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Cities as Instruments of Human Security: Transitions in Urban Water Systems and Public Water



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# Cities as Instruments of Human Security:
# Transitions in Urban Water Systems and Public Water

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy
in Urban Planning

Marcia Rosalie Hale

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ABSTRACT OF THE DISSERTATION

Cities as Instruments of Human Security:
Transitions in Urban Water Systems and Public Water

by

Marcia Rosalie Hale
Doctor of Philosophy in Urban Planning
University of California, Los Angeles, 2018
Professor Leobardo F. Estrada, Chair

This dissertation examines the role that cities can play in human security with particular emphasis on urban water systems. Global environmental change and shifting geopolitical alliances are increasing the vulnerability of individuals and communities. In the absence of enforced human rights protections at international and national levels, cities have agency to ensure that urban spaces are contributing to human security, ensuring that basic needs of individuals are prioritized including water, food, and shelter, as well as medical and legal attention. However, urban water systems, as the literal lifeblood of cities, are the focus of this research.

Urban water systems across the globe are transitioning, undergoing fundamental change. This study first examines transition in two particular cities, in order to understand the conditions, barriers and opportunities of change. A human security analysis follows, drawing on these findings as well as that of a third city. Made up of three discrete papers, the first two articles are case studies in which the evolution of the

urban water system as well as its current and future transitions are constructed through participant observation and interviews with primary actors within each city, including Athens, Greece and Los Angeles, U.S. In the third paper, these findings as well as research in Istanbul, Turkey are garnered to inform a human security analysis of urban water systems, especially those in the semi-arid Mediterranean climate region.

While each city has a unique profile with distinct social, economic, political and environmental characteristics, some drivers of change are unsurprisingly shared including global environmental change and aging infrastructure. Findings however reveal another shared vulnerability with deep human security implications: rising numbers of urban inhabitants that are without permanent housing. And while the drivers of homelessness vary across and within the cities studied, there are shared connections to global trends of income inequality, climate change and political instability. Analysis reveals a lack of public water in the cities of interest, a particular concern in dry Mediterranean and arid climates. Recommendations are made for re-introducing public water into the modern city as an assertion of human security.

The dissertation of Marcia Rosalie Hale is approved.

Stephanie S. Pincetl

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2018

## Dedication page

This dissertation is dedicated to Leo Estrada – in honor of your character and your commitment. You have taught me how to use scholarship in the service of social justice and modeled supportive and effective leadership in countless ways. My work will always be a reflection of all that I have learned from you.

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This work also reflects many influences in my personal life: The Johnsons: Johnny, Tom, Marcia, Hoyt and family who taught me so much about business with integrity and whose generosity helped ease my transition to LA; Ro Elgas, who came into my life when I was 18 and has inspired and supported my vision ever since, continuously showing and exploring new worlds with me along with Ron, the laughing Buddha and visionary; Randi, David, Chloe and Lev Dressler whose love, support and grounding this dissertation probably wouldn't exist without, and whose modeling continue to inform my principles and my dreams; Elena Zager who has been sunshine and wings when I was crawling through the dead of night and joyous co-conspirator during all the places in between, along with her other conspirators, Zenia and Drew who create so much love; my father, whose choices over the course of his life gave me the exposure to the world that motivates my work; my siblings, my lifelong collaborators and teachers in conflict transformation: my brother Adam Hale, who has shown me different realities and teaches me ever more nuanced levels of love and my sister Jennifer Hale, whose commiseration and inspiration are central lights in my life. And finally, my profound gratitude for my mother, Eileen Hale, for being my most constant support. Your love has seen me through and shown me how to love the world. Thank you also for showing me how to hop worlds, and for always being there to talk things through. The gifts your support and presence continue to bring to my life are immeasurable.

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- 2017. "Case Studies: Cases for Forgiveness, Change, and Social Justice." Presented at the ISA Conference: Understanding Change in World Politics, Baltimore, Maryland.
- 2016. "Words Matter: How Language Shapes Mediation, Peace-building and Our Ability to Transcend Conflict." Presented at the Southern California Mediation Association Conference, Discourse and Diplomacy: From Interpersonal Conflict to International Relations, Los Angeles, CA.
- 2016. "The Evolution of Revolution: Crisis & Change within the Los Angeles Urban Water System." Presented at Under Western Skies: Water - Events, Trends and Analysis, Calgary, Alberta.
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## INTRODUCTION

Urban water systems play a crucial role in human society. As the World Bank estimates that 54% of the world's population was residing in cities in 2016, urban water systems directly support more than half of the people on the planet, as well as the industry driving human civilization ("Urban population (% of total) | Data" 2014). They are the most critical system in any city, as water is fundamental to human life and without its successful procurement and provision, no other system can function. However, the ways in which water is procured and processed by cities also has massive upstream and downstream human and ecological impacts. Modern water systems, reflective of modernist cities, are characterized by big infrastructure that often includes pipes and technologies to import water from far outside of city boundaries, and often from outside of the watershed, leaving fewer resources for the regions that water is sourced from (Dinçkal 2008; Gandy 2004; Kaika 2006). Polluting industry has historically complicated the scenario by dumping or leaching toxic water back into the supply.

Today, many of these urban systems are transitioning, undergoing transformation of their fundamental form. Driven by aging components, global environmental change, and population growth, fundamental change must occur in order for many systems to continue meeting demand (Ernstson et al. 2010; Geels 2002; de Haan, Rogers, Frantzeskaki, and Brown 2015; Pahl-Wostl 2007). It is a moment that requires great investment of thought and capital; it also presents opportunity to create systems designed with consideration of upstream and downstream inhabitants and that are

inclusive of all those residing directly within urban boundaries. This moment is especially significant given the path dependency of large infrastructure systems such as water and energy, as they are exceedingly difficult to change due to their size, complexity, and the financial resources invested to build them (Bos and Brown 2012; Brown, Ashley, and Farrelly 2011; Marshall and Alexandra 2016). Moments of transition should therefore be harnessed to further ecological and human health (Brown, Keath, and Wong 2008; Wong and Brown 2009).

The intensity and significance of the current moment for water infrastructure is compounded by several other trends that have far-reaching implications. Transitions in urban water systems are occurring alongside increased urbanization resulting from not only endogenous but also exogenous growth, which is itself fueled by domestic and international migration (Crawley and Skleparis 2018; Jha, Gupta, Chattopadhyay, and Amarayil Sreeraman 2017; McDonald et al. 2014; Srinivasan, Seto, Emerson, and Gorelick 2013; Swyngedouw 2015). Importantly, urbanization and homelessness are linked, with growing trends of people around the globe having the experience of being houseless (Casino and Jocoy 2008; Chamie 2017; “Global Homelessness Statistics” n.d.).

Concurrently, the international geopolitical system has been undergoing severe shocks, with post-World War alliances shifting and their reflective institutions constrained (Haass 2014). The implications for human and environmental health are severe. For example, human rights and social justice norms bend under the weight of growing nationalism

and its impact on immigration policy (Postelnicescu 2016; “What Rising Nationalism Means for Migrants and Refugees” 2017). The Trump administration in the U.S. has notably crippled local and global environmental protections and their associated institutions, as exemplified in the removal of the U.S. from the Paris Climate Agreement (Durr 2017). It is from within these fundamental changes to society and world order that I ask the central question guiding this research: How can cities become stronger instruments of human security?

Because of its foundations in human rights and social justice principles (Sen 1977; United Nations 1948), human security was chosen as the normative theoretical frame guiding this research. Ensconced in international frameworks beginning with the United Nations Development Programme’s 1994 Human Development Report, the principle of human security holds that global insecurity is best addressed by insuring “freedom from want” and “freedom from fear” (*Human Development Report* 1994). This concept is revolutionary for its implications, especially around basic needs and radicalism, essentially proposing that violence is largely fueled by desperation including physical hunger as well as the threat or reality of physical, emotional and psychological violence. This project focuses on urban water systems as purveyors of the most basic of needs.

Human security is especially relevant when thinking about systems - while human rights and human security are both focused at the level of individual human beings, human security explicitly prioritizes the well-being of individuals over the state apparatus (Barnett, Matthew, and O’Brien 2010; Human Security Unit 2009; Matthew 2010;

Newman 2010), and seeks to address underlying drivers of inequality and violence (Thomas 2001). And while the concept of human rights has held currency over the past years, there is concern is that public and political support is waning in the shadow of resurging nationalistic and authoritarian consciousness (Atkins 2017; Bloom 2017; Falk and Faessel 2017). The concept of human security therefore provides another door through which to do the work of protecting human life and dignity. Planning urban water systems in particular with future conflicts and human security in mind may offer a way of retooling human rights and social justice principles and inserting them into the lexicon, processes, and ethos of the institutions and systems that will have great influence over the world's future. This lens is particularly applicable to city-level analysis, as it provides a language and conceptual framework through which to examine urban systems. In this research, I analyze how urban water systems can act as instruments of human security and query particular locations to reveal the challenges and opportunities of this agenda.

I encountered the urban human security framework while examining the water systems of Athens, Greece; Istanbul, Turkey; and Los Angeles, United States through a critical lens, the intention of which was to look at each system from the standpoint of its most vulnerable people (Collins 1986; Harding 1992; Jermier 1998). These cities were chosen for their location in the Mediterranean climate region, a zone across which there are shared experiences of global environmental change (Iglesias, Garrote, Flores, and Moneo 2007; Underwood, Viers, Klausmeyer, Cox, et al. 2009). While I found interesting variance in the histories and constructs of these systems, the most striking finding was their shared vulnerability in the face of global inequality, migration and

environmental change. And most significant is the vulnerability of current and future inhabitants experiencing homelessness in these destination cities. Secondly, I found that access to public water varies across these cities with Istanbul notable for its historic fountains, standing in stark contrast to the relative dearth of fountains in Athens and Los Angeles. Public water is a primary consideration of basic needs for inhabitants experiencing homelessness, because while each city reports 100% access to improved water sources, this statistic most accurately reflects supply to buildings rather than access for people ("Improved water source (% of population with access) | Data" 2015). Key findings of this research indicate that the studied cities plan urban water systems around supply for buildings and system reliability rather than access for individual inhabitants.

This dissertation is constructed of three papers including two case studies and a third theoretical article, based on in-person interviews and participant observation, as well as primary and secondary sources. The two case studies analyze the evolution and future transitions of two specific urban water systems, including Los Angeles, U.S. and Athens, Greece. The third article casts cities as instruments of human security and powerful actors within the changing geopolitical landscape, with analysis grounded in urban water systems as locations in which human security can be planned for.

As case studies, the first two papers utilize system transition and historic institutional analysis to explore the urban water systems of Los Angeles, U.S. and Athens, Greece in order to examine each for its environmental, social, political, and economic contexts.

The Los Angeles article was co-authored with principle investigator Dr. Stephanie Pincetl, in collaboration with UCLA's California Center for Sustainable Communities and with funding from the National Science Foundation. Of particular interest in analyzing these cases are the pressures impacting each system, as well as associated barriers and opportunities for transition. I further investigated the history of regime change and current transition strategies. While a human security agenda provides the normative direction for transition in the third and final paper, system transition and historic institutional analysis articulate the context and pathways of change.

The third article draws on these case studies as well as a more preliminary analysis of the urban water system of Istanbul, Turkey. Building on findings of the drivers of change and transition strategies in each system, the central question guiding this article is: How can urban water systems better support human security? Lack of public water is identified as a primary barrier to human security, especially within semi-arid and arid regions. As noted above, this investigation is located within the Mediterranean climate region which is at risk of increasing temperatures, drought and desertification, all of which have severe human health implications (García-Trabanino et al. 2015; McMichael 2013). Cities in this climate zone are also notable economic, cultural, and often political engines of their regions, suggesting that they might be destinations for endogenous and exogenous migration, and further have the economic and political power to realize timely transitions. This dissertation is concluded in the third article by calling for further research into the role public water can play in urban human security.

I began my PhD program interested in exploring interventions in natural resource conflicts that could serve as a means of peace-building and peace-keeping. Along the way my research detoured and I found myself considering current and future impacts of global environmental change and locating my inquiry primarily in cities, given the percentage of the population that are urban inhabitants. Cities also host high numbers of climate and political migrants in addition to domestic homeless populations (Barigazzi 2016; Chamie 2017; Crawley and Skleparis 2018; Gioli, Khan, Bisht, and Scheffran 2014; Jha, Gupta, Chattopadhyay, and Amarayil Sreeraman 2017); the statistics are significant, as they represent some of the planet's most vulnerable people, a population most in need of human security protections. Cities are therefore uniquely positioned to provide institutional and physical structures to meet human security goals. This research then serves a larger project that I intend to engage over the course of years, which will analyze the role that both cities and natural resources can play in mitigating and preventing violent human conflict.

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**“Regime Change and Transformation in Urban Water: The Los Angeles Case”**


## ABSTRACT

The Los Angeles metropolitan area water system is a complex sociotechnical system in transition. Past research shows that large sociotechnical systems are path-dependent and therefore slow to change, yet forces from global environmental change to aging infrastructure are driving transition in many urban water systems around the world. In order to better understand related barriers and opportunities, we take the case of the Los Angeles system and construct a historical framework of regime change. Interviews with water managers, activists, policy-makers, and other experts inform this framework and further articulate current transition in the system toward “self-reliance” which as this study shows, is related to local water and would require full system transformation. Our research situates transition within a historical trajectory of regime change; identifies the inception point of current transition; analyzes the relationship between transition and removing barriers to change; and articulates change in consciousness as a primary transition which includes both self-reliance and regional water management in the Los Angeles case.



Keywords: Water governance; urban water; sociotechnical systems; regime change; transition; water self-reliance


## INTRODUCTION

Urban water systems play a critical role in the maintenance and well-being of society. With approximately half of the world’s people now residing in towns and cities (Brenner

and Schmid 2014), urban water systems serve to directly support over 50% of the global population. Importing water affects the health of ecosystems native to its source as well as those it passes through (Kidd and Shaw 2007), and the quantity and quality of water processed by the city may also impact settlements outside of the urban periphery. Water moving through cities is often polluted by both industry and domestic contamination. How urban water systems are built, managed and maintained is therefore of concern for the entire watershed and supply chain, as downstream impacts can be severe – however water is often thought of as a local resource (Biswas 2004; Jønch-Clausen and Fugl 2001; Lubell and Lippert 2011). These issues are ubiquitous. Many of the world's cities rely on water sourced far outside their boundaries (McDonald et al. 2014), and such systems around the globe are increasingly threatened by compounding factors including global environmental change, population growth and aging infrastructure (Bouwer 2000; Vörösmarty 2000). These pressures are driving significant change, or transition, as systems age out or become irrelevant in current climatic and societal contexts (Markard, Raven, and Truffer 2012a; Walton 2016; Wen, van der Zouwen, Horlings, van der Meulen, et al. 2015).

The Los Angeles area water system is such a case. Sitting on the edge of southwestern California, between the Pacific Ocean to the west and the Mojave Desert to the east, Los Angeles County stretches along the borders of mountain, desert and ocean. The region's Mediterranean climate and semi-arid ecosystem is sensitive to fluctuations in temperature and precipitation, as are the man-made systems that supply water to its communities. The sprawling metropolis then grew through a massive importation

system consisting of three primary aqueducts (Blomquist 1992; Erie and Brackman 2006).

As the city grew, this “Aqueduct Empire” (Erie and Brackman 2006) historically met growing demand by increasing imports. However, there has been a recent transition in attitudes and narratives associated with Southern California water (Hughes and Pincetl 2014; Hughes, Pincetl, and Boone 2013; “Stormwater Management Importance Underscored in Los Angeles Basin Study Released by Bureau of Reclamation” 2016). Drought, considered the worst on record, struck in 2011 serving to direct focus toward the unsustainability of the region’s water system and to push innovative thinking or, as our research shows, it has pushed consideration, acceptance, and implementation of innovation, a change that is currently evident in the narratives of both water policy and management that have transitioned from water imports to self-reliance, as has been documented in previous research (Hughes and Pincetl 2014; Hughes, Pincetl, and Boone 2013; Pincetl, Porse, and Cheng 2016; Porse, Glickfeld, Mertan, and Pincetl 2016). Self-reliance is now codified into policy at the city and county levels, asserting goals for reducing imports which will then require fundamental systemic change in order to fulfill. Calculations around basin size, sewage flows, infiltration capacity and other variables are being done by researchers and water managers to determine how self-reliant the region can become (Gold, Hogue, Pincetl, Mika, et al. 2015).

Practically, the fulfillment of this narrative transition to self-reliance would manifest through recognizing and managing water as a regional rather than a local resource.

Considering water health at a regional scale is important, as both ground and surface water cross political boundaries and impacts from the amount and ways in which water is used are therefore felt regionally. Around the world, urban water infrastructures intensify these impacts by drawing water from “almost half of the global land surface” and transporting it across great distances through massive importation systems (McDonald et al. 2014, 103). Moving toward a system that is more self-reliant, that is less reliant on imports from other water basins, could therefore contribute to more sustainable regional water management.

The Los Angeles case is a particularly striking instance of this transition in urban water, given the infrastructure system that has been built around the city-region’s historic dependency on imports. Further, the City of Los Angeles has a long history as an urban innovator; it is a future-thinking city that remakes itself often and does so through the construction of massive systems, from water conveyance to highways. As a creative-leader globally, Los Angeles is on the vanguard for this discussion of and experimentation with water self-reliance and regional management.

Therefore, examining and documenting the Los Angeles case is important, as planned change at this scale within complex systems is rare and difficult to realize (Brown, Ashley, and Farrelly 2011; Elzen, Geels, and Green 2004; Farla, Markard, Raven, and Coenen 2012; Markard and Truffer 2008). Infrastructure systems are multifaceted. These “socio-technical systems,” include large physical and technical infrastructure, as well as the soft infrastructure of institutions that run the systems and the cultures that

inform them (Pincetl, Chester, and Eisenman 2016; Rutherford and Coutard 2014). This paper offers a historical analysis of transition within an urban water sociotechnical system, concluding that systemic transformation is required to fulfill its agenda.

While questions regarding the functionality of institutional systems and efficiency of technical infrastructure are central to research seeking to drive sustainable transition, scholars have identified a deficiency in the social histories of environmental change that could serve to illuminate how people understand and respond (Carey 2005; Chakrabarty 2009; Howe 2011; Hulme 2009; Parsons and Nalau 2016). Our research contributes to this scholarship, which documents transition in the context of its evolution. This approach is especially important to the larger body of interdisciplinary scholarship that seeks to understand global environmental change (Matthew 2010; Wolf 2004) and society's potential for adaptation, because the global scale process of adaptation cannot be understood without understanding how it may work out in specific cases (Penning-Rowsell, Johnson, and Tunstall 2006), as "processes that are manifest in localities" (Neil Adger, Brown, and Hulme 2005, 2). We provide a sketch of a system in transition based on empirical evidence. First, we present its historical framework in order to situate current change as a product of historical development, and then we demonstrate the roots of transition using interview data to show how it is occurring, as well as interpretation about its causes, challenges and potential.

**Sociotechnical Transition and Four Interrelated Ideas:**

The term “sociotechnical transition” refers to the coevolution of social and technical systems - the arc of change in their relationship to one another helps us to understand how and why broader societal change affects the development or breakdown of those “regimes” that drive industries, sectors and systems (Graugaard 2014; Smith, Voß, and Grin 2010). This conceptualization is particularly useful when considering large infrastructure systems such as those that deliver water and power. These sociotechnical systems are crucial to society and heavily path dependent, rendering them both in need of change to stay relevant and simultaneously resistant to its forces (Markard, Raven, and Truffer 2012b; Unruh 2000). From this paradox, sustainability transition research has developed in order to understand “how and under which conditions new and radically more resource efficient socio-technical configurations emerge,” as well as “how existing socio-technical configurations support or hinder major transformations to sustainability” (Truffer and Coenen 2012, 2).

This field of research is especially important as it applies to urban water systems. Historically, urban water systems have undergone transition through several key regimes. Brown et al. (2009) characterizes these regimes as Water Supply, Sewered and Drained Cities. Haan et al. (2015) note that traditionally, transition from one system to another occurred incrementally and in a similar sequence for cities around the world, as drivers for change and technological innovations emerged. The Water Supply City regime, for example, focused on moving water into cities in order to provide drinking water to its residents, and marked the transition from village wells to public water networks. The resulting urban system supported larger populations, and sewers were

added to move waste in what Brown et al. refer to as the Sewered City. Stormwater systems were then added to quickly remove unwanted water that fell or flowed through the area in the regime the authors labeled the Drained City. Today, many cities have well established water systems that include complex institutional structures of governance tied to the expansive physical and technological infrastructures required by each new sociotechnical system. These established layers – and siloed institutions and practices -- within the larger water systems create path-dependencies and lock-ins that are resistant to change (Brown, Ashley, and Farrelly 2011; Pahl-Wostl 2007). New systemic forms are difficult to transition into (Melosi 2000, 2008; Tarr 1984a, 1984b, 1996), as their "infrastructural and institutional solutions do not align with the established regimes" (de Haan, Rogers, Frantzeskaki, and Brown 2015, 2).

This research follows scholarship that examines adaptation to water regime changes. The work of Penning-Rowsell et al. especially informs this study, as it puts forward testable concepts of how change emerges, which we have used to think about a historical reconstruction of the Los Angeles socio-technical system, including narratives and assumptions that have changed over time. The **first** concept driving this study is that system transformation is evolutionary, the result of a historic arc of transition and adaptation, and that both this change *within* the form and change *of* the form itself emerge from those system stages or regimes that came before (Norgaard 2009). Referencing Norgaard, Kallis states that change is evolutionary in that "its constituents parts exhibit variation and that this variation changes over time, increasing by *innovation*, and decreasing by systemic *selection*"(Kallis 2010, 797). In addition to

analyzing the evolutionary process of the LA water system, this paper explores drivers of innovation and barriers that serve systemic selection.

The **second** concept contends that crisis catalyzes rather than creates change, and that those associated ideas and innovations can often be found to have pre-dated the crisis (Penning-Rowsell, Johnson, and Tunstall 2006). Evidence of this proposition is important to collect, as "any global scale adaptation to a future climate will be an amalgam and sum of local responses … So, to understand – and thereby assist – any adaptation to global environmental change we need to study how governments respond to comparable stimuli" (Penning-Rowsell, Johnson, and Tunstall 2006, 324). Mediterranean climate, sprawling metropolitan character, and the evolutionary arc of the Los Angeles system render it a fitting case for consideration by scholars, as its elements relate to many other systems around the world.

**The third concept is** that removing barriers to transition is of equal importance to adopting ideas and innovation in preparation for crisis and change. Our study shows that while there is catalytic potential for transformation due to the occurrence of crisis and the emergence of ideas about transition in policy and popular narrative, barriers can retard the process disallowing sustainable transition. Therefore, while it is important to be proactive about finding innovative solutions in advance of crisis, city leaders and water managers should give strong consideration to removing the barriers that impede change, such as institutional lock-ins and jurisdictional fragmentation, which retard innovations, such as lack of stormwater capture in the Los Angeles case. To make

these points, we show the complexity of system barriers within historical context, in order to illustrate the compounding nature of lock-ins and the need for preemptive planning to remove these barriers.

**Lastly**, we explore the role of consciousness as a variable that is often missing from similar studies of system change (O'Brien 2012). While transitions in sociotechnical relationships can create new behaviors, attitudes and norms, which themselves can result in more sustainable behaviors becoming the norm (Truffer 2003), it is really a change in consciousness that will solidify change in society (O'Brien 2012, 672). Therefore, identifying and analyzing predominate narratives or frames of reference that can be used as proxies for consciousness helps to provide a map of sorts to track concurrent change in awareness and policy.

## HISTORICAL ANALYSIS

This paper examines the arc of transition for an urban water system. As argued by Parsons and Nalau (2016), "thinking historically about transformational change provides an opportunity to assess the processes that shape both vulnerability and resilience, and the circumstances under which transformational change occurs" (Abstract, 82). The Los Angeles case offers such an example of heightened vulnerability, currently owed to drought, climate change and an aging system, which is occurring within the context of a legacy system and prior social and environmental vulnerabilities. We establish seven individual water regimes that developed over time and then draw distinctions between

transition and transformation over the course of their implementation. The first five regimes constitute foundational layers and the last two are distinguished from the previous ones by having implemented systemic transition; in other words, we distinguish between foundational regimes and those that are the result of transition within a fully established system.

**Definitions:**

We use the term "regime" as it is defined within transition studies: a system of social practices around material devices, including the production and use of artefacts, as well as the meanings and values around them including new and existing knowledge (Brown, Keath, and Wong 2009; Geels 2002; Hernández-Palacio 2016).

Transition points are incremental changes that can be discerned between and within regimes. Transitions are the processes through which ideas are catalyzed to become codified into policy and evolve into norms.

Transformation involves fundamental change in a system's form. Our case is illustrative of full system transformation that would need to take place in order to remove the barriers that stand in the way of realizing emergent policy goals around self-reliance.

Frames of reference are "perspectives, habits-of-mind (and) mindsets"(Mezirow 2000, 7–8), and therefore point to associated belief systems and societal values. Frames of reference in this study serve as an abstraction of collective beliefs, worldviews and therefore consciousness.

Consciousness then can be seen in shared frames of reference, as a "collective preoccupation, a shared vision, of what the imagined future could or should be like"

(Parsons and Nalau 2016, 88). We theorize consciousness plays a role in infrastructure transitions. In order to illuminate the how we transform our frames of reference, special attention is paid to consciousness as a less considered layer of the system (O'Brien 2012). We explore predominate frames of reference used within the Los Angeles system in order to elucidate what O'Brien calls the "relationship between consciousness and individual and collective transformative action" (O'Brien 2012, 672).

## THE RESEARCH

Our research explores these themes through interviews with twenty key nonprofit groups, water agencies, and public officials, as well as scientists and other topical experts. These accounts, supplemented by existing literature, helped us to construct a historical framework and explore self-reliance as a frame of reference. Interviews were conducted during late 2014 and early 2015. Interviews averaged 1.5 hours and most were conducted in person although several were done by phone. Interviews were recorded and transcribed by the researchers. Transcriptions were imported into ATLAS.ti data analysis software. We developed codes that represented themes from either the interview protocols specifically, or the broader questions guiding this research in order to conduct the analysis of the interviews. One or multiple codes were applied to the text when appropriate. The database created in ATLAS.ti was then used as a search and sort tool for thematic analysis.

The added value of this study is to understand a contemporary transition embedded historically within its physical and institutional architecture. There is currently a dearth of

case studies that document the interdependence and co-evolution of change within urban water systems. We use the framework articulated by Brown et al. (2009) to show how the evolution of ideas and infrastructure in past regimes have paved the way for transition to the Self- Reliant City, which emerges from two prior, including: 1) water policy and management transitioning to include demand reduction; and 2) the advocacy community shifting to include water supply in its traditional focus on water quality issues. The third transition to self-reliance is a profound change that departs from the traditional strategy of importation, as well as coming full circle back to a supply-side focus. We then discuss why systemic transformation will be necessary to realize the goals that are reflected in current narratives and policies, and further contribute an analysis of the role consciousness plays in such transformation.

**Los Angeles Climate Context:**

> *"The history of California in the twentieth century is the story of a state inventing itself with water. The principle centers of urban settlement and industrial and agricultural production in California today were in large part arid wastelands and malarial blogs in their natural condition. The modern prosperity of the state has consequently been founded upon a massive rearrangement of the natural environment through public water development."* (Kahrl 1982, 1)

Water scarcity has long been an issue in the Western U.S. Growth was once constrained by water availability but modern engineering harnesses and directs resource flows across watersheds, allowing expansive development previously

unimaginable. While this rearrangement was successful in supplying water to a growing population in an arid, Mediterranean climate, its environmental sustainability has always been questionable and its fundamental efficacy in today's social and environmental climates is dubious (Pincetl, Porse, and Cheng 2016). Severe drought struck the state in 2011 with noticeable impacts across the Los Angeles metropolitan area which, much like the rest of the state, relies heavily on winter snowpack in the Sierra Nevada Mountains for annual water supply due to the engineered system of imported water supply. California's reservoir system was built to manage snowfall that accumulates in the Sierra Nevada range, where it is stored naturally and then released during spring and summer months as melt-off that feeds the state's system of conveyance, including rivers, dams and aqueducts. In spring 2015 however, following four years of drought coupled with the warmest winter on record, snowpack was at its lowest levels since record keeping began in 1950 (Rice 2015). Future water supplies are uncertain in the face of climate change and according to some experts, drought conditions may increase in both frequency and intensity, extending out into longer periods of time, representing what may become the norm for California (Dettinger and Cayan 2014; Diffenbaugh, Swain, and Touma 2015; Griffin and Anchukaitis 2014; Pincetl and Hogue 2015). Speaking about climate change, drought, and their combined and compounding impacts, one interviewee lamented:

> ***"if people really understood it (climate change) we'd be talking about little else because it's going to fundamentally change the hydrologic cycle – which means everything else changes, food production, ecosystems, water***

***facilities are all obsolete . . . Hydrological system change makes all other systems obsolete – the results are so radical … people don't get it yet and unfortunately we might have to get hit in the face with it like we are with this drought (for people to understand) – except this drought is nothing, it's a piker and we can't even get through this drought without severe changes – but this is nothing – it's like a 3rd grade test and we're going to have a college exam soon."***

**Historical Arc of Transition:**

Placing current events within a historic trajectory, we apply the seven distinct regimes mentioned above, each of which contained different types and extent of change. We emphasize three major transition points. As seen in Table 1, the first two transition points occurred early, within the Conservation City regime and are situated within the five original regimes that formed the foundational layers, which established and consolidated the current system. The third and ongoing transition distinguishes the Self-Reliant City, which would require full system transformation to realize as it necessitates changes in the institutions and infrastructures that were created during the previous six regimes. Los Angeles shares the general evolutionary path of many western projects (Brown, Keath, and Wong 2009). Each of the seven water regimes is characterized by the goals and social norms of its era, reflected in a key attribute, goal, or a problem the transition was trying to solve.

| REGIME | GOALS AND ATTRIBUTES | EMERGENCE (approximate dates) | TRANSITIONS |
|---|---|---|---|
| Irrigation City | Reliability and Agriculture | 1769 | |
| Sewered City | Wastewater and Public Health | 1887 | |
| Drained City | Stormwater and Property Protection | 1908 | |
| Piped City | Canals and Urban Growth | 1913 | |
| Water Conscious City | Water Quality Issues and the Advocacy Community | 1963 | |
| Water Conservation City | Water Conservation and Urban Growth | 1990 | 1)Demand-Side Approach<br>2) Supply-Side Issues |
| Self-Reliant City | Self-Reliance and Local Water | 2011 | 3)Supply-Side Approach |

Table 1

The ***Irrigation City*** was established by Spanish colonists in order to support settlements along the Los Angeles River (Kahrl 1982). This first layer of the system then was comprised largely of irrigation technologies and managing institutions (Pincetl 1999; Pincetl, Porse, and Cheng 2016). The ***Sewered City*** emerged as a response to disease and a way to manage human waste, which accompanied urban population explosion during the Industrial Revolution (Sklar 2008). The ***Drained City*** was

characterized by an extensive stormwater system, built to manage intensive flooding at the time. One interviewee reflected on the following story:

> ***"Go back to the atmospheric river storms that were legendary in 1864, when Governor Leland Stanford went to Sacramento to be sworn in as governor - he went in a rowboat. It rained for 45 days – during that flood in the Central Valley you could have gotten on a rowboat in the pueblo in LA in 1864 and gone down to Santa Ana, because the whole coastal plane was flooded. They had huge floods in the 1930s. In 1934 they almost cancelled Rose Bowl Parade because of the floods. Woody Gunthrie wrote a song about all the squatters during the Depression that died undocumented on the LA River."***

The city's current stormwater system retains this early design, a concrete vestige of another time devised to rid the city of water as quickly as possible. As one interviewee stated: "***I don't disagree that today the LA River is not how I would've designed it – but they had huge floods in the 1930s - So they did a massive project. Today it's the wrong thing to do ... but concrete made sense then because of floods*.**" Scarce water resources are the price we now pay for that system, which loses to runoff and evaporation an average as high as 80% of the stormwater native to the upper Los Angeles River (Green 2007, 16).

The ***Piped City*** is however the regime most fundamental to the development and character of the Los Angeles Metropolitan Region. Between 1913 and 1973, three major

canal systems were built to import water into the city region. The Los Angeles Aqueduct was completed in 1913 and built to support city growth. Notably, voters approved the bond measure that funded the project in 1905, following the decade-long drought of 1895-1904 (Blomquist 1992, 54). At the time, it was the longest aqueduct in the world. The Metropolitan Water District of Southern California (MET) was founded in 1928 to bring Colorado River water to the city-region (Erie and Brackman 2006). Whereas the Los Angeles Aqueduct was built to support the City of Los Angeles, MET was established to support growth of the Southern California region. This goal was met with two more aqueducts, the Colorado River Aqueduct, completed in 1941, and later connection to the State Water Project, completed in 1973 (Erie and Brackman 2006). MET functions as the Institutional entity that manages and sells these imports to 26 cities in the region, with the exception of the Los Angeles Aqueduct that is owned and used by the City of Los Angeles and its Department of Water and Power.

The ***Water Conscious City*** marks the dawn of water advocacy in Los Angeles. When construction began in 1963 on the State Water Project, the region's general strategy for addressing shortages was to import resources from distant water-rich regions, a modernist approach that was challenged during the 1960s and 70s as the Environmental Movement ushered in a new way of thinking about natural resource use (Pincetl 1999). Early activists were concerned with water quality issues, many of which were a direct result of the Sewered and Drained Cities, as by design, their infrastructure emptied contaminated runoff and sewage into coastal waters (Sklar 2008). The result

was a highly polluted coastline, as well as pervasive contamination of land and water along the inland pathways of these systems.

As an early water quality advocate for Santa Monica Bay during the 1960s and 70s, the late Dorothy Green was at the forefront of the advocacy community. In order to address these issues, Green founded the advocacy organization Heal the Bay in 1985, along with Felicia Marcus, Mary Nichols, and Fran Pavley. One of the interviewees referred to these four women as among the most important environmental actors in the state's history.

Around the same time, in 1978, David Gaines founded the Mono Lake Committee to protect the lake and ecosystem that feeds Los Angeles Aqueduct, bringing further awareness to the profound environmental impacts and associated costs of this importation system. In 1974 and again in 1978, Jerry Brown was elected governor and proposed a peripheral canal to expand the State Water Project. The environmental community was appalled and galvanized to oppose the project (Pincetl 1999). Through associated organizing efforts, focus was placed on water allocations, leading to the realization that Los Angeles' importation strategy was premised on water sources that did not exist. As one interviewee described, Dorothy Green at this point began to form the conceptual framework of One Water, in which the sewage and stormwater systems would be integrated. Stormwater capture was a fundamental aspect of this system that Green articulated through *Unpave LA* with its agenda to reduce the pavement and concrete fabric covering the city-region. Conservation was another key concept to this

emerging consciousness and the water advocacy and management communities began to turn their attention to the question of where and how to conserve resources.

The ***Conservation City*** followed, which was characterized by two transitions within this fully formed water system. The first was a shift from supply-side dominated management to a combination of demand-side management or conservation strategies, which were coupled with continued exploration of new supplies. As several interviewees noted, it was during the late 1980s and early 1990s that conservation became the emergent frame for thinking about issues of water shortage, as it could be inclusive of the reality of water shortage as well as the goals of city growth and environmental sustainability. Due to conservation efforts, such as replacement programs for low-flow toilets, Los Angeles uses the same amount of water as it did thirty years ago, while the population simultaneously increased by 1.2 million people (Hughes, Pincetl, and Boone 2013). As one water manager summarized: "***For the City of LA, they've added about one million people since 1976, 77, 78 … and their water use is about the same as it was since then. But in the last 25 years the whole region, which has grown from about 14.5 million to 19 million since 1990 to 2015 … (doesn't) use any more water, from Ventura County to San Diego."***

During this same time period, a second transition began in the Conservation City, spurred by the advocacy community. This change was marked by a shift in focus from quality to supply issues. As one interviewee remarked: ***"Water quality used to be everything, but now supply is the big thing."*** Advocacy had originally been

organized around water quality, before thought leaders noticed supply side issues of provision and governance. Green's early work contributed to the foundations of this transition; while her organization Heal the Bay was focused on water quality issues, she threw the proverbial flag much further by focusing on the supply-side through advocating for the use of recycled water and storm water capture, especially through the campaign "*Unpave LA*"; addressing issues of institutional fragmentation, the need to infiltrate the substantial stormwater, and pushing for transparency in decision-making and budgeting. Further, Green blew the doors open of the traditional way of doing business by water agencies, behind closed doors and obscurantist details of supply and delivery, such as source, quality and price of by questioning the institutional structure and its activities. She actively and publicly questioned the institutional processes and procedures, decision making and implicit vested interests. Interviewees noted that she did this however in a remarkably inclusive way that encouraged everyone to come to the table and cooperate, if not quite collaborate (true collaboration is a still a challenge in the system according to multiple interviewees).

***Self-Reliant City – From Demand Back to Supply Side Management:***

Drought beginning in 2011 drove the third and current transition to the last regime type in our typology, from demand back to supply-side innovation. As one interviewee suggested, although the seeds of this transformative thinking can be found as far back as the 1970s in the work of Dorothy Green and others, it was not widely considered or accepted until crisis once again hit the system, causing severe shortages and corresponding cutbacks (Mini, Hogue, and Pincetl 2014a, 2014b, 2015). Effects were therefore felt across regions, sectors and socio-economic demographics, resulting in

political and public support of policy change. A narrative of self-reliance emerged, codified in a number of policies including:

- Los Angeles City Mayoral Directive: “Emergency Drought Response – Creating a Water Wise City”
- Los Angeles Sustainability Plan
- Los Angeles City Building Code
- Supervisor Kuehl’s County Drought Resiliency Plan
- Metropolitan Water District turf replacement incentive program, among other public water agencies doing the same

While the Self-Reliant City is still being formed and defined, the narrative transition has already drawn attention from researchers and has been documented in water planning and management and journals (Hughes and Pincetl 2014; Hughes, Pincetl, and Boone 2013; Pincetl, Porse, and Cheng 2016; Porse, Glickfeld, Mertan, and Pincetl 2016). Policy and interview data shows that the Self-Reliance regime’s defining questions are being organized around the supply-side. Most significantly, the term “self-reliance” challenges the historic reliance on water imports as necessary to compensate for local scarcity, suggesting that there may be sufficient local water for local needs. However, its definition occupies a spectrum rather than a point. We found this frame is built around the need and ability to reduce imports and harness local water, yet its precise goals, methods, tools and approaches are ambiguous - its definitional ambiguities perhaps being the root of the trouble. When asked to define the term, interviewees responded

with a range of concepts, from reliable sources of water to ecological sustainability. For example, one interviewee summarized self-reliance as local water:

> ***"Self-sufficiency means you have enough local water and live within your watershed… You are largely independent of the need to rely on import sources of water - water from outside the watershed. LA Aqueduct is imported because it's a different watershed … I can see why someone would make the argument though to include LA Aqueduct as local because they own it ... Self-reliance is not relying on others – there were legal battles for Owens Valley – they had to give up certain things – but also realized they can have legal battles over local water."***

Another interviewee highlighted reliability as the goal of self-reliance:

> ***"Self-reliance means they have reliability to avoid outages or shortage of supply during droughts or extreme weather events or other catastrophic things like earthquakes – it's a reliability goal. Self-sustainability means there are ample water supplies – some might define that self-reliance is a local supply versus water that is imported. But there isn't a major metropolitan city on the west coast that doesn't import water, and there are few cities in the country that don't import water from multiple places."***

A third interviewee presented self-reliance as an agenda that would require a mixture of local and imported water:

> ***"Water self-reliance means that in an extreme allocation reduction from MET we minimize harm done to community. So, we remain reliant to some degree on MET water but not to the extent that could really harm us in extreme shortages. We work with that system so in non-shortage years we take more water and store it in basins to build up supply for use in extreme situations – this is the sort of self-reliance that we're thinking about. All of this by the way is balanced with cost – it would be nice to be completely self-reliant and eliminate all imports from Colorado, State and Owens, and we could do it, but it would be cost prohibitive - and so at some point it gets into a grey area of balancing cost with desire for greater self-reliance."***

Increasing the complexity of the self-reliance agenda, the tools needed to achieve associated goals (by any definition) are varied and still largely aspirational with a lot of emphasis placed on conservation and capture of storm and waste water. The early work of activists such as the late Dorothy Green portended the need for system transformation, in her case to an urban landscape that would be reengineered to enable stormwater to percolate to recharge groundwater. As one water expert stated: "***Sustainability means conjunctive use – there's no silver bullet for self-sufficiency – we have to employ a number of things – recycle, stormwater, conservation, desalination*****" …** and stressing the need for demand modification …

***"not just conservation but continually ramping down so that per person use is greatly reduced* (in order to) *make sure the next generation has water to drink and sustain an economy*".** The interviewee went on to acknowledge the need in today's dynamic world not just for *a* transition, but for constant transition, saying that "***everything needs to be re-thought and re-worked and once you do that, re-think and re-work it again – just has to be this way from here on out*".**

## WHY TRANSFORMATION?

The modern history of Southern California water provision can be crudely summarized as: *Importation* through big infrastructure projects built to meet current and future demand; *Conservation* efforts intended to reduce demand in order to be able to meet it; and *Self-Reliance* emerged as an awareness of local water resources when neither of these strategies was sufficient to insulate the population from the impacts of drought and climate change. Self-reliance requires rethinking the entire system, which is difficult as it must take into consideration, just at the level of Los Angeles County, 88 cities, over 100 different water suppliers, and 23 groundwater basins with various rights holders (Pincetl, Porse, and Cheng 2016; Porse, Glickfeld, Mertan, and Pincetl 2016).

The water regimes characterized in this paper reflect distinct layers that have been evolving together over time to create a complex system, wherein transformation is a daunting process; changes required for self-reliance are far more difficult than constructing the original infrastructure. While early engineering was a display of great technical and institutional ingenuity, re-engineering the system requires addressing both

physical and soft infrastructures – the sociotechnical system. The complexity of the interrelated elements acts to create lock-ins staunchly resistant to further change. Transformation is needed, which requires “radical changes to the way in which water servicing is planned, designed, constructed, operated, managed, governed and valued, in order to achieve more sustainable outcomes” (Ferguson, Brown, and Deletic 2013) ….. Such radical change can be profoundly hampered by the very construct of the physical and social systems in question. The following four sections discuss the physical infrastructure, institutional structure, groundwater system, and system of human consciousness that must transition in order for the proposed transformation to occur.

***Physical Infrastructure***: The first and arguably most challenging structural issue is the material infrastructure of the region’s water system. Transitions within material or physical urban water infrastructures are inherently difficult, due to their vast size and high capital investment. In Los Angeles, this includes the extensive system of pipes and technology designed to import water; if imports were to cease, so too would the use and economic productivity of this infrastructure and therefore its capital investment would be lost. Summarizing both why system transformation is needed and the widespread perspective that acts as barrier, one interviewee stated: ***“Do you abandon billions of dollars of existing infrastructure? From a policy perspective, this makes no sense – if someone buys the infrastructure for $50 billion and then you go and invest in desal or other it could work, but who would purchase this infrastructure? No one would.”***

The urban landscape also poses structural challenge, especially the stormwater system which was designed to rid the city of water as quickly as possible. One interviewee stressed that *"**changing land use even outside the channel (the Los Angeles River) is key - street gutters are designed in the same way: to throw water away. Other areas around the world aren't designed this way – they have catchments – they hang on to their water – it's not impossible and shouldn't be that hard to do – it's just not built into our existing plan".***

***Institutional Fragmentation:*** The institutional architecture of water governance poses further issue, especially in its fragmentation. **"*Water management is incredibly balkanized and competitive. There's a hidden politics between districts – each makes sense on their own but don't make sense when seen as a whole*" (Interviewee).** Previous research has shown how historical development resulted in this system marked by a plethora of institutions with overlapping responsibilities and jurisdictions, but often very different regulatory oversight (Figure 1). Regulatory mismatch and gaps are evident in issues such as lack of democratic access, decision-making and accountability, as well as lack of transparency (Pincetl, Porse, and Cheng 2016, 21), resulting in the misuse or outright theft of funds from managing officials and delivery of poor quality water at high costs (Chang n.d.; Radio 700). One nonprofit interviewee called this system "***personally offensive***" and noted that there are about 140 water retail agencies in Los Angeles County, many of which supply less than 20,000 residents equating to a dearth of oversight and capital for improvements. There are three broad institutional categories of water delivery in the region, mutual, investor

owned, and wholesalers or water districts. The purpose of the wholesalers is to import water and then sell it to other providers. Without imports, wholesalers in their current form would become irrelevant, and as one water manager stated, "***no organization dies or becomes less powerful voluntarily*****".** The interviewee went on to suggest that wholesalers could transition form in order to manage regional pipelines designed to move water efficiently through a self-reliant system, or conversely serving as a **"conservation polity"** or a regional representative on state issues**.**

Fragmentation also renders the system resistant to change. Technical and fiscal issues require investment but capital is lacking, small entities encounter difficulties accessing capital for updates and retrofits (Pincetl, Porse, and Cheng 2016, 20; Walton 2016) Special districts were originally formed to raise funds, going back to the Wright Act of 1887 (Pincetl, Porse, and Cheng 2016, 9; Porse, Glickfeld, Mertan, and Pincetl 2016, 5). Today's result however is a complex institutional landscape which, rather than treating water resources as regional assets, is marked by siloed budgets that serve to discourage collaboration toward system change. Jurisdictional and institutional fragmentation can further result in the cost of change being placed on communities that have the least ability to pay, which has deep social justice connotations and can impede broader transition at the system scale. Commenting on the social justice dimension, one interviewee stated that "***if the era of cheap water is over, we still have to protect the people who don't have ability to pay ... people … should have adequate supply of water so we can't base this just on who has the money".***

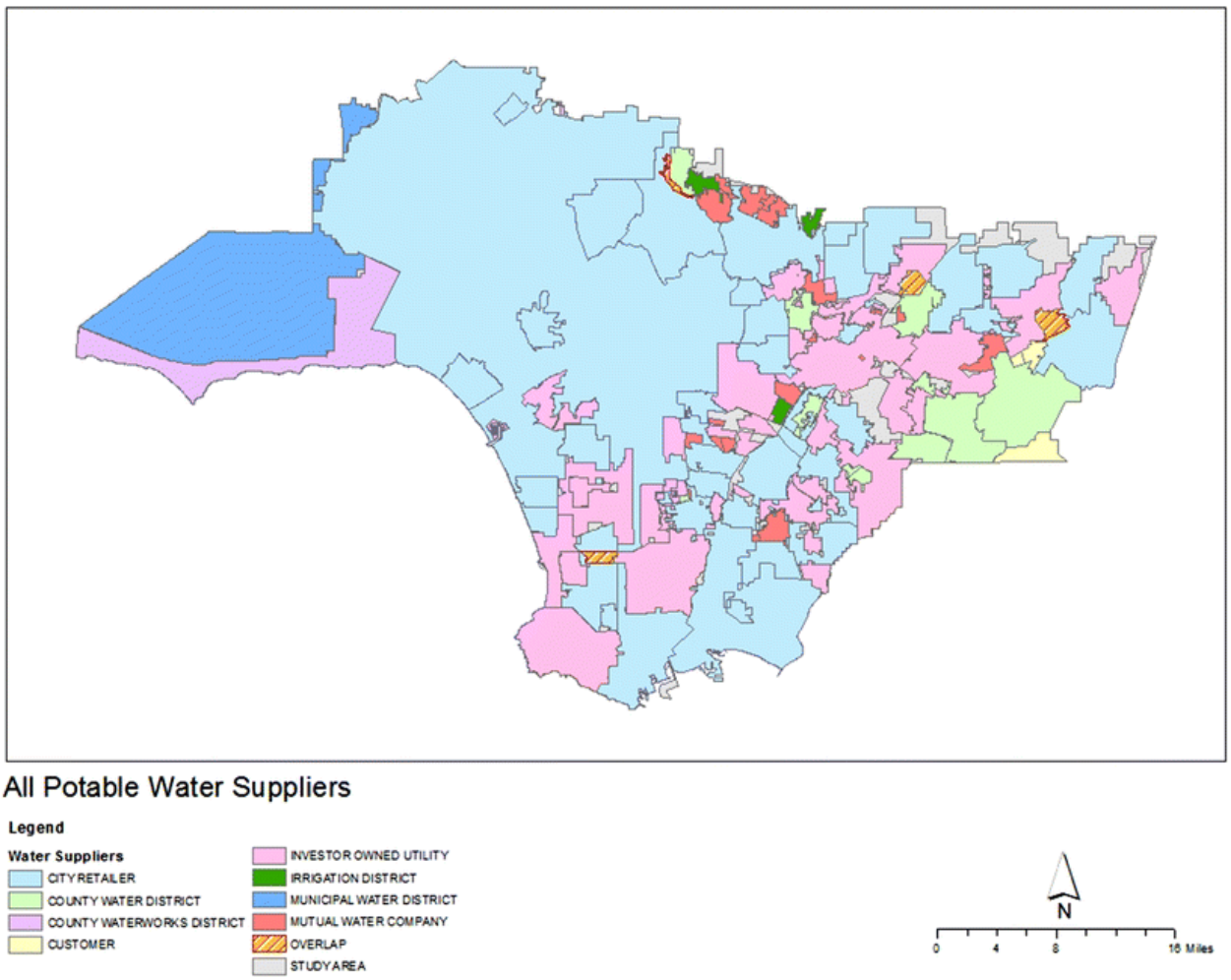


Figure 1 (Pincetl, Porse, and Cheng 2016, 212)

***Groundwater Basins***: The groundwater system underlying the region is a crucial component of the Self-Reliant City, as these aquifers provide huge water storage capacity. The groundwater system is however as complex as it is important, presenting its own structural issues that compound with those from the system above, as reported in (Pincetl, Chester, and Eisenman 2016; Pincetl, Porse, and Cheng 2016; Porse, Glickfeld, Mertan, and Pincetl 2016) . Evolution of the groundwater system in the region mirrors that of the water system above ground. Recorded history of active pumping from local aquifers dates back to the nineteenth century, when some areas even had artesian

wells. While development above ground got its start several decades earlier, the groundwater system reflects the same path: water sources were found and cultivated (Water Supply City), supply was diversified by imports (Piped City), and then this supply was supplemented by conservation measures (Conservation City) (Porse, Glickfeld, Mertan, and Pincetl 2016, 7). The Drained and the Sewered cities impacted the groundwater system by diverting water that would have percolated back into the aquifer under normal conditions. Those environmental impacts that were being addressed during the Water Conscious City were similarly occurring underground, as pollution from both industry and runoff (that which did have a chance to percolate through), made its ways into the basins, where much of it remains today awaiting remediation before it is safe for use.

Governance of groundwater presents unique challenges, given exclusive rights allocated to public and private users at both large and small scales (Porse, Glickfeld, Mertan, and Pincetl 2016, 7). Since 1949, many of the region's basins have undergone processes of adjudication through which water rights were established (Figure 2), which now inhibit system change as existing groundwater rights preclude incentive for investing in transition. As one advocate described:

> ***"water rights and water law are not our friends. Adjudication has served us well … It's served us well up to a point but needs to change faster than the legal system is allowing it to. It can't change quickly enough. For example: If you change your urban fabric so that we can infiltrate water here, basins***

***don't get credit for water … in LA if you're an apartment developer and want to get credit for infiltrated water you can't do that. Our system of water laws is a hindrance.***

A "wholesale change in system operations" is therefore needed to address private property rights that were cemented through basin adjudications; finances compound the issue, as there are high transaction costs associated with these legal changes (Porse, Glickfeld, Mertan, and Pincetl 2016, 12). Another interviewee noted that several basins in the region cross watersheds, which complicates watershed based management, stating however that we should ideally ***"manage water resources where water resources fall - then you're managing your own local resources***".

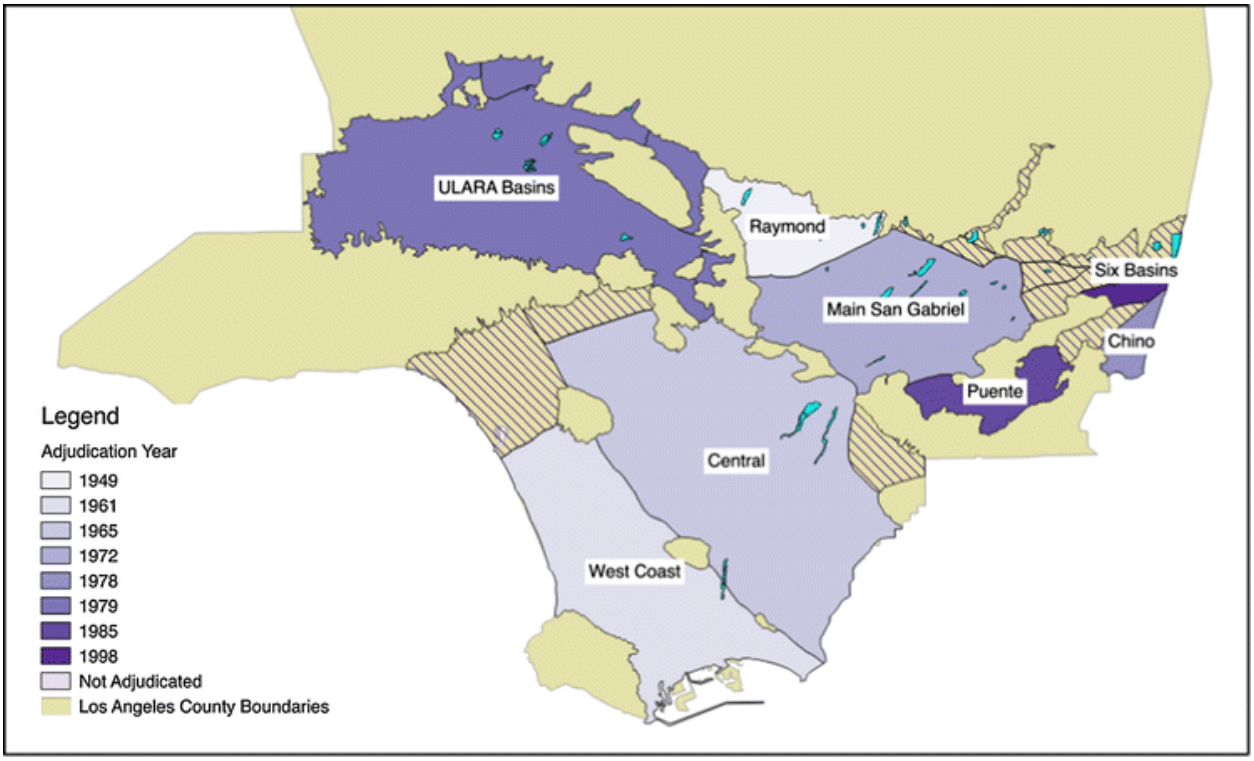


Figure 2 (Porse, Glickfeld, Mertan, and Pincetl 2016, 798)

***Consciousness:***

Transformation to a system conducive to self-reliance requires transitions within its physical infrastructure, institutions, rules, laws, and regulations. But because sociotechnical systems "comprise a cluster of elements, including technology, regulations, user practices and markets, cultural meanings, infrastructure, maintenance networks and supply networks" (Geels, Elzen, and Green 2004, 3), transition involves not only changes in technology, institutions, industries and firms, but also changes in attitudes, perceptions and beliefs associated with "user contexts and symbolic meaning" (Geels, Elzen, and Green 2004, 4). Cultural meanings, attitudes, perceptions, beliefs, user context, and symbolic meaning collectively constitute a level of the system that is distinct from yet permeates and informs physical infrastructure, institutions, and laws. We conceptualize this layer as consciousness, which is reflected in the dominant paradigms or ontologies guiding the system.

It has been suggested that a change in consciousness will change society, and more specifically that transformation in dominant ontologies of climate change, and their corresponding scientific and cultural paradigms is necessary to keep up with environmental change (Hulme 2009; O'Brien 2012). Transformation of dominant ontologies of water are then of great importance, a process that can be observed via changing frames of reference and narratives within policy and practice. Frames of reference allow us to glimpse consciousness and its operating ontology, as they are "perspectives, habits-of-mind (and) mindsets" (Mezirow 2000, 7–8), and therefore point to associated belief systems and societal values which are themselves reflections of the

consciousness that guides them. Graugaard defines frames as "'habits' of the imagination which give structure to thought by way of reference to other frames" (Graugaard 2014, 68). "And since frames come in systems, a single word typically activates not only its defining frame, but also much of the system its defining frame is in"(Lakoff 2010, 71–72). In this way, consciousness is the system within the system undergoing transformation.

Graugaard goes on to explain how consciousness creates our institutional and infrastructure systems, as habits of the imagination are enacted on the physical world; he quotes Lakoff as saying: "frames can become reified – made real – in institutions, industries, and cultural practices. Once reified, they don't disappear until institutions, industries, and cultural practices disappear" (Graugaard 2014, 68–69; Lakoff 2010, 77), or until the form of the system changes in which institutions, industry and culture are nested. In this way, the presence of self-reliance as a dominant frame of reference can be understood as a profound transition, the movement of which has implications for the entire system of consciousness that it is part of, evidenced eventually in a transition from reification to innovation and then creation.

Transformational learning, the affiliate of transition, is "the process by which we transform our taken-for-granted frames of reference (meaning perspectives, habits of mind, mind-sets) to make them more inclusive, discriminating, open, emotionally capable of change, and reflective so that they may generate beliefs and opinions that will prove more true or justified to guide actions" (Mezirow 2000, 7–8). This includes the

capacity to become critically aware of one's own assumptions (and those of others), the capacity for critical reflection and open-mindedness, and the capacity to take in multiple perspectives and viewpoints, including those that challenge prevailing norms and interests (O'Brien 2012).

Increasing import supply was the frame of reference for meeting demand in previous water regimes, until conservation became the emergent frame during the 1980s for thinking about issues of water shortage, as it was inclusive of the reality of shortage as well as the goals of city growth and environmental sustainability. One advocate reflected that, ***"when people are connected to something that they can do they are empowered in learning more".*** Self-reliance as a frame of reference could hold similar power, as it is being used to contain traditional goals of reliability, as well as the system's more recent directives of environmental and social health, including the aspirational goal of local water reliability. It could therefore contribute to a change of consciousness by broadening people's awareness of the realities of the system; it also acts as a directive and a tangible goal. Within this shift room is made to consider other things that were once impossible when viewed from a prior consciousness, for example, as one interviewee suggested, "unbuilding" rather than rebuilding infrastructure:

> ***I love when people come up against their walls of what's possible - reasons for saying no . . . fascinating to see what people's limits are. Then with crisis comes change! What was unthinkable suddenly comes back on the table. (And) we have to make fundamental structural changes ....***

***Considering carbon is a nice benefit – full lifecycle carbon costs of rebuilding river channels, streets and structures to control nature, instead of unbuilding – factor collateral costs of doing things the 20th century way you will be induced to work differently but many are not seeing it yet."***

## CONCLUSION

This research shows that a profound transition is underway in the Los Angeles water system. Of course, change is not always welcome, and transformation is not always positive (Parsons and Nalau 2016). It is therefore important to understand current transitions within their historical context. By situating the current Los Angeles case within the historical arc of change and evolution, we aim to provide insights to scholars who research transformation in complex systems, and evidence to policymakers and water managers who are tasked with guiding transition.

There were four specific dimensions of this case that we set out to explore. First, the system's seven distinct regimes and their transition points were described in order to exemplify the evolutionary nature of transformation, suggesting that current and future regimes will also be linked to the drivers of change and transition points of their predecessors. Second, by describing the Los Angeles case, we showed how the current drought crisis accelerated discussions among some advocates and agencies toward self-reliance, however the transformative thinking that inspires this transition originated in prior regimes. Therefore, while crisis acted as catalyst for accepting and

implementing innovation, it did not drive the innovative thinking itself, which occurred 40 years before when Dorothy Green was considering how to reshape water management in Southern California. Third and related, the complex structural challenges to change demonstrated in the Los Angeles system show that removing barriers to innovation is perhaps of equal importance to preparing its goals and instruments. Lastly, self-reliance as a frame of reference was treated as an indicator of change not just in language and policy, but also in consciousness itself, which is perhaps the most profound affiliate of transformation in sociotechnical systems – the shift in consciousness in this case is not as much from imported to local water sources as it is from local to regional awareness and management of water as a resource.

Self-reliance and local water are however still largely aspirational, given the existing institutional and infrastructure systems outlined here. While this research served to describe transition in narrative and policy, it is yet to be seen if and how fundamental change in governance and infrastructure will take place. Interviews of water advocates, managers, researchers, and topical experts such as engineers and lawyers, show the various ways in which this change is perceived and understood, demonstrating that there is a range of meaning within the self-reliance agenda. Future research is needed to further describe and analyze the evolving arc of transformation, in order to theorize about its management.

It has been observed that “human society is inexperienced at trying to steer itself, deliberatively and quickly, in fundamentally new directions” (Patt et al. 2010, 385). In

today’s dynamic and ever changing world, the ability to steer ourselves with both agility and awareness of complexity becomes increasingly crucial. Steering our urban infrastructures can play a key role in regional stability and cases such as the Los Angeles water system reflect the intricacies of such a feat, regardless of whether this example will further serve as inspirational or cautionary tale.

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**“Evolution and Transition in the Athens Urban Water System”**


## ABSTRACT

This article offers a political ecology analysis of transition within Athens’ urban water system. While sociotechnical systems around the globe are transitioning, each has unique drivers, challenges and opportunities. The growing body of literature on this topic is enriched through additional case studies. This particular case study of the Athens system considers historic and future dynamics including environmental, political, economic and cultural dimensions. Through interviews with primary actors within the system, participant observation, as well as primary and secondary sources, evolution of the modern urban water system is summarized. Current and future drivers of change are analyzed along with barriers and opportunities to transition. Greek culture and its reflective institutions are found to be critical to future transitions.



Key words: Water; cities; urban water systems; sociotechnical systems; transition


## I. INTRODUCTION: POLITICAL ECOLOGY OF TRANSITION

Water systems across the globe are being pressured to adapt to ever-changing environmental and socio-economic realities (Ferguson, Brown, and Deletic 2013; de Haan, Rogers, Frantzeskaki, and Brown 2015; Pahl-Wostl 2007). At the most broad level is the global water system consisting of all human, technological, physical, biological and biogeochemical components (Pahl-Wostl 2007). Global environmental

change exerts pressure on this meta-system through the hydrologic and climate cycles, as well as through urbanization and changes in forest and ocean systems (Barnett, Matthew, and O'Brien 2010). Critical to these processes are those urban water systems that supply water to more than 54% of the world's people, a population that is estimated by the World Health Organization to grow to 60% by 2030 ("WHO | Urban population growth" n.d.), and which are undergoing transition alongside other urban systems (Hedjazi and Pineda 2014).

Transitions are fundamental changes or systemic transformation to large infrastructure systems such as those that deliver water and energy (Ferguson, Brown, and Deletic 2013). Urban water systems are conceptualized in the literature as "sociotechnical" systems made up of interrelated networks, infrastructure, technology and institutions (Bos and Brown 2012; Smith, Voß, and Grin 2010). "The urban water system is a complex adaptive system composed of technical, environmental and social components (water infrastructure, water resources and water users respectively) which interact dynamically and continuously with each other and whose relationships evolve in time" (Koutiva and Makropoulos 2016, 35). Transitions within urban water systems are cast in the literature as "sustainable" socio-technical transitions which grapple with "how to promote and govern a transition toward sustainability, i.e., a fundamental transformation towards more sustainable modes of production and consumption" (de Haan, Rogers, Frantzeskaki, and Brown 2015; Markard, Raven, and Truffer 2012, 955).

This research takes a political ecology approach to analyzing socio-technical infrastructure transitions by identifying those factors within the local, regional and international political economy that act as axes of change alongside biological and biogeochemical factors. Material transformation is understood as a product of these interactions (Gibbs 2002; Pincetl, Bunje, and Holmes 2012; Pincetl, Jonas, and Sullivan 2011). Recognizing cities as “dense networks of interwoven sociospatial processes that are simultaneously local and global, human and physical, cultural and organic” provides a rich lens through which to perceive the “myriad transformations and metabolisms that(Chamie 2017; “Global Homelessness Statistics” n.d.) support and maintain urban life” (Swyngedouw and Heynen 2003, 899).

## II. METHODOLOGY

In order to grapple with future transitions in the Athens socio-technical water system (hereafter referred to in shorthand as “water system” or “urban water system”), this article first steps back to chart its path of evolution, especially primary factors driving regime change, or transformation from one state of the system to the next (Brown, Keath, and Wong 2009; Smith, Voß, and Grin 2010). From this foundation of geopolitical, regional, and institutional context, interviews with primary actors within the system inform an analysis of the system’s current state, including pressures to transition, as well as opportunities and challenges to change.

This qualitative project is based on the complimentary approaches of interviews, participant observation, and text analysis to inform the construction of the Athens water system (Bogdan and Biklen 2007). Interviews and participant observation were conducted in Athens, Greece during April and May of 2016. All interviews were conducted in-person and through a semi-structured format that averaged 2.5 hours and provided respondents with ample opportunity to explore those aspect of the system that are most familiar (Robson 2011). This applied project contributes evidence from the contemporary water system that is intended to inform action; data collected as first-hand accounts of pressures and change within the system enhance decision-making by consolidating the experiences and knowledge of key actors engaged in its transitions (Rossman and Rallis 2012, 5).

## III. SYSTEM EVOLUTION

### Athens Overview:

System evolution is another way to think about sociotechnical transitions, as historic movements between regimes or the arc of change between regimes over long periods of time. The industrial revolution sparked the world's most profound transition as the process of modernization that marks the 20th century (Pincetl, Bunje, and Holmes 2012). Big infrastructure projects characterize the evolution of socio-technical systems during the modernist era, with examples seen around the world of massive importation systems including aqueducts and dams (Kelley 2011). Modernization included changes

to both the social and the technical systems, often shifting control of resources from communities to the state (Yazdanpanah, Hayati, Zamani, Karbalaee, et al. 2013).

The evolution of Athens' water system followed this path of modernization. With globalization as the neoliberal cousin of modernity, foreign capital and modernization went hand in hand. In the case of Greece, infrastructure investment has come largely from international sources, with private American capital jumpstarting the modern system of importation, and wastewater treatment funded by the European Union ("Greece to Receive €1.3b from EU for Infrastructure Projects" 2017; Kaika 2006).

The following sections follow the evolution of Athens' water system through the stages of "hydraulic growth" that allowed for the city to grow from what interviewees and scholars have described as a town watered by wells to a metropolis focused on demand-management and conservation (Kallis and Coccossis 2003). Kallis and Coccossis defined the beginnings of this transition as a movement toward "rational growth … meaning a cost-effective management of risk and wastage, but with the growth-serving objective remaining intact and exogenous to the planning process (Kallis and Coccossis 2003, 245). Interviews reveal contemporary forces pressuring systemic change, as well as opportunities and challenges to sustainable transition.

**Evolutionary path:**

Like all cities, Athens boasts a water system that reflects temporal, human and ecological influences. "The urban water system is a complex adaptive system

composed of technical, environmental and social components (water infrastructure, water resources and water users respectively) which interact dynamically and continuously with each other and whose relationships evolve in time" (Koutiva and Makropoulos 2016). However, the evolution of this particular system is notable for two primary reasons. Firstly, the city has been continuously inhabited for more than 7,000 years and is among the oldest in Europe and in fact the world (Tung 2001, 266). The Hadrianic Aqueduct, a Roman innovation built around 1,800 years ago, supplied the city with water until the 1920s (Christaki, Stournaras, Nastos, and Mamasis 2016). Secondly, the evolutionary path of Athens' water system has been primarily driven by actors and factors far outside of both city and country limits. This antiquity and exogenous influence are frequently referenced by both interviewees and scholarly literature.

Athens is the capital and largest city in Greece, with a history reaching as far back as the 11$^{th}$ millennium BC ("Ancient Athens," n.d.) . It sits on the Attica peninsula which offers entry into both the Mediterranean and Aegean seas. This is the most distant and driest part of Greece. Early inhabitants solved the spatial mismatch by transferring water to the Mediterranean south through a system of ancient aqueducts (Leigh 1998). Still standing today, the Hadrianic aqueduct which was built in 140 AD transferred groundwater from an associated aquifer as well as sources from Parnitha, Penetli and the Kifissos River through its 20 km long main tunnel (Christaki, Stournaras, Nastos, and Mamasis 2016). In ancient Athens, surface, ground and alluvial water were all utilized as well as rainwater harvesting. As one interviewee suggested, **these early**

**urban inhabitants had the impression it was not safe to rely on one source - the diversification of resources was a philosophy that started in ancient times as early city planners chose to rely on multiple sources for water security**.

From “Map of Greece” via Wiki Commons - https://commons.wikimedia.org/w/index.php?curid=22052


From “Map of Greece” by The World Factbook 2013-14. Washington, DC: Central Intelligence Agency, 2013 via Wikipedia Commons - https://commons.wikimedia.org/wiki/File:Gr-map.png#filehistory

While still a small, sparsely populated town, Athens became the capital of Greece in 1834 following the Greek War of Independence (Economidou 1993). Kallis and Coccossis describe Athens during this period as a “small settlement with practically no

industry, living by its administrative function as the capital of liberated Greece" (Kallis and Coccossis 2003, 246). One interviewee describes Athens in the period following independence from the Ottoman Empire as **"a patchwork of small towns surrounding the Acropolis and the port in Piraeus, which relied on the ancient system of aqueducts and public fountains."** Early attempts to modernize the city's water system were focused on reconstructing the Hadrian aqueduct which had fallen in disrepair and out of use during the 15th century, replaced by the Ottoman system of public fountains fed by wells and other aqueducts (Christaki, Stournaras, Nastos, and Mamasis 2016; Kaika 2006, 281). From 1834 to 1889, almost all funding for Athens urban water system went into this "archeological modernization" of the ancient Hadrian aqueduct (Kaika 2006, 277).

The turn of the century however saw the return of Greek diaspora to Athens, who brought with them not only wealth but also industrial knowledge and connections to international capital; this influx further encouraged national infrastructure to be developed with Athens as the center, including roads and ports (Kallis and Coccossis 2003). However the city still lacked water infrastructure and funding for a modern system (Kaika 2006). The end of WWI and domestic economic reforms brought changes to Greece that included expanded linkages to foreign capital; following the new geopolitical and economic role of the U.S. in the post-war era, an American consortium submitted to the national government a proposal in 1918 for a dam and a reservoir to provide water to Athens, which would later be bid out to the New York-based multinational construction firm, Ulen & Co (Kaika 2006, 286).

Regional and geopolitics conspired to speed up Athens' processes of modernization. A final episode of war broke out between Greece and Turkey in 1919, culminating in the Lausanne Convention which forced exchange of populations between the two countries (Clogg 2013). In 1923, during what has been called the "disaster of the Greek population in Asia Minor", Greek refugees fled home from what is now the Republic of Turkey (Economidou 1993, 35). One interviewee shared a family member's story: **this side of the interviewee's family had been settled in what is now Turkey but for many years had been the Ottoman Empire with more fluid boundaries between Greek and Turkish communities; this family member woke up one night with a gun to their head and the demand that they leave with their family that night.** There were many such refugees seeking to settle in the political borders of the modern state of Greece and many chose Athens, doubling the city's population to 704,247 (Kaika 2006, 286), which was approximately the size of the state of Athens during the Classical period (approximately the 5$^{th}$ and 4$^{th}$ centuries BC) (Economidou 1993, 34).

Inflated water demand resulted and in 1924 the U.S. company Ulen was brought in to increase supply, which was first done by repairing the Hadrianic aqueduct and expanding its capacity through the extension of additional branches and construction of wells and microdams (Christaki, The Majestic Hadrianic, 3, 2016). The same company later spearheaded the 'Build-Operate-Transfer' scheme of the Marathon project (1928-1931), which supplied the city water from nearby Lake Marathon through a dam, a treatment plant, and underground distribution (Kallis and Coccossis 2003, 248). Notably, the dam has an external panel made of Pentelikon marble, which the Acropolis

is also constructed from (Kaika 2006, 278; Wessles, Vardakos, Weingartner, Eslamian, et al. 2017, 499).

Under the agreement, Ulen financed, built, and operated Athens water for 22 years as the private company it created for the purpose, the Hellenic Water Company Inc. (EEY) (Kallis and Coccossis 2003). Up until this point, responsibility for supplying water was held by the municipalities. The Marathon project represented a highly contested transfer of power from the municipality to the State, as well as from the people of the State to foreign capital (Kaika 2006), an agreement that was reached in no small part due to the growing need for housing and services for refugees from Asia Minor (Kallis and Coccossis 2003).

Geopolitics next exerted influence on Athens water during the late 1930s and early 1940s. Starvation was the deadliest weapon of World War II and the end of the 1930s saw a great migration of rural populations (Collingham 2011). This next wave of population growth in Athens spurred a construction-based economy to meet housing needs during the war, sponsored by the State through tolerating and then legalizing self-built, informal structures, and an “internationally unique institutional system” which encouraged investment of domestic savings into the housing market, attracting both rural population and funds (Kallis and Coccossis 2003, 247).

This accommodative approach to housing needs supported a growth trend, with people and industry resettling in Athens. The State supported urban growth in part through the

provision of basic urban infrastructure including water and electricity. As part of this expansion, a system was built to transfer water from Lake Yliki, 90 kilometers from the city. Thus urbanization, industry expansion, and job opportunities in the 1960s earned Athens the moniker of the Greek ‘economic miracle’ (Kallis and Coccossis 2003, 248). This massive growth also furthered consolidation of resource power into the hands of the State. It was mandated in the post-war era that all buildings in Athens and neighboring Piraeus be connected to the central water system (Kaika 2006), a requirement that was furthered along by a dearth of sewage systems, which resulted in pollution that turned wells used by homes and suburbs into cesspools (G. Kallis & Coccossis, 2003, pp. 249–250).

The system of importation as well as state control ramped up in 1980. Continued population growth drove the Mornos dam and aqueduct project, which transports water to Athens from 190 km to the west (EYDAP n.d.). State control of water resources also consolidated in 1980, when the State-created EYDAP Inc. took over all water supply and sewage debt and assets from EEY, after purchasing its Ulen shares in 1974 (Kallis and Coccossis 2003).

Although the general sentiment from interviewees in 2017 was positive toward EYDAP, this was not always the case for public perception toward the State-run water company. Drought struck less than a decade after EDYAP was formed and the Mornos project completed, and neither were able to respond effectively to the crisis. At the time it was built, Mornos was the largest gravity dam in Europe and the second longest aqueduct; it

was expected to meet Athens' water demand until 2010, however it was found in October 1990 that water reserves would only be sufficient for 56 days, motivating conservation efforts (Kallis and Coccossis 2003, 251).

This drought crisis has been characterized both as a management failure (Kallis and Coccossis 2003) as well as a convenient opening harnessed by the neo-liberal government to further its privatization agenda (Kaika, 1999). It does seem certain that the failure shocked the system out of infrastructure expansion and into prediction and demand reduction, characterized by Kallis and Coccossis as a turn from a hydraulic to a rational growth paradigm. This cognitive construct was reflected in the interview data, with **all participants pointing to conservation as at least one of the primary directions and strategies for transition - no respondents advocated for import expansion.**

The 1980s were also significant as Greece joined the European Union (EU) in 1981 while under the leftist leadership of the Communist Party of Greece ("EUROPA - Greece" 2016). Membership in the EU requires adherence to its policies, which combined with funding had a strong impact on the evolution of Athens' water system**. One respondent reported the U.S. to have been the leader in environmental change worldwide during the 1970s. The interviewee reflected that the EU modeled its early environmental standards after the U.S. Environmental Protection Agency, and Athens was required to meet water quality standards as a stipulation of membership.**

As drought calmed, there was increased attention placed on wastewater. The Saronic Gulf surrounding the Attica peninsula was growing highly polluted by both residential sewage and industrial waste. Evidence of sanitation systems in Greece date back to the Bronze Age. Classic toilets, sewers and fountains were expanded during the Ottoman period (mid 14$^{th}$-1923AD) including fountains and flowing water for cleaning before prayer, as indicated by Islamic culture and ritual; toilets, which were part of most Ottoman architecture, both religious and secular; and hammams and baths over natural thermal springs for bathing (Antoniou et al. 2014). Sewage however went untreated, funneled directly into the Saronic Gulf until municipal wastewater treatment was mandated and funded by the EU (OECD 1999). The first treatment facility with a design capacity of 24,000 $m^3$ per day of septic sewage and 20,000 $m^3$ per day of municipal wastewater began operations in 1986 and Psyttaleia, a second much larger facility that treats an average of 730,000 $m^3$ of wastewater, began operating in 1994 ("ΕΥΔΑΠ-Wastewater Treatment" n.d.).

In 2000, the European Union adopted the Water Framework Directive (WFD), committing member states to achieve quality standards for all water bodies up to one nautical mile from shore. Interviewees discussed ramifications at length, as each country must meet basic standards, with freedom around interpretation and implementation. In the case of Athens, two notable changes after 2000 were the addition of sludge treatment at the Psyttaleia facility as of 2007, and the still ongoing construction of additional treatment facilities to service peripheral regions of the Attica

peninsula (“Greece to Receive €1.3b from EU for Infrastructure Projects” 2017). Membership in the EU and the WFD continue to be central shaping mechanisms in Athens and in Greece more broadly, as is discussed in the following section on current and future transitions.

In 2001, the final phase of Athens’ water importation system was complete. Began in 1992, the Evinos project consists of the Evinos Reservoir and the tunnel connecting that water to the Mornos Reservoir (EYDAP n.d.). Planned to meet Athens’ water demand until 2030, the project is estimated at US$392M, 85% of which was provided by the European Union Cohesion Fund (International Water Power and Dam Construction n.d.).

## IV. SYSTEM TRANSITION

*You are in Athens. It is the year 1830. Greece’s liberation war has just ended and 12 thousand Athenians have returned home. You are standing on top of the Acropolis watching the city below. Nothing remains but ‘piles of scattered ruins … stones and parts of walls’.1 You see people around water fountains waiting to fill their buckets, others pulling water from wells. At the time no one could have predicted the drastic transformations the city was to face.*

*Fast forward. The year is 2004. You are again standing on*

*top of the Acropolis. Everywhere you look now there are multistorey apartments, thousands of them. Four million people now inhabit the city. There are no longer fountains or wells, but 4 reservoirs, far from the city, with a capacity of 1.5 billion cubic meters (cu.m). Water passes through 500 km of canals, 4 treatment plants, 7000 km of underground pipes and flows out to 1.7 million taps.* (Kallis 2010, 796)

The above passage captures the evolutionary path of transition that has occurred in Athens' modern water system over the past two centuries. Today however, Athenians might wish those public fountains and wells still existed, as economic crisis has devastated the country for more than a decade. While interviewees report artificially low water costs, growing numbers of houseless people suggest even the most meager bill is difficult to pay in crisis times. The following sections provide an analysis of the current state of the Athenian water system, the pressures it faces to transition, as well as primary opportunities and challenges to change.

**Economic Crisis:**

Contextualizing the contemporary Athens water system and all of its changes is the profound economic crisis and associated corruption that have driven economic, political, and cultural transitions across the country. Following Wall Street's crash in 2008 and waves of recession reaching across the globe, Greece announced that its economy was less stable and in more deficit than it had been reporting, which promptly resulted in the

country being blocked from financial markets and by 2010, teetering on the edge of bankruptcy (“Explaining Greece’s Debt Crisis” 2016). Already operating under a deficit before the crash, the Greek economy has suffered exponentially in the following years. Regional and international institutions now have a strong grasp of control over the country’s policies and resources, even though, in the words of Eleni Portaliou: “public debt is not the debt of societies. It is the debt of the global banking system, which collapsed because of the uncontrolled speculative movements of financial capital” (Portaliou 2016). While part of a global recession, its specific circumstances, notably government corruption (Kouretas and Vlamis 2010), has left Greece among the most indebted countries in the world with a debt to GDP ratio of over 180% and the highest unemployment in the EU (Ellyatt 2016).

In response to the crisis, austerity measures have been imposed by foreign capital, the state, and the Troika which consists of the International Monetary Fund, the European Commission and the European Central Bank - measures that include reducing the salaries, rights, and social benefits of workers, increased taxes, and cuts to both public sector jobs and welfare benefits, even though a growing body of evidence documents severe social and environmental harms resulting from such an approach (Calvário, Velegrakis, and Kaika 2017; Zeitchik 2015). Economic contraction and austerity measures have driven unemployment, still reported at 20.5% as of November 2017 (“Unemployment statistics - Statistics Explained” n.d.). Youth unemployment (ages 15-24) has been most severely impacted, reaching up to 55% in Greece during 2015 (Milevska 2014) and leading youth homelessness and substance abuse to rise steeply

in what has been called a “lost generation” (Zeitchik 2015). Extreme poverty throughout Greece rose from 2.2% in 2009 to 15% in 2016, with approximately 1.6 million out of the population of 11 million people living in extreme poverty (Ellyatt 2016).

Workplace conditions for those who are employed have also worsened during the crisis. Workers’ rights have long been a challenge in Greece, with issues including minimum wage calculated lower for youths (“The Youth Unemployment Rate in Greece” 2017), and as reported by a female interviewee, **women getting fired when pregnant or not being paid, women over 30 not being hired, a severe gender pay gap, and what she referred to as a “rape culture” that women in and out of the workplace have to contend with**. But these problems have deepened in the turbulent job market. The issue of non-payment was frequently mentioned as having expanded during the crisis for both males and females. One interviewee expressed the two questions that Athenians ask one another these days: **1) do you have a job? and 2) are you getting paid?** For while people are desperate for work, taking jobs below their qualifications and juggling multiple positions to make ends meet, employers, including reportedly the State, are frequently absent on payday - while Athenians are grateful to have a job, it does not guarantee a paycheck. **A male university employee had been waiting more than a year for a paycheck from the state system, a circumstance that he appeared resigned to, given its common character.**

In addition to austerity, Greece has been pressured by the Troika to privatize its infrastructure as a form of debt repayment. Although privatization has been required

since 2010 as part of international bailouts, only 4.4 billion euros or $5.17 billion had been raised by October 2017 as a result of “political resistance and red tape” (“Greece names new CEO to lead privatization agency” 2017). This relatively paltry sum stands in contrast to the startling amount of national infrastructure that has been sold. As reported in June 2017 by Michael Nevradakis:

> “Just in the past year, 14 major regional Greek airports were privatized, as was the port of Piraeus, Greece’s largest port and one of the largest in Europe. More recently, the port of Thessaloniki, Greece’s second-largest city, was also privatized to a consortium of investors. In addition, special privatization funds have been created where the ownership of public assets such as water utilities has been transferred, leading up to their future sale.” (Nevradakis 2017)

Harnessing terminology employed by David Harvey, Stathis Kouvelakis refers to this expropriation of national wealth as “accumulation by dispossession” going on to explain that in the case of Greece, dispossession is “not to a country of the Global South or Eastern Europe but to a member of the eurozone since its creation and of the European Economic Community since the early 1980s” (Portaliou 2016).

The future of Greece is very uncertain in light of the crash; it is a crisis that has been deep and long with reverberating effects throughout Greek life. One of the most significant factors in its pervasive impact on Greek society seems to be its lack of foreseeable resolution, which has led to disillusionment, hopelessness and a more

isolated and fragmented society. **One interviewee, appearing in their 50s, expressed that they do not expect to see an end to the crisis in their lifetime, nor in the span of their children's working careers, but that they do hope that their grandchildren are able to reach adulthood and build careers in a different economy**. Another respondent lamented that: **"People are very pessimistic – we used to be pessimists in a happy way but now we are very pessimistic about the future and we are in a very long downturn and this is evident to everyone – if things are all going to be private in a few years this is even more concerning – I believe there will be a huge transfer of wealth to private, and foreign-private enterprise."**

Greece's water systems have been a focus of this pressure to privatize, especially EYDAP/ ΕΥΔΑΠ in Athens and EYATH/ΕΥΑΘ serving the northern city of Thessaloniki, the country's two largest urban systems. **Interviewees report Greek sentiment across the country to be mostly opposed to privatization in general, but especially to privatization of the water system, as evidenced in a referendum enacted in Thessaloniki in which 90% voted against it.** Activist Maria Kanellopoulou offered this description:

> "In the end, a lot of the citizens, as I said before, are obliged by outrage to take back control of the water companies. We really don't need to see that happening in Greece. We know exactly what the consequences are, and it is shameful that cities in Europe that have long [experienced] these kinds of policies now try to impose them in a European country with economic hardship such as Greece.

> There is no need to make things even more difficult than they already are." (Nevradakis 2017)

However, this struggle is not new in modern Greece. As Kaika reports, in effort to repay the $10 million loan from Ulen to build the Marathon project, the Greek state attempted during the 1920s to make connection to the new supply network mandatory for all new households, which resulted in great pushback from the public which was unfamiliar with and rejected the concept of water as a commodity to be bought and sold (Kaika 2006, 287)(Kaika 2006, 287)- "handing over the city's water resources to foreign private capital and management went against the dominant perception of waster as a public good and national heritage" (Kaika 2006, 287).

**Current state of the water system:**

Strengthening opposition to privatization of the water system is a sense of pride in its current success, especially through the management of EYDAP/ ΕΥΔΑΠ and EYATH/ΕΥΑΘ. Perception of success is rooted in current levels of efficacy in both cities. Athens' water system specifically is meeting current demand (Kallis 2010) and supply is anticipated to be stable until at least 2030 (International Water Power and Dam Construction n.d.). Four water treatment plants with a capacity of 1,840,000 $m^3$/day process raw water supplied primarily by surface sources from Marathonas, Yliki, Mornos and Evinos reservoirs through a 485 km aqueduct system (Golfinopoulos et al. 2017, 379). A result of the 1980 merger of the Hellenic Water Company and Greater Athens Sewerage Organization, the Athens Water Supply and Sewerage Company

(EYDAP/ ΕΥΔΑΠ) manages both supply and wastewater through two executive divisions (“ΕΥΔΑΠ-ORGANIZATIONAL STRUCTURE” n.d.). The sewerage is a 6,000 km network that serves 92% of wastewater needs in the Athens Metropolitan Area including storm water runoff and sewage (“ΕΥΔΑΠ-SEWERAGE NETWORK OPERATION” n.d.).

**Interviewees all reported the system to work well at its most broad level**. Supply is reliable and cheap. One activist interviewed stated that currently water bills are not **“crazy high and there is help for families that can’t afford them”**. Maria Kanellopoulou, a spokesperson for the activist group Save Greek Water, described the system in this way:

> “What is interesting to note, in the case of Greece: we have both EYDAP and EYATH, which are very profitable and stable companies. Only [in 2015], EYDAP made 138 million euros in gross profits … We have companies that are profitable, which offer cheap water, as well as some of the cheapest tariffs in Europe right now, and let’s just say that in Greece we still drink water from our taps. Tap water is drinkable.” (Nevradakis 2017)

There has however long been concern about inefficiency in the system (O’Riordan and Voisey 2013). Interviewees named **prevalent leaks and inefficient consumption to be two primary concerns**. And while the system is currently providing Athenians with reliable water, the conditions allowing for this supply are not expected to stay stable. In

addition to environmental uncertainties, unstable socioeconomic conditions also drive system change (Koutiva, Gerakopoulou, Makropoulos, and Vernardakis 2017). The following section outlines primary pressures for system transition, as reported by interview respondents, followed by opportunities and challenges to change.

## PRESSURES TO TRANSITION

### Global Environmental Change:

While the system is currently supplying cheap, reliable water, respondents are concerned with what one interviewee referred to as **"non-predictable inflows".** In the case of Athens, this includes most immediately the impact of inflows on both supply and in terms of disaster. Inflows of water supply are impacted regionally, especially given Athens' reliance on imported sources. Flows are also impacted by natural disaster in the alternating forms of drought and flood.

The many dynamics that impact flows are factors in global environmental change. Global environmental change includes changes in hydrologic, climate, ocean and forest systems, as well as urbanization (Barnett, Matthew, and O'Brien 2010). For example, the 2007 fire season on neighboring Peloponnese Peninsula was among the most extreme natural disasters in recent Greek history and was buffered by summer heat waves and winter droughts, the effects of which were extreme due to urbanization (Gouveia et al. 2016). Drought, desertification and flooding are three specific concerns as outlined below.

**Drought and desertification:**

Cycles of drought and floods are normal for Athens, but global environmental change leaves the Attica peninsula vulnerable to more extreme events. Climate change is evident in shifting precipitation patterns, from extreme droughts such as those on the Peloponnese Peninsula, to shifting climate patterns that have become the new norm (Pincetl and Hogue 2015). As one interviewee lamented, **Athens used to get rain during autumn, but summer and winter now meet without the interruption of seasonal storms**.

Shifting weather patterns threaten desertification in Athens and surrounding areas, a concept Athenians have historic and modern connection to. Land degradation was captured in the ancient texts of Solon, Plato, Theophrastus, Cicero, Pliny and Lucretius (Yassoglou and Kosmas 2000, 27). Today degradation is compounded by the effect of global environmental change; **interviewees report strong winds that blow sands from the Sahara Desert, tinging the air red and leaving the same colored dusting on cars and buildings**. However, unlike the Sahara, where aridity is a "single and sufficient factor to cause desert like conditions", desertification in Mediterranean Europe requires other thresholds be crossed by human action, as outlined by the authors below (Yassoglou and Kosmas 2000, 27–28):

- *Climate and bioclimate is characterised by large moisture deficits, temporal variability and frequent extreme events.*
- *Landscapes are rugged, with steep slopes, large elevation differences and are*

*highly dissected by torrential steams.*

- *Surface geology favours formation of soils which are sensitive to drought and erosion.*
- *Hydrology is characterised by the scarcity of surface and ground waters, and by the need to bring water from elsewhere to satisfy demand.*
- *Soil formation rates are much slower than soil loss, resulting in inadequate rootable depth and water storage capacity on sloping land.*
- *Out of phase rainfall and vegetative periods.*
- *Four millenniums of human land use and frequent abuses of land.*

Having an arid, Mediterranean climate and reliance on imported water, in addition to continuous population for far more than four millenniums, Athens and the broader Attica peninsula are especially vulnerable to global environmental change, including desertification. While Athens' water system has been largely resilient against drought patterns over the past two decades, more extreme events up to and including desertification could change both supply and demand.

**Flooding:**

The Mediterranean coast is characterized by intense rainfall events with peak storm intensity leading to flooding (Diakakis 2012). Increased urbanization and population growth over the last century have led to urban sprawl and intensified flood risk across Southern Europe (Diakakis, Deligianakis, and Mayroulis 2011; Salvati, Ridolfi, Pujol, and Ruiz 2016). **One respondent explained that unplanned development in the 70s**

**and 80s led to dense urbanization and bad (or non-existent) design**. Although there has been a decrease in flood-related deaths in Athens over the past several decades attributed to building improvements (Diakakis and Deligiannakis 2013), **interviewees expressed a concern for floods based on both the danger of increasingly severe weather events and urban infrastructure. In regard to infrastructure, respondents pointed to a lack of green space and otherwise permeable surfaces as a flood risk, along with the city's density and characteristically small streets, which several interviewees attributed to the largely unmanaged and unplanned building boom in the 1980s and 1990s** (Diakakis, Foumelis, Gouliotis, and Lekkas 2011).

**Population growth:**

While the system is currently supplying reliable water to the population of Athens, demand is subject to uncertain socio-economic conditions. **Respondents voiced concern that available volume may not meet the demands of an expanded population.** There are two primary levels of concern, endogenous and exogenous growth. Due to the financial crisis, endogenous growth is much less worrisome. In the shadow of the crisis, it is reportedly common for adults well into their 30s to live with their parents. Families across generations and geographies have consolidated under one roof, hampering marriage and other family planning in the younger generation. **Most respondents commented on this social state, and it was also a common conversation point among other Greeks that I interacted with during this study**. Also common was talk of a morose feeling in Athens, which **interviewees frequently commented on as a new atmosphere to the city since the crisis began**.

Hopelessness is one factor of this bleakness, as the economic situation is not expected to improve much in the next decade or so. A common expectation coming from this reality is that endogenous population growth will continue to stagnate if not decline.

**"Before there was a clear trend of population growth but since repression, Greek growth has declined. Athens has been stable because of migration into the country but austerity measures will have severe impact. Young people around 30 find it impossible to family plan – usually you have kids around 35-40 and have 1.3 average – the typical was 30-35 now much older and many are not having children. Also, people who are highly educated now leave the country." (Interviewee)**

The same was not said for exogenous growth. Instability and population growth in neighboring countries could have an impact on Athens' water system. Population growth fueled by migration increases water demand through residential use and also in the form of food and energy demand. As one respondent stated**: "Refugee communities could radically change demand on cities – not demands that change gradually but a massive change – I don't think we are prepared for this".**

Another interviewee identified regional volatility as one of the greatest threats to the water system:

**"Given growing instability from a political point of view, the entire area of eastern Mediterranean security could be an issue in the near future … Turkey is one issue but the primary modification of this region is the US and I don't think they would allow high conflict between Greece and Turkey. Instability is more generalized – stable states have fallen the last 6 years: Tunisia, Egypt, Libya, Syria . . . there is an arc that has been expanding dangerously toward Greek borders – this makes Greece the second defense system buyer in the NATO alliance – Greece is second major buyer after US. Increasing population growth in northern African and western Asia and low growth rates in European Mediterranean – increased food demand and high energy demand … this is more risky than climate change because of big immigrant waves toward these countries. The risk is not so much invasion or terrorism but increased migration."**

The economic crash compounded by the refugee crisis has increased the houseless population. **Interviewees remarked that before the crash, it was extremely rare that someone would not have a place to live, as family networks are strong in the country**. The situation now has grown dire. As one interviewee remarked**: "Homeless people are new to Athens. We used to have two homeless people in the Athens metropolitan area – now there are so many."**

**European Union:**

Greece joined the EU in 1981 and has since been subject to EU law ("EUROPA - Greece" 2016). EU mandates generate institutional pressure on the water system to transition. These mandates have shaped the modern Greek water system through both funding and enforceable standards. EU standards and funding drove for instance the construction of the country's first wastewater treatment plant. Today, EU compliance pressure and funding remain primary pressures on the system, with 38 million euros allotted in Cohesion funds during 2016 in order to bring Attica's wastewater up to standards ("Greece to Receive €1.3b from EU for Infrastructure Projects" 2017; "Greece To Receive ECU 21.1 Million From The Cohesion Fund For Projects In The Field Of The Environment" n.d.). Additional issues are discussed in the following sections.

**Water Framework Directive:**

Passed in 2001, the EU's Water Framework Directive 2000/60/EC (WFD) is a water policy framework for member countries, accompanied by the Groundwater Directive, the Environmental Quality Standards Directive, and the Two Commission Decision which establishes a database of almost 1,500 sites to allow for comparison of ecological status and standards between member countries ("The EU Water Framework Directive - integrated river basin management for Europe" 2016). Intended to drive major legislative reform, the "WFD 2000/60/EC establishes a new institutional framework, providing guidance for a common approach, common objectives and shared principles, definitions and measures for water resources and supply management, within EU member states" (Kanakoudis, Papadopoulou, and Tsitsifli 2015). The WFD applies pressure to the Athens water system, as is discussed in the following sections.

**Infrastructure updates and funding compounded by crisis:**

Aging components and operational issues are driving the need for infrastructure updates around the globe, which could culminate in more expansive transition if technologies or planning approaches are introduced that change the system's fundamental form (Brown, Keath, and Wong 2009; de Haan, Rogers, Frantzeskaki, and Brown 2015; Pahl-Wostl 2007). The same is the case in Athens, which grapples with aging infrastructure as well as transient populations and climatic conditions that can challenge the relevance of the current system's construct (Makropoulos 2017). **Interviewees report primary pressures on the system to include aging infrastructure and operational issues such as leakages and malfunction of critical system components.**

**Water Privatization:**

Privatization has the potential to exert strong pressure on the current system. One water manager explained there are **more than 100 water companies in Greece that are part of municipalities. However, there are two companies on the stock market that represent the lion's share of Greek water, including EYDAP serving Athens and EYAΘ in Thessaloniki.** As part of the overall trend of privatization impacting Greece, both companies are under pressure to increase the percentage available for sale. One respondent lamented: "**There are many examples in last years of public goods being privatized – they say if they fail state will pay but this isn't very efficient –**

**national roads and airports, hydroelectric, in general the whole energy system, telecommunication (this was the first to privatize), and ports."**

The prospect of a more fully privatized water system has been met with forceful resistance from the Greek populace (Nevradakis 2017). Characterized by one respondent as the **"wholesale of Greece"**, private capital, and largely foreign private capital, is buying the country's infrastructure. **Interviewees all voiced varying levels of resistance with reasons including water as a public good that would be difficult to regulate if privatized; concern for monopoly conditions as there are no substitutable goods for water; concern for price increases and service quality and infrastructure maintenance decreases; as well as the fact that Greek people have paid over the years for the system in place, and respondents note that proposals would sell it for a fraction of its worth.**

> **"Infrastructure costs billions and billions – it's not the stock market value of the company. Estimation that in Greece infrastructure is $8 billion and $700 million is the stock market value – so you take a company for peanuts – and usually don't even have to money in the bank" (interviewee).**

One interviewee provided this summary of the situation:

> **"Europgroup oversees the Greece financial situation – it's part of the Troika. The president of Eurogroup, his party was wiped out of Dutch elections, he's pushing to privatize all the water companies in Greece when**

**all the water companies in the Netherlands are public. Need to see from a balanced perspective – would private do better job than public or not? My view is private companies have the immediate problem that they should be interested in balance sheets and shareholders and profits – also need to figure out infrastructure – you need to build rivers essentially to imports (to be profitable). American waterworks associate identified huge gap in infrastructure need and spending (back in 1918). You need to have players in there for a long term. Why would private companies do this? Why would international companies come here and invest billions when they are unsure of stability? … in the UK … there is a very strong regulator … anytime there is a private company doing anything you need to make sure that there is a heavy hand of regulation because water opposed to energy will not work on its own. Water … is a natural monopoly because you can't choose another provider. In Greece there are no funds, so we can't regulate ... this is why I'm opposed (to privatization)."**

As this process is still being contested, it is speculation as to exactly what changes would take place in a more fully privatized system. However, it is almost certain that both management and pricing would undergo change.

## DIRECTION OF CHANGE – OPPORTUNITIES

Interviewees reflected on several key directions of transitions that present opportunities for a more sustainable system in the face of both environmental and socio-economic change:

**Conservation/demand management:**

In line with the rationalization paradigm outlined by Kallis and Coccossis (2003), respondents universally reported demand management and conservation to be the most valuable direction of system transition. **There were no advocates of expanding the system or otherwise increasing imports. Environmental impacts were cited as a reason for this, along with reliability concerns associated with extended systems suffering more breakages, needing more maintenance, and becoming more vulnerable to regional environmental and socio-economic change, as well as intentional or unintentional attacks. As one interviewee stated, conservation is the only option, "or else we have to go further away and bring water from even further parts of Greece – which is an unthinkable option."**

Droughts over the past decades, and especially the severe drought in the late 1990s and early 2000s, compelled change for a time. **One interviewee reported that during that drought, there was policy prohibiting car or yard washing and water use was drastically reduced**. A similar effect was felt a decade earlier during the drought period of 1988-1994 when demand management was facilitated through price increases averaging 240% across all levels, which resulted in a 33% drop in domestic demand from 150 liters per day in 1989 to 100 liters per person per day in 1993 (Koutiva and

Makropoulos 2016, 41). However, as the authors report, awareness campaigns ended with the drought and by 1997, consumption had returned to 150 liters per day. **This cycle was noticed by at least six out of the 12 interviewees who called for sustained information campaigns and public education efforts to be cornerstones of conservation and demand management efforts.**

**Technology:**

Technology was a common topic during interviews, especially smart technologies that serve dual purposes of demand management and leakage alerts. Several interviewees pointed to **decentralized systems** as a future option, complete with rain capture and storage capabilities, that would use technology to link to the larger system for monitoring and regulation. Respondents were also hopeful about the potential for **green appliances** to reduce water demand. **Desalination** was also frequently discussed, although usually in the context of the islands. Given the cost of infrastructure and energy, desal technology is currently cost prohibitive for mainland Greece.

**Wastewater/Recycling:**

Wastewater is one very specific area in which technology can have a large impact, with several **interviewees pointing to potential for introducing recycling technologies into new buildings**. As one respondent stated:

> **"How can waste water reuse be utilized? There is almost 1 million cubic meters/day … this is the next step to develop a master plan for reuse –**

**there are identified agricultural and industrial water needs and also urban green water needs – there are private and municipal wells inside of the city that are completely unregulated. This is not a problem for the city of Athens but for the country as a whole – this is a growing discussion in Europe especially countries in the south."**

**Another interviewee advocated for widespread adoption of sewer mining technologies as a method of recycling wastewater**. Even with more advanced technology (the facility currently does primary and sludge treatment), the island location of Athens' primary treatment plant makes it difficult to bring treated water back from the plant and into the city. However, sewer mining technologies are small, mobile units that reach into sewers to capture and treat water on site that can then be used to water parks, which the respondent named as the main consumption of municipalities. Another interviewee who works for a municipality reported that underground water is used to clean roads, which could be another application of sewer mining technologies. **Seeing this as part of the circular economy trend sweeping Europe, the original respondent noted that Switzerland is creating carbon from their own waste, and surely Athens can generate meet its non-potable demand with reclaimed water**.

**Groundwater:**

Interviewees also named groundwater clean-up and storage as a promising future strategy to increase self-reliance in the Athens water system. **Respondents working in the scientific community were actively working on groundwater recharge efforts,**

**as they cited it as relatively cheap but suffering from public perception issues and in need of a public information campaign**. As one respondent stated, **"it's a strange national resource because it's hidden"**. Polluted aquifers were cited as an issue throughout the country from urban contamination, industry, salt water intrusion, agriculture and sewage, but also referenced as an opportunity to deepen system sustainability in the future.

Related to groundwater, green space and more permeable surfaces were often referenced as a goal of future transition. Many interviewees noted the dearth of parks and other green space in Athens, citing this as an issue connected to public health and pollution, as well as stormwater management and groundwater recharge**. One interviewee told the story of a park near the city center where locals smashed the cement and planted trees and now meet there on a weekly basis to discuss how to manage the community**. Respondents universally advocated for more green space to be constructed in the city, with one interviewee framing this as the need to **"lean toward the hydrologic cycle"**.

## CHALLENGES TO TRANSITION

### Funding:

The economic crisis has constrained system transition in several key ways. First and most directly is the impact on available funding for upgrades. Due to budget deficit and debt, Greece does not have internal revenue available for infrastructure updates. While

Cohesion funds from the EU have financed much of the water sector's development since 1981**, one interviewee who used to be tasked with interpreting and applying WFD mandates explained that these funds are meant as a one-time grant in order to bring water systems across the EU up to similar standards; the funds are not meant for maintenance, upkeep, upgrades, or other forms of reoccurring disbursement.**

A secondary challenge is public perception and support. The economic crisis has resulted in high unemployment rates and drastically reduced lifestyle standards across the country. On top of ongoing economic decline, the refugee crisis is also at the forefront of people's minds. While there are currently **10-12 refugee camps in broader Athens**, reported by an interviewee intimately familiar with the situation, there are many more people of both domestic and international origins "squatting" or existing houseless in the city. And it is difficult for policy-makers and constituents alike to prioritize infrastructure when immediate basic human needs are a challenge to meet. As one interviewee stated: **"It's hard to talk about climate change when people are dying at your borders and there's no food".**

**Institutional:**

Institutional challenges were often referenced as barriers to transition. WFD mandates require member countries to construct River Basin Management Plans for their river basins; economic analyses of water use that identify pressures on water quality which could prevent fulfillment of WFD targets; and pricing policies that support sustainable

water use (Bithas, Kollimenakis, Maroulis, and Stylianidou 2014). **Interviewees voiced frustration with these requirements, as they are seen to focus on quality and river basins rather than quantity and groundwater, and ecosystems rather than people.** These factors drive the perception that EU water policy was designed for (and by) the water-rich countries of the north, rather than those of the Mediterranean south.

**Pricing:**

**As reported by interviewees familiar with the process of implementing WFD mandates, pricing has been a challenge. The WFD requirement for full cost recovery, including environmental costs as well as product and operating costs, was cited as a reason for looming price increases. One respondent estimated that prices would need to be increased by at least 20% in order to come into compliance. Concern was also expressed for drought and other environmental events that could make supplies scarcer, along with impending and much-needed system upgrades that require funding. Another associated challenge is the need to supply people with water under the human right to water framework and anticipated challenges associated with the aforementioned issues, as well as privatization which for many implies price increases.** Scholars and scientists have been working on models to strike this balance in Greece between "total cost recovery, sustainable use of the water resources and; social equity" (Bithas, Kollimenakis, Maroulis, and Stylianidou 2014, 79).

**Groundwater:**

EU standards also impact the ability Greece has to work with groundwater recharge and reuse. Respondents familiar with EU policy and the WFD identified the EU as a primary barrier and therefore a nexus of change, as EU is very cautious about allowing recharge for fear of contaminating aquifers. Policy solutions are needed as the standards around recharge are currently unclear. As one interviewee explained: **"Aquifer recharge and recovery is on the rise in Europe. Perhaps you can use groundwater more efficiently. But there has been a distinct caution about allowing water to be recharged because they (EU) fear they might be polluting groundwater, impacting quality of the water – so cost is high to inject groundwater because it has to be treated to high levels."** This respondent noted **only one successful piece of legislation for reuse, which was authored by Professor Andreas Andreadakis when he was the Special Secretary for Water (2009-2012).**

**Interpreting EU Policy:**

Underlying these specific challenges are general issues with interpreting and applying EU policy. While the EU sets standards, member countries are responsible for interpreting and applying these mandates as policies customized to national and local contexts**. In Greece, the Ministry of Environment and the Agency of Water Resources were reported as responsible for applying legislation to water districts, and as one district representative explained, this can be very difficult with limited funding and manpower, which has become even more sparse during the crisis.**

More fundamentally, **respondents familiar with the history of EU policy in Greece reported a culture of apathy around this process in which EU legislation is often adopted in its raw form without customization.** This kind of blind adoption often has deleterious effects, as the EU intends for legislators in member countries to craft national policy based on its frameworks but specified to national contexts. Greeks are reportedly resentful of these outside mandates and therefore just accept them without interpretation or application, often rendering policy irrelevant and ineffectual. **One respondent explained that this resistance, specifically in applying the WFD comes in part because Greece was not involved in the process of writing the framework and therefore feels resistance rather than ownership.**

Complicating this scenario is the impression that there is not much internal motivation to innovate environmental standards and policy. The EU was reported as being instrumental, even necessary, to Greece's decision-making process, even though it is conversely resented for this role. **One interviewee reflected that Greece needs membership in the EU and especially in NATO, as it used to be bordered by communists and now feels threat once again from Turkey. Adherence to EU policy is a price of membership, however Greece does not share its ecological sensitivity.**

**Culture – Historic identities:**

One of the most interesting findings from these long-form interviews is the tapestry of historic identities that respondents connect to contemporary dynamics within Athens'

water system, which is perhaps summarized in the following characterization by Armakolas and Triantafyllou of the Greek system as including “such factors as the ideology of glorifying ancient Greece and Byzantium, the particularities of Greek national identity building, the role of Christian Orthodox religion and tradition, Greeks’ historical ambivalence towards the West, the low levels of social trust, the lack of institutionalization and the weak and clientelistic character of the modern Greek state.” (Armakolas and Triantafyllou 2017, 613).

Greek “national identity building” in specific is tightly intertwined with the experience of occupation, the trauma of which and persistence in Greek identity is reflected in this passage written by Father George on the website of St. Andrew Greek Orthodox Church in South Bend, Indiana:

> “By the end of the 15th century, Greece was under Turkish Muslim rule. Over the next 400 years, the Greeks were slaves to the Turks, deprived of their human rights, considered as second-class citizens (rayas means beast in Turkish language), worked and live only for their rulers. Harems of Pashas were full of Christian girls while the body guards of Sultan (Jenisaries) were Christian children who were taken by force from their parents and trained to fight and kill their own people.” (Konstantopoulos 2015)

The imprint of occupation in Greek memory and culture was connected to both legislation and willingness to pay: **“Many have the feeling that infrastructure is an obligation of the state – they can pay for running costs but not infrastructure –**

**this goes back a long way to when they were tenants but now they are the owners …. but still, the feeling is that it should be provided by state" (interviewee).**

Yet underneath the identity of the occupied is that of ancient Greece, both the history of empire and its centrality to the society and politics of the contemporary west. Richard Clogg opens his tome on the country by saying:

> "All countries are burdened by their history, but the past weighs particularly heavily on Greece. It is still, regrettably, a common-place to talk of 'modern Greece' and of 'modern Greek' as though 'Greece' and 'Greek' must necessarily refer to the ancient world. The burden of antiquity has been both a boon and a bane." (Clogg 2013, 1)

Clogg notes that this identification with the proud past fueled the Greek nationalist movement that separated the modern Greek state from the Ottoman Empire and that "indeed such attitudes have persisted to the present" (Clogg 2013, 1). However, this proud identity rooted in antiquity is in contrast to the memory of oppression and occupation that characterized the era of Ottoman rule, apparently creating contradictory attitudes and apathy, as evidenced in the handling of national infrastructure. As one respondent explained, **"We think it's our property but we don't have to care about it".**

Both of these historical layers undergird “Greek’s historical ambivalence towards the West” (Armakolas and Triantafyllou 2017, 613), and attitudes toward the EU specifically, which suggest resentment toward the legislative processes and maybe even membership itself. Membership in the EU was attractive in large part for the protection it would provide to a country still reeling from occupation and war. However, there is acute resentment held around EU involvement in national affairs, “a ‘schizophrenic’ situation whereby Greeks demand the protection and support of Western powers, while at the same time they constantly criticize them for their international role and the meddling in other countries’ affairs” (Armakolas and Triantafyllou 2017, 613).

The drive for self-determination therefore collides with the trauma of occupation. Exemplifying this combination of attitudes, one interviewee familiar with the country’s legislative interface with the EU described: **“The Greek political system still follows old system of we do what we want”** - a pithy statement that explains the economic mismanagement and irresponsible fiduciary actions taken by the Greek government, which ultimately resulted in the economic crisis (Kouretas and Vlamis 2010). And the economic crisis is deepening tensions between Greece and the EU. As one interviewee exclaimed: **“the whole country is up for sale – 51% in private hands”.** Resentment is fueled by the awareness that those buying Greek infrastructure are connected to the EU countries pushing the hardest for privatization.

However even before the crisis, there was tension with the EU characterized by ongoing resistance in applying the WFD. While the EU publishes directives expecting states to interpret and transpose them into national law, several interviewees explained that **most Greek secretaries approach the process as a "box ticking exercise" and translate the directives exactly.** One **interviewee explained that Greece is not often involved in drafting policy because it seldom sends representatives to participate in the prolonged EU legislative processes.** This issue is connected with two associated challenges: **1) the unpredictable presence of a high-level, well-informed and well-funded civil service; and 2) short time horizons in the political system.** The interviewee pointed to the UK system as an alternative in which continuity is maintained through voting cycles by permanent secretaries that are essentially deputy ministers. **In this way, when a new government comes in they change 20 people rather than 200; this is in contrast to the current trend in the Greek system of two-year political cycles (interviewee).** The very structure of Greek governance therefore might pose a significant challenge to changing policy that would support transition.

## V. CONCLUSION

The Athens water system is distinctive in its evolution, having been propelled through the path of modernity largely by external forces including armed conflict, regional and international institutions, and foreign capital. This modern complexity entangles with

3,400 years of prior recorded history (Than 2011) to inform rich, and often contradicting, attitudes and identities. The tapestry of these forces constitutes the pressures shaping the contemporary system.

While the antiquity of Athens and its early water system is of historic interest, it does not have much impact on the future direction of transition. The social element of this socio-technical system however might. Interviewees discussed attitudes toward the EU, the Ottoman Empire, and ancient Greek ancient identity that could play a role in future transition. While much research has been done on conservation behaviors in Greece (Kanakoudis, Papadopoulou, and Tsitsifli 2015; Koutiva, Gerakopoulou, Makropoulos, and Vernardakis 2017; Koutiva and Makropoulos 2016; Makropoulos 2017), more research is needed to understand this rich cultural influence on socio-technical transitions.

Changing patterns in the political economy exert pressure on the system. The economic crisis influences potential for system transition in two fundamental ways: 1) there are limited to no funds available in the national budget for system upgrades; 2) pressure from the Troika to privatize the water system as a response to national debt. Population growth and conflict within the region drive migration, which respondents cited as a concern for future pressure on the system. Notably, armed conflict has been linked to global environmental change in Syria, the country of origin for many refugees in the global migrant crisis (Kelley, Mohtadi, Cane, Seager, et al. 2015). Drought and desertification associated with global environmental change are expected to force

transition long-term, as are other natural disasters such as floods. Further research is needed to track these comingled forces and the ways in which the Athens system is able to respond.

Finally, while this research has captured the current state of the system through the perspectives of interviewees engaged in its evolution, further research is needed to understand the system through the experiences of those that are most vulnerable. As noted by respondents, Athens' houseless population has risen dramatically since the economic crisis began, a broad community made up of Greek nationals who have fallen into poverty as well as impoverished migrants fleeing their countries of origin. In order to analyze ways in which the system can transition to meet current and future needs of the most vulnerable, similar qualitative studies should be conducted in these communities. In this way, political ecology of transition analysis can inform and guide the "myriad transformations and metabolisms that support and maintain urban life" (Swyngedouw and Heynen 2003, 899) in support of all city inhabitants.

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**“Cities as Instruments of Human Security: A Case for Public Water”**


## ABSTRACT

The geopolitical landscape is shifting alongside global environmental change, which itself connects the world’s most intractable issues across political borders. In this landscape, cities are actors with the ability to impact billions of individual lives within their regions, as well as global issues through their networked impacts. I ask how cities can garner this power to become instruments of human security. This central question is placed within urban water systems, given their crucial role in both human and urban health. As urban water systems around the world are undergoing fundamental change or transition, I ask: What is driving transition within the urban water system? What is the transition strategy? What opportunities exist to further human security? Just as human security is concerned with humans rather than the state apparatus, it is also concerned at the urban level with the well-being of individual city inhabitants rather than system sustainability. Three specific cities within the Mediterranean climate region are analyzed. Homelessness is found to be a growing concern related to urban water systems. Findings point toward public water, including fountains and taps, as a strategy to increase human.



Key words: Critical human security; water; cities; urban water systems; homelessness; migration; public water

## INTRODUCTION

The role of cities in human civilization has changed over time, along with urban conditions. Cities were once walled fortresses, providing physical protection for their inhabitants from outside forces (Nicholas 1997). Over time however, the greatest threats to residents became those that grow from within the city itself, including poverty and disease. The modernist city that emerged from the Industrial Revolution sought to bring order and rectify urban ills by engineering scarcity and disease out of the system in order to foster "sanitation, cleanliness, rationality and order" (Graham and Marvin 2001, 44).

But the modernist city did not account for the perpetuation of destitution, which is guaranteed by its sister systems of neoliberalism and capitalism – and cities are sites in which this contradiction is made manifest. Referencing Brenner and Theodore, Jessop asserts, "it is in cities and city-regions that the various contradictions and tensions of (neoliberalism) are expressed most saliently in everyday life" (Brenner and Theodore 2002; Jessop 2002). Homelessness is one particularly violent expression. Neoliberalism's laissez faire approach to capital's ever-expanding nature dovetails with fluctuating job and housing markets to ensure the experience of domestic homelessness (Farrugia and Gerrard 2016; Goode and Maskovsky 2001; Wee 2016). The colonial present in the "time of empire" guarantees violent military struggle (Roy 2006) that colludes with environmental instability to drive global migration, which often manifests experiences of homelessness (Akgündüz, Van Den Berg, and Hassink 2015;

Baban, Ilcan, and Rygiel 2017; Jha, Gupta, Chattopadhyay, and Amarayil Sreeraman 2017).

Further contradiction can here be found in the interplay between the modernist city and its promise of order, as its engineering, technology and expertise are practically focused on buildings, failing to account for people living within the city without one. The gravity of this contradiction deepens as rates of homelessness rise globally, with up to 20% of global population houseless or inadequately housed (Chamie 2017; “Global Homelessness Statistics” n.d.). There is domestic homelessness driven by factors such as increased property values, oscillating labor markets, and unsupported mental health vulnerabilities. Migration is another form of homelessness that varies in its temporality but whether migrants are moving between or within states, they are often moving through cities for some period of time without shelter (Akgündüz, Van Den Berg, and Hassink 2015; Jha, Gupta, Chattopadhyay, and Amarayil Sreeraman 2017; Randall 2018; Sengupta 2016, 2017). In the midst of these conditions, which appear to be norms for the near if not the far future, how can we create non-hostile environments to meet the basic needs of short and long-term urban inhabitants?

Urban water systems are sites of particular interest, given their centrality to human and city life. Clean water is one of the greatest promises of the modernist city and among its greatest feats is the centralized system delivering supply directly into individual homes and buildings, which replaced historic systems of standpipes, fountains and wells that urban inhabitants collected and hauled water from (Kaika 2006; Kallis 2010). This

massive transformation resulted in cities around the world reporting 100% access to improved water sources (“Improved water source (% of population with access) | Data” 2015). However, this statistic more accurately reflects supply to buildings rather than access for people.

Focusing on urban water systems, this paper grapples with how cities can be stronger agents of human security, given trends in homelessness. Human security as normative theoretical lens is outlined in the section below. Transition analysis aimed at urban water systems serves as explanatory theory, discussed in the following sections. Both approaches are synchronized within a critical theoretical approach, which seeks to view urban systems from the standpoint of the most vulnerable (Collins 1986; Harding 1992). While nowhere near exhaustive, findings focus on the role that public drinking water plays at the intersections of human security and urban homelessness. Other basic needs include shelter, food, medical care, and legal protections, however drinking water is the most fundamental of all and therefore the focus of this study.

**Critical human security and cities:**

Human security provides a robust normative lens, given its foundation in the principles of human rights and social justice. Its power is amplified through systems analysis, as human security places individuals rather than the state apparatus at the center of concern (Adger et al. 2014; Barnett, Matthew, and O’Brien 2010; Human Security Unit 2009). While human security goals have traditionally been the purview of nation-states and international institutions, the increasing relevance of cities as instruments to meet

this agenda is compelling (Szpak 2015). Largely a function of paralysis and “disarray” in the state and international systems, paralysis is reflected in growing inequality, nationalism and authoritarianism evidencing a crippled post-world war order (Haass 2014).

In the gap left by nation-states and international institutions, cities have two particular forms of agency: individual and networked impacts. First, the sheer amount of the world’s people residing in cities equates to billions of individual lives directly impacted by city policy. And the urban population is growing. Global population is expected to exceed 9 billion by 2050, 70% of which or 6.3 billion are expected to live in cities (United Nations, Department of Economic and Social Affairs, and Population Division 2014). A particularly timely example of how city policy can further human security in individual lives is the prevalence of Sanctuary Cities in the U.S. and Canada, which have refused to cooperate with exploitive and inhumane national immigration policy.

Secondly, cities have great agency in networked impacts, through the human, financial and political power represented in cities. However, there is a multiplier on this power and great capacity for action represented by networks of cities that organize to impact global problems, which nation-states and the international community are increasingly unable to effectively address (Barber 2013; Szpak 2015). A timely example of networked power is the commitment by the Unites States Conference of Mayors to uphold emission reduction targets outlined in the Paris Climate Accord, even though the

U.S. president officially withdrew the nation from the international agreement (Durr 2017).

Cities then have capacity and potential to impact billions of individuals directly and global issues indirectly through networked effects, which leads to the central question guiding this research: How can cities become active instruments of human security?

In order to conduct this analysis, I locate the question in urban water systems. Water is of particular interest as the most crucial resource on which the entire city system relies. “Water is the only universal urban resource that in this sense is a must” (Tvedt, and Oestigaard 2014, 2). The infrastructure systems that move flows of water through cities are critical. These sociotechnical systems are comprised of social structures (including institutions, norms and rules), ecological structures (including climate, geology and rivers), and technological structures (including pipes, dams and pumps), all of which are engaged with actors in processes within a specific context (Ferguson, Brown, and Deletic 2013).

Globally, these complex urban water systems are under strain. Population growth, aging infrastructure and climate change are driving fundamental restructuring, known in the literature as “transitions” (Ferguson, Brown, and Deletic 2013; de Haan, Rogers, Frantzeskaki, and Brown 2015; Pahl-Wostl 2007; Van der Brugge, Rotmans, and Loorbach 2005). Research has placed particular emphasis on sustainable transitions, or restructuring toward forms that are more natural, efficient and resilient (Bos and Brown

2012a; Hellström, Jeppsson, and Kärrman 2000; Marlow, Moglia, Cook, and Beale 2013; Newman 2001). But do these transition strategies place emphasis on human security in addition to system reliability?

This research looks through case studies and asks: What is driving transition within the urban water system? What is the transition strategy? What opportunities exist to further human security? Interviews with primary actors within the water systems inform transition analysis while a critical approach to human security examines each system from the standpoint of its inhabitants who are experiencing homelessness.

## METHODOLOGY

In order to examine human security in urban water systems, three primary cities were selected with semi-arid or Mediterranean climates (McDonald et al. 2014). This research is part of a larger study, the goal of which is to map the evolution of and current transitions within urban water systems in order to predict future conflicts and guide change. In order to predict and plan for future events, it is useful to consider global environmental change at the level of climate regions, given shared impacts and responses across these zones. “The implications of climate-change effects are region-specific in that the existing climate and the characteristics of its communities influence the potential responses to climate change” (Lawrence et al. 2010, 1425). Therefore, we can expect to find shared impacts of GEC in ecosystems across climate regions, even if the region is geographically dispersed. This scale of analysis may be most fitting for

research and scholarship intended to address global challenges, as these issues cross borders and do not adhere to the political boundaries that have divided the world since the end of WWI.

For this study, three cities were identified that share Mediterranean or semi-arid climate types (van Leeuwen and Sjerps 2016; Rohli, Joyner, Reynolds, and Ballinger 2015), as this climate region is particularly vulnerable to global environmental change including rising temperatures, shifting precipitation patterns, urbanization and species loss (Iglesias, Garrote, Flores, and Moneo 2007; Shankman 2017; Underwood, Viers, Klausmeyer, Cox, and Shaw 2009) which can all have severe impacts on water systems. Athens, Greece; Los Angeles, U.S.; and Istanbul, Turkey were selected for this study based on their regional role as primary cities, defined as the largest urban agglomeration in their respective countries (McDonald et al. 2014, 97). These particular cities were also selected based on their cosmopolitan character and location between regions, both geographically and culturally, with Athens situated at the frontier of Eastern and Western Europe, Los Angeles as a minority majority city in the U.S. located near the Mexican border, and Istanbul straddling the European and Asian continents geographically as well as Europe and the Middle East culturally. These factors contribute to a rich political ecology for systems analysis.

Fieldwork was conducted in all three cities with varying levels of complimentary analysis including participant observation, interviews, and text analysis of primary and secondary sources (Bogdan and Biklen 2007). Interviews as well as primary and secondary

sources elucidate strategies for coping with water stress and transition toward more sustainable systems. This study takes a critical approach to human security and views the system from the standpoint of those most vulnerable, in this case people experiencing domestic homelessness and migrants (Collins 1986; Harding 1992).

The level of empirical work varied between cities with the highest level occurring in Los Angeles and the lowest in Istanbul; interviews were not conducted in Istanbul given political upheaval. Primary and secondary sources outline the evolution of each urban water system, as well as elucidate the history and current state of public fountains.

Empirical data is drawn from:

I. 40 interviews conducted in Athens and Los Angeles with decision makers and influencers, as well as members of the houseless community in Los Angeles (2014-2017).
II. Participant observation conducted in each of the three cities (2013-2017).

## SUSTAINBLE SYSTEM TRANSITIONS

Big infrastructure systems supply modern cities with water (Marlow, Moglia, Cook, and Beale 2013). The “modernist” era of “big pipes” in a centralized system emerged with the Industrial Revolution during the 19$^{th}$ century (Newman 2001) and spread with the facilitation of globalized capital (Kaika 2006). Many of these systems are now aging out due to ecological irrelevance as well as system failures (Bos and Brown 2012b;

Ferguson, Brown, and Deletic 2013; Newman 2001), vulnerabilities that can create or deepen water stress and ultimately threaten access, with deep human security implications. Water stress in this paper refers to the ratio of water use/available (McDonald et al. 2014).

Urban water systems have historically responded to water stress by transitioning or changing their fundamental form. Richter et al describe several general stages of transition that sequentially include exploiting local freshwater, building importation systems to bring water in from other basins, and finally to increasing self-reliance through recycling and desalinating local water (Richter et al. 2013). Brown et al describe distinct stages that urban water systems evolve through, beginning with a focus on supply in which centralized systems are built around big infrastructure that often includes importing water (Brown, Keath, and Wong 2008). According to the authors, systems later transition into more sustainable forms sensitive to pollution and the need for conservation. Finally, the source of water itself is reconsidered and local water supply is developed from rainwater, storm water, sewage and sea water.

The growing literature in sustainable transitions illustrates deepening vulnerability in water systems around the globe including aging infrastructure, population growth, and pressures from global environmental change that could alter the volume of water infrastructure has been planned around (Brown, Farrelly, and Loorbach 2013; Grant et al. 2013; Pincetl and Hogue 2015). Transition to more sustainable urban water management is intended to reach three goals, including: “1) a more ‘natural’ water

cycle; (2) enhanced water security through local source diversification and (3) resource efficiency" (Marlow, Moglia, Cook, and Beale 2013, 7152). Scholars have explored less centralized and more experimental institutional forms to meet these goals, calling for adaptive governance as a cornerstone to sustainable transitions (Bos and Brown 2012a; Farrelly and Brown 2011; Pahl-Wostl 2007). Sustainable transitions in urban water systems (as distinct from other urban systems such as energy) in particular are crucial because of direct feedback loops between water and ecosystems:

> "While the operations in many sectoral systems have negative consequences for ecosystems, in urban water, a degraded ecosystem also has negative consequence for the quality and safety of the sectoral services provided. For example, the security and safety of water supply depends directly on adequate rainfall and rivers' ecological health."(de Haan, Rogers, Frantzeskaki, and Brown 2015, 1).

Given the especially tenuous relationship between water, ecosystems and development in arid and semi-arid climates, I examined the transition strategies of the three aformentioned cities in the Mediterranean climate region in order to analyze how human security can be furthered in each system. Each of my chosen cities are primary cities within their regions that grapple with similar vulnerabilities. Both Istanbul and Los Angeles are water stressed, and Athens and Los Angeles rely on water sources outside of their watersheds, which could lead to or increase water stress (McDonald et al. 2014).

## ATHENS

### System overview:

Athens is the southernmost capital in Europe, located on the Attica peninsula which offers entry into the Mediterranean and Aegean seas. It is the driest and most distant part of Greece, with a semi-arid Mediterranean climate. One of the world's oldest continuously inhabited cities ("Ancient Athens: c. 1100 BCE - 529 - Oxford Reference" n.d.), early residents engineered a system of ancient aqueducts to bring water from the wetter north (Christaki, Stournaras, Nastos, and Mamasis 2016; Leigh 1998). Today, it is the capital and largest city in Greece, housing one-third of the nation's population ("The World Factbook — Central Intelligence Agency: Greece" n.d.), totaling 745,514 city inhabitants and 3.8 million metropolitan population ("Athens - New World Encyclopedia" n.d.). Currently, respondents reported enough water to meet urban demand, from imports piped through a series of modern aqueducts with a total length of 485km ("ΕΥΔΑΠ-Water Transfer Aqueducts" n.d.).

### Drivers:

While Athens is not currently experiencing water shortages, interviewees were concerned about how future supplies will be impacted by global environmental change, which includes changes in hydrologic, climate, ocean and forest systems, as well as urbanization (Barnett, Matthew, and O'Brien 2010). These changes are expected to alter the availability of water resources over time, through extreme events such as

drought, desertification and flooding, in addition to prolonged shifts in weather and precipitation patterns. Higher temperatures and fewer rainfall events are evidence of climate change in the region. As one interviewee stated, "**Athens used to get rain during autumn, but summer and winter now meet without the interruption of seasonal storms**." Climatic conditions further challenge the relevance of the current system's construct (Makropoulos 2017) which is strained by aging infrastructure and operational issues, reported by respondents to include leakages and malfunction of critical system components. Athens importation system ranks it among cities with the largest cross-basin transfer globally, exacerbating these vulnerabilities (McDonald et al. 2014).

The European Union is a primary institutional driver in Athens' water system. Since joining in 1981, Greece has been subject to institutional pressures from the European Union ("EUROPA - Greece" 2016) and EU mandates have driven transition within the country's water sector. The 2001 Water Framework Directive in particular, provides objectives, principles and guidance for water resources and supply management. These legislative pressures coupled with funding from EU cohesion grants have been instrumental in the development of the city's wastewater system, as well as its supply. Today, this relationship is both more tenuous and important as economic crisis, ongoing since 2008, strains national and city resources. The crisis has resulted in the privatization of much of the country's infrastructure and there is pressure from EU member states to also privatize the water sector. In the meantime, Athens wastewater infrastructure continues to expand, funded by cohesion funds from the European Union

**Transition strategy:**

Athens has a mixed transition strategy with conservation the focal point in the immediate future; green design including stormwater capture and recycling are considerations for increased self-reliance in the more distant future (Kallis 2010; Koutiva, Gerakopoulou, Makropoulos, and Vernardakis 2017; Koutiva and Makropoulos 2016). Interviewees universally reported demand management as fundamental to both current and future transition strategy. There were no advocates of either system expansion or increasing imports. As one interviewee stated, conservation is the only current option, **"or else we have to go further away and bring water from even further parts of Greece – which is an unthinkable option."** Interviewees expressed interest in extending public information campaigns that were successfully used during previous droughts to increase conservation. Respondents were also hopeful about the role that technology can play in applications as diverse as demand management and leakage alerts, green appliances, and desalination. Wastewater recycling, as well as groundwater cleanup and storage are two additional strategies reported for the more distant future.

## LOS ANGELES

**System overview:**

Los Angeles sits on the southwestern edge of the California coast, between the Pacific Ocean to the west and the Mojave Desert to the east. Its Mediterranean climate is

created in part by the Pacific Ocean to the west and its easterly border of mountains and desert. Although incorporated in 1925 and therefore established for less than a century (“History of Los Angeles” n.d.), the City of Los Angeles has a population of four million; it is the most populous city in California and the second most populous in the U.S (“Los Angeles Population 2018” 2017). Greater Southern California however is among the top 20 largest metropolitan regions in the world with a population of more than 18 million (“Los Angeles Population 2018” 2017). The sprawling urban agglomeration is supported primarily by imported and ground water (Porse, Glickfeld, Mertan, and Pincetl 2016). Water is imported by three aqueducts, the largest stretching more than 400 miles to the north (Pincetl, Porse, and Cheng 2016).

**Drivers:**

Drought is perhaps the most obvious and stringent driver in the Los Angeles system. The worst drought on record, occurring in severe form from 2011-2014, alarmed water managers and residents alike, especially given accompanying high temperatures which exacerbated precipitation deficits (Griffin and Anchukaitis 2014; Pincetl and Hogue 2015). The system was built to rely on water imported from around the state, largely produced by mountain snowpack that melts off during summer months to feed the engineered system of rivers, dams and aqueducts. However, in spring 2015 snowpack was at its lowest levels since record keeping began, following four years of drought and the warmest winter on record (Rice 2015). Los Angeles is considered both one of the most water stressed cities in the world and among cities with the largest cross-basin transfer, which further drives the requisite of transition.

Vulnerabilities in the sociotechnical system are exacerbated by drought. Water management is highly decentralized in the Los Angeles metropolitan area which results in institutional misalignment that can act as both a driver of and a barrier to change, as well as being associated with a lack of transparency and accountability (Pincetl, Porse, and Cheng 2016). Adaptations in water rights and use, especially related to the region's aquifers, are driven by climate change and then require changes in water governance (Porse, Glickfeld, Mertan, and Pincetl 2016). Aging infrastructure occurring across the system of pipes, aqueducts, and technologies further compounds the need for system transition (Poston and Stevens 2015).

**Transition Strategy:**

Since the drought began in 2011, cities and municipalities across Southern California have been seriously exploring self-reliance as a transition strategy while continuing to increase conservation (Hughes, Pincetl, and Boone 2013). Interview respondents reported a range of meanings for the self-reliance agenda, from increasing system reliability to eliminating imported water completely. One interviewee summarized the moderate position that self-reliance **"means you have enough local water and live within your watershed… You are largely independent of the need to rely on import sources of water - water from outside the watershed."**

This understanding is echoed in the Mayor's sustainability plan, which calls for a 50% reduction of water imports by 2025 and for 50% of water to be sourced locally by 2035

(*Sustainable City pLAn* 2015). In addition to improving conservation, self-reliance can be increased by cleaning up groundwater, infiltrating stormwater, and recycling. A range of strategies are being employed to reach these goals, from turf replacement to desalinating groundwater (Haskell 2018).

## ISTANBUL

### System overview:

Istanbul is a geographic and cultural bridge between the Asian and European continents, separated by the Bosporus straight. The city is home to one-fifth of Turkey's population, with more than 14 million people residing in the metropolitan area (Sivri, Cilingirturk, Seker, Imamoglu, and Ucan 2017, 376; "Türkiye İstatistik Kurumu, Nüfus Projeksiyonları, 2013-2075" 2013). Its history is intertwined with that of Athens, as Greek settlers established the proper city of Byzantium around 660 BCE (Bloom and Blair 2009, 1). Since then, the city, renamed Constantinople, was the capital of the Roman Empire before becoming Istanbul, the capital of the Ottoman Empire, and finally Istanbul, the economic, cultural and historic capital of the contemporary Republic of Turkey (Altinbilek 2006). During the Byzantine Era, Emperor Hadrian (117-138) notably built aqueducts in both Istanbul and in Athens (Leigh 1998; Saatci 2013). The urban population of modern Istanbul relies on surface water for more than 97% of its potable supply, moved through at least 15 dams and 17,808 km of pipelines (van Leeuwen and Sjerps 2016).

**Drivers:**

Ranked among the most water-stressed cities in the world (McDonald et al. 2014), Istanbul's supplies are strained primarily by global environmental change and population growth. Throughout history, the city has struggled to meet water demand due to its distance from drinking water sources (Saatci 2013). Aqueducts since at least the time of the Roman Empire have brought water to the city walls, but soaring population growth coupled with waves of drought have driven water scarcity in recent years. Drought is of particular concern in the future as climate change is expected to drive more extreme weather events in the region (van Leeuwen and Sjerps 2016; Sivri, Cilingirturk, Seker, Imamoglu, and Ucan 2017; Underwood, Viers, Klausmeyer, Cox, and Shaw 2009).

Population growth further stresses water resources as demand increases. Although Turkey's urban growth rate peaked in the 1980s, Istanbul's population still increases exponentially each year by about 3.3% and is forecasted to be 20 million by 2030 (Sivri, Cilingirturk, Seker, Imamoglu, and Ucan 2017, 17). In the 21$^{st}$ century, this rate of growth has been approximately twice that of the overall country, attributed largely to in-migration (Altinbilek 2006, 243). However, external migration has also increased exponentially, with more than 2.7 million refugees from the war in Syria alone (Baban, Ilcan, and Rygiel 2017, 41). Reported as among Istanbul's social problems, migration correlates to increased water demand generally while the city has struggled to address illegal settlements in particular, which both use and pollute water sources (van Leeuwen and Sjerps 2016; Sivri, Cilingirturk, Seker, Imamoglu, and Ucan 2017).

**Transition Strategy:**

Istanbul has pursued a mixed transition strategy that includes expanding its importation system, recycling and conservation. The Greater Melen System is being developed to import water from the east and includes tunnels under the Bosporus to transfer water from the Asian to the European side (Altinbilek 2006). This 180km pipeline is anticipated to meet growing water demand until 2040, effectively postponing but not eliminating shortages (van Leeuwen and Sjerps 2016, 12).

Conservation and recycling strategies are also in development, including household water reuse and rainwater capture (Baban et al. 2011). These strategies are familiar to Istanbul, as a city that got central water supply in the 1950s, only to resort back to individual supplies and rainwater capture during a severe drought in the 1990s during which “water could be supplied to residences only one day in a week and as a result, each apartment had their own water reservoir system to cope with water shortages” (Saatci 2013, 7). During this drought period the city also replaced aging pipes and infrastructure to conserve water (Baban et al. 2011; Saatci 2013), which is also an aspect of the city’s future conservation strategy.

## HUMAN SECURITY IN URBAN WATER SYSTEMS

While very different in their approach, each of these three transition strategies is overtly focused on system reliability, placing little direct emphasis on human security, or access

to those living inside of the system. The transitions literature is also concerned with making the sociotechnical system more sustainable including institutions, pipes, structures and technology (Bos and Brown 2012a; Brown, Keath, and Wong 2009; de Haan, Rogers, Frantzeskaki, and Brown 2015; Pahl-Wostl 2007). The focus on sociotechnical components is again mirrored in development data, which suggest 100% access to improved water sources in each of the three cities, defined as:

> *(WHO/UNICEF define) an improved drinking-water source as one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular from contamination with fecal matter. Improved water sources include piped water into dwelling, plot or yard; piped water into neighbor's plot; public tap/standpipe; tube well/borehole; protected dug well; protected spring; and rainwater.* ("Improved water source (% of population with access) | Data" 2015)

Practically however, this data reflects supply to buildings rather than access for people, particularly in modernists cities across the Mediterranean climate region in which boreholes are impractical given the concrete nature of modern cities; rainwater capture is impossible during dry periods; and public wells and taps have become scarce to nonexistent (Kaika 2006; Kallis and Coccossis 2003; Pincetl, Porse, and Cheng 2016).

Yet interviews suggest that improving human security through urban water systems has some legislative precedent in the Human Right to Water. Recognized in 2002 by the

United Nations Committee on Economic, Social and Cultural Rights in its general comment No. 15 (and later by the General Assembly in 2010 as the Human Right to Water and Sanitation (HRWS), the human right to water focuses on universal access for basic needs (WASH) and is recognized in international law through treaties, declarations and standards (Office of the High Commissioner for Human Rights 2002). The human right to water highlights three key aspects of water governance: provision, end goals and responsibility (Mirosa and Harris 2012, 6). I focus here on end goals, while considering the city as the agent of responsibility.

Increasing human security by ensuring the human right to water is a conceptual transition from buildings to people. There are two significant gaps associated with considering water supply to buildings. The first is that improved water access capability does not guarantee water provision to building inhabitants. Pricing and ability to pay become barriers to residents who are experiencing low income or cycles of poverty. The second gap is that not every human has a building. People who are experiencing homelessness are not considered at all in this statistic. These human security considerations are increasing in import as global environmental change generates higher temperatures and increased aridity across the region (Iglesias, Garrote, Flores, and Moneo 2007; Pincetl, Chester, and Eisenman 2016; Shankman 2017; Underwood, Viers, Klausmeyer, Cox, and Shaw 2009), leaving those unable to pay for water at greater risk of dehydration and associated disease (García-Trabanino et al. 2015; Johnson and Sánchez-Lozada 2013).

**Pricing:**

In modernist cities, ensuring that the people in buildings have access to water is largely an issue of pricing, given that centralized systems have ensured building supply. The pricing problem is multidimensional and ubiquitous. Pricing is at the center of debates around both the human right to water and privatization; the nature of water as a public good, aging infrastructure in need of repairs, and ecosystem balance are fundamental considerations (Bakker 2007; Mirosa and Harris 2012). The tension between water as a public good, cost of provision, and efforts at privatization are illustrated in Greece where the economic crisis has driven mass privatization of the country's infrastructure including ports, airports and utilities (Kadritzke 2016; Nevradakis 2017; Portaliou 2016), and there is continued effort to further privatize the water sector (Nevradakis 2017).

Interviewees in both Athens and Los Angeles reflected on these tensions, the central question being how to balance access, infrastructure, and ecological well-being. Water providers in both systems reported expectations from regulators that water be priced to reflect real cost including ecosystem services. However, this is rarely the case in practice and several respondents remarked that this market environmentalism approach could drastically increase the cost of water. In Athens for instance, respondents lamented that adhering to this standard would increase the cost of residential supply by as much as 20%, creating intense burden on the majority of city inhabitants who are financially struggling in the economic crisis. The same is true in Los Angeles where there is vast disparity in both income and the price of water. Because of the decentralized system and numerous water purveyors with different rates, some

households pay $200 per year while comparable households in the same system pay more than $2000 for same quantity (DeShazo and Pierce 2017, 2; Deshazo, Pierce, and McCann 2015).

**Homelessness:**

Ensuring that people without buildings have access to water is of growing concern. Homelessness is on the rise in each of the three cities studied, a spike that is occurring alongside climate change which leads to increases in both temperatures and aridity in the Mediterranean climate region (Guiot and Cramer 2016; Iglesias, Garrote, Flores, and Moneo 2007; Underwood, Viers, Klausmeyer, Cox, and Shaw 2009). Human health impacts of both climate change and homelessness are myriad, however those that intersect specifically with water include but are not limited to water-borne disease, dehydration, heat exhaustion, and renal disease (García-Trabanino et al. 2015; Hill and Stamey 1990; Johnson and Sánchez-Lozada 2013; McMichael 2013; Uddin, Walters, Gaillard, Hridi, et al. 2016). One respondent in Los Angeles who has been experiencing homelessness reported being hospitalized three times during summer 2017 for dehydration.

The drivers of homelessness in each city vary drastically, highlighting its structural nature linked to income inequality and poverty, global environmental change, political turmoil, and armed conflict. In Athens, homelessness is largely driven by the economic crisis (Ellyatt 2016; Zeitchik 2015). Respondents noted that before the crash, it was extremely rare that someone would not have a place to live, as family networks are

strong in Greece. The situation now has grown dire. As one interviewee remarked:

***"Homeless people are new to Athens. We used to have two homeless people in the Athens metropolitan area – now there are so many."***

Los Angeles has the opposite problem in which regional prosperity and high property values are pricing low income residents out of the housing market and into homelessness (Holland 2018; McEvers 2017). Across the state, there are more than 130,000 homeless people (Dillon 2018), or as some members of that community prefer, "roofless" people (Goertzen and Alkofer 2018). "Tent cities" have sprung up around the Southern California region, along highways and side streets alike.

The situation in Istanbul is more closely intertwined with geopolitics and especially the ongoing war in Syria. There are more than 2.7 million Syrian refugees in Turkey (Baban, Ilcan, and Rygiel 2017), and while there are no exact numbers, many refugees reside for some time in Istanbul. While conducting fieldwork in the city (2014-2016), it was common to see families panhandling by busy tourist sites and huddled together asleep in side streets. Migrants from other areas flee political, economic and environmental disasters, including people experiencing homelessness as part of their migration from Georgia, Russia, Iraq, Ghana and Afghanistan, among other countries (Kazanci 2016). As a large metropolis, Istanbul is also a primary destination for internal migration, as evidenced by the frequency of informal settlements categorized as one of the city's social problems (Altinbilek 2006; van Leeuwen and Sjerps 2016). Domestic homelessness is driven by the more common characteristics of natural disaster, a lack

of affordable housing, domestic violence, job loss, drug addiction and mental illness ("Homes and Homelessness" 2015; Kazanci 2016).

What these urban inhabitants experiencing homelessness all have in common is a basic need for water in a cityscape warmed by rising temperatures and increased aridity. And their numbers will most likely increase as the trend in homelessness might be a new norm, driven by growing inequality and migration associated with both global environmental change and political instability (Carrington 2016; McMichael 2013; Randall 2018; Sengupta 2018). Current and future trends in migration and homelessness have implications for both system sustainability and human security, a reality that cities may soon have to consider in resource planning.

Respondents in the Athens system for instance reported adequate water supply for the current population, and zero trending negative endogenous population growth in the shadow of the economic crisis that is pushing family planning to be done on a much longer time horizon, if at all. The system however could be strained by exogenous growth driven by instability and population growth in neighboring countries. As one respondent stated, linking in effect the drivers of population growth in Athens to those of homelessness in Istanbul**:** ***"Refugee communities could radically change demand on cities – not demands that change gradually but a massive change – I don't think we are prepared for this"*****.**

Another Athens respondent reflected:

***"Given growing instability from a political point of view, the entire area of eastern Mediterranean security could be an issue in the near future … Turkey is one issue but the primary modification of this region is the U.S. and I don't think they would allow high conflict between Greece and Turkey. Instability is more generalized – stable states have fallen the last 6 years: Tunisia, Egypt, Libya, Syria . . . there is an arc that has been expanding dangerously toward Greek borders – this makes Greece the second defense system buyer in the NATO alliance – Greece is the second major buyer (of arms) after the U.S. Increasing population growth in northern African and western Asia and low growth rates in European Mediterranean – increased food demand and high energy demand … this is riskier than climate change because of big immigrant waves toward these countries. The risk is not so much invasion or terrorism but increased migration."***

Migration trends are part of global environmental change, including temperature and aridity increase, as well as urbanization related to climate, political and economic change. And as they continue, its critical to think about system sustainability. However, it is also crucial to consider human security for those residing in and migrating through water systems.

**DISCUSSION - PUBLIC WATER**

While completing fieldwork in Athens, Los Angeles, and Istanbul, which included travel to many different parts of each city, it was common to observe people sleeping on streets and in parks, which I associate with people experiencing homelessness. Each city reports corroborating trends (Baban, Ilcan, and Rygiel 2017; Dillon 2018; Kazanci 2016; van Leeuwen and Sjerps 2016; Zeitchik 2015). However, as I moved through these cities, I also noticed a key difference: while it was rare to see public water fountains outside of parks in Athens and Los Angeles, they were a much more common part of Istanbul's urban fabric.

Often ornately decorated, fountains are features of the city's Ottoman history and Islamic roots in which water is not only necessary to the commerce and social interactions of city-life, but also to physical cleanliness related to spiritual purity in the Islamic faith (Dinçkal 2008). In fact, there were more than 1,000 public fountains in Istanbul during the Ottoman Empire, which began in 1453 with a city population estimated around 100,000 (Altinbilek 2006, 241–242). Public fountains remained the primary water source in Istanbul until 1950 when the majority of houses were connected to the central system (Dinçkal 2008).Today, most of Istanbul's public fountains have been closed but some remain, standing as a reminder of public water.

Access to public water becomes more crucial when considering the various ways in which water has been privatized including bottled water for sale; restrooms that are for customers only; and restrooms that charge a fee. Public water could then be the

primary source of water for those experiencing homelessness, which Athens, Istanbul and Los Angeles illustrate as an increasingly common condition associated with global trends of income inequality, political instability, and environmental conditions. And the significance of water access will only grow with higher temperatures and increased aridity associated with global environmental change, which also increases the need for water intake to prevent dehydration and heat exhaustion (García-Trabanino et al. 2015; Johnson and Sánchez-Lozada 2013).

Cities therefore have the ability to strengthen human security by increasing access to public water sources. While fountains such as those in Istanbul stand as an example, public water was not limited to Ottoman or even Islamic culture - it has in fact been a defining characteristic of both village and urban settlements throughout history (Salzman 2005). In their work on drinking fountains, Phurisamban and Gleick echo Pausania, the second century Greek writer in saying, “a place is never rightfully a ‘city’ without water fountains” (Phurisamban and Gleick 2017, 1). One interviewee reflected on the traditional presence of fountains in Greek villages, noting that even today most villages in Greece still have a central fountain or well.

So then what then happened to public fountains in cities? It is important to first distinguish between historic fountains and those born in the industrial era. While large communal fountains from which people filled vessels have been a hallmark of human civilization (Salzman 2005), the single-user drinking water fountain of the late 1800s followed the Industrial Revolution (Dippel 2014; Simone 2011). Preliminary research

suggests that the single-user fountain, which co-evolved with modernist infrastructure, was supplanted by bottled water (Gleick 2010; Pierre-Louis 2015; Wilk 2006), while the historic, multiple-user public fountain was largely usurped by modernist infrastructure itself (Kaika 2006; Kallis 2010; Kallis and Coccossis 2003). Kallis paints a vivid picture of this transition in Athens:

> *"You are in Athens. It is the year 1830. Greece's liberation war has just ended and 12 thousand Athenians have returned home. You are standing on top of the Acropolis watching the city below. Nothing remains but 'piles of scattered ruins … stones and parts of walls'.1 You see people around water fountains waiting to fill their buckets, others pulling water from wells. At the time no one could have predicted the drastic transformations the city was to face. Fast forward. The year is 2004. You are again standing on top of the Acropolis. Everywhere you look now there are multistorey apartments, thousands of them. Four million people now inhabit the city. There are no longer fountains or wells, but 4 reservoirs, far from the city, with a capacity of 1.5 billion cubic meters (cu.m). Water passes through 500 km of canals, 4 treatment plants, 7000 km of underground pipes and flows out to 1.7 million taps."* (Kallis 2010, 796)

There is however a resurgence of the drinking water fountain underway. In an effort to cut down on plastic water bottle use, London's Mayor Sadiq Khan is funding the installation of new fountains across the city (Davis 2017, 2018a). With one spigot for drinking and another that releases a larger stream of water for refilling bottles, these

new fountains are a blend of large communal fountains from which people filled vessels and single user fountains (Davis 2018b). Paris has more than 1,000 public fountains, but it is adding sparkling water fountains in effort to reduce plastic bottle use and improve the urban environment (Beardsley 2017). There are similar efforts underway in U.S. cities, which are also concerned with public health, namely decreasing the consumption of sugary drinks that lead to diabetes and other adverse health impacts (Avery and Smith 2018; Long et al. 2018; Phurisamban and Gleick 2017). Nancy Stoner, the former *Acting Assistant Administrator for the EPA's Office of Water, outlined the benefits and costs of public water:*

> *"Reinvigorating public water fountains provides a variety of benefits. They provide a service to residents and tourists who need a drink of clean water. They provide an alternative to sodas and other high-sugar drinks for children, both in schools and around town. When old, broken-down drinking fountains are restored it preserves historic relics of our cities. Water fountains can also save money… On average, the cost to treat, filter and deliver tap water is 0.2 cents per gallon – roughly 750-2,700 times less expensive than bottled water. In spite of this cost difference, Americans drink around 30 gallons of bottled water per person per year. And with one estimate that 1,500 bottles of water are consumed in the U.S. every second, this is a huge amount going into the recycling and waste stream. Since cities bear the cost of collecting, transporting, recycling and land-filling plastic bottles, reducing this stream could save city resources. Many cities are taking action. Minneapolis, New York City, San Francisco and Washington, D.C. are encouraging residents to drink tap water, in part by*

> *reinvigorating public water fountains. EPA is also working with mayors across the country through the U.S. Conference of Mayors to promote the value of public water fountains."* (Stoner 2012)

In addition to fountains, the World Bank and UNICEF include public taps in the category of "improved water sources" ("Improved water source (% of population with access) | Data" 2015). Cape Town, South Africa, also within the Mediterranean climate region, is an example of a city that still uses public taps to bridge gaps in the centralized water system. Public taps in Cape Town service the urban poor created largely by Apartheid's "social engineering spatial planning and rural-urban migration" (De Swardt, Puoane, Chopra, and du Toit 2005), which casts Cape Town also as an example of internal migration resulting from economic and political conditions that drive displacement and urbanization.

Ranked highest in financial inequality (Barr 2017; "World Development Indicators | DataBank" n.d.), South Africa struggles with post-Apartheid transformation. In one attempt at progressive resource policy, albeit highly contested for both its general existence and specific terms (Mirosa and Harris 2012), the Free Basic Water Policy (2001) mandates that municipalities provide free of charge 6KL of water per person per day. In adherence with the country's policy, Cape Town provided 12% of inhabitants with access to water outside of their dwelling or yard in 2011, in addition to the 87.3% of residents reported to have water access inside of their dwellings or yards (Harris, Rodina, Luker, Darkwah, et al. n.d., 3). As it is now feared that Cape Town will run out of water in 2018, reportedly the first major city to do so (Aleem 2018; Baker 2018; Lee

2018; Welch 2018), further research is needed to understand the role that public taps are playing in the water crisis in order to analyze social and environmental implications of public water.

Further research is also needed in order to better understand adaptation strategies of people experiencing homelessness and moving through cities without extensive access to public water. This is especially important given growing rates of urbanization, migration and homelessness. Migration as an adaptation strategy to climate change and water scarcity in particular is on the rise (Gioli, Khan, Bisht, and Scheffran 2014; Jha, Gupta, Chattopadhyay, and Amarayil Sreeraman 2017; Miletto, Caretta, Burchi, and Zanlucchi 2017; Randall 2018). While the results of this study highlight growing homelessness in Athens, Istanbul and Los Angeles, further research is needed to predict the extent to which these trends will continue. Studies suggest that cities within the Mediterranean climate region are experiencing especially intensive urbanization, which is driven by both internal and external migration (Iglesias, Garrote, Flores, and Moneo 2007; Underwood, Viers, Klausmeyer, Cox, and Shaw 2009). More research is needed to understand how cities can plan for this growth, especially in the water sector.

## CONCLUSION

Urban water systems around the world are undergoing transition, reflected in a growing literature that seeks to illustrate, theorize, and guide change. Transition however should consider human security specifically in addition to system sustainability. In regard to

water, this analytical shift from buildings to people is critical during the era of global environmental change in which increased temperatures and changes in precipitation patterns both drive migration and make access to water increasingly crucial to human health. Urbanization is another aspect of global environmental change, fueled by both exogenous and endogenous growth. These factors, exacerbated by income inequality and political turmoil, generate populations of people who for some period of time experience being houseless.

With up to 20% of the global population houseless or inadequately housed (Chamie 2017; “Global Homelessness Statistics” n.d.), water delivery planned around buildings becomes particularly problematic. Clint Borge of the The Borgen Project advocacy group reports that in the Middle East alone, up to 45 million people lack access to drinkable water, with the most vulnerable those without permanent housing, including a high percentage of refugees (Ponti 2017). Increased temperatures and aridity compound to turn the problem hostile as lack of access can lead to serious health consequences including dehydration and heat exhaustion that can themselves result in death (García-Trabanino et al. 2015; Mackenbach 2007; McMichael 2013).

But cities can transition into less hostile forms. Public water is an extension of basic care that used to be a feature of village and urban life. Today, a resurgence of public water can serve multiple functions: In addition to improving urban life and decreasing plastic bottle use, more public water sources would increase human security by

supporting everyone moving through the city, including those without permanent housing.

Access to drinking water is of course only one step in making cities more habitable and less hostile. A critical human security lens opens up new questions about how the modernist city can transition to support human well-being by providing for basic needs including water, shelter, food, medical care, and legal protections. Each of these factors is important in supporting inhabitants, especially those that are migrating away from political violence or active warfare, and for all those experiencing the economic violence of being homeless. And while all basic needs are critical, water is perhaps the most fundamental and easily provided for. Public fountains are a first step in creating post trauma cities in which people can escape hostility and heal.

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