts and the ensuing policy responses. I analyzed these data using mechanism-based process tracing methods. In both cases, causal mechanisms linking government responses to widened inequalities include what I identify as *values-reinforcement mechanisms* and *strategic communication mechanisms*. The common presence of these mechanisms reveals the resilience of dominant social values and constructions, even in response to socio-environmental challenges. The particular importance of interlinked policy- and household-level decisions around groundwater resources during drought events also emerged through comparative analysis of the cases. To conclude, I suggest practical implications based on these insights and areas for future research, highlighting droughts as consequential policy sites for advancing social and environmental justice.

Keywords: environmental justice; drought policy; causal mechanisms; process tracing; hydraulic citizenship; water politics; California; South Africa

1. Introduction

Water is simultaneously a source of life and of conflict – vital and mundane while also powerful and oppressive. It embodies nature's cyclicity in persisting across space and time, constantly morphing form as an indicator of climatic conditions and sociocultural development. Its extreme forms, floods and droughts, the latter of which this study concerns, hold humbling capacities that remind manmade infrastructural and social systems of nature's ultimate dominance. With drought events projected to increase in frequency and severity under climate change (Dai 2013; Trenberth et al. 2014), it is essential that governments respond effectively. In a global context of acute social inequality, manifested in different ways at local levels, "effectiveness" must be defined in terms of environmental and social justice (IPCC 2022).

Recent severe droughts in California, USA and the Western Cape Province, South Africa exemplify the interlinked socio-environmental challenges that drought projections foresee, and provide an important opportunity to examine government responses to drought events and water scarcity more broadly. From roughly 2012-2016, California's severe, historic drought induced a mismatch between supply and demand, challenging the state's water system from infrastructural, social, financial, and political angles (Lund et al. 2018). Then-Governor Jerry Brown issued a series of Executive Orders (EOs) mandating water conservation as the state awaited rain (Taylor 2016), with varied impacts on and returns from urban, suburban, and rural Californians (Palazzo et al. 2017; Pérez-Urdiales and Baerenklau 2020). Tiered mandates imposed upon urban water districts, combined with the complexities of California's water rights and supply distribution systems, added to the contentiousness around scarce water statewide. In the Western Cape, three consecutive years of sparse rainfall from about 2015-2018 manifested in historically low levels in the dams that comprise the Western Cape Water Supply System (WCWSS), which stores the City of Cape Town's water supply and secondarily supports the province's agricultural industry (Visser 2018). Cape Town was approaching "Day Zero" – the "apocalyptic" (Voci et al. 2020; Walwema 2021) moniker for the exact date on which the dams would reach 13.5% capacity,[1] triggering

[1] "Day Zero" refers to the projected date on which WCWSS dams would reach 13.5% capacity, below which the water is difficult to extract. Day Zero was initially scheduled for May 13, 2018, based on projections made in late 2017, when the City rolled out the 'Day Zero' campaign (Millington and Scheba 2020). The City postponed the projected date of Day Zero several times over the course of the crisis, before ultimately calling it off indefinitely (Alexander 2019).

supply cutoffs to residences citywide (Millington and Scheba 2020). In response, the municipal government implemented increasingly stringent water use restrictions through an intense communications campaign. Commensurate with a relatively simple calculation of dam levels divided by daily consumption, restrictions eventually reached Level 6B: 50 liters per person per day (Millington and Scheba 2020).

In both California and the Western Cape, government responses to severe drought emerged in ways that reflected their contexts and histories – including the underlying social inequality present in each region – through portfolios of regulatory, price-based, communication-based, and technical interventions (Table 1). Measured in terms of volumetric or percentage citywide water use reductions, local to international communities and media lauded Cape Town's successful conservation – a perspective that local actors and experts share. California also achieved its statewide conservation goals, but asymmetrically across urban water districts (Palazzo et al. 2017).

Quantitative metrics, however, are insufficient to assess the social impacts of government drought response – particularly in contexts of existing socioeconomic inequality and known cases of ongoing water injustice, as in both California and the Western Cape. The variegated nature of social relationships to and experiences of water provision *in the absence of drought* reflects each region's "baseline" water inequality, against which to measure inequality outcomes that government responses to drought may engender. Taking into account baseline inequality, this study assesses social impacts of government drought response through identifying the causal mechanisms of widened inequality in both case studies.

This paper proceeds as follows: In Section 2, I construct the study's theoretical framework through invoking and expanding upon Anand's (2017) concept of hydraulic citizenship to define water inequality, and by introducing a mechanismic[2] theory of causation that I later apply to the cases. In Section 3, I provide further information on each case study region and their comparative value for approaching my research questions, contextualize my use of mechanism-based process tracing methods, and detail my data collection and analysis methodology. In Sections 4 and 5, I present my results in two parts: first using the hydraulic citizenship framework to evaluate and evince widened inequality in both regions, then applying mechanism-based process tracing. I find

[2] I came across the term "mechanismic" while reviewing the literature on process tracing (see, for example, Gerring 2008, Falleti and Lynch 2009). My use of this term reflects its use within this literature, which aims to distinguish the idea of process as "mechanism-based" from the idea of processes as "mechanical."

that in both cases, causal mechanisms linking government responses to widened inequalities include *values-reinforcement mechanisms* and *strategic communication mechanisms*. The common presence of these mechanisms reveals the resilience of dominant social values and constructions, even in response to socio-environmental challenges. The particular importance of interlinked policy- and household-level decisions around groundwater resources during drought events also emerged through comparative analysis of the cases. In the Conclusion, I suggest practical implications based on these insights and their broader relevance and propose areas for future research, highlighting droughts as consequential policy sites for advancing social and environmental justice.

Table 1: Summary of key policy responses in each region by intervention type.

	California	*Western Cape*
Emergency declarations	EO B-17-14: State of Emergency Declaration (State of California 2014a) EO B-25-14: Continued State of Emergency Declaration (State of California 2014b)	March 2017: Citywide disaster declaration May 2017: Provincial disaster declaration February 2018: National disaster declaration (Ziervogel 2019)
Regulatory	EO B-29-15: Reduce statewide water use by 25%, relative to 2013 levels (State of California 2015, sec. 2) SWRCB assigned urban water districts one of nine possible conservation levels ranging from 8-36% required use reduction, set relative to a baseline of the district's residential per capita consumption from Jul-Sept 2014 (Palazzo et al. 2017)	Mandatory use restrictions at increasingly stringent levels, imposed on households to contribute to overall citywide and provincewide reductions (Ziervogel 2019) February 2018: Most stringent restrictions (Level 6B) declared – 50 L/person/day (DWS 2018)
Price-based	EO B-29-15 directed urban suppliers to implement conservation water pricing structures (State of California 2015, sec. 8) Fines as an enforcement mechanism (Zhang, Teodoro, and Switzer 2021)	Restructuring of water tariffs: bills included a fixed charge that depends on the size of the pipe delivering water (June 2018)
Communication-based	"Save Our Water" campaign – mostly leveraged conservation tips (Liang, Henderson, and Kee 2018) Collection and communication of household water use data constrained by privacy mentality	"Day Zero" campaign – "apocalyptic" rhetoric, numbers-based (Voci et al. 2020; Walwema 2021) Water Dashboard (City of Cape Town n.d.; Joubert and Ziervogel 2019) Cape Town Water Map, launched Jan 2018 (Sinclair-Smith et al. 2018)
Technical/ infrastructural	Reduced volumes of water deliveries from the state's major water projects (Lund et al. 2018)	Installation of water management devices (WMDs) expanded to high-income households (Bischoff-Mattson et al. 2020; DWS 2018) Pressure management: reduced rate of flow to lessen volume of water residents could access quickly and minimized amount lost to leaks (DWS 2018)

2. Theoretical framework: Understanding water injustice through the lens of hydraulic citizenship

The concepts and realities of water (in)equality and (in)justice mean populations do not experience "water crises" equally. Rather, experiences of water crisis evince and are constituted by the unequal ways people access and interact with water resources, and how government responses to an exogenous shock on those resources, such as severe drought, may impact these "hydrosocial networks" (Zwarteveen and Boelens 2014, 144). I therefore understand "water injustice" to refer to the visible existence and persistence of everyday water inequalities, and how governance and decision-making around water rights, allocations, and uses produce injustices; this understanding aligns with political ecology framings of water and water scarcity (Johnston 2003; Mehta 2001; Wutich et al. 2022).

Understood in this way, water injustice is fundamentally a question of citizenship: an individual or community's inclusion in, or exclusion from, the water access network of the geopolitical region and system in which they exist (Anand 2017). Anand's (2017) concept of "hydraulic citizenship" offers a useful framework for operationalizing the concept of water injustice, helping reveal the social and political implications of water inequality. Anand defines hydraulic citizenship as "the ability of residents to be recognized by city agencies through legitimate water services," or in other words, "substantive membership in the city's water distribution regime" (2017, 8, 7). By this definition, water inequality and injustice represent the different ways people relate to the state and reflect varied degrees of inclusion in society. Using this concept to frame the social impacts of California's and the Western Cape's drought responses reveals the political roles of decisions around water as key indicators of state-society relations, and how those relations differ *within* societies: "water access separates subjects from citizens, in that those who are considered to be proper urban citizens are provided water by the state, whereas others are not" (Sultana 2020, 1408).

Hydraulic citizenship is a spectrum whereby an individual's status as a "hydraulic citizen" is not static; rather, it is a dynamic reflection of the prevailing cultural and institutional forces at play – the active "social constructions" (Ingram, Schneider, and deLeon 2007) – producing water inequalities, defined by the factors in Table 2. These prevailing conditions are useful for understanding "baseline" water inequality in both focal regions of this study, as they are revealed in manifestations of unequal hydraulic citizenship *prior* to the drought onsets. In other words,

historical and present social constructions (Ingram, Schneider, and deLeon 2007) emerge in the baseline water injustices that afflict distinct populations in both the California and Western Cape cases.

Table 2: Definition of factors that determine place on the hydraulic citizenship spectrum.

	Definition
Access systems	The relative ease and means by which an individual or community obtains clean, potable water – including the location of water access relative to their home, the volume they can and may obtain, and the purposes for which they are allowed access to water, as controlled by political, geophysical, and infrastructural forces. Embedded within access systems are also infrastructural histories: when, why, how, for whom, by whom, and with what larger goals in mind infrastructures were built – and how these origins relate to, and are revealed in, their contemporary existence and functioning.
Costs (actual and perceived)	Actual costs: the financial burden of paying for water – either for the material water itself or for connection to the infrastructure that transports the water, which often cannot be disaggregated. Perceived costs: the "opportunity costs" of water use, i.e., the extent to which water must be prioritized for one use over another, and psychological understandings of how one's own water use does or does not affect others'
Adaptive capacities	The actions an individual or community can take in response to a shock such as drought; these capacities may be endogenous (e.g., financial resources to invest in supply augmentation, or ability to relocate) and/or exogenous (e.g., public or private sector support).

Differential social relationships to water access regimes – unequal experiences of hydraulic citizenship – therefore reveal the underlying and deep-seated social constructions of populations that, through water and drought policy decisions and frameworks, manufacture everyday water inequality. Policymakers "socially construct target populations in positive and negative terms and distribute benefits and burdens so as to reflect and perpetuate these constructions" (Ingram, Schneider, and deLeon 2007, 93). Government drought responses can likewise reflect uneven

constructions of water users and communities, perpetuating injustice by reinforcing existing inequalities, widening already unequal experiences of hydraulic citizenship.

Social construction theory also posits that while policy designs generally operate in feedback loops that reproduce prevailing institutional cultures and power relationships, they sometimes reject these patterns and advance social change (Ingram, Schneider, and deLeon 2007). In this way, policy design and implementation play a key role in determining one's place on the hydraulic citizenship spectrum and the degree to which it can and does change – particularly in response to an exogenous shock on water access systems, such as drought. Given that policy responses *can* diverge from historical patterns that reinforce inequalities, how, why, and under what circumstances *do* they, or not? Through application to the two case studies, I operationalize the concept of water inequality through the hydraulic citizenship spectrum to propose *how and why* – not only *if* – inequality increases as a product of context-bound drought response.

A mechanism-based perspective helps situate an understanding of how policy contributes to placing people on the hydraulic citizenship spectrum in unequal ways, as per social construction theory. The concept of causal social mechanisms, within the broader literature on process tracing methods, has many proposed definitions and contested meanings (Beach 2017; Hedström and Ylikoski 2010; Mahoney 2001). These varied definitions generally agree that mechanisms serve to demystify the "black box" between inputs and outcomes – to explain social phenomena at a fine-grained level beyond descriptive (Hedström and Swedberg 1998). Gerring's (2008) mechanismic understanding of causation (Figure 1) provides a core definition that underlies more applied iterations.

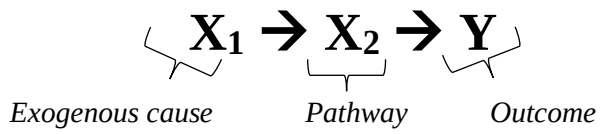

Figure 1: Gerring's (2008) basic mechanismic understanding of causation.

In this definition, X_2 contains theories of *how* X_1 might be related to Y, and implies the potential for X_1 to cause Y through multiple pathways, as X_2 may be broken down in any of number of ways (Gerring 2008). This generalized definition leaves room for varied levels of nuance across studies that draw on mechanism-based process tracing; a researcher's choice of analytical model

amongst these myriad possibilities should find grounding in its utility for their particular purposes (Gerring 2008; Hedström and Swedberg 1998).

Hedström and Swedberg's (1998) typology of social mechanisms (Figure 2) provides a point of departure for developing a mechanismic theory appropriate for my study. In Hedström and Swedberg's typology the causal process is tripartite: separated into situational mechanisms, action-formation mechanisms, and transformational mechanisms. Together, these three types of mechanisms represent the micro-level parts that comprise the causal process linking the initial macro condition to the outcome macro condition (Figure 2).

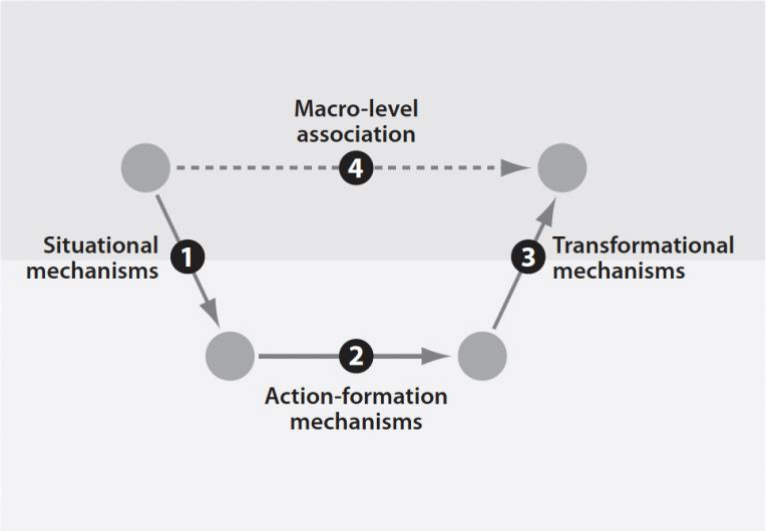

Figure 2: Hedström and Swedberg's (1998) typology of social mechanisms (Figure from Hedström and Ylikoski 2010).

While this typology is useful for disaggregating the nuanced elements of the causal pathway and in considering the role of context, I view the mechanismic process as less rigid. Additionally, Hedström and Swedberg's model considers individual actors the "elementary causal agents" and their actions and interactions as constitutive of the causal linkages (Hedström and Swedberg 1998, 11). I depart from this position in that I consider individuals' actions and interactions as they operate within, and are indicative of, larger systems and power structures. This view renders sociopolitical institutions, rather than individuals acting within them, the agents. Given these synergies and points of departure, I propose a mechanismic theory that is well-suited for answering my overarching research question of how and why government drought responses

emerged and widened inequalities (Figure 3). This framework sets up my comparative analysis of the cases in Section 5. It also clarifies contextual factors as *constraints on* mechanisms and how they operate (Falleti and Lynch 2009), rather than *as* types of mechanisms themselves.

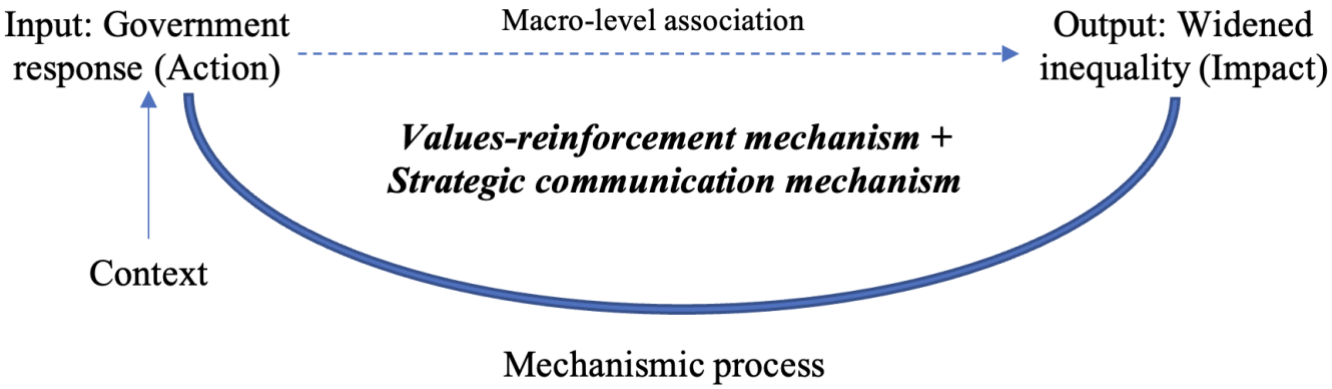

Figure 3: Proposed causal-mechanismic process linking government drought responses to widened inequality.

Further, and in part due to their relative nebulousness, mechanism-based perspectives have unmet potential for use within studies of policy process theories and frameworks (van der Heijden et al. 2021). The benefit of using a mechanism-based approach in this study is therefore twofold: in addition to installing causality into my propositions, it contributes theoretical advances to policy process studies at a higher level.

3. Research design and methods

3.1. Case study regions: selection and descriptions

Case study research methods support holistic, contextualized understandings of cases to support causal explanations of *why* variables produce outcomes, rather than seeking to isolate variables (de Vaus 2001), and thus suit my project. In "[attempting] to understand the significance of particular factors within the context of the whole case rather than by screening out context," a comparative case study approach fits the goals of my research (de Vaus 2001, 244). Moreover, examining two case studies with analogous shocks on different national and geopolitical contexts facilitates comparative value.

California and the Western Cape Province are naturally arid, drought-prone regions, with year-to-year rainfall variability (Baudoin et al. 2017; Griffin and Anchukaitis 2014). Nonetheless, the recent multi-year droughts in each were severe, record-setting, and linked to anthropogenic climate change (Table 3). In this way, California and Western Cape serve as microcosmic examples of broader global environmental change, including projected increased drought frequency and severity under climate change (Dai 2013; Trenberth et al. 2014), and projected impacts of climate change on water scarcity more generally (Gosling and Arnell 2016; IPCC 2022; Schewe et al. 2014).

Table 3: Characterizing the severity and association with anthropogenic climate change of the California and Western Cape drought events.

	California	*Western Cape*
Record-setting drought severity	– "unusually dry, hot, and severe, by any reckoning… the worst of record by many metrics" (Lund et al. 2018, 2) – "exceptionally severe… the most severe drought in the last 1200 years" (Griffin and Anchukaitis 2014, 9017) – "unique in modern history… the driest since record keeping began in the late 1800s" (Hanak et al. 2015, 1)	– "a severe multi-year drought that led to the levels of supply dams falling to an unprecedented low… " (Burls et al. 2019, 1) – "the rarity of the event is unquestionable" (Otto et al. 2018) – "among the most severe of the last 100+ years, with 2017 ending as the driest year in the record" (Burls et al. 2019, 2)
Link to climate change	– "anthropogenic warming is increasing the probability of co-occurring warm-dry conditions like those that have created the acute human and ecosystem impacts associated with the 'exceptional' 2012-2014 drought in California" (Diffenbaugh, Swain, and Touma 2015, 3931) – "the type of drought California is increasingly likely to experience as the region's climate warms" (Hanak et al. 2015, 1) – "Anthropogenic warming has intensified the recent drought" (Williams et al. 2015, 6824)	– "While the [2015-2017 drought] is a very rare event, climate change has significantly increased, more than doubled, the likelihood of a prolonged drought to occur." (Otto et al. 2018, 9) – "it is possible that man made climate change has contributed to the severity of the current drought, and even though it is an extremely rare event, similar droughts may not be rare in the future" (Wolski, Hewitson, and Jack 2017)

Further, comparing the regions in terms of their water supply, allocation, and distribution systems is useful for testing my theoretical framework and questions about how context bounds the mechanisms of widened hydraulic citizenship outcomes. California's water supply system and distribution network is infamously complex, fragmented, and polycentric, at all levels of governance (Palazzo et al. 2017; Pincetl, Porse, and Cheng 2016). The sources of urban and agricultural water supply are distinct: generally, urban supply originates as rainfall or snowmelt captured and stored in dams, while agricultural supply comes from groundwater to a significant extent (Faunt et al. 2016). At a higher level, California's statewide water supply and distribution systems are notably diversified, reliant on the large-scale hydraulic engineering feats of the 20th Century including the State Water Project (SWP), Central Valley Project (CVP), and California Aqueduct (Escriva-Bou, Hanak, and Mount 2019). The WCWSS, on the other hand, relies almost fully on surface supply, stored in six major interlinked reservoirs, for all allocated uses in the province: 95% of all water supplied by the WCWSS comes from dams, shared between all uses (Muller 2020). The WCWSS falls under the national-level management of the Department of Water and Sanitation (DWS), though municipal governments hold responsibility for service delivery as a reflection of the country's post-apartheid decentralization reforms (Millington and Scheba 2020). Unlike in California, where groundwater represents an important fraction of the state's water supply system, groundwater in the Western Cape is not generally perceived as an important resource at a systems level and its use is near negligible (Olivier and Xu 2019; Riemann, Chimboza, and Fubesi 2012). Heavy reliance on surface supply renders the WCWSS, and the communities and industries it supplies, highly sensitive to changes in surface supply such as reduced rainfall as in the drought period (Muller 2020). California's relatively high supply diversification, including a mix of groundwater and surface water, constrains outcomes of reduced rainfall to a comparatively lesser extent.

California and the Western Cape Province are the primary agricultural regions in their respective national contexts and derive political value and power from their agricultural economies. Correspondingly, rural versus urban water allocations are a source of social and political tension in both regions (Felde and Novak 2014; Rawlins 2019). California allocates a significantly higher proportion of water to agriculture, relative to urban use, compared to proportional allocation in the Western Cape. In California, about 80 percent of human water use

goes toward agriculture, located in the state's Central Valley;[3] the remaining 20 percent goes to cities and towns (Lund et al. 2018). Much of this 20 percent provides for non-essential uses: landscape irrigation accounts for half of California's urban water use, contributing little to the state economy. California's agricultural sector is inherently water-intensive and relatively non-resilient in that there are limited ways to adapt or respond to water shortage (Lund et al. 2018). In contrast to California's relatively low urban allocation, the WCWSS allocates the majority, about two-thirds, of its total system yield to the City of Cape Town (Muller 2020); this water represents over 95 percent of total Cape Town water use (Ziervogel 2019).

It is also noteworthy in the context of my research questions that both study regions formally acknowledge the human right to water (HRTW): California in its Water Code, since 2012 (California Secretary of State 2012), and the Western Cape through South Africa's Constitution (Republic of South Africa 1996). Despite these formal, legislated acknowledgements, both regions have evidently failed to ensure conferral of the HRTW upon all swaths of their respective constituencies (Francis and Firestone 2011; Goddard, Ray, and Balazs 2021; Humby and Grandbois 2011; Rodina 2016) – hence the spectrum of hydraulic citizenship, and in particular, what hydraulic citizenship looks like on the "lowest" end of the spectrum in each case (see Section 4). It bears noting that the HRTW faces implementation issues more generally: despite acknowledgement at the level of the United Nations (UN 2010), water injustices persist in cities, regions, and countries around the world notwithstanding their socioeconomic, climatic, or hydrological characteristics (Gerlak and Wilder 2012; Sultana and Loftus 2020).

Units of analysis: levels of government decision-making

To render the cases analytically comparable to the greatest extent, it was necessary to reconcile the difference in the geographic and administrative scales of focus typically applied to each case. The academic and policy literature on the California drought tends to focus on the state-level response, particularly the various EOs implemented by then-Governor Jerry Brown and the implementation and enforcement of these orders through the State Water Resources Control Board (SWRCB) and Department of Water Resources (DWR), and generally discusses urban water

[3] The area comprising the southern two-thirds of California's Central Valley is known as the San Joaquin Valley, which includes the San Joaquin Basin and the Tulare Basin (USGS n.d.). The counties in the San Joaquin and Tulare Basins are the main locations of water injustice in California to which I refer.

districts' actions as they emerged under the auspices of these state agencies (Lund et al. 2018; Maggioni 2015; Pérez-Urdiales and Baerenklau 2020; Tortajada et al. 2017). Perspectives on the Western Cape drought typically center city-level action in referencing "Cape Town's Day Zero water crisis," with then-Mayor Patricia de Lille, then-Deputy Mayor Ian Nielsen, and other high-level municipal figures as the primary faces of the response (Bischoff-Mattson et al. 2020; Brick, De Martino, and Visser 2018; Joubert and Ziervogel 2019; Muller 2018; Parks et al. 2019; Shepherd 2019; Ziervogel 2019). The basic logic underlying these respective scales of focus is that while California includes several major urban areas with diverse water use dynamics, Cape Town is Western Cape's only large city[4] and represents the majority of water consumption in the Province – a fact that also helped construct the narrative of the Day Zero crisis as a primarily urban, Cape Town-specific one.

My focus on the California and Western Cape levels of government – one level below national, as opposed to, for example, taking a city-level view – was deliberate for several reasons, beyond strengthening the analytical comparability of the cases. It more accurately captures the scope of drought impacts, as the hydrological and meteorological extents of the droughts, and thus their physical and social impacts, exceeded municipal boundaries – despite the construction of the Western Cape's drought as a "Cape Town" experience (Otto et al. 2018). It is also appropriate given South African political history to widen the field of vision of the Day Zero crisis beyond Cape Town, as post-apartheid decentralization reforms devolved responsibility for public services to municipal government, although they ultimately act under the authority of the provincial and national levels – a structure which lends to political and electoral contention (Cameron 2014). Lastly, as the literature and media coverage around the Day Zero water crisis mainly focuses on the City's response, expanding to a province-level view adds to the novel contribution of this study.

3.2. Mechanism-based process tracing

Process tracing offers a methodology for understanding causality in qualitative social science research, and in supporting "theoretical pluralism," is particularly well-suited to addressing the complex nature of policy studies (Kay and Baker 2015). For application to this study, process

[4] Cape Town is a "Category A" or "metropolitan municipality" as defined by South Africa's Municipal Structures Act: it serves as an economic center with a high population density and holds exclusive legislative authority within its area (Republic of South Africa 1998). It is the only such municipality in the Western Cape Province.

tracing is an appropriate methodology as it extends the analysis beyond merely demonstrating that responses widened inequalities, toward a deeper understanding of how and why. In so doing, process tracing methods of analysis center the forces and systems that underlie outcomes and shocks that may trigger change, which in turn encourages centering the values and power structures embedded in these context-bound processes. George and Bennett (2005) note that process tracing "finds a place in the constructivist approach," which crystallizes the compatibility of process tracing with this study's theoretical framing.

Process tracing is not inherently comparative, but "taken on its own only enables within-case inferences about causal processes, meaning that process tracing case studies have to be nested in comparative designs to enable cross-case generalizations to be made" (Beach 2016, 470). This call for the use of process tracing in comparative case study research further supports the use of process tracing methods to meet the goals of my research study. Bengtsson and Ruonavaara's (2017) approach to comparative process tracing offers a useful example for doing so in explicating the need for both within-case and between-case analysis, on which I draw in my application of process tracing.

3.3. Data collection and analysis

Data collection: Semi-structured interviews

I conducted semi-structured interviews with strategically selected participants: six focused on California and four on Western Cape (Appendix A). I identified interview participants based on their in-depth knowledge and expertise of the water policy and governance landscape in their respective region, and/or of the specific drought event period. Interviews took place virtually using Zoom software, ranged from 40 to 65 minutes in length, and took place between July and October 2021. Interviews were recorded through Zoom, which generated written transcripts that I subsequently reviewed against the recorded audio and corrected for accuracy and clarity.

Interview questions focused on three themes: A) Characterizing and defining drought severity and dynamics; B) Characterizing and contextualizing the government response; and C) Evaluating and critiquing the effectiveness and effects of the response. Part A included questions related to discourse and terminology around the drought events, including the descriptions used by governments, publics, and media, e.g., "crisis" or "emergency," and the implications of the ways the drought events were defined and discussed in both government and community spheres. Part

B focused on interviewees' understandings of the specific policy decisions that emerged in response to the drought events, including how they reflect their contexts. Part C prompted interviewees to reflect critically on the drought events and policy responses, including in relation to their potential variegated impacts on distinct population groups. I tailored my interview guide to suit and emphasize each interviewee's expertise: California or Western Cape, and their personal and professional knowledge, experience, and interests.

The structure and content of my interview guide was informed by my prior and contemporaneous review of the relevant literature and policy documents. Throughout my research design and development process, I read comprehensively about each drought event, water policy contexts, and relevant institutional histories. I reviewed documents including government statutes and other communications around the droughts; relevant media coverage; and grey and academic literature on the drought events themselves, water policy and politics in the case study regions and more broadly, and more general work on topics such as the HRTW, crisis and emergency rhetoric in responding to environmental change, and theories of the policy process. Much of the insight I gained from this reading emerges in Section 4 especially, as foundational for my characterization of the hydraulic citizenship spectrum in each case.

Data analysis: Interview coding

I coded the interview transcripts using NVivo software. I followed an *a priori* coding approach, also called "template coding," using the research questions to develop a framework for organizing my data analysis (Blair 2015). Blair's endorsement of template coding as an analytical method that allows the data to speak *through* rather than *at* the researcher aptly summarizes my own rationale for employing this method (Blair 2015, 19).

Template coding requires deriving *a priori* codes from the research problem itself, including relevant theoretical frameworks and existing literature in which the research question is situated (Blair 2015) – which, again, largely emerges in my approach to Section 4. Unpacking my overall research question – how and why government responses to the drought events in California and Western Cape influenced inequality – led me to determine three high-level codes, following Blair's general method (Figure 4).

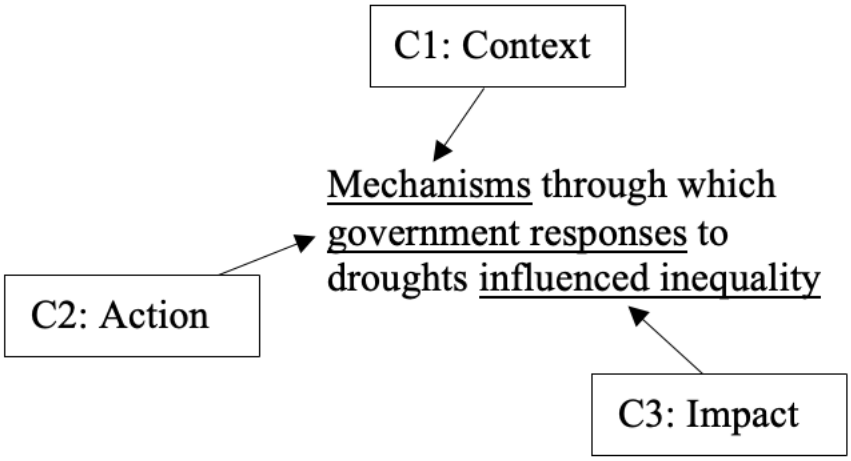

Figure 4: Deriving high-level codes from initial research question.

These three codes provided an initial framework for approaching and deriving meaning from the interview transcripts in relation to my research questions. I used Code 1 (C1, Context) as an umbrella category for interview participants' comments related to the relevant pre-existing institutional and culture features of their respective region and its water systems, both policy and infrastructural. Data coded under C1 generally came from responses to questions I conceived of within Part A of my interview guide. That said, the foundational and contextual nature of the facts and perceptions that comprise the data coded under C1 meant that I found data relevant to the C1 subcodes throughout each interview, and that it was complemented by my reading. Code 2 (C2, Action) encompassed interview data relevant to the actual ways that the respective government responded to the drought, for example, specific policies put in place. Importantly, the theoretical framework through which I am approaching this research at a high level, and the way I approached coding more specifically, allows insight into how the contexts *shape* responses. This connection provides further clarity on the relationship between "context" and "mechanisms" (Figure 4), leveraging a theoretical understanding of mechanisms as contextually bound (Falleti and Lynch 2009). I used Code 3 (C3, Impact) to categorize comments on the policy and social impacts of the droughts and related decisions. C3 included subcodes aligning with the components of hydraulic

citizenship I used to measure water inequality impacts (Table 2), and other subcodes to mark policy and political impacts (Appendix B).

As a final note on my data analysis and interpretation methods: it is relevant to acknowledge my own subjectivity, which likely shaped my choice of coding technique and my interpretation of the data (Blair 2015). Such is the case with most, if not all, qualitative research endeavors; in this case, my personal familiarity with the cultures of each region allowed me to discern nuanced or circumstantial language and references that I may not have otherwise.

4. Results I: Using the hydraulic citizenship spectrum to identify widened inequalities

Drawing on insight from previous studies, media coverage, and interview data, I show that government drought responses in both cases exacerbated existing water inequality, i.e., widened the hydraulic citizenship spectrum. To do so, I first describe each study region's baseline hydraulic citizenship spectrum to evince inequality prior to the drought onsets. Characterizing these baselines provides a structure for illustrating how inequalities widened as an outcome of government drought response, demonstrating how the theoretical framework outlined in Section 2 presents in each case (Figure 5; Figure 6). In this section, I ground my analysis in the existing literature and media coverage that I reviewed as part of my research design and development process; the novelty of my results in this section mainly lies in my application of the theoretical framework to the cases.

4.1. California

Poorest (post-drought)	*Poorest (baseline)*		*Wealthiest (baseline)*	*Wealthiest (post-drought)*
Domestic well failures; worsened quality and contamination issues	**Reliance on domestic wells; chronic exposure to toxic contamination**	*(A) Access systems*	**Clean water reliably piped to homes; no volume limits; high percentage used for ornamental landscaping**	**Pushback against restrictions; private deliveries to avoid high surcharges for exceeding use limits**
Lower-income water users are more sensitive to price changes	**Average water expenditures are ~3x EPA affordability threshold**	*(B) Costs*	**Negligible; in some views too low to signal scarcity**	**Price increases do not challenge household budgets; variable social (reputational) cost**
Increased reliance on govt-funded bottled water grant initiatives; low capacity to invest in further supply augmentation or relocate	**Often pay 2 water bills: 1 for unusable (contaminated) water that comes to homes, another for usable bottled water**	*(C) Adaptive capacities*	**Ample, but not necessary**	**No issue buying bottled water if necessary (generally was not); can relocate if necessary**

Figure 5: The spectrum of hydraulic citizenship in California under baseline circumstances (unshaded areas), evincing how it widened post-drought (shaded areas).

Baseline

"It doesn't take a drought for there to be water crisis years in California" (Interview 1).

Outside of drought, the idea of "water crisis" in California, as this interview quote alludes to, refers to the flagrant injustices that the state's most socioeconomically marginalized and politically vulnerable communities experience as normal. These injustices arise from chronic, intertwined water quality and quantity issues: full or partial reliance on domestic wells means these populations' water supplies are disproportionately prone to the linked issues of contamination from agricultural runoff and groundwater overdraft.

Exposure to toxic agricultural contaminants disproportionately affects California's Central Valley communities for several reasons. First, drinking water contamination occurs mainly within small water systems that supply rural towns and unincorporated communities (Del Real 2019), relying on customer bases too small to recover their operation and maintenance costs – a reflection of California's fragmented water supply system (Pannu 2012). Second, 95% of Central Valley residents rely on groundwater (Balazs et al. 2011), which is more vulnerable to contamination *and* harder to clean up (Del Real 2019). And third, the agricultural industry's strong lobby, combined with the weak political clout[5] of farming communities bearing the brunt of industry pollution via their water, constructs a power dynamic that further marginalizes these communities from decision-making spaces (Del Real 2019; Felde and Novak 2014; McClure 2012; Wines and Medina 2015).

To adapt to this chronic exposure, residents of California's poorest counties must purchase bottled water *in addition to* paying for toxic tap water. In a survey of San Joaquin Valley households, Moore et al. (2011) found that approximately 95% rely at least in part on bottled water, exacerbating water unaffordability relative to income: average water expenditures amongst this sample are nearly triple the US Environmental Protection Agency (EPA)'s water affordability threshold. Even without the added expense of bottled water, disparities in tap water affordability are shaped in part by "a lack of strongly tiered water rates" which Pincetl and Hogue describe as

[5] Much of this weak political clout is attributable to the historical development of California's agricultural industry as dependent on exploitation of immigrant labor, combined with restrictive national immigration policies, constructing an industry largely supported by undocumented workers (Greene 2021).

common amongst utilities in the Los Angeles Department of Water and Power (LADWP) service area, but also note "is prevalent throughout the state" (Pincetl and Hogue 2015, 851).

On the other end of the spectrum, wealthy Californians living in urban and suburban enclaves hydrate gardens with the same clean, reliable, essentially unlimited water supply they use to drink and bathe. The generally positive correlation between income and household water rates holds true in California, where the wealthiest households' water use patterns are typically higher than poorer ones, and moreover, largely provide for ornamental landscaping, rather than survival or even personal luxury (Harlan et al. 2009; Mini, Hogue, and Pincetl 2014). These households' abilities to maintain lush, indulgent landscapes indicates that water access and costs are normally unproblematic for this segment of California's population. In fact, water costs tend to make up relatively negligible portions of household budgets; in a traditional economic sense, water prices do not signal scarcity to high consumers (Porter 2014). The crisis of water in California thus refers not only to the regular injustices its rural agricultural communities experience, but also to the acute disparity between their experiences and those of California's wealthy elite – whose introductions to "water crisis" came only with severe drought, and even then, largely remained abstract.

Post-drought

"Our biggest crisis was with small rural communities whose wells were running dry, because of the drought, but also because the agricultural users around them were drilling deeper wells" (Interview 1).

Building on baseline precarity, thousands of domestic wells ran dry during the drought period – not as a reflection solely of aridity or physical water availability, but of the entangled relationship between these wells and large-scale agricultural groundwater extraction. The lived experiences of the drought for the rural communities that rely on domestic wells reveals this relationship, and in turn unveils "the social processes that produce inequities in rural agricultural communities that are present before and long after a drought" (Greene 2021, 34).

The levels and quality of water in domestic wells is linked to agricultural groundwater extraction; this link becomes especially evident during droughts, when agricultural reliance on groundwater escalates. The proportion of California's water use that comes from groundwater

varies annually relative to surface water availability, as groundwater often fulfills supply shortfalls in low precipitation years – contributing about 30 percent of total state water use in a wet year or up to 70 percent under severe drought conditions (Faunt et al. 2016). During the 2012-2016 drought, groundwater pumping increased to fulfill about 70 percent of Central Valley water demand, representing an estimated 180 percent increase compared to long-term average withdrawal rates (Faunt et al. 2016; Pauloo et al. 2020). This increased reliance on groundwater was a consequence of reduced agricultural deliveries from the state's major water projects, the CVP and SWP – a precedented adaptive action that the state leveraged within its drought response portfolio (Table 1), though the severity of the drought meant that "there were curtailments that hadn't ever been done" (Interview 2). Increased agricultural pumping to augment reduced surface deliveries – enabled by California's notoriously unsustainable non-regulation of groundwater broadly – mitigated agricultural losses while dehydrating the domestic wells that largely supply Central Valley agricultural communities (Pompeii 2020). This attributable displacement of impact from agriculture to communities has been quantified and documented: over two thousand domestic wells were reported dry during the 2012-2016 drought period – a likely underestimate given the voluntary nature of reporting (Pauloo et al. 2020).

The hydrogeological explanation for the link between agricultural groundwater withdrawals and the status of domestic wells stems from the nature of the pumping process itself and the land subsidence that overdraft can and does induce (Faunt et al. 2016; Pauloo et al. 2020); in other words, the displacement of impact onto communities was unsurprising and largely predictable. Groundwater overdraft in the name of the agricultural economy is not novel; however, its impacts compound:

> These same farmers have pumped groundwater over time, but are now dramatically depleting the Central Valley aquifers as they can afford to deploy bigger pumps deeper into these aquifers. Not only have their practices polluted groundwater, but pumping is leaving a number of low-income communities with no water what so ever, and they are potentially threatening the viability of those aquifers forever. (Pincetl and Hogue 2015, 851)

There is, however, a perversity: "you don't want to prevent agriculture from using that groundwater or growing stuff because most of the people in those poor communities are reliant on the jobs in that sector" (Interview 5). In other words, while increased groundwater extraction for agriculture worsened water access, quality, and reliability issues for domestic well users in likely

lasting ways, *not* doing so – allowing the industry to suffer, rather – would harm these same users in other socioeconomic capacities.

By way of reconciling domestic well failures, the state funded emergency water supply programs for impacted communities – complicating the baseline reliance on bottled water that many of these households experience. From one perspective, this spending demonstrates the state's awareness of active injustices and recognition of the HRTW. From another, it further reduces rural communities' agency over their own water security. The roll-out of these bottled water grants is also inseparable from state politics, as California policymakers often must take stances on water-related conflicts – and further, can be understood as widening the hydraulic citizenship spectrum for these already disadvantaged communities in that their water access becomes more dependent on political whims or external "generosity," and thus more tenuous.

The spectrum of hydraulic citizenship also widened at the level of costs, as EO B-29-15 directed urban suppliers to implement water pricing structures to induce conservation (Table 1), though California's fragmented water supply and delivery network render drought-induced changes in pricing structures difficult to characterize at a statewide level. That said, urban water districts in California did commonly increase rates during the drought period, as directed by the EO – a relatively predictable outcome, given that most of a water utility's costs are fixed, such that reduced demand in response to mandated conservation implies revenue losses for utilities (Mitchell et al. 2017). Also predictably, lower-income communities tend to suffer more as a result of water rate increases; for example, "when the city of Los Angeles, under conditions of drought, increased the cost of water, lower income customers were more sensitive to changes than higher income customers" (Pincetl and Hogue 2015, 851) – the same is common across the state (Mitchell et al. 2017; Pérez-Urdiales and Baerenklau 2020).

Domestic well failures in Central Valley communities therefore epitomize the widening of the hydraulic citizenship spectrum for those already most disadvantaged; the spectrum also widened on the other end, as California's wealthy elite experienced the drought largely in the abstract. This elite experience of "psychological distance" from the drought (Becker and Sparks 2020) emerged from the relatively lower visibility of physical dryness for urban Californians already far-removed from their water sources, in contrast with rural reliance on domestic wells, combined with their abilities to evade restrictions and the relatively low financial burden associated with changes in water pricing.

The divergence between these experiences again clarifies *whose water crisis* California's was: "For some people locally, it was a crisis… there was no doubt that if your well went dry, it was a crisis for you. But statewide, it was not a crisis," (Interview 5) given that "in general terms, [the state] didn't have a lot of problems in cities" (Interview 4). While domestic well users saw and experienced drought impacts acutely, Californians connected to major urban water districts tended to know the drought from media rather than from personal experience, felt negligibly affected by conservation mandates, and experienced "little disruption" to their daily lives – demonstrating "'intellectual' but not a 'practical awareness' of the drought" (Becker and Sparks 2020, 4). As one interviewee put it: "people were hemorrhaging water on their lawns to make them as green as a Scottish golf link; in the middle of a drought, or even in the middle of any August, that's crazy" (Interview 1).

4.2. Western Cape

Poorest (post-drought)	*Poorest (baseline)*		*Wealthiest (baseline)*	*Wealthiest (post-drought)*
Longer lines at taps; enforced restrictions; sometimes violent conflict/police presence	**Volume limits enforced by flow limiting devices (WMDs); reliance on precarious communal taps**	*(A) Access systems*	**Clean water reliably piped to homes; no volume limits**	**Water still piped to homes; use restrictions evaded by (C)**
Higher private & social costs	**High: cuts into FBW allowance & expedites time between visits to communal taps**	*(B) Costs*	**Not relevant**	**Price increases do not challenge household budgets; high social cost, mitigated by (C)**
None	**Barriers to applying for subsidized housing that come w/ water connections**	*(C) Adaptive capacities*	**Ample, but not necessary**	**Ample & prevalent: boreholes & rain tanks**

Figure 6: The spectrum of hydraulic citizenship in the Western Cape under baseline circumstances (unshaded areas), evincing how it widened post-drought (shaded areas).

Baseline

"People in the townships[6] have been living with 'Day Zero' for decades" (Interview 10).

Before the emergence of the drought and the ensuing Day Zero crisis, access systems differed markedly across the population as a product of how contemporary water policies and infrastructures reflect colonial and apartheid legacies in maintaining racialized water inequality (Chikozho, Danga, and Saruchera 2017; Enqvist and Ziervogel 2019; Marcatelli and Büscher 2019; Rodina and Harris 2016; Swatuk 2010). On one end of the spectrum, Cape Town's poorest communities living at the margins of the city – a vestige of apartheid spatial engineering which relegated non-white South Africans to areas with typically, and deliberately, poor resource availability and access (Findley and Ogbu 2011; Swatuk 2010) – rely on South Africa's post-apartheid Free Basic Water (FBW) policy. As its name suggests, the FBW policy provides registered "indigent" households with a minimum free water allowance of 25 liters per person per day, in theory to materialize the constitutional HRTW (Hellberg 2020; Muruvan 2002; Yates and Harris 2018). The poorest of the poor access water only from communal taps, which are often inconveniently accessible, badly maintained, crowded, and unsanitary (Enqvist and Ziervogel 2019; Rodina 2016). While requisite for many, use of communal taps implies health and safety risks, particularly for women and children who bear disproportionate burdens of collection (Rodina 2016). As a result of the high burden of access at this end of the spectrum, the opportunity costs of water are also high: each use, on top of cutting into a household's FBW allowance, brings the household closer to the next visit to the tap and its implications. Households that rely on communal taps as their sole water source have no augmentative opportunities in the case that taps are overcrowded, out of order, or otherwise unavailable. Some households may apply to receive government-subsidized homes which come with private, in-house connections, through a lengthy, complex eligibility determination process which poses several barriers (Rodina 2016).

In the context of post-apartheid water sector reforms, policies such as FBW were historically enforced by infrastructural innovations that complemented regulatory and market-

[6] In the South African context, "townships" are the abundant "informal settlements" that exist on urban peripheries as an almost untouched-relic of the apartheid regime's racialized urban planning ideology in support of its political goals, including control of the non-white population (Findley and Ogbu 2011).

based governance measures in their use of neoliberal economics to effect – and moreover, to justify – continued inequality. Two specific infrastructures helped in maintaining biopolitical control over racialized sectors of the population: prepaid water meters and physical flow restrictors known as water management devices (WMDs) (von Schnitzler 2008). In a broader context, "water metering technologies have been highlighted as 'human technologies of rule' that condition particular citizen responsibilities" (Rodina and Harris 2016, 340), foregrounding an understanding of their role in the state's construction of differentiated hydraulic citizenship across the population. These technologies, in turn, ensure sustained reliance on communal taps and their precarity.

On the other end of the spectrum, Cape Town's wealthy elite had little reason to think twice about turning the tap prior to the drought event – grounded in historical funneling of water rights toward white ownership dating back to colonial- and apartheid-era water allocation ideology. The water laws of these regimes constructed a system that effectively allocated the vast majority of resources to the country's white minority, through the forceful relocation of non-whites from resource-rich areas, largely in support of white-owned irrigated agriculture. Strengthened state control over water resources as a key piece of apartheid governance contributed to the evolution of water law "directly to serve the interests of dominant actors," which, in this instance, revolved around largely individualistic agricultural enterprises, industrialization, and economic development (Swatuk 2010, 527). The role of water policy and infrastructural development within apartheid logic evolved into the emergence of natural resource management, and water resource management in particular, as a focal point in post-apartheid state-building (Funke et al. 2007; Movik 2011; Swatuk 2010). This focus manifested in a contradictory touting of water equality goals in the country's new Constitution, for example, amidst espousal of neoliberal economic principles in its revised water management ideology, influenced partly by broader global trends in economic development discourse of the period (Narsiah and Ahmed 2012; Swatuk 2010).

In the present day, these histories of white-skewed water rights and ownership, and competing treatments of water as right and as a commodity, undergird the baseline of hydraulic citizenship for South Africa's wealthy elite. This baseline mirrors that of California's elite: affluent households located in lush enclaves of Cape Town irrigate gardens, fill backyard pools, and are generally unencumbered by water costs and access regimes.

Post-drought

"Who is the 'we' in 'do we have enough'?" (Interview 9).

Reflections on the Day Zero crisis may hold one of two perspectives: that water inequality became more potent or at least more visible (Funke et al. 2007; Movik 2011; Swatuk 2010), or that the crisis was a "social leveler" in impacting broad swaths of the population (Robins 2019; Shepherd 2019). I build on these conversations to propose that the government drought response effectively broadened the spectrum on which hydraulic citizenship manifests. Of note is that despite the racial desegregation that defined the "negotiated transition" from apartheid to democracy, South Africa remains characterized by "an economic system largely controlled by a white capitalist elite" (Whitehead 2013, 5). Thus, a class-based spectrum for visualizing hydraulic citizenship, in this instance, is synonymous with a race-based one, whereby "poorest" and "wealthiest" refer almost exclusively to black and white South Africans, respectively.

The City's policy response stretched the hydraulic citizenship spectrum in both directions: households on the poorest end now faced even higher access burdens, costs of use, and even fewer supply augmentation prospects or other forms of adaptive capacity, while impacts on wealthy elites demonstrate spectral broadening on their end, too. While mandatory use restrictions and tariff hikes should, in theory, *lessen* ease of access and *increase* opportunity costs of use, ample abilities to invest in supply augmentation rendered ease of access *higher* and opportunity costs *lower*, relatively, for these wealthy populations.

The City imposed water use restrictions that tightened over the course of the crisis to reflect the dwindling dam levels and therefore nearing proximity of "Day Zero" – these levels and their differential social impacts reflect, also, social constructions of populations vis-à-vis water use. The most stringent restriction amount of 50 liters per person per day, Level 6B, was *double* the amount of water supplied through the FBW policy, meaning "it is twice as much water as many South Africans rely on every day under normal circumstances" (Hellberg 2020, 198). Thus the restriction policy and the global attention it garnered reflects "the dominant imaginaries of what is appropriate for particular populations" (Hellberg 2020, 198), or in other words, exemplifies how social constructions are revealed in specific decisions in response to drought response. While wealthy communities and international spectators marveled at how *little* water Capetonians were expected

to live with in response to drought, poor communities had already been allotted *half* that amount for everyday survival – again, "living with Day Zero for decades" (Interview 10) – placing the Level 6B restrictions in perspective.

In any case, wealthy populations commonly evaded restrictions by leveraging their adaptive capacities, providing further perspective on the restrictions' differential impact. This population's abilities to take "gated actions" (Simpson, Shearing, and Dupont 2020, 1042) including installation of private boreholes and rainwater catchment tanks stem not only from drastically higher wealth, but also from the fact of land ownership to support these infrastructures – ownership that unequivocally reflects legacies of apartheid social and spatial engineering ideology. Elite actors leveraged the drought shock to effectively reconfigure water access systems, widening the existing disparity, and at no small cost:

> Anybody could drop a borehole, you had to pay for the costs, and if you were happy to do that, you did it. I mean it wasn't very cost effective… it was unbelievable how many people were doing it, and I was quite surprised… that's a huge expense. (Interview 10)

The drought, to these elite, was a shock that exposed infrastructural failures to the public eye and thus fostered unprecedented cognizance of water as a scarce resource. The legibility of water scarcity for this group stemmed, too, from Cape Town's Water Map: an "innovative and somewhat controversial behavioral-modification tool" through which Capetonians could, and did, monitor household-level compliance with restrictions across the city through an open-access online spatial viewer (Sinclair-Smith et al. 2018, 62). Water became a salient concern for white, middle- and upper-class Capetonians in a way previously reserved for only non-white populations; the water crisis experience forged a particular experience of hydraulic citizenship amongst this privileged minority that paralleled the longstanding nature of hydraulic citizenship amongst the non-white majority (Robins 2019). These wealthy households

> need a license to extract more than 10,000 liters of water per day from that water source. But if they, as a small homeowner, garden and so on, you're never going to be delivering 10,000 liters of water on your garden unless you have a massive property. So, they don't declare it… they just go ahead; they might register their boreholes, but that's about it. And the borehole drillers are not required before they drill to actually have a license to register it, so there's a loophole in that (Interview 7).

What my interviewee refers to as a "loophole" can be understood, rather, as an apt representation of the self-reinforcing nature of systemic inequality. He also added: "the city's got a map which indicates where these boreholes are, or registered ones, but they probably represent a very, very small amount of actually what was going on there and how people were using their water," contributing, too, to the perpetuation of water inequality (Interview 7). The elite ability to invest in supply augmentation exemplifies how water institutions in Cape Town, and in South Africa moreover, reproduce injustice through gatekeeping movement along the hydraulic citizenship spectrum via constraining adaptive capacities.

While this group invested in augmentative technologies on their properties, poor residents grappled with a water access system characterized by longer queues and enforced limits at communal water taps – and increased instances of closures. The case of the Newlands Spring – a long-standing historical and cultural water access site – is both representative of this injustice and historically symbolic of much of South Africa's fraught sociopolitical history. The Newlands neighborhood originally became a white area in reflection of how apartheid ideology shaped South Africa's cities: through forced relocation of non-white communities and the vastly unequal allocation of natural and capital resources in favor of the white population and economically profitable uses. In the Day Zero context, the intentional whiteness of the suburb surrounding the Spring contributed to its closure to public access by the City in late January 2018, following physical conflict and complaints from local residents over traffic congestion and crowding in an otherwise quiet, largely monochromatic neighborhood (Robins 2019). At the same time, the City introduced plans to *open* 200 new temporary public water distribution sites for all four million Capetonians in the event of true "Day Zero" – the day when residential taps would run dry – a plan calculated to be "utterly preposterous" in logistical terms (Interview 9). The choice to close public access sites such as Newlands Spring, contrasted with the installation of boreholes on private properties, provides an anecdotal illustration of the widened spectrum.

On the technical side, WMDs "(re)emerged as a symbolic issue in this context – particularly where they were installed without the informed consent of residents and applied to households with relatively limited scope to reduce water use" – i.e., poor, mainly non-white residents with already-low water usage (Bischoff-Mattson et al. 2020, 200). Further, new tariff structures that emerged corresponding with restriction levels "disproportionately [affected] the city's most marginalized residents" by "further [prioritizing] economic over equity commitments"

(Millington and Scheba 2020, 13, 12). In itself, the inequity embedded in the tariff rate increases is unsurprising: economic and market-based approaches to urban water conservation tend to imply equity concerns as demand elasticity is lower for wealthier users (Olmstead and Stavins 2009). The long-standing culture of anti-privatization activism in post-apartheid South Africa contributed to community reactions to the tariff hikes: the Water Crisis Coalition, an activist group formed in the context of the Day Zero crisis, "insisted that the City's water conservation measures, especially the tariff increases, were a violation of both constitutionally enshrined rights to water and a moral economy based upon the idea of water as a public good" (Robins 2019, 13). Further, the tariffs associated with restriction Level 6B targeted not only high-consumption households, as precedented; they also had significant impacts on increased water prices for "non-indigent" households that consumed relatively little water (Schreiber 2019).

5. Results II: Characterizing mechanisms of widened inequality

Causal mechanisms linking government responses to widened inequalities include what I identify as *values-reinforcement mechanisms* and *strategic communication mechanisms*. In both cases, underlying dominant social constructions, evident in baseline water inequalities, shaped and constrained the operation of these mechanisms to produce widening of the hydraulic citizenship spectrum as parallel outputs (Figure 3). Tracing these processes clarifies the contextually bound nature of the mechanismic process within each region.

5.1. Values-reinforcement mechanism

Government responses to both droughts reflect the persistent power of dominant political-economic values and social constructions; put differently, tracing the processes by which responses widened inequality in both cases reveals the common presence of the *values-reinforcement mechanism*. In California, responses reinforced priority valuation of the state's globalized agricultural economy, while in the Western Cape, responses reinforced values rooted in maintaining the status quo of racialized wealth distribution as a potent legacy of the historical national development agenda.

In California, emergency declarations waived certain regulations in the name of urgency, which, combined with reduced surface deliveries from the state's major water projects, enabled the increased agricultural pumping that polluted and dehydrated rural domestic wells. The drought-induced reductions coincided with "historically high water demand" (Lund et al. 2018, 2), impacting industry and community spaces in ways that essentially reflect their underlying values and vulnerabilities.[7] The picture in Western Cape differs: "While Cape Town has narrowly avoided the taps running dry in this instance, this has been at the cost of water to irrigate the farms" (Otto et al. 2018, 9) – a distribution of priorities that is difficult, if not impossible, to imagine in California. The cost to agriculture is evident in that in February 2018, the City delayed Cape Town's projected date of "Day Zero" to reflect a buffer that declining agricultural use provided, as many agricultural users within the WCWSS had already depleted their allocation. Government framing of agricultural allocation depletion as "a welcome decline in water usage," and further

[7] See Table 1 of Lund et al. 2018 for compiled data from the DWR and US Bureau of Reclamation on these reductions from 2011-2017.

noting that "had agricultural releases not slowed down, the threat of Day Zero would have moved closer," (City of Cape Town 2018) clarifies that responses reinforced the valuation of Western Cape's urban residents – particularly affluent, mainly white, Capetonians – as politically powerful wealth-holders. This contrast reflects the two study regions' relative and contextualized valuations of agriculture, and perceptions of agricultural water use and the ways and extents to which it interacts with urban use.

There is an important background dynamic related to the built infrastructures of water supply in each place and the decisions that underlay and justified their development (see Section 3.1). It was insightful to hear Western Cape experts reference the value of the Province's agricultural industry, having the California case in mind: "in the South African context, because of our history, agriculture has to kind of get significant amount of water, because it's kind of seen as part of the country and we're a country that grows food" (Interview 10); and "this was also an agricultural crisis, and often when we are talking through this crisis, the agricultural sector is left out" (Interview 7). It is key to contextualize this view, keeping in mind that the history referenced here is one in which agricultural development was entwined with, and essential to, colonial opportunism and nation-building, accumulation and gatekeeping of white wealth, and the ideologies that forged and justified apartheid – all of which have clear persisting legacies, evident in baseline inequalities and the forces that shape them. In this way, the value placed in South African agriculture, with its hub in the Western Cape Province, is inseparable from the racialized value systems of the historical institutional context.

Comparatively, California's valuation of agriculture, viewed in national historical context, is tied not to apartheid nationalism but to westward expansion in pursuit of American exceptionalism, economic development, and geopolitical power. Simply put, California is a paradigmatic "hydrocracy" – an irrigated empire with a history inseparable from water politics and infrastructural development (Molle, Mollinga, and Wester 2009). Amidst a backdrop of existing inequalities that is largely linked to the high political and economic value ascribed to agriculture, it is cogent that this industry's power is a causal factor in widened inequalities that manifested from drought responses. As one of my interviewees quite bluntly put it:

> The water use in agriculture that's causing the pollution, that causes the overdraft, that causes the dry wells – that's so much more valuable, it's like 100 times more valuable, than the cost of deepening those poor souls' wells. (Interview 5)

Water for California's residential sector, in contrast, "is considered to have lower use value" (Buck, Nemati, and Sunding 2016, 2) – affirming that the state's logic behind targeting water conservation mandates at the urban residential sector stems from relative valuation of agricultural uses. One caveat several California experts noted was that the agricultural industry did not emerge unscathed by the drought and the government response to it, as many farmers faced economic losses to a degree – but that "it's also business, and it's a risky business, and they know the risks" (Interview 1). In other words, the way the drought and related responses impacted the industry can be understood as part and parcel of California's agricultural industry by definition.

One further caveat that arose in interviews in both regions was the degree to which policy choices around the drought *did* consider – or at least, purported to consider – baseline social inequalities, perhaps suggesting the potential for responses to depart from dominant values to an extent. In California, the impression of equity considerations arose from the way the state tiered conservation mandates considering baseline water use levels by district, to ensure that already lower-use communities did not face restrictions commensurate with their higher-use neighbors. However, the impacts of the state's conservation mandates were "asymmetric" – correlating with socioeconomic and demographic variables "such that poorer and older communities, those with more children or more elderly residents, and those with more Hispanic residents were harder hit by the regulations" (Pérez-Urdiales and Baerenklau 2020, 9). Moreover, and perhaps related to that correlation, varied adaptive capacities rendered populations unequal in their abilities to skirt restrictions through private supply augmentation measures. Additionally, the state's provision of bottled water grants to in-need communities may suggest consideration of social and water inequality during the drought period. Lauding the state government for emergency bottled water provision, however, normalizes community reliance on state-supplied bottled water in a way that misses the forest for the trees, so to speak. In the Western Cape, the impression of equity came from the government's purported focus on high-consuming households:

> What I did like is that during the drought, [the government] put WMDs into wealthy homes, which was basically something that they'd only used in poor areas before… So, it's great that during the drought they were like, "okay, we don't care if this is a wealthy household, we don't care that you can pay your bill; you have to use less than [the mandated restriction amount] and we're giving you a warning and if you don't, we're putting in a device and you're paying for it." (Interview 10)

However, an interviewee currently based in Cape Town observed: "ostensibly [WMDs] were being installed in high-consuming areas; I'm less convinced, as I just moved into a low-income neighborhood, and I have a smart meter neatly installed that cuts off at a certain point" (Interview 9) – alluding to potential falsehoods in the government's purported use of WMDs to curb high water consumers *specifically* in the drought context.

In summary, tracing the processes by which the hydraulic citizenship spectrum widened in each study region reveals how context-specific, deeply rooted values underlay, and could not be abandoned within, decisions around drought response – demonstrating the resilience of the social constructions that produce and reproduce these values and how they manifest.

5.2. Strategic communication mechanism

Both governments generated and communicated information strategically, in ways that leveraged choices around content, framing, and targeting to instill senses of responsibility for mitigating drought crises upon populations. In California, communication between government and society produced disparities in understandings of the drought, relating back to the idea of urban Californians' perceptions of "psychological distance" (Becker and Sparks 2020) versus rural communities' acute exposure. The psychological distance arose largely from the lack of *visible* shortage for California's elite – in controlling this visibility, the communication mechanism de-emphasized this group's responsibility for behavioral change in responses to the drought, relative to communities with closer connections to visible shortage.

In Western Cape, numbers-based communication captured public attention across the board. This numeric focus is evident in the Day Zero narrative and the way it manifested: in constant calculations of dam levels versus water use levels, and algorithmic determinations of household water use restrictions and the exact timing of "Day Zero" based on the relationship between the two – communicated through Cape Town's real-time Water Dashboard (City of Cape Town n.d.). Personal contributions to "averting" Day Zero were tangible and actionable; further, the clear quantification of drought and its necessary implications for human behavior reflects the relatively more straightforward structure of Western Cape's water supply system, versus California's which is practically unquantifiable for its complexity and supply diversification. The strategic numeric focus that characterized government communication around Day Zero and its

implications brought a level of practical awareness and legibility of the drought to virtually all swaths of the population in a way absent in California.

Despite these differences, both exhibitions of the *strategic communication mechanism* leveraged the notion of drought as crisis or emergency, which underpinned and served to justify the roll-out of regulatory, price-based, communication-based, and technical actions (Table 1). In California, Governor Brown's January 2014 statewide drought emergency proclamation facilitated actions that would otherwise have been delayed or obstructed altogether. One interviewee who previously held a position in state government said:

> we needed the EOs to waive a lot of the procedural rules… to be able to move at the speed you needed to during a drought… we waived our environmental quality rules which applied… we needed EOs to give us the authority to do stuff and spend money… the EOs allowed us to take those tactical moves. (Interview 1)

Similarly in the Western Cape, Mayor de Lille's March 2017 disaster declaration, and strategic provincial- and national-level declarations, allowed "the ability to override certain things you normally need to do" and to access special funding (Interview 10). In Western Cape, inter-governmental party politics were also germane:

> Western Cape is a different government party to the national level, so the perception very much was that the then-Premier was trying to unlock the disaster funding that would be available if there was a disaster declared at national level. And so, by declaring it a disaster at provincial level, she has specific mandate or a specific ability to then access those funds or unlock those funds. (Interview 9)

Emergency or disaster declarations in both cases not only served these bureaucratic purposes; they also helped the respective governments shape their constituencies' perceptions of, and reactions to, the droughts. In California, emergency rhetoric magnified public awareness of the drought issue, and "that's very, very, very useful. It encourages people to do water conservation, it mobilizes people politically" (Interview 5). In Western Cape, too, the heavy disaster framing created similar awareness, and buttressed the impact of the "Day Zero" narrative. More so than California's "Save Our Water" campaign, the Day Zero narrative came to characterize the dominant framing, and thus understandings, of the drought and its implications – not only amongst local communities but also in local, national, and international media (Allsop 2018; Onishi and Sengupta 2018). Two interviewees articulated the psychological impact of the

Day Zero narrative and numbers-based communication more broadly: "that concept created, first of all, a psychological shift in people's consciousness" (Interview 7); "there was something quite spectacular about the idea of the taps running dry" (Interview 8). Further, the proximity of Day Zero, dam levels, and citywide and household water use levels became part of everyday small talk across the population – "it was virtually part of every social conversation" (Interview 7) – buttressed by the Water Map and the social comparison it facilitated (Sinclair-Smith et al. 2018).

The social impact that "Day Zero" created in the Western Cape did not surface in California, nor did California's communication campaign urge water conservation to the same extent. While the state dedicated significant financial resources toward its "Save Our Water" communication campaign – over one million dollars just in 2014, for example – it was largely ineffective in terms of causal contribution to water use reductions. "Exposure to pro-conservation messages," which dominated California's communication strategy, "actually *decreased* participants' attitude toward water conservation" (Liang, Henderson, and Kee 2018, 553). The relative inconsequentiality of California's campaign was verified by my interviews: the "Save Our Water" motto did not come up in any, in stark contrast to the frequent and virtually inescapable use of the "Day Zero" term amongst Western Cape-based interviewees and drought-related conversations more broadly.

While evidently different in their potency, both communication strategies leveraged the notion of urgency. In thinking about these constructions of urgency – their origins and impacts, both intended and perhaps unintended – it is useful to consider Spector's (2019) "crisis-as-claim" model alongside Whyte's (2020) writing on "crisis epistemologies." Spector conceptualizes crisis not as a particular event, but as a deliberate political choice – one that relies on narrativity to reify urgency (Hay 1999; Spector 2019). This model offers a way to understand the California and Western Cape crises as products of both the extant sociotechnical systems of water provision – reflecting social constructions – and the governments' choices to claim the droughts as crises to garner attention and convey urgency as "exercises in power and assertions of interests" (Spector 2019, 81). Whyte's (2020) "crisis epistemologies" idea furthers this notion and connects it more clearly to the idea of perpetuating injustice, as is evident in my framework and its application to the case studies. Whyte's argument that "today, people perpetuate colonialism in the name of responding to environmental crisis," in other words, that construction of crises leverages ideas of "unprecedentedness and urgency" to uphold and "mask numerous forms of power," further

contextualizes the role of these narratives and how they comprise mechanisms of widened inequalities, broadly and applied to these cases (Whyte 2020, 1, 6).

Like the crises moreover, strategic communication of responsibility and urgency targeted populations in variegated ways, in line with baseline experiences of water injustice. In other words, perceptions of individual responsibility for "averting crisis" were shaped both by the crisis narratives themselves, and by underlying contexts. Considering whom each of these campaigns selectively targeted provides insight into which population groups were expected to make behavioral changes, in what ways – conversant with the social constructions idea more broadly, and related notions of "deservingness" or "worthiness" (Schneider and Ingram 2019). The "Day Zero" messaging targeted formal households and tourists (Schreiber 2019), explaining its pervasiveness in everyday social settings and in conversations beyond South Africa. The concept was self-reinforcing in fostering acute, constant awareness of water quantities: dam levels, water available, water used, by whom, when, where. In California, tiered percentage reduction mandates at the urban water district level had differential impacts, resulting in disproportionate exposure to drought burden upon districts comprising already more marginalized communities (Pérez-Urdiales and Baerenklau 2020; Pompeii 2020).

The feeling of individual responsibility that the Day Zero narrative produced did not emerge in a vacuum, but rather has roots in the South African political historical context. One of my interviewees nodded to these roots in noting: "In South Africa, the state is fragile. And so, citizens feel, to some extent, 'we've got to save the day here', because the state is struggling to be able to manage it" (Interview 7). There is somewhat of a paradox here: actors across the spectrum felt personal responsibility to make changes to their daily lives, but the nature and severity of those changes are distinct in the ways they widened the spectrum itself. Increased attention to water as a scarce resource, and as a political resource, also materialized with potential long-term impacts:

> People really had a new way of engaging with water, a new way of understanding water. We understood the water system in ways that… even myself as working in the water field hadn't understood before… So, the understanding of the water system has improved, which I think makes it easier to then appreciate kind of resource scarcity. (Interview 10)

Trust in government shapes how the selective communication mechanism operates in each region. Embedded within this notion are ideas of privacy: in contrast to the Western Cape, where social comparison emerged as people viewed their peers' water use data freely on the Water Map

(Sinclair-Smith et al. 2018), the American cultural mentality of privacy – "this is my way of life, my water, my data, it's mine" (Interview 3) – necessarily barred the same type of social comparison dynamic to emerge. The sentiment that water use data is "private information" means that "the state doesn't have access to private homeowners' water use, any of those records… unless we get special exceptions, and then it's all wrapped down and super confidential" (Interview 2). This is in stark contrast with Cape Town's Water Map, for example, which leveraged legal justification privileging public benefit over potential privacy infringement concerns to publish water use data – assisting also in citizen enforcement of, and social accountability around, collective efforts to avert Day Zero (Sinclair-Smith et al. 2018).

The distinctly American privacy mentality evokes another aspect of the selective communication mechanism more broadly: what data are collected and communicated, or just as importantly, barred from collection or communication – themselves reflections of political cultures. In both study regions, governments and local experts demonstrate awareness of data collection and communication capacities as a factor that both presented barriers and provided opportunities in contexts of drought response: in California, especially around groundwater,

> data was what we [the state government] doubled down on, as opposed to the people who were saying "let's rip up the water rights system." What we said was, "wait a minute, let's get the data." Because there's so much in California water that's faith-based, and that's part of the problem; that's why everything's a crisis and everything's a water war. (Interview 1)

In the Western Cape: "there were issues… in terms of data… that the data wasn't up to date" (Interview 10), though the advent of the Water Dashboard was "a really great success… what it showed was: the City does have the ability to aggregate the data effectively" (Interview 9). Beyond barriers and opportunities, though, data collection and communication are evidently shaped and constrained in deliberate ways by legalities and other cultural differences.

Bringing together the ideas of societal trust in government and the politics of data collection and communication: Wilder and Ingram (2016) define "water equity" by the participatory inclusivity of water governance processes. By this token, water justice is fundamentally unachievable in a context in which strategic communication between government and communities stymies its pursuit.

5.3. Pertinence of decisions around groundwater

In identifying the causal mechanisms commonly present in both cases, I also found decisions around groundwater at both government and household levels to be a shared pertinent and consequential factor. Decisions around groundwater resources – who can drill, where, when, how much, and under what circumstances – are particularly revealing of how social constructions manifest: reflecting priorities grounded in California agriculture and Western Cape's wealthy, elite, mainly white, urban population, respectively. These priorities in both cases are vestigial of historical, institutional, and social contexts. It is also pertinent that both the California and Western Cape governments have inadequate control over and information about groundwater use, largely linked to the nature of groundwater itself as an invisible, underground resource – but also due to institutional histories around groundwater non-regulation, in California's case, and broader non-reliance on groundwater, as in the Western Cape and South Africa moreover. Groundwater can and should be relevant during droughts for its ability to supplement lost surface supply (see Section 3.1). However, when droughts increase reliance on groundwater, they simultaneously slow aquifer recharge rates and worsen quality, and thus contribute to maladaptation (Christian-Smith, Levy, and Gleick 2015; Levy et al. 2021). It is therefore key to advance models of sustainable groundwater governance both during and outside of drought periods that enable departure from, rather than reinforcement of, social constructions of inequality.

California's groundwater management system, or historical lack thereof, is notoriously haphazard and inadequate: before the 2014 passage of the Sustainable Groundwater Management Act (SGMA), groundwater extraction was wholly unregulated and uncounted. In most of California, including the Central Valley, "there are no such adjudicated pumping restrictions, so it is a free for all – or rather those with the most money to dig the deepest wells get the most water" (Pincetl and Hogue 2015, 853). The same can be said of the Western Cape, the difference being that "those with the most money" refers not to agricultural powerhouse users but to wealthy urban and suburban households whose private borehole installation, too, represents virtually unrestricted groundwater resource exploitation – again, reflecting social constructions and the tenacious values-reinforcement mechanism.

6. Discussion and Conclusion

As simultaneously social and environmental phenomena, water scarcity crises present opportunities to address the social impacts of environmental change and clarify the role of policy in shaping these impacts. With droughts projected to increase in frequency and severity, it is imperative that governments implement policies around drought events that effectively center socioeconomic inequality. Several interview participants from California shared the perception that the water crisis in the Western Cape "cut it a lot closer" (Interview 5) – that California's situation "while it was dire, it wasn't as dire as Cape Town" (Interview 6). As I have shown, though, comparing the direness of the two droughts depends on definitions of successful government response, and on the pre-existing systems shaping baseline distributions of hydraulic citizenship. Problematized in this way, it is ultimately ineffectual to compare the two cases by narrowly quantitative metrics: the explanations for how and why the drought events and related responses unfolded as they did, and how and why inequalities intensified in each case, cohere only in their own historical and institutional context. That said, there are general takeaways to glean: in both cases, causal mechanisms linking government responses to widened inequalities include what I identify as *values-reinforcement mechanisms* and *strategic communication mechanisms*. The common presence of these mechanisms reveals the resilience of dominant social values and constructions, even in response to extreme events and socio-environmental challenges. The particular importance of decisions around groundwater resources during drought events also emerged through comparative analysis of the cases.

6.1. Practical implications

"There's an opportunity that comes out of crises" (Interview 7).

Drought events provide essential opportunities to critically examine physical, social, and political systems around water access – to "rethink and reevaluate how we're using water, how we want to build our future communities when it comes to water" (Interview 6). Drought responses thus constitute important, consequential policy sites for advancing environmental and social

justice. Understanding the causal mechanisms through which government drought responses exacerbate inequalities highlights the weight of these responses in this context.

One major challenge that this study underscores is the obstinacy of the social values and constructions that produce and reproduce inequality. While this reality makes it challenging to depart from existing patterns of injustice altogether, it is also a call for advancing innovative systems-level solutions that, however incrementally, dismantle the power structures that uphold these patterns. One such way is to encourage a rhetorical shift from focus on "drought" and "drought-proneness" to "aridity" and "aridification" – lending to the notion that dryness and year-to-year variability in dryness are permanent, natural features of these regions and known futures under climate change, departing from a view of droughts as emergent and urgent crisis events. This type of shift could support proactive rather than reactive policymaking around water shortage or scarcity situations – and, seen through Whyte's (2020) crisis epistemologies lens, could in turn contribute to decolonial water management approaches.

One Western Cape interviewee poignantly posed the question: "What legacy has this left for water access in the long term?" referencing the government's response to the drought (Interview 9). This question holds relevance in both cases and in many ways remains to be seen, though the nature of the determinants and mechanisms of widened inequality suggest some level of durability. Put differently, it is plausible that the post-drought hydraulic citizenship spectrum in each case constitutes a new baseline against which to measure the effectiveness of future drought responses vis-à-vis inequality. This point is especially cogent given projected climate change impacts on drought frequency and severity in these regions and more broadly, and the continued need for governments to respond in ways that center social and environmental justice.

Beyond relevance to droughts, the results and implications of this study relate to arguments that experiences of extreme climate events – be they droughts, floods, wildfires, heatwaves, or blizzards – may not engender attitudinal changes or collective action on climate change despite their potential to do so (Boudet et al. 2020). In this case, partial attribution of water crisis events to climate change (Table 3), and lived experiences of these events, did not necessarily foster increased discussion or action around climate change in the longer-term aftermath of the droughts. In a similar vein, demonstrated widened inequality did not necessarily increase attention on the social and environmental justice implications of drought response. These disconnects point to the need for policy process studies to move beyond assessing policy responses for their evolution and

implementation effectiveness, toward evaluating them from the vantage point of environmental justice. This shift can contribute to understandings of how extreme environmental events not only offer potential opportunities for policy change, but also constitute key policy sites for pursuing environmental justice within those opportunities.

The relevance of decisions around groundwater in both cases resonates with the current high-level focus on increasing the visibility of groundwater and the implications around it, evident in the 2022 UN World Water Day theme, for example: "Groundwater – Making the Invisible Visible" (UN 2022). Californian water decisionmakers are already acutely aware of decisions around groundwater, as evinced, for example, in the 2014 passage of SGMA – widely considered by local experts to be "a really big win of the last drought" (Interview 4); "a move in the right direction on groundwater" (Interview 5) that the drought helped facilitate. The Western Cape Province, reliant on surface supply, is positioned to preemptively consider the equity implications of groundwater resource use and management and supply diversification going forward, particularly as a more drought-resilient supply source, and supply diversification moreover.

6.2. Areas for further research

The perspectives and methods used in this paper to assess widened water inequality offer a model for potential application to other regions that have experienced or are prone to severe drought and water crisis. Given that similar events have already garnered attention worldwide – e.g., São Paolo, Australia, Mexico City, Chennai – and are projected to increase, ideally this study's theoretical and methodological contributions can be useful for assessing the equity implications of responses to other experiences of the so-called "global water crisis" (Bakker 2012, 914), and of socio-environmental shocks beyond drought.

Further, while this study demonstrates two cases of inequality increasing, applying similar analytical lenses to more cases of severe drought could help determine whether and how inequality may *decrease* after drought. Such analyses could pose and address questions around the baseline contexts and distributions of hydraulic citizenship that may lend to more equitable drought response outcomes, and the mechanisms of *narrowed* inequality, rather. So too, the results and implications of these studies could contribute to proactive policymaking around droughts and other severe events that inherently center environmental justice.

I mentioned in Section 3 the HRTW legislated in both California at the state level and South Africa at the national level, and to issues in their operationalization and fulfillment, as this study in part demonstrates. Other governments at varying administrative levels worldwide, including the UN level, have passed similar legislation. There is notable potential for future research into what successful implementation of the HRTW looks like, and where it has been achieved, if anywhere – this research should also consider the multi-dimensional academic debate about the utility and limitations of the HRTW concept more broadly (Bakker 2008; Mirosa and Harris 2012; Sultana and Loftus 2020). Such insights could contribute to drought responses that better prioritize equity implications, to ensure that widened inequality is not the default outcome of drought events and related government responses.

In California, there is current discussion on the impacts and shortcomings of SGMA since its passage, particularly as the state experiences another severe drought, ongoing at the time of this study's publication. The current drought suggests opportunities for future in-depth longitudinal studies of drought in California, and may also encourage expediting SGMA implementation, perhaps with a greater consideration of its equity implications. Western Cape has not to date experienced another severe drought, though there is, of course, also opportunity for similar comparative analysis. Such longitudinal studies could also assess how different administrations' political priorities impact drought responses, and how drought response may impact an administration's popularity or electability, along with countless other temporally specific factors.

Finally, in this paper I have focused on extremes – two ends of a spectrum – but there are also elements along each part of the spectrum worth studying. The experiences of countless people and communities whose statuses as hydraulic citizens lie somewhere between the spectral extremes are contextually varied in their own nuanced ways that were beyond the direct scope of this paper, but present an opportunity for future research with regards to these case studies and beyond.

References

Alexander, Christian. 2019. “Cape Town’s ‘Day Zero’ Water Crisis, One Year Later.” *Bloomberg CityLab*.

Allsop, Jon. 2018. “In Cape Town, Journalists Count the Cost of ‘Day Zero’ Water Narrative.” *Columbia Journalism Review*. https://www.cjr.org/analysis/cape-town-day-zero-water.php.

Anand, Nikhil. 2017. *Hydraulic City: Water & the Infrastructures of Citizenship in Mumbai*. Durham: Duke University Press.

Bakker, Karen. 2008. “The ‘Commons’ Versus the ‘Commodity’: Alter-Globalization, Anti-Privatization and the Human Right to Water in the Global South.” In *Privatization: Property and the Remaking of Nature-Society Relations*, ed. Becky Mansfield. Blackwell Publishing, 38–63.

———. 2012. “Water Security: Research Challenges and Opportunities.” *Science* 337: 914–15.

Balazs, Carolina, Rachel Morello-Frosch, Alan Hubbard, and Isha Ray. 2011. “Social Disparities in Nitrate-Contaminated Drinking Water in California’s San Joaquin Valley.” *Environmental Health Perspectives* 119(9): 1272–78.

Baudoin, Marie-Ange, Coleen Vogel, Kirsty Nortje, and Myra Naik. 2017. “Living with Drought in South Africa: Lessons Learnt from the Recent El Niño Drought Period.” *International Journal of Disaster Risk Reduction* 23: 128–37.

Beach, Derek. 2016. “It’s All about Mechanisms – What Process-Tracing Case Studies Should Be Tracing.” *New Political Economy* 21(5): 463–72.

———. 2017. “Process-Tracing Methods in Social Science.” In *Oxford Research Encyclopedia of Politics*, Oxford University Press. https://oxfordre.com/politics/view/10.1093/acrefore/9780190228637.001.0001/acrefore-9780190228637-e-176 (December 29, 2021).

Becker, Sarah, and Paul Sparks. 2020. “‘It Never Rains in California’: Constructions of Drought as a Natural and Social Phenomenon.” *Weather and Climate Extremes* 29: 100257.

Bengtsson, Bo, and Hannu Ruonavaara. 2017. “Comparative Process Tracing: Making Historical Comparison Structured and Focused.” *Philosophy of the Social Sciences* 47(1): 44–66.

Bischoff-Mattson, Zachary et al. 2020. “Shape of a Water Crisis: Practitioner Perspectives on Urban Water Scarcity and ‘Day Zero’ in South Africa.” *Water Policy* 22(2): 193–210.

Blair, Erik. 2015. “A Reflexive Exploration of Two Qualitative Data Coding Techniques.” *Journal of Methods and Measurement in the Social Sciences* 6(1): 14–29.

Boudet, Hilary et al. 2020. “Event Attribution and Partisanship Shape Local Discussion of Climate Change after Extreme Weather.” *Nature Climate Change* 10(1): 69–76.

Brick, Kerri, Samantha De Martino, and Martine Visser. 2018. “Behavioural Nudges for Water Conservation: Experimental Evidence from Cape Town.” *Draft Paper*: 1–58.

Buck, Steven, Mehdi Nemati, and David L. Sunding. 2016. “The Welfare Consequences of the 2015 California Drought Mandate: Evidence from New Results on Monthly Water Demand.” In Boston, Massachussetts.

Burls, Natalie J. et al. 2019. “The Cape Town ‘Day Zero’ Drought and Hadley Cell Expansion.” *npj Climate and Atmospheric Science* 2(1): 27.

California Secretary of State. 2012. Water Code (California State Legislature) *An Act to Add Section 106.3 to the Water Code, Relating to Water*. http://www.leginfo.ca.gov/pub/11-12/bill/asm/ab_0651-0700/ab_685_bill_20120925_chaptered.pdf (March 16, 2022).

Cameron, Robert. 2014. “Vertical Decentralisation and Urban Service Delivery in South Africa: Does Politics Matter?” *Development Policy Review* 32(S1): S81–100.

Chikozho, C., L. Danga, and D. Saruchera. 2017. “Articulating the History and Major Departure Points Evident in Post-Apartheid South African National Water Policy and Law.” *Physics and Chemistry of the Earth* 100: 270–77.

Christian-Smith, Juliet, Morgan C. Levy, and Peter H. Gleick. 2015. “Maladaptation to Drought: A Case Report from California, USA.” *Sustainability Science* 10(3): 491–501.

City of Cape Town. 2018. “Day Zero Projection Moves out Due to Declining Agricultural Usage.” *City of Cape Town*. https://www.capetown.gov.za/Media-and-news/Day%20Zero%20projection%20moves%20out%20due%20to%20declining%20agricultural%20usage (April 13, 2022).

———. “Water Dashboard.” https://coct.co/water-dashboard/ (November 8, 2020).

Dai, Aiguo. 2013. “Increasing Drought under Global Warming in Observations and Models.” *Nature Climate Change* 3(1): 52–58.

Del Real, Jose A. 2019. “They Grow the Nation’s Food, but They Can’t Drink the Water.” *The New York Times*. https://www.nytimes.com/2019/05/21/us/california-central-valley-tainted-water.html (March 19, 2022).

Diffenbaugh, Noah S., Daniel L. Swain, and Danielle Touma. 2015. “Anthropogenic Warming Has Increased Drought Risk in California.” *Proceedings of the National Academy of Sciences* 112(13): 3931–36.

DWS. 2018. *Water Outlook 2018 Report*. Cape Town, South Africa: Department of Water and Sanitation.

Enqvist, Johan P., and Gina Ziervogel. 2019. “Water Governance and Justice in Cape Town: An Overview.” *Wiley Interdisciplinary Reviews: Water* 6(4): e1354.

Escriva-Bou, Alvar, Ellen Hanak, and Jeffrey Mount. 2019. *California’s Water Grid*. Public Policy Institute of California.

Falleti, Tulia G., and Julia F. Lynch. 2009. “Context and Causal Mechanisms in Political Analysis.” *Comparative Political Studies* 42(9): 1143–66.

Faunt, Claudia C., Michelle Sneed, Jon Traum, and Justin T. Brandt. 2016. “Water Availability and Land Subsidence in the Central Valley, California, USA.” *Hydrogeology Journal* 24(3): 675–84.

Felde, Kitty, and Viveca Novak. 2014. “The Politics of Drought: California Water Interests Prime the Pump in Washington.” *OpenSecrets News*. https://www.opensecrets.org/news/2014/04/the-politics-of-drought-california-water-interests-prime-the-pump-in-washington/ (March 29, 2022).

Findley, Lisa, and Liz Ogbu. 2011. “South Africa: From Township to Town.” *Places Journal*. https://placesjournal.org/article/south-africa-from-township-to-town/?cn-reloaded=1 (December 15, 2020).

Francis, Rose, and Laurel Firestone. 2011. “Implementing the Human Right to Water in California’s Central Valley: Building a Democratic Voice through Community Engagement in Water Policy Decision Making.” *Willamette Law Review*: 43.

Funke, Nikki et al. 2007. “Redressing Inequality: South Africa’s New Water Policy.” *Environment: Science and Policy for Sustainable Development* 49(3): 10–23.

George, Alexander L., and Andrew Bennett. 2005. *Case Studies and Theory Development in the Social Sciences*. MIT Press.

Gerlak, Andrea K., and Margaret Wilder. 2012. “Exploring the Textured Landscape of Water Insecurity and the Human Right to Water.” *Environment* 54(2): 4–17.

Gerring, John. 2008. “The Mechanismic Worldview: Thinking inside the Box.” *British Journal of Political Science* 38(1): 161–79.

Goddard, Jessica J., Isha Ray, and Carolina Balazs. 2021. “Water Affordability and Human Right to Water Implications in California.” *PLOS ONE* 16(1): e0245237.

Gosling, Simon N., and Nigel W. Arnell. 2016. “A Global Assessment of the Impact of Climate Change on Water Scarcity.” *Climatic Change* 134(3): 371–85.

Greene, Christina. 2021. “‘Drought Isn’t Just Water, It Is Living’: Narratives of Drought Vulnerability in California’s San Joaquin Valley.” *Geoforum* 121: 33–43.

Griffin, Daniel, and Kevin J. Anchukaitis. 2014. “How Unusual Is the 2012–2014 California Drought?” *Geophysical Research Letters* 41(24): 9017–23.

Hanak, Ellen et al. 2015. *What If California’s Drought Continues?* Public Policy Institute of California.

Harlan, Sharon L., Scott T. Yabiku, Larissa Larsen, and Anthony J. Brazel. 2009. “Household Water Consumption in an Arid City: Affluence, Affordance, and Attitudes.” *Society & Natural Resources* 22(8): 691–709.

Hay, Colin. 1999. “Crisis and the Structural Transformation of the State: Interrogating the Process of Change.” *The British Journal of Politics and International Relations* 1(3): 317–44.

Hedström, Peter, and Richard Swedberg. 1998. “Social Mechanisms: An Introductory Essay.” In *Social Mechanisms: An Analytical Approach to Social Theory*, eds. Peter Hedström and Richard Swedberg. Cambridge University Press.

Hedström, Peter, and Petri Ylikoski. 2010. “Causal Mechanisms in the Social Sciences.” *Annual Review of Sociology* 36(1): 49–67.

van der Heijden, Jeroen, Johanna Kuhlmann, Evert Lindquist, and Adam Wellstead. 2021. “Have Policy Process Scholars Embraced Causal Mechanisms? A Review of Five Popular Frameworks.” *Public Policy and Administration* 36(2): 163–86.

Hellberg, Sofie. 2020. “Scarcity as a Means of Governing: Challenging Neoliberal Hydromentality in the Context of the South African Drought.” *Environment and Planning E: Nature and Space* 3(1): 186–206.

Humby, Tracy, and Maryse Grandbois. 2011. “The Human Right to Water in South Africa and the Mazibuko Decisions.” *Les Cahiers de Droit* 51(3–4): 521–40.

Ingram, Helen, Anne L. Schneider, and Peter deLeon. 2007. “Social Construction and Policy Design.” In *Theories of the Policy Process*, ed. Paul A. Sabatier. Westview Press, 93–128.

IPCC. 2022. *Climate Change 2022: Impacts, Adaptation and Vulnerability - Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Intergovernmental Panel on Climate Change.

Johnston, Barbara Rose. 2003. “The Political Ecology of Water: An Introduction.” *Capitalism Nature Socialism* 14(3): 73–90.

Joubert, Leonie, and Gina Ziervogel. 2019. *Day Zero: One City’s Response to a Record-Breaking Drought*. http://dayzero.org.za/.

Kay, Adrian, and Phillip Baker. 2015. “What Can Causal Process Tracing Offer to Policy Studies? A Review of the Literature: A Review of Causal Process Tracing Literature.” *Policy Studies Journal* 43(1): 1–21.

Levy, Zeno F. et al. 2021. “Critical Aquifer Overdraft Accelerates Degradation of Groundwater Quality in California’s Central Valley During Drought.” *Geophysical Research Letters* 48(17). https://onlinelibrary.wiley.com/doi/10.1029/2021GL094398 (February 20, 2022).

Liang, Yuhua (Jake), Lauren K. Henderson, and Kerk F. Kee. 2018. “Running Out of Water! Developing a Message Typology and Evaluating Message Effects on Attitude Toward Water Conservation.” *Environmental Communication* 12(4): 541–57.

Lund, Jay, Josue Medellin-Azuara, John Durand, and Kathleen Stone. 2018. “Lessons from California’s 2012–2016 Drought.” *J. Water Resour. Plann. Manage.* 144(10).

Maggioni, Elena. 2015. “Water Demand Management in Times of Drought: What Matters for Water Conservation.” *Water Resources Research* 51(1): 125–39.

Mahoney, James. 2001. “Review Essay: Beyond Correlational Analysis: Recent Innovations in Theory and Method.” *Sociological Forum* 16(3): 576–93.

Marcatelli, Michela, and Bram Büscher. 2019. “Liquid Violence: The Politics of Water Responsibilisation and Dispossession in South Africa.” *Water Alternatives* 12(2): 760–73.

McClure, Robert. 2012. “Agriculture Is Nation’s Biggest Water Polluter but Usually Goes Unpunished.” *InvestigateWest*. https://www.invw.org/2012/08/16/farm-pollution-draws-scru-1293/ (March 19, 2022).

Mehta, Lyla. 2001. “The Manufacture of Popular Perceptions of Scarcity: Dams and Water-Related Narratives in Gujarat, India.” *World Development* 29(12): 2025–41.

Millington, N., and S. Scheba. 2020. “Day Zero and The Infrastructures of Climate Change: Water Governance, Inequality, and Infrastructural Politics in Cape Town’s Water Crisis.” *International Journal of Urban and Regional Research*.

Mini, C., T. S. Hogue, and S. Pincetl. 2014. “Patterns and Controlling Factors of Residential Water Use in Los Angeles, California.” *Water Policy* 16(6): 1054–69.

Mirosa, Oriol, and Leila M. Harris. 2012. “Human Right to Water: Contemporary Challenges and Contours of a Global Debate.” *Antipode* 44(3): 932–49.

Mitchell, David et al. 2017. *Building Drought Resilience in California’s Cities and Suburbs*. Public Policy Institute of California.

Molle, François, Peter P Mollinga, and Philippus Wester. 2009. “Hydraulic Bureaucracies and the Hydraulic Mission: Flows of Water, Flows of Power.” 2(3): 23.

Moore, Eli, and Eyal Matalon. 2011. *The Human Costs of Nitrate-Contaminated Drinking Water in the San Joaquin Valley*. Oakland, CA: Pacific Institute. http://www.pacinst.org/reports/nitrate_contamination/nitrate_contamination.pdf (March 19, 2022).

Movik, Synne. 2011. "Allocation Discourses: South African Water Rights Reform." *Water Policy* 13(2): 161–77.

Muller, Mike. 2018. "Lessons from Cape Town's Drought." *Nature* 559(7713): 174–76.

———. 2020. "Some Systems Perspectives on Demand Management during Cape Town's 2015–2018 Water Crisis." *International Journal of Water Resources Development* 36(6): 1054–72.

Muruvan, Sugandree. 2002. "Free Basic Water Implementation Experiences." In Kolkata (Calcutta), India.

Narsiah, Sagie, and Waquar Ahmed. 2012. "The Neoliberalization of the Water and Energy Sectors in South Africa and India." *Journal of Asian and African Studies* 47(6): 679–94.

Olivier, David W., and Yongxin Xu. 2019. "Making Effective Use of Groundwater to Avoid Another Water Supply Crisis in Cape Town, South Africa." *Hydrogeology Journal* 27(3): 823–26.

Olmstead, Sheila M., and Robert N. Stavins. 2009. "Comparing Price and Nonprice Approaches to Urban Water Conservation." *Water Resources Research* 45(4): 1–10.

Onishi, Norimitsu, and Somini Sengupta. 2018. "Dangerously Low on Water, Cape Town Now Faces 'Day Zero.'" *The New York Times*. https://www.nytimes.com/2018/01/30/world/africa/cape-town-day-zero.html (April 25, 2021).

Otto, Friederike E L et al. 2018. "Anthropogenic Influence on the Drivers of the Western Cape Drought 2015–2017." *Environmental Research Letters* 13(12): 124010.

Palazzo, Joseph et al. 2017. "Urban Responses to Restrictive Conservation Policy during Drought." *Water Resources Research* 53: 4459–75.

Pannu, Camille. 2012. "Drinking Water and Exclusion: A Case Study from California's Central Valley." *California Law Review* 100(1): 223–68.

Parks, Robbie, Megan McLaren, Ralf Toumi, and Ulrike Rivett. 2019. *Experiences and Lessons in Managing Water from Cape Town*. Grantham Institute.

Pauloo, R A et al. 2020. "Domestic Well Vulnerability to Drought Duration and Unsustainable Groundwater Management in California's Central Valley." *Environmental Research Letters* 15(4): 044010.

Pérez-Urdiales, María, and Kenneth A. Baerenklau. 2020. “Assessing the Impacts of Urban Water-Use Restrictions at the District Level: Case Study of California’s Drought Mandate.” *Journal of Water Resources Planning and Management* 146(5).

Pincetl, Stephanie, and Terri S. Hogue. 2015. “California’s New Normal? Recurring Drought: Addressing Winners and Losers.” *Local Environment* 20(7): 850–54.

Pincetl, Stephanie, Erik Porse, and Deborah Cheng. 2016. “Fragmented Flows: Water Supply in Los Angeles County.” *Environmental Management* 58(2): 208–22.

Pompeii, Brian. 2020. “The Social Production of the Great California Drought, 2012–2017.” *Yearbook of the Association of Pacific Coast Geographers* 82(1): 15–37.

Porter, Eduardo. 2014. “The Risks of Cheap Water.” *The New York Times*. https://www.nytimes.com/2014/10/15/business/economy/the-price-of-water-is-too-low.html (April 10, 2022).

Rawlins, Jonathan. 2019. “Political Economy of Water Reallocation in South Africa: Insights from the Western Cape Water Crisis.” *Water Security* 6: 22.

Republic of South Africa. 1996. “South Africa’s Constitution of 1996 with Amendments through 2012.” : 1–152.

———. 1998. *Local Government: Municipal Structures Act*. https://www.gov.za/sites/default/files/gcis_document/201409/a117-980.pdf (April 16, 2022).

Riemann, K, N Chimboza, and M Fubesi. 2012. “A Proposed Groundwater Management Framework for Municipalities in South Africa.” *Water SA* 38(3): 445–52.

Robins, Steven. 2019. “‘Day Zero’, Hydraulic Citizenship and the Defence of the Commons in Cape Town: A Case Study of the Politics of Water and Its Infrastructures (2017–2018).” *Journal of Southern African Studies* 45(1): 5–29.

Rodina, Lucy. 2016. “Human Right to Water in Khayelitsha, South Africa – Lessons from a ‘Lived Experiences’ Perspective.” *Geoforum* 72: 58–66.

Rodina, Lucy, and Leila M Harris. 2016. “Water Services, Lived Citizenship, and Notions of the State in Marginalised Urban Spaces: The Case of Khayelitsha, South Africa.” 9(2): 20.

Schewe, Jacob et al. 2014. “Multimodel Assessment of Water Scarcity under Climate Change.” *Proceedings of the National Academy of Sciences of the United States of America* 111(9): 3245–50.

Schneider, Anne L., and Helen M. Ingram. 2019. “Social Constructions, Anticipatory Feedback Strategies, and Deceptive Public Policy.” *Policy Studies Journal* 47(2): 206–36.

von Schnitzler, Antina. 2008. “Citizenship Prepaid: Water, Calculability, and Techno-Politics in South Africa.” *Journal of Southern African Studies* 34(4): 899–917.

Schreiber, Leon. 2019. *Keeping the Taps Running: How Cape Town Averted “Day Zero,” 2017-2018*. Innovations for Successful Societies, Princeton University. https://successfulsocieties.princeton.edu/sites/successfulsocieties/files/LS_Cape%20Town%20Water_FINAL.pdf (April 3, 2021).

Shepherd, Nick. 2019. “Making Sense of ‘Day Zero’: Slow Catastrophes, Anthropocene Futures, and the Story of Cape Town’s Water Crisis.” *Water* 11(1744).

Simpson, Nicholas Philip, Clifford D. Shearing, and Benoit Dupont. 2020. “Gated Adaptation during the Cape Town Drought: Mentalities, Transitions and Pathways to Partial Nodes of Water Security.” *Society and Natural Resources* 33(8): 1041–49.

Sinclair-Smith, Ken et al. 2018. “City of Cape Town’s Water Map.” *Journal - American Water Works Association* 110(9): 62–66.

Spector, Bert. 2019. *Constructing Crisis: Leaders, Crises, and Claims of Urgency*. Cambridge, UK; New York, NY, USA: Cambridge University Press.

State of California. 2014a. *Executive Order B-17-14*. https://www.ca.gov/archive/gov39/2014/01/17/news18368/index.html (March 30, 2022).

———. 2014b. *Executive Order B-25-14*. https://www.ca.gov/archive/gov39/2014/04/25/news18495/ (April 12, 2022).

———. 2015. *Executive Order B-29-15*. https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/040115_executive_order.pdf (April 12, 2022).

Sultana, Farhana. 2020. “Embodied Intersectionalities of Urban Citizenship: Water, Infrastructure, and Gender in the Global South.” *Annals of the American Association of Geographers* 110(5): 1407–24.

Sultana, Farhana, and Alex Loftus. 2020. *Water Politics: Governance, Justice and the Right to Water*. Routledge.

Swatuk, Larry A. 2010. “The State and Water Resources Development through the Lens of History: A South African Case Study.” *Water Alternatives* 3(3): 521–36.

Taylor, Mac. 2016. *The 2016-17 Budget: The State’s Drought Response*. Legislative Analyst’s Office (LAO), State of California. Legislative Analysis.

Tortajada, Cecilia, Matthew J. Kastner, Joost Buurman, and Asit K. Biswas. 2017. “The California Drought: Coping Responses and Resilience Building.” *Environmental Science and Policy* 78(September): 97–113.

Trenberth, Kevin E. et al. 2014. “Global Warming and Changes in Drought.” *Nature Climate Change* 4(1): 17–22.

UN. 2010. “Resolution 64/292: The Human Right to Water and Sanitation.” https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/64/292.

———. 2022. *UN World Water Development Report 2022: Groundwater: Making the Invisible Visible*. Paris, France: UNESCO. http://books.google.com/books?id=e38KAQAAIAAJ (April 11, 2022).

USGS. “California’s Central Valley.” *California Water Science Center*. https://ca.water.usgs.gov/projects/central-valley/about-central-valley.html (April 11, 2022).

de Vaus, David. 2001. *Research Design in Social Research*. Sage.

Visser, Wessel P. 2018. “A Perfect Storm: The Ramifications of Cape Town’s Drought Crisis.” *The Journal for Transdisciplinary Research in Southern Africa* 14(1): 1–10.

Voci, Denise, Catherine J. Bruns, Stella Lemke, and Franzisca Weder. 2020. “Framing the End: Analyzing Media and Meaning Making During Cape Town’s Day Zero.” *Frontiers in Communication* 5: 576199.

Walwema, Josephine. 2021. “Rhetoric and Cape Town’s Campaign to Defeat Day Zero.” *Journal of Technical Writing and Communication* 51(2): 103–36.

Whitehead, Kevin A. 2013. “Race-Class Intersections as Interactional Resources in Post-Apartheid South Africa.” In *Social Inequality and the Politics of Representation: A Global Landscape*, ed. Celine-Marie Pascale. Newbury Park, CA: Sage, 49–63.

Whyte, Kyle. 2020. “Against Crisis Epistemology.” In *Routledge Handbook of Critical Indigenous Studies*, eds. Brendan Hokowhitu et al. Abingdon, Oxon; New York, NY: Routledge, 2021.: Routledge, 52–64. https://www.taylorfrancis.com/books/9780429802386/chapters/10.4324/9780429440229-6 (March 29, 2022).

Wilder, Margaret, and Helen Ingram. 2016. “Knowing Equity When We See It: Water Equity in Contemporary Global Contexts.” In *The Oxford Handbook of Water Politics and Policy*, eds. Ken Conca and Erika Weinthal. , 1–28. www.oxfordhandbooks.com.

Williams, A. Park et al. 2015. “Contribution of Anthropogenic Warming to California Drought during 2012–2014.” *Geophysical Research Letters* 42(16): 6819–28.

Wines, Michael, and Jennifer Medina. 2015. “Farmers Try Political Force to Twist Open California’s Taps.” *The New York Times*. https://www.nytimes.com/2015/12/31/us/farmers-try-political-force-to-twist-open-californias-taps.html (March 29, 2022).

Wolski, Piotr, Bruce Hewitson, and Chris Jack. 2017. “Why Cape Town’s Drought Was so Hard to Forecast.” *The Conversation*. https://theconversation.com/why-cape-towns-drought-was-so-hard-to-forecast-84735.

Wutich, Amber et al. 2022. “Water Security and Scarcity.” In *Oxford Research Encyclopedia of Anthropology*, Oxford University Press. https://oxfordre.com/anthropology/view/10.1093/acrefore/9780190854584.001.0001/acrefore-9780190854584-e-475 (March 31, 2022).

Yates, Julian S., and Leila M. Harris. 2018. “Hybrid Regulatory Landscapes: The Human Right to Water, Variegated Neoliberal Water Governance, and Policy Transfer in Cape Town, South Africa, and Accra, Ghana.” *World Development* 110: 75–87.

Zhang, Y., M. P. Teodoro, and D. Switzer. 2021. “Public Water Waste Reporting: Contextual Correlates and Conservation Outcomes.” *Water Resources Research* 57(4). https://onlinelibrary.wiley.com/doi/10.1029/2020WR027805 (June 16, 2021).

Ziervogel, Gina. 2019. *Unpacking the Cape Town Drought: Lessons Learned*. Cities Support Programme, African Centre for Cities.

Zwarteveen, Margreet Z., and Rutgerd Boelens. 2014. “Defining, Researching and Struggling for Water Justice: Some Conceptual Building Blocks for Research and Action.” *Water International* 39(2): 143–58.

Appendices

Appendix A: Interview participant information

	Case study	*Date*	*Sector*
Interview 1	California	July 9, 2021	State government
Interview 2	California	July 9, 2021	State government
Interview 3	California	July 12, 2021	Non-profit
Interview 4	California	July 13, 2021	Non-profit
Interview 5	California	July 14, 2021	Academia
Interview 6	California	July 21, 2021	Academia
Interview 7	Western Cape	August 12, 2021	Academia/municipal government
Interview 8	Western Cape	October 6, 2021	Academia
Interview 9	Western Cape	October 11, 2021	Non-profit
Interview 10	Western Cape	October 19, 2021	Academia/municipal government

Appendix B: Interview codebook

Code	*Sub-code*
Action	Emergency declarations
	Framing-narrative
	Priorities
	Restrictions-conservation
	Timing
Context	Baseline inequality-vulnerability
	Defining events
	Govt-society trust
	Info-data
	Political economy (ag-urban)
	Politics
	Previous investments
	Supply system
Impact	Access
	Adaptive capacity
	Cost
	Policy impact
	Scale-location of impact