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Stakeholder Perceptions of a Small-scale Wastewater Treatment Facility in DeKalb County, GA

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STAKEHOLDER PERCEPTIONS OF A SMALL-SCALE WASTEWATER TREATMENT FACILITY IN DEKALB COUNTY, GA

by

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ABSTRACT

In DeKalb County, metro Atlanta, GA, frequent and high-volume sewer spills, aging wastewater infrastructure, and increasingly high-density development have left the county with limited solutions to waste management challenges. As a result, a federal judge issued a consent decree to DeKalb County to mitigate these sewage spills, which mandated $700 million in sewer improvements to redress 836 raw sewage spills between 2006 and 2010. Although DeKalb County is rehabilitating its wastewater pipelines, innovative and sustainable solutions are needed. This research investigates key ideas in urban political ecology and hydrosocial geography. Through a case study of Emory University's WaterHub, a small-scale wastewater facility in DeKalb County, this thesis examines socio-natural sewage characteristics and the problems they pose for institutions and cities. Results address connections between primary stakeholders' motivations, integrative water management, stakeholder perceptions, and significance of this case study to the larger DeKalb County area.

INDEX WORDS: Water governance, Sewer spills, WaterHub, DeKalb County, Small-scale wastewater treatment facilities

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DEDICATION

I would like to take this opportunity to dedicate the completion of my thesis to my parents and friends. Without their support, I could not have completed this thesis. Finally, I want to thank God for the strength, determination, and vision to continue to work on this thesis even when the journey to completion seemed bleak.

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1 INTRODUCTION

The ability of societies to supply fresh water and treat wastewater has had a profound impact on urban ecosystems. In DeKalb County in metro Atlanta, GA, frequent and high-volume sewer spills coupled with the county's aging wastewater collection infrastructure and increasingly high-density development have left the county with limited solutions. Human-environment geographers have shown the capability of water to shape social, economic, and political aspects of communities. Urban political ecologists, in particular, have addressed different stakeholder perspectives on stormwater challenges (Cousins, 2017b), and studied the processes by which social norms of appropriate treatment of water, technological advances, as well as economic, political, and environmental factors influence urban water metabolism. Their research has primarily focused on conflicts over water supply (Borden, 2014), disparities in access to clean water (Truelove, 2011; Dos Santos et al., 2017), inadequate infrastructure related to social power (Swyngedouw, 2009; Gandy, 2010), and the manipulation of stormwater runoff to mitigate problems such as urban flooding and its consequences to public health (Cousins, 2017a; Cousins and Newell, 2015). However, less urban political ecological research exists on human-environment relations with wastewater, especially in the United States. This research addresses our limited understanding of stakeholder perceptions of small-scale wastewater treatment facilities and urban governance of wastewater in general.

The purpose of this research is to explore stakeholder perceptions regarding decision-making about small-scale wastewater treatment facilities intended to diminish burdens on large-scale, centralized wastewater systems in urban settings. A case study focused on Emory University's WaterHub in DeKalb County, this thesis examines socio-natural characteristics of sewage and the problems it poses for institutions, cities, and environments. The WaterHub is an

onsite, small-scale wastewater facility designed to reclaim water for campus use. WaterHub stakeholders who have been engaged through this research include Emory staff members, facility operators, water management professionals, as well as water conservationist and environmental advocates in DeKalb County. In assessing environmental problems, Meehan and Rice (2011) emphasize the value of gathering knowledge through stakeholder engagement. Building on a broadly urban political ecology (UPE) approach with a hydrosocial orientation, this research project queries stakeholder knowledge about wastewater management processes to produce a better understanding of urban governance of wastewater processes (e.g., the hydrosocial cycle) and how they shape decision-making about wastewater treatment facilities (WWTFs).

Examining key stakeholder perceptions of Emory University's WaterHub and its wastewater treatment capabilities, this research aligns with urban political ecologists' analyses of the hydrosocial cycle or the process of how "water and society make and remake each other over space and time" (Linton and Budds, 2014). Whereas other approaches to wastewater management often focus on technical and engineering approaches to solutions (Al-Sàed, 2007; Muga and Mihelcic, 2008), this research insists on the need to understand stakeholders' views, values, and perspectives as essential to addressing wastewater problems. This research emphasizes a directive to seek out a multiplicity of stakeholders included in the planning process (particularly in small-scale wastewater research) (Guest et al., 2009). In line with research on the hydrosocial cycle, the qualitative study conducted for this research aimed to understand relevant stakeholders' views on the value of small-scale WWTFs, stakeholder roles in the development of the WaterHub, and if stakeholders believe that small-scale WWTFs can address wastewater governance challenges in the larger DeKalb County area.

1.1 Research Questions

In order to investigate the governance of wastewater using the concept of the hydrosocial cycle, this project employs a qualitative research methodology to answer the research question: What were the successes and challenges in the planning process of the WaterHub? This overarching research question guided my interviews with a range of stakeholders to better understand the nature of the planning process. Through qualitative analysis involving semi-structured interviews with the relevant stakeholders of Emory's WaterHub in DeKalb County, this research provides insight into stakeholders' underlying perspectives on human-environment interactions and how these perspectives shape their approach toward crafting more sustainable wastewater infrastructure.

This research question also allows for an analysis of key ideas in hydrosocial geography. Solutions to water challenges are not merely technical; they require understanding of social and power relations among stakeholders who manage water infrastructure. The management of water infrastructure in this research is embedded within hydrosocial literature. Understanding the decisions taken by stakeholders who work in water governance cannot be isolated to only specific types of stakeholders. Therefore, cultivating various stakeholders during the decision-making process facilitates the ability to gather multiple perspectives and solutions to tackle water infrastructure issues. Research under hydrosocial geography acknowledges a need to bridge the gap between natural and social in water governance. Often, the hydrological cycle is depicted as an isolated process apart from social and political processes. Such a rendition of the resource governance landscape further perpetuates the stigmatization that natural processes are separate from social constructions, which further delays the conversation to find targeted solutions with socio-environmental change in water management. The aim of this research is to examine a

potential fix to water infrastructure problems in DeKalb County, focusing on a tailor-made and innovative wastewater technology organized by diverse stakeholders to address water resource use at a university institution. By interviewing stakeholders and examining policy and planning documents to answer the research question, this project demonstrates how proponents of the WaterHub focus on a specific subset of environmental and societal goals to create their vision of resilient and sustainable water management solutions.

1.2 Background

The WaterHub, a small-scale wastewater facility located in DeKalb County of metro Atlanta, GA, provides a site for this research aimed at understanding stakeholders' perceptions of WWTFs. In DeKalb County and other metro Atlanta areas, most wastewater treatment systems are centralized. DeKalb's extensive centralized wastewater system and facilities treat 78 million gallons of waste per day. In recent decades, the county has experienced a high number of sewage spills, which are costly to clean-up and have led to regulatory action by state and federal agencies (EPA, 2010). These sewage spills, according to county officials, result from an aging wastewater collection transmission system (WCTS) (Estep, 2020). To mitigate these sewage spills, county officials plan for rehabilitation of sewer pipes to increase capacity of pipelines and relieve stress on the wastewater collection transmission system (DWM, 2015:6-14). Despite planning efforts, the sewage spills have not stopped.

As a result of this inadequate wastewater infrastructure, DeKalb County is under a Consent Decree issued by a federal judge, signed on December 13, 2010, directing the county to mitigate its sewage spills incidents. The purpose of a Consent Decree is to resolve and reform a dispute between two or more parties—in this case, the Environmental Protection Agency (EPA), Georgia's Environmental Protection Division (EPD) of the Department of Natural Resources, and DeKalb

County. The Consent Decree states that DeKalb County is in violation of the Clean Water Act (CWA) and the Georgia Water Quality Control Act (GWQCA). DeKalb County is "to perform injunctive measures as described in the Consent Decree, to pay a civil penalty of $226,500 to the United States and $226,500 to the State of Georgia, and to perform a Supplemental Environmental Project valued at $600,000" (Katz, 2010). The Complaint, exhibited in the Consent Decree, filed by The United States of America on behalf of the United States EPA in conjunction with Georgia's EPD, mandated $700 million in sewer improvements to redress 836 raw sewage spills between 2006 and 2010 (DOJ 2010).

The origin of the dispute between the EPA and DeKalb County was the excessive amount of sewage spills. The EPA authorizes Georgia's EPD under the CWA to administer the National Pollutant Discharge Elimination System (NPDES). DeKalb County's NPDES permit enables it to discharge its pollutant to the United States and Georgia waterways through Snapfinger Creek and Pole Bridge Creek WWTFs. In 2006, there were 256 reported spills (highest reported discharges from 2006 to 2009) from DeKalb County's Wastewater Collection Transmission System (WCTS) (DWM Consent Decree, 2017). While the spills were caused primarily by a buildup of fats, oil, and grease (FOG), the deteriorating state of the county's WCTS infrastructure also contributed. FOG seems harmless when disposed of down household drains, but as it cools, it separates, creates build-ups, and clogs wastewater sewer pipes, causing spills. These spills create additional costs from cleaning, maintenance, and replacement; unfortunately, citizens pay these additional costs by way of increased wastewater bills (South River Watershed Alliance, 2017). Altogether, the age breakdown of the WCTS infrastructure is that 16 percent of the infrastructure is over 50 years old, 48 percent between 25 to 50 years old, and the remaining 36 percent below 25 years old (DWM Consent Decree, 2017). The recommendation from the Consent Decree reads as follows:

> The express purpose of the Parties entering into this Consent Decree is for the County to use its best efforts to prepare and implement all plans, measures, reports, and construction, maintenance, and operational activities called for under this Consent Decree to achieve the goals of: (1) full compliance with the CWA, the GWQCA, and the regulations promulgated thereunder, and (2) the elimination of all SSOs. (DeKalb County Watershed Management Consent Decree, 2017)

According to the objectives set by the Consent Decree, DeKalb County needs to meet the standards set by the CWA and GWQCA and eliminate all Sanitary Sewage Overflows (SSOs). Due to the Consent Decree, DeKalb County created and implemented a FOG management program to control FOG-related spillage amongst other programs and assessments. The County reported a 58 percent decrease in FOG-related spills from 2006 to 2009. In March 2007, DeKalb County adopted a FOG ordinance, a regulatory uniform standard for DeKalb County to treat and disseminate FOG from sewage pipelines and public waterways. In practice, the implementation of the FOG ordinance did not decrease the number of sewage spills resulting from FOG build-ups. This 2007 FOG ordinance draft lacked "enforcement incentive," which was emphasized by an environmental leader interviewed in this research. According to this leader, DeKalb County is currently in violation of the 2011 Consent Decree—behind on developing a hydraulic model, which was required within six years of the 2011 Consent Decree. DeKalb County set a goal in 2011 to completely resolve the issues existing in its WCTS but needed two to four more years' assessment and rehabilitation of priority areas. However, the two to four more years have passed, and direct action to resolve FOG-related spills seems to be minimal or nonexistent. FOG-related spills have continued to increase over the past nine years. In August 2017 alone, 3.9 million gallons of untreated sewage poured into Nancy Creek in Brookhaven, and two weeks later, another 6.4 million gallons leaked into Snapfinger Creek near Stonecrest (Niesse, 2017). Additionally, the AJC reported on February 24, 2020 that 9.2 million gallons of waste spilled into Meadow Creek

path (Estep, 2020). Although this quantity of sewage spill is reported to be the highest amount in more than a decade, DeKalb County has already experienced 90 sewage spills estimated at 2.9 million gallons this year. Before the end of February in 2020, DeKalb County reported approximately 12.1 million gallons in sewage spills (Estep, 2020). The 2011 Decree will expire approximately in two months on June 20th, 2020, but the enforcement action is likely to be extended as the County has acknowledged that they are behind on the infrastructure improvements required to stop the sewage spills. Reported late last year in an AJC article, Michael Thurgood, DeKalb County's CEO addressed that the County has completed 52 percent of construction on its infrastructure projects but there is a possibility that the 2020 deadline will need to be extended five more years (Mitchell, 2019).

While FOG continues to be a major problem, DeKalb County officials now attest the cause of these more recent sewage spills to excessive stormwater entering into the sewer system. According to the AJC article, this process, known as stormwater intrusion, occurs when rainwater infiltrates the sewer system through broken or damaged pipes, intrusive tree roots and other aging infrastructure. These sewer spills are occurring as the County is under a federal Consent Decree mandated to fix its aging wastewater infrastructure, which the County has invested $300 million towards (Estep, 2020).

This brief historical background into DeKalb County's Consent Decree highlights the high priority of concern about wastewater in DeKalb County. Moreover, the metropolitan Atlanta area, particularly DeKalb County, does not only experience issues with violations of sanitary regulations but also with conflicts over surface water withdrawal. The states of Georgia, Florida, and Alabama have been involved in an inter-basin water conflict over surface water withdraws from the Apalachicola-Chattahoochee-Flint (ACF) River Basin and the Alabama-Coosa-Tallapoosa River

Basin for nearly 30 years (Lancaster and Atwood, 2017). Much of this conflict centers on water withdrawals from Lake Lanier, which is managed by the U.S. Army Corps of Engineers. Florida and Alabama have disputed the use of this impoundment as a water supply for municipalities in metro Atlanta. While not subject to specific lawsuits, inter-basin transfers of water out of the ACF exacerbate pressure on the contested water resources of this river basin. An inter-basin transfer occurs when surface water is withdrawn from one basin, used, and transferred into a different basin. The Atlanta metropolitan area relies on the Chattahoochee River Basin for approximately 99 percent of its water supply (Water Supply and Water Conservation Management Plan, 2009). In 2008, DeKalb County recorded an inter-basin net annual average transfer of 37.2 million gallons per day (Mgal/d) withdrawn from the Chattahoochee to the Ocmulgee River, which drains into the South River (EPD Interbasin Transfers Briefing Document, 2010). As well, the Chattahoochee River Basin experienced the highest water loss at 69.1 Mgal/d while the Ocmulgee gained 61.9 Mgal/d in 2008 (EPD Interbasin Transfers Briefing Document, 2010). DeKalb County had the highest amount of inter-basin transfer in 2008 more than any other county listed in Georgia (EPD Interbasin Transfers Briefing Document, 2010). This data is not surprising as the Georgia Department of Natural Resources, Environmental Protection Division permits the county to withdraw up to 140 million gallons per day (DWM, 2018). As facilitated by this permit, DeKalb County's public supply is one hundred percent reliant on surface water from the Chattahoochee River (Lawrence, 2016). In 2010, an estimated 74.95 Mgal/d of surface water was withdrawn from Fulton County to DeKalb County with approximately 13.7 percent accounted as system losses (Lawrence, 2016). Furthermore, there are no available reports on current annual water withdrawal or inter-basin transfers for DeKalb County to compare. These water supply concerns add stress to DeKalb County's ability to properly manage its wastewater issues. The County is currently dealing

with millions of dollars in fines for these sewer spills and interstate legal disputes with neighboring states.

The metropolitan Atlanta region, which includes DeKalb County is entangled in an inter-basin transfer dispute with Alabama and Florida over surface water withdraws. Meaning that DeKalb County's inter-basin transfer violations along with the County's struggle to fix its WCTS infrastructure is putting a strain on the County's financial resources. As the County attempts to address its sewer spills and WCTS infrastructure, the County continues to pay millions of dollars in fines on an increasingly limited deadline year after year. Perhaps it is time for DeKalb County to invest and seek other methods to manage its surface and wastewater infrastructure issues. The WaterHub is a small-scale, onsite, infrastructure designed for wastewater reuse. The WaterHub is a successful exemplar of how to mitigate wastewater collection at a high-volume site.

2 LITERATURE REVIEW

2.1 Water Histories: Examples from the Hydrosocial Cycle

Globally, humans have an important impact on the water cycle, and can drive and shift the exchange of water circulation within the human system, thereby impacting the natural system. The emergence of academic literature on political economy and ecology of water has impacted the changing perception of water to incorporate humans in the center of water systems classified as the Hydrosocial Cycle (Swyngedouw, 2009; Linton and Budds, 2014). The Hydrosocial Cycle is a "socio-natural process by which water and society make and remake each other over space and time" (Linton and Budds, 2014: 175). A hydrosocial cycle framework holds that humans are embedded within the water cycle and acknowledges that humans can act as a catalyst or a hindrance to the hydrological cycle. The concept of natural processes and society are often examined separately but hydrosocial research examines the water cycle as an inclusive physical

and social process (Swyngedouw, 2009). Swyngedouw's analysis of the hydrosocial cycle encompasses a critical lens, while Linton and Budds's analysis focuses on an applied approach to hydro-social research.

An example of water as a political tool is provided in an analysis of water and identity in the Chilean Andes by Boelens (2014). According to this analysis, Andean societies have a long and rich history with water as it drives political power that links time, space and place. Because water connects people across space and over time, it "…driv[es]…local common property institutions, and fuses people, place and production in socio-cultural systems and shared techno-ecological histories" (Boelens 2014: 234). Boelens (2014) analyzes water control practices in Mollepata, Peru. Next, Boelens (2014) rationalizes patterns of politics that have created present water flow system that links to Andean worldview while identifying and examining the juxtaposition of social and natural structures within the hydrosocial cycle that have created hierarchies in water control and water patterns. This study of power, identity, and water in Peru, points to how a hydrosocial approach to water resource governance in a wide variety of contexts requires attention to specific power relations among key stakeholders.

Often, decision-making for water governance is addressed strictly from an economic perspective. McDonnell (2014) addresses the inadequacy of approaching water-related practices solely from an economic perspective. This research discusses an absence of socio-cultural and ecological factors included in water management decisions in the Arabian Gulf, a region that supports 40 percent of the world's transportation routes for oil. McDonnell (2014) first unpacks the current waterscape of Abu Dhabi as a region that has transformed its arid landscape through contemporary water production separated from the traditional water management practice in the Arabian Gulf region. Due to Abu Dhabi's oil producing power, this region has become a center

for modern innovation in water technology, (e.g., extraction of groundwater, desalination of seawater, recycling of wastewater) leading to rapid economic development. According to McDonnell (2014), there is a relationship between energy production and water production as high energy consumption is linked to sustenance of water production, water cycling, and water circulation. Although there have been advances in contemporary water technology in this area, the region continues to rely heavily on groundwater that amounts to 64 percent of its water resources. Heavy reliance on groundwater has increased other efforts to access water resources such as desalination and recycled wastewater for potable water use and landscape irrigation.

Furthermore, Abu Dhabi's modern waterscape or hydrosocial cycle is not isolated from outside economic and social influences. Abu Dhabi's economic system is influenced by outside states, which enables high-energy production linked to high-water production in order to formulate its state's power (McDonnell (2014). This analysis of Abu Dhabi shows that control over water resources creates power, and not only in the sense of energy production, but also in the sense of political power.

Water resources are pertinent to economic and political power. Conversely, Boelens (2014) shows that modern views of water management are shaped and driven by historical foundations established in each society; therefore, these historical water traditions and patterns are difficult to transform in contemporary water and wastewater management practices. This article addresses Peru's traditional water practices and identifies which practices have currently structured contemporary water governance. Understanding these practices contribute to the knowledge base that has formed Peru's hydrosocial identity, and lessons from this review can be applied to other regions or cities. The hydrosocial perspective does not negate traditional practices but more so focuses on how key stakeholders can understand traditional drivers of water patterns yet

collaborate to adapt and build water infrastructure that is resilient to changing climate patterns as well as able to meet societal demand.

The role of humans as it relates to water resources is further defined as the hydrosocial cycle (Swyngedouw, 2009; Linton and Budds, 2014). Both scholars acknowledge the role of stakeholders. These very disparate examples of research that have employed the concept of the hydrosocial indicate that water governance, such as the struggle to adequately address wastewater in DeKalb County, is intimately and intricately connected to other aspects of society including economic and social inequalities. As the scholarship reviewed in this section indicates, water stakeholders play essential roles in managing water resources, and this management can have a drastic impact not only on the quantity and quality of water resources but also social equity, uneven power relations, and differential access to resources across social groups.

2.2 Political Ecology Analysis of Stakeholder Engagement

Political ecology research highlights water distribution and power in society as a socio-politically driven force. This socio-politically driven force is navigated by stakeholders with decision-making power and power to control resources (e.g., water and wastewater resources). Political ecologists discuss the engagement of stakeholders in work towards sustainable societal transformations (Görg et al., 2017).

The push to include a variety of stakeholders early in the planning process in wastewater management is not a new idea, but more focused research in this area has developed in political ecology. Political ecology is “an approach to, but far from a coherent theory of, the complex metabolism between nature and society” (Budds, 2004). In regard to the urban landscape, political ecologists study various societal processes that occur in the urban built environment. There are debates as to whether political ecologists have embraced more of the “political” than the ecology

portions of the dual title (Budds, 2009). However, political ecology remains a dominant field in the study of human-environment interactions within contemporary geography (Walker, 2005). Scholars agree that a politically-centric view of political ecology dismisses the value of environmental processes while reinforcing power struggles over environmental resources. Critically, the politically-centered research of political ecology embraced a gap within the research field as more researchers became dominantly reliant on the environmental science field to explain environmental processes. However, environmental science research is not immune to politics. It is not purely a "technical and neutral assessments of environmental processes" (Budds, 2009). Forsyth (2003) reinforces Budd's argument by initiating that environmental science as the dominant and leading work influences the way the natural environment is addressed and proposes that political ecology debates have not questioned the "socio-political factors" or the explanations that politically drive the course of environmental science research. Moreover, focusing primarily on environmental change without assessing the socioeconomic drivers in environmental science leads to the conclusion that nature is more "complex than often represented within the environmental science field" (Budds, 2009). Furthermore, conceptualizing nature as complex, isolative, as it appears without human interference, positions the conversation towards how nature should be rather than how it really is. This view of nature further reinforces the idea that humans are separate from nature. As if, nature and society are two variables independent of one another.

Integrated research has grown in popularity in political ecology literature for some time now. Görg et al., (2017) stress that strategies to achieve sustainable societal transformations would be better addressed from an integration of social-ecological transformations (SET) rather than a political approach alone. Ultimately, there are two concepts driving the thought process behind Socioecological Transformations: 1. "socioecological transformations are coming although the

form and shape of what is to come is not easily predicted; and 2. socioecological changes are also necessary if we are to avoid the catastrophic futures that appear to be coming towards us" (Braun, 2015). These two concepts define the reality that the world as we know it (society and environment) is changing and evolving. Although society is progressively calculating and anticipating this change, much of what is to come, is unknown and will not be precisely predictable. Using political strategies to address societal transformations is insufficient and reinforces un-sustainable practices (Görg et al., 2017). Solely targeting societal issues through political approaches isolate transformation from societal issues such as, "climate change, biodiversity loss, resource depletion, food security and social inequality" (Görg et al., 2017). Swyngedouw et al. (2002) support Görg et al.'s (2017) political ecology perspective that urban socio-political issues need to be tackled from a multidisciplinary approach and argue that creating sustainable environments will require all aspects of social and management systems.

Furthermore, Swyngedouw et al. (2002) elaborate that sustainability planning should be comprehensive, which includes all "social actors" at all geographical scales meaning, political, economical, social, ecological, urban planning and governance systems. However, a holistic approach to sustainable management practices, which focuses on balancing the economical, societal, and ecological factors, is not the initial considerations on a practical contemporary scale. Urban political ecologists critically examine SET; however, literature on "just and sustainable alternatives to existing political, economic, and ecological practices" is lacking (Braun, 2015:239). Görg et al., (2017) illuminate the importance of integrated research but also indicate that a SET approach would be applied to a broad community perspective and require multiple players connected at the root to transform societal issues. On the other hand, socioecological change in the present that prepares us for the future is necessary—even more so when dealing with natural

disasters (e.g., flooding) and man-made urban phenomena (e.g., water/wastewater infrastructure issues) (Braun, 2015). Ultimately the planet has ecological and social limitations. The interconnectedness today is greater than it was one decade ago, and scientific knowledge has propelled society into the Anthropocene era, meaning human activity is driving most of the change that we are experiencing ecologically and socially. Therefore, collaborative social, political, and economical action reduces risk and increases sustainable practices for present and future socioecological change.

Political ecology is the niche of study in which political power is examined as it relates to natural resources. The most recent contribution to the field encourages environmental decision-making to include varying stakeholders during the planning stage (Guest et al., 2009). Often, the politics in political ecology are directed by stakeholders from a specific group and holding similar ideologies and experiences. A political approach alone has become ineffective to comprehensively address societal issues. Görg et al. (2017) discusses the concept of social-ecological transformations (SET) within social ecology and political ecology to encourage varying perspectives and stakeholders involved in water management. The aim is to allow for more sustainable practices to emerge in water governance. The result of this approach would produce more transformations towards sustainable practices applied to water-related issues. In addition, a SET approach seeks to understand the socio-political occurrences that hinder transformation towards sustainable practices.

3 DATA AND METHODS

This research utilizes a qualitative methodology, which involves a case study using semi-structured interviews along with complementary analysis of policy, legal, and technical documents. A qualitative approach is better suited for this research as it produces a wealth of

knowledge collected from a small selection of people, which illuminates variances and gaps (Patton, 2002). An advantage of qualitative data is that it can produce specific results and an abundance of findings in a short period of time. To guide the discussion to potentially reduce the number of gaps and variances in the data collection, the researcher is able to navigate the conversation to fill any holes within the time frame and also collect detailed interviews. For example, in situations when one stakeholder will not be able to complete the storyline, when a different stakeholder is interviewed, this interviewee can potentially fill in the blank. This specific research requires an intimate exploration of the case study site and communication with a small selection of stakeholders. The data collected from interviews provides very detailed information from a small number of stakeholders involved in the research. By using a qualitative data collection approach, this research aims to purposefully collect information from participants and analyze this information in a context that allows for a better understanding of socio-cultural debates and paradigms shaping water and wastewater governance decision-making. The unique case study that is Emory's WaterHub provides an alternative research approach (stakeholder perspective) to small-scale wastewater facilities research that is conventionally driven by technical, design, and financial analysis (Al-Sàed and Mubarak, 2006; Baki et al., 2018).

3.1 Case Study: Emory University WaterHub

The Emory University WaterHub is located on the campus of Emory University in DeKalb County, Georgia. Figure 1 shows the inside of the WaterHub.

Figure 1. Emory University's WaterHub ecological unit. (Sustainable Water, 2018)

The WaterHub is "an on-site water recycling system" (Emory University, 2017) developed by Sustainable Water, a company that provides "commercial-scale water reclamation and reuse solutions across the United States" (Sustainable Water, 2018). Sustainable Water bases its works on "ecologically-driven solutions" that "provide turn-key project development services at no capital cost to [their] clients" (Sustainable Water, 2018). Upon driving on Peavine Creek Road towards the parking lot of the WaterHub, there is a noticeably grassy/ shrubby region on the left. This is the lower level hydroponics unit. To the untrained eye, the lower unit appears to be a region of overgrown grass and shrubs. Looking to the right, the parking lot is located between the lower unit and a see-through glass building on the far right, on top of a hill. This glass building labeled "EMORY WATERHUB" in white capital letters is the upper hydroponics unit. The inside of the upper unit is displayed in Figure 1 above.

The grand opening of the WaterHub was celebrated in April 2015, following construction made possible through a contractual Water Processing Agreement (WPA) between Emory and

Sustainable Water. According to Sustainable Water and proponents of the project at Emory University, the WaterHub is designed to replicate ecological systems found in nature to reclaim treated wastewater for non-potable reuse (e.g., cooling, irrigation, and toilet flushing). Sustainable Water (2018) claims that the Emory WaterHub is the first of its kind in the U.S., and it is beneficial in that it reduces water supply risks, saves millions of dollars in utility costs, and improves environmental stewardship. Furthermore, the WaterHub's sustainability contribution indirectly provides advantages to DeKalb County's centralized wastewater system that includes two major functions:

- Decreasing the burden on DeKalb County's overwhelmed sewage treatment facilities, which are currently under a federal Consent Decree for violations of the Clean Water Act, and the Georgia Water Quality Control Act.
- Decreasing the need for treated clean water from DeKalb County's water system, which withdraws its water supply that is the subject of transboundary water conflict from the Chattahoochee River.

3.2 Data Collection

3.2.1 Sampling Data

This research gathers and analyzes interviews collected from key stakeholders in DeKalb County. The sample size for this study included 10 participants. While this is a small number of interviews and the primary method for this research is semi-structured interviews, Guest et al. (2006) suggest that as few as 6 interviews can suffice to analyze metathemes in studies with a small sampling size. Hagaman and Wutich (2017:35) have identified that with the use of qualitative methods via interviewing, a minimum sample size of 12 and a maximum sample size of 16 are satisfactory to achieve repetition of common themes specifically in homogenous groups.

The term homogeneous group for this study is used to describe a selected sub-group of individuals who possess knowledge of water-related practices (e.g., wastewater management, water governance, or water conservation). Sampling within a homogenous group focused on targeting participants that are knowledgeable about water-related practices still allows for detailed results on this research topic but does not limit or discredit the diversity of stakeholders as each participant has come to attain varying knowledge and experiences to contribute to this research. These participants include 5 Emory University staff members and interns (one intern and 2 staff members from the Office of Sustainability Initiatives, one staff member from Office of campus services, and one staff member from facilities management). As well, there are 3 WaterHub facility operators from Sustainable Water. Finally, 2 water professionals (one from South River Watershed Alliance and one from American Rivers) who have accumulated local knowledge of water governance and management in DeKalb County, were also included. Altogether, there are 10 participants. Over 12 participants were contacted for the interview process; however, some declined, and some did not respond to interview invitations via email or phone call.

3.2.2 Participant Data Management

Semi-structured interviews, which lasted 30 to 60 minutes were conducted and collected at each participant's office or private meeting location. The interviews were audio-recorded with permission from participants. The interviewer took notes on an interview guide during each interview. Each interview guide was kept in a folder, then stored in a locked office drawer. Each interview audio was manually transcribed to a Word document. A transcription pedal was utilized to control the rate at which each interview spoke in order to transcribe each interview audio verbatim.

3.2.3 Ethics

This research was reviewed by the International Review Board (IRB) to follow proper steps to ensure that all participants interviewed for this study was protected (IRB number: H19103). All participants recruited for this research study were adults who are over 18 years old. The participants invited for this study work at the county level or university level, and all participants have a minimum of a high school degree. The estimated lowest reading level for the population chosen for this study is at a 12-grade level. All participants were required to sign an informed consent form. The interview participants are educated up to at least a 10^{th}-grade level and have obtained a high-school diploma. All participants do speak and understand English. Consent was written and obtained in English. The estimated reading level for the informed consent form is at a 10.4-grade level according to the Flesch-Kincaid grade level readability statistics found in Microsoft Word. Consent was obtained by the student principal investigator, Leesi Barinem. For every interview, informed consent was handed over by the student principal investigator to the participants to read and verbally agree to participate with a "Yes" or decline with a "No." If the participants verbally state "Yes" to continue the interview, the participants was then prompted to sign the informed consent form. Given that the research did not present any more than minimal risk of harm to subjects than their normal daily life a second written consent form was available in case the participants would have liked a copy.

Additionally, this study was not designed to benefit the participants personally. Overall, the benefit to society is the hope to gain information about the participants' perception of a small-scale wastewater facility particularly Emory University's WaterHub, the importance of stakeholder collaboration and engagement, and perspective on sewage water management in DeKalb County, as a contribution to the field of human geography. The participants will not receive compensation for participating in this study.

3.3 Interviews and Data Analysis

Interview transcripts and audio recording were imported into NVivo 12 Qualitative Data Analysis Software, which was then used to organize and code for comparative purposes. As interviews were conducted and transcripts analyzed, three themes emerged from the data: the purpose or motivation to build the specific WaterHub model, the planning process, and perceptions of the effectiveness of constructing more small-scale wastewater facilities. Additionally, research through reviewing and analyzing DeKalb County planning and policy documents such as the Consent Decree and news reports provided depth to the background knowledge of the research area. These documents were utilized to structure a timeline of the wastewater issues occurring in DeKalb County. Examining these planning documents along with the interview transcripts provided a way to compare and contrast a possible solution gathered from interview data to discuss how efforts to develop the WaterHub relate to the water challenges in the wider DeKalb County area.

The significance of using an interview technique creates rapport before, during, and after the interview. Especially during the interview, developing rapport means understanding another person's view of the world and reflecting that understanding by communicating verbally and using body language (Hay, 2000). Thus, matching interviewee posture, pitch, tone, speed is a conscientious effort. Before the interview, developing the interview questions in the interview guide serve to produce a productive discussion during the interview. A pyramid structure was the basis of the interview guide. The pyramid structure consisted of three sections and allowed for easy-to-answer questions to start the interview while gradually moving to more complex questions about the research. The interview guide for this research implored approximately 8 introductory

questions or less (such as participants' outlining their roles, responsibilities or duties, outlining actions of organization or institution, etc.) in the first section. The next section tailored approximately 15 questions to stakeholder perceptions of the WaterHub. The third section included approximately 7 questions to view stakeholder knowledge of the planning process, and stakeholder perception towards the feasibility of more small-scale water treatment and reclamation facilities in DeKalb County.

4 RESULTS AND DISCUSSONS

The following section discusses the findings pertaining to the research question as it addresses successes and challenges in the planning process for the WaterHub. This discussion section is broken into three sections that each elaborate on the three themes derived from analysis of the interview transcripts. The first section, discusses the theme regarding motivations of primary stakeholders gathering to construct the WaterHub. Section 2 focuses on the theme of collaborative water management or integrative water management decisions made during the planning process. Section 3 delves into the theme surrounding stakeholder perceptions of the WaterHub, highlighting the benefits and drawbacks of the WaterHub, and discusses the significance of this case study to the larger DeKalb County area. Ultimately, Section 3 answers if stakeholders believe that more small-scale WWTFs, like the WaterHub, could reduce burdens on DeKalb County's overwhelmed, aged, and centralized wastewater collection system.

4.1 Motivation of Stakeholders to Build a Small-Scale Wastewater Treatment Facility

This section highlights stakeholders' motivations towards the case study, a social-environmental process of building a small-scale wastewater facility (the WaterHub) at Emory University. I define stakeholder in this project to be anyone who has knowledge on water processing, conservation, or governance. This research had two groups of stakeholders, primary

and secondary. Primary stakeholders or Emory University stakeholders specifically refer to people who were involved in the construction or daily operation of Emory University's WaterHub. Secondary stakeholders are people who have knowledge on water processing, conservation, or governance who were not involved in the construction or the daily operations of the WaterHub but are able to provide perspective on the applicability of the facility in the larger DeKalb County area. Emory WaterHub stakeholders emphasize the value of wastewater as a resource that can be reclaimed and reused in place of domestic water. As I interviewed a primary stakeholder, he emphasized the trend of waste overtime. He mentions that our ancestors were sustainable with food resources. For examples, our ancestors hunted an animal and utilized every part of the animal from the skin to the bones. This behavior was sustainable and has been passed on to present society as we tend to measure waste and ways to make waste streams more sustainable. This primary stakeholder further describes Emory's enthusiasm to transform into a waste-conscious campus:

> *[W]e also established a new program here at Emory on waste, which we are really pushing…for zero waste. (Primary Stakeholder)*

This stakeholder explains Emory's goal to achieve a zero-waste policy on campus. Currently, Emory has removed all landfill containers and has implemented more sustainable waste stream choices such as recycling and composting. As students and others walk on campus, they only have the choice to discharge trash into containers labeled with either recycle or compost. This perception of waste is contrasted to societies that perceive waste or wastewater facilities as displeasing to have in close proximity. Hardy (2011) suggests that "a small group of citizens— usually those living near a proposed facility site— are awakened to the potential harmful impacts of the development in its community" and perceive threats that could include noise, traffic, and public health and safety conditions (Hardy, 2011: 191). This is not the case with Emory

stakeholders. Meehan and Rice (2011), like Emory stakeholders, propose that waste is a natural and social object (Meehan and Rice, 2011). Moreover, wastewater treatment facilities are often located in neighborhoods of lower socio-economic status (Cutter, 1995; Zimmerman, 2003). This research presents the perception of a wastewater facility built on the campus of an academic institution, like Emory University embedded in a median household income neighborhood (U.S. Census Bureau, 2018). Unlike domestic wastewater facilities that treat, and release treated water to surface waters such as creeks, streams, lakes, and rivers, Emory University primarily reuses its wastewater within the institution. This prompts the question to explore why a university would choose to build a wastewater facility on campus. Meehan and Rice (2011) suggest that the production of waste is not independently natural or political.

Emory University is a private institution located in the historic North Druid Hills neighborhood in Atlanta, Georgia. The University works actively to promote its excellence in sustainability alongside other successes. Emory reports that its researchers generate $734 million in research funding yearly. Emory University promotes its healthcare system as "one of the world's leading healthcare systems" via the Emory University Hospital (Emory University, 2019). Moreover, Emory University strives to create a culture for sustainability and innovation. The WaterHub is a key aspect of such sustainability initiatives at Emory. In 2016, Emory along with two other institutions won the U.S. Water Prize (specifically for the WaterHub reclamation facility) awarded by the U.S. Water Alliance (Emory University, 2019). This award recognized Emory as one of the leaders advancing the "one water" movement by creating innovative solutions towards sustainability, "meaning strategies integrated across the water cycle and within urban management overall" (Emory University, 2019).

According to interviews, Emory staff members have come together to promote Emory's culture of innovation and sustainability, in part through their work on the WaterHub. This new culture is defined in Emory's vision, mission, and value. As one of the staff member's mentioned,

> *If you look at our values, we actually use the acronym SCORE. So, it is Safety, Collaboration, Ownership, Respect, and Excellence and our focus is to enable the university to basically create the innovations of tomorrow. (Primary Stakeholder)*

The vision, mission, and value were communicated amongst Emory staff members prior to the creation of the WaterHub, but this innovation has become a cornerstone of the sustainability initiatives on campus. Emory staff members embraced opportunities to collaborate and integrate new technology to advance sustainable practices on campus. Initiatives such as geothermal wells and solar energy had preceded the creation of the WaterHub.

Emory has recruited staff members with prior professional experience that will further its sustainability initiatives. One stakeholder emphasized that he had been involved in sustainable efforts throughout his professional career, even before joining Emory. For example, he worked with the Navy for 20 years collaborating with the University of Hawaii and Department of Energy on wave energy using ocean waves. After innovating with wave energy technology such as buoys and desalinization plants, this interviewee expressed that his experience provided the familiarity and receptivity to take on a project like the WaterHub. When asked what if any, were his roles and responsibilities in the development of the WaterHub? He explained that prior to being introduced to Sustainable Water (SW), he initiated an energy think tank to generate ideas. He then met with SW for a pitch meeting. He loved the WaterHub idea and was shocked to find out that the technology existed but a WaterHub had not been built in the U.S. He headed a group to conduct a feasibility assessment to test wastewater flow and capacity, and where reclaimed water could be used and on campus. Moreover, the team conducted a water profile to figure out how much water

is used for drinking, showering, toilet flushing, cooking, cleaning, and mechanical systems such as make-up water. Make-up water is the largest water used to power steam boilers and cooling towers and replaces non-potable water. Make-up water is fed to steam boilers and cooling towers as resource water to accommodate condensation. He noted that "approximately 40 percent of our water is mechanical make-up water" (Emory WaterHub Stakeholder). The WaterHub supplies make-up water used in the steam boilers and cooling towers to heat and cool buildings. To monitor this make-up water, a water meter is used, which reflects make-up water use on campus.

Another primary stakeholder, when asked to outline her role and responsibilities in the development of the WaterHub, stated that her role was to implement Emory's sustainability vision. Emory's sustainability vision initiated the opportunity to cultivate Emory as a national leader in sustainability. To prepare to expand its sustainability impact on campus, Emory conducted a water feasibility assessment. She mentioned that Emory had a history of implementing decentralized, small-scale water solutions such as a rainwater cistern—a large underground tank that collects storm water and can be used to irrigate and flush toilets:

> *We then did a greywater system where you could collect rainwater and shower water in addition to the storm water to use for toilet flushing. (Primary Stakeholder)*

These small-scale water conservation goals as part of Emory's sustainability initiatives were financially feasible and reduced water utility costs. She continues "we were saving hundreds and thousands of dollars per year". However, Emory wanted to increase the scale of its initiatives from not only water reduction goals but also carbon reduction goals. Both of these interviewees agree and encourage other institutions or organizations to conduct a water profile, or as the second interviewee referred, a water footprint analysis, before initializing a project like the WaterHub.

Regardless of the choice of words, they both encourage that a water profile assessment is helpful to understand water quantity and how water is used on campus.

Both interviewees mention the premise for the technology needed to build the WaterHub already existed, but successful examples were modeled and applied only outside the United States. Emory researched and learned to model the WaterHub technology from countries such as Hungry, France, and China specifically, case studies from France. Sitzenfrei et al., (2013) argues that "the lack of case studies" (in the U.S.) hinders the process to develop and assess the impact of decentralized solutions to wastewater facilities. For Emory, the perception of a small-scale, sustainable, and an onsite wastewater facility was an opportunity to expand its goals to grow awareness towards sustainability and water conservation on campus. Sustainability has been a major goal for Emory stakeholders since 2015. Emory's 2015 Sustainability Vision and Strategic Plan states a 10-year goal to reduce its energy use per square foot (EUI) and a reduction in potable water consumption by 50 percent by 2025 (Annual Energy Report Final, 2017). As of 2017, two years from the 2015 benchmark, the overall EUI is reported to be 8.6 percent and there has been progress initiated towards the goal to reduce potable water consumption by 50 percent due to the WaterHub (Annual Energy Report Final, 2017). Emory's Sustainability Agenda also aligned with the United Nations 2030 Agenda for Sustainable Development.

4.2 The Planning Process

This section focuses on the specific roadmap or planning process leading to the creation of the WaterHub. This section includes the process of gathering a broad range of stakeholders to increase stakeholder dialogue during the planning stage (Junghans et al., 2018). Questions such as, who were the stakeholders included and excluded from the project, were asked. As well, this section displays the successes and challenges during the planning process. These successes and

challenges inform on a roadmap for future institutions, non-governmental, or governmental entities considering a similar approach to developing a small-scale WWTF and management strategy. Environment, motivation, governance, and planning were the key words mentioned during the interview as interviewees discussed the planning process.

Prior to the creation of the WaterHub, small-scale sustainability initiatives such as rain harvesting, solar energy, community gardens, and waste recycling were part of Emory's culture of sustainability. The planning process for Emory stakeholders began from these small-scale sustainability initiatives and evolved into a large-scale vision, mission, and value outlined in the 2015 Sustainability Vision and Strategic Plan. Through this preparation, an opportunity for Emory to form a partnership with SW presented itself. On the other spectrum, the planning process for SW began from a sales perspective. The idea for the WaterHub was showcased at conferences, which piqued the interest of Emory to collaborate with SW. SW responded by gathering stakeholders from the university to provide momentum to the project. SW intentionally created awareness amongst the many departments at the university. By creating awareness amongst university members, the potential of the project manifested from an idea to a vision of how the project could serve some of the departments on campus. The various departmental members were more likely to endorse the project and more importantly, they were included in the decision-making process. Sodiq et al. (2019) term this process of recruiting diverse stakeholders as inclusive risk governance. An inclusive risk governance structure creates momentum in the decision-making process by presenting a portfolio of stakeholders with varying attitudes, knowledge, values, and benefits to support the project (Sodiq et al., 2019).

A SW associate mentions:

> *You have to build a group of stakeholders and they could be anywhere from sustainability, to academic, to students, to CFOs, utility group, engineering group. (Primary Stakeholder)*

I argue that the governance model for this project is an integrative or collaborative governance structure. The decision to create the WaterHub was modeled by the mission, values, and vision of the university to increase a sustainability footprint on campus. However, in order to implement this vision, a collaborative approach took place amongst various members at the university, ranging from students to faculty and staff. A collaborative approach amongst university members further strengthened the mission, values, and vision of the university, which created a conducive environment between primary stakeholders during the planning process. Part of gathering stakeholders that are involved in water processing is to understand who has the power to make decisions within the university system. These university stakeholders are positioned at offices such as campus services, utility, sustainability, academic, real estate for leasing the land, to buildings and grounds. The goal in the early stages is to get all these stakeholders to become excited and on board with the project before the project can travel up the chain of command to the president of the university.

Furthermore, when asked what is the most challenging part during the beginning stage? A primary stakeholder noted that the most challenging portion in the beginning is to get through the contract phase, the physicality of the land, meaning negotiating and agreeing on a piece of land feasible for the project. Part of the reason why decentralized facilities do not see the light of day is because of the planning process. Sitzenfrei et al. (2013) ratify that the "availability of adequate models" that are already limited is due to "the time- and cost-intensive preparation phase". Moreover, "[s]ustainable urban water management systems produce more benefits" due to the low cost of investment, short term construction, and increase water productivity, which overtime

outweighs the intensive preparation processes (Sodiq et al. 2019). After this initial phase, the project transitions primarily into construction dealings and construction issues. The next step is to build a financial package. Although there were many benefits that came from the project, the major success that made the project feasible in the time span and space was highly dependent on financing. The financial feasibility of this project was possible through a third party.

4.2.1 Water Processing Agreement (WPA)

The details of the financial package are unknown; however, what is publicly known is the method in which Emory chose to fund the project. Emory partnered with SW to create a Water Processing Agreement (WPA). The goal of the WPA is to take the burden off the host client that lacks knowledge of building a WWTF. Emory had experience building student housing and academic buildings; however, they had never built a WWTF. SW's philosophy is "to find a vehicle to alleviate the stress and risk to develop and execute the system" (SW Associate, 2018). Both the host client and the investors benefit from this agreement. Although the investors will incur the capital and operational cost, they are leased the land to build the project. The host client receives a reduced price at a fixed discounted rate for every gallon of water extracted and delivered from the investors. This discounted rate is approximately 10 percent off DeKalb County's rate. The revenue savings are then net to utility operations and utility operations can move the savings to any other department on campus. On the investor's side, the investor makes money through a cash flow positive or profit over the duration of the project, which could be approximately 20 to 30 years. Basically, the host client agrees to this contract to save money on its utility bills through a discounted rate and through technology that will lower cost per bill. The investor agrees to this deal due the leased land to build, and investment in a technology that will continue to produce residual surplus for approximately 20 to 30 years. A SW associate compares this WPA agreement

to a mortgage plan. SW is investing in themselves through leased land and earnings from the operational and capital cost over approximately 2 to 3 decades.

4.3 Stakeholder Perception of a Small-scale Wastewater Treatment Facility

All 10 interviewees agree that there are more benefits to the construction of the WaterHub than its drawbacks. The quotes listed below exemplify responses from three different interviewees from three different groups. It is important to keep in mind that the first two interviewees are primary stakeholders and the third interviewee is a secondary stakeholder as defined by this research. Primary stakeholders are directly linked to the creation of the WaterHub while secondary stakeholders were not involved in the creation of the WaterHub but have knowledge of water processing and management from professional experiences. The responses below compare each stakeholder's perspective of the benefits of the WaterHub. One interviewee when asked the question, "do you believe that the WaterHub has benefits? If so, what are some of these benefits?" replied,

> *Oh God yes. I can't find the downside. Everything about it makes sense; the socioeconomic impacts are there for helping reduce combined sewer overflows, which tends to be in lower economic neighborhoods. You have of course a sustainability aspect for reusing and making our wastewater source more sustainable. (Primary Stakeholder)*

This stakeholder mentions the socioeconomic benefits of the WaterHub to reduce burden of combined sewage overflows by drawing a correlation to sewage overflows in lower income neighborhoods.

Additionally, they emphasize the sustainability benefit of the facility to reuse and recycle wastewater. The next interviewee's response is expected to support the prior interviewee's statement above as they both represent members from the same group, primary stakeholders. When asked the same question, this interviewee stated,

> *"Oh yeah…I think that the biggest benefit is that we found a way to clean sewer water or really, you know wastewater and as we call it, blackwater and you are reusing that in locations that we were originally using domestic water so, that is an enormous benefit". (Primary Stakeholder)*

This stakeholder's response, like the previous, relays the importance of the facility's ability to filter wastewater and reuse it as a resource. Specifically, they associate the benefit of reuse water as a resource that serves as an alternative to domestic water use.

The next response was not expected to support the two interviewees' responses above because this interviewee is outside the group that is directly responsible for the construction of the WaterHub. When asked the same question, the third interviewee replied,

> *Yeah…if used properly, it can be a really good compliment to water management systems. (Secondary Stakeholder)*

This third interviewee agrees with primary stakeholders that there are benefits to the facility. However, the perspective of this stakeholder focuses on the benefit implications of the WaterHub as it relates to water resource management. This stakeholder further explains by stating their affiliated organization's mission and vision for water resource management:

> *We promote what is called Integrative Water Management, where you look at water as a single resource and then you attempt as a utility to manage all the water as a single resource, your wastewater, stormwater, drinking water, and source water get managed so that they are connected in some way. (Secondary Stakeholder)*

This interviewee especially focused on a greater application of the WaterHub and its contribution to water resource management in DeKalb County. Although, the benefit of the WaterHub serves as a tool to practice integrative water management, it is still at a small scale. This interviewee subtly hints that the WaterHub can serve for Emory to practice monopolizing and consolidating its utility water resources on campus.

The perception of this interviewee, like the others, was overwhelmingly positive. These three interviewees mentioned socioeconomic benefits to reduce sanitary sewer overflows in DeKalb County, sustainability benefit for using a system that reclaims sewer water and recycles water, and integrative water management applications. In addition, the process of reclaiming wastewater replaces the need to rely heavily on domestic water. Sitzenfrei et al. (2013) emphasize that "the common feature of all solutions is the push from a central solution to a decentrali[z]ed solution in urban water management." This push to decentralized solutions has caused technical and socio-economic issues; however, more case studies and decentralized models have created opportunity for comprehensive assessment (Sitzenfrei et al., 2013). The trend of discourse was targeted at concepts of water conservation specifically reclaimed water and sustainability. There are no consensuses on one overarching description of sustainability in academia although, the Brundtland report is acclaimed for the most referred definition. The Brundtland report states that sustainability or "sustainable development is [a] development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (International Institute for Sustainable Development, 2018). Godschalk (2004) contests that sustainability is composed of three sectors, ecology, economy, and equity or social equity.

Furthermore, the emphasis on reclaimed water, a term meaning reuse or recycle, directly links back to the definition in the Bruntland Report that encourages development that meets present needs without compromising the needs of future generations. The concept of reclaimed water then reinforces the technology used in the facility, which incorporates hydroponic reactors and biota. The hydroponics reactor in the facility is a technology that can be used to recycle wastewater in a closed system. Another interviewee further addresses that the technology selected for the WaterHub, provide not only an environmental benefit but also notes that the choice to construct a

decentralized facility that is uniquely designed to use hydroponic reactors and biota together in the same system is a step forward towards innovation to treat wastewater. Provided that the unitis unlike the conventional centralized technologies that currently exist because the biotas specifically have long root systems providing large surface area for microbes to breakdown organic waste. She states,

> *I think that it is proven that we have harnessed nature and mechanics [and] to be able to accomplish [it] in a short period of time [which produces] the WaterHub. (Primary Stakeholder)*

The interviewee further elaborates that the design to incorporate hydroponics along with biota serves the environment by reducing the amount of potable water demand in the region. Being that water will evaporate off the cooling towers, it is beneficial that the source of water is reclaimed versus domestic. Also, the interviewee above mentions not only a financial benefit but also expresses that there is a narrative to be told, a living-learning laboratory, and a social responsibility. This primary stakeholder mentions the environmental benefit of the WaterHub's ability to reclaim and recycle water, which reemphasizes Emory's reduction goal in domestic water consumption use while also exclaiming the financial benefit to the third-party partnership and the host client. Additionally, this interviewee also places a spotlight on the social benefits by stating that the WaterHub project produces a narrative that reinforces social responsibility, a sense of obligation and ownership to maintain the WaterHub and establishes a reputation to be protected. He continues to list that the WaterHub is a learning-living laboratory, an opportunity for research in house at Emory and it is the first model of its kind in the United States. Across disciplines, sustainable development is practiced and interpreted differently, which drives policy applications designed to fit the relevant sectors in development practice. At the root of this discussion exists the need to balance human-social and economic activities with the sustenance of ecological systems (Sneddon

2000). Often the management of environmental systems is predominately managed from an economic sustainability perspective, a self-reliant on sociopolitical systems to mitigate social-environmental issues that often neglects or diminishes the ecology and social equity sectors of sustainability.

Sustainability and its application to development is a broadly contested topic applied to human and non-human processes. The perception of the WaterHub project as a sustainability project reinforces the trends in water management towards the hydrosocial cycle. Examining the perception of the WaterHub project through the lens of the hydrosocial cycle, allows for emphasis to explore "social power and structures of governance, technologies, infrastructure, political policies, water itself, alongside subjectivities and cultures" (Palomino-Schalscha et al., 2015). The hydrosocial cycle offers a foundation to analyze the Emory culture and WaterHub case study in an isolative scenario and illuminate the power and governance structure at play in this specific project. Socio-political decisions towards water shape the waterscape of the urban-built environment. How water is managed reflects the power structure of decision-makers who control how decisions are implemented and community members who receive the decision. In the case of the WaterHub, staff members, faculty, and students received the decision. Different groups of people attribute different meanings and values to water thus, in the case of Emory's WaterHub, stakeholders who worked on this project perceive it as a sustainability project.

Perceptions of the WaterHub project also included inquiry into drawbacks of the project. When asked, do you believe that the WaterHub has drawbacks? If so, what are these drawbacks? 7 out of these 10 stakeholders address some potential drawbacks. An interviewee discussed a "slight negative impact on the rates that DeKalb County will be losing because Emory is not paying them for that." However, the stakeholder further stipulated that the benefits of the project "far

outweighs the reduction in their flow of water that they cannot process anyway." This interviewee is referring to the rate at which Emory is paying SW to treat wastewater and use it as reclaimed water on campus is lower than if they were paying DeKalb County directly to clean its wastewater. A manager at SW explained that the rate is approximately 10 percent lower that DeKalb County's rate, but the percentage allocated by Sustainable Water to its clients varies per project and location. In comparison, most DeKalb County residents and low consumption users fall at a 2-inch meter reading rate and under. 2-inch meters are currently on a bi-monthly meter-reading and billing cycle sewer rate of $11.34 per 1000 gallons. 99 percent of all meters in the water system measure at 2 inches and under (DWM, 2016). This document only highlights water and sewer rates for residents. It does not include academic, industrial, or commercial building rates and charges. However, DeKalb County offers the opportunity for industrial or commercial wastewater users to apply for the Application for Commercial and Industrial Wastewater Retainage Credit "for an adjustment on wastewater service charges for metered water that is not discharged to the sanitary sewer system" (DWM, 2019).

Along with water rates, other interviewees mention other drawbacks. Most interviewees agreed that the benefits of the WaterHub outweigh the drawbacks. Some interviewees mentioned potential drawbacks of building a decentralized wastewater facility while some described challenges that occurred in the early construction period. Another interviewee emphasized challenges with "getting the water chemistry right." This interviewee is referring to the process of accessing and reassessing the phosphorus, nitrogen, carbon, and oxygen levels in the system to balance effects of eutrophication and etc. Another interviewee advocated for an awareness of the geographic region and watershed that the decentralized wastewater system will be applied. They continue by providing some scenarios. For example, in the piedmont region, the water relies on

wastewater returns. Ideally, wastewater returns find its way back to an immediate water source, but wastewater returns are disadvantaged by the distance traveled. The interviewee mentions a policy that affected the Flint River by stating that the Flint River had certain policies that hindered the river's ability to mention water balance. For a very long time, water withdrawals were allowed from the Flint River, but water returns were not allowed back into the river. The reasoning behind this flint policy was due to a lack of high treatment to assimilate waste levels. This policy left the Flint River with less water returns. Thus, this interviewee warns to be careful about creating systems where water is not balance in local rivers. It is critical to example water that is being withdrawn from rivers along with water that is returned to the same river system. Another example mentioned in the interview, discusses reclaimed water for irrigation and how it impacts regions differently. In regions where the water table is low, using reclaimed water to irrigate will produce a quicker return to recharge ground water. Contrarily, Atlanta located in the piedmont region with its complex geology takes longer to collect groundwater. Using wastewater as reclaimed water in DeKalb and evaporating it through cooling towers (essentially the use of the WaterHub's make-up water), from a water resource management perspective, the water balance must be evaluated.

For over a decade, the topic of sustainable water management has transformed how "people relate to water and how [people] access and control it" (Palomino-Schalscha et al., 2015). This new dynamic in geographic literature towards water management combines human understanding of natural occurrences with political and social needs. Ultimately, the scale of the WaterHub produces measurable results for Emory University and its conservation goals. The motivation or purpose of the WaterHub, the successes and challenges of the planning process, and the benefits and drawbacks based on stakeholder perceptions towards the WaterHub conservation goals are clearly outlined above. However, another research finding not specifically stated during interview

discussions but more so implied by lack of emphasis remains. The question of how efforts to develop the WaterHub related to the water challenges in the wider DeKalb County was not a priority for primary stakeholders who developed the WaterHub. The goals of the WaterHub stakeholders were focused on the sustainability of the campus and institution and less concerned with possible benefits to the burdened infrastructure of the county. This apparent disconnect between the campus sustainability goals and solutions for the county-wide problem with wastewater was not expected. This unexpected finding that emerged from the data analysis could serve as a further area of study to contribute to hydrosocial literature on the scalar differences in how stakeholders frame sustainability. The significance of this research would then link stakeholder's beliefs towards the benefits of the WaterHub and wastewater infrastructure issues in DeKalb County, further exploring how more small-scale wastewater facilities if applied on a county scale, would contribute to reducing DeKalb County's wastewater and water infrastructure issues.

Stakeholders agree that the WaterHub contributes to diminishing DeKalb County's wastewater and ageing water infrastructure issues in three ways:

1. The 400,000 gallons a day that is being treated by the WaterHub is a load off the treatment that DeKalb would need to treat.
2. The facility reduces the supply of domestic water needed to be used on campus.
3. The facility increases the availability of domestic water for the County of DeKalb.

For example, the facility's ability to recycle wastewater and produce make up water to power steam plants, cooling towers, and flush toilets is sustainable. In addition, stakeholders suggest that more facilities like the WaterHub could make a larger impact with DeKalb County, especially if

more decentralized WWTFs can be built in high priority areas where sewage spills are occurring frequently.

Although stakeholders agree that benefits to decentralized WWTFs like the WaterHub outweigh the drawbacks, the motivation to build the WaterHub was unrelated to these specific contributions to DeKalb County's domestic water supply and wastewater load outcomes. These benefits from the WaterHub to DeKalb County's water infrastructure challenges were outweighed by negotiations concerning the loss of revenue to the county resulting from the decrease in water supply and wastewater fees that Emory would pay because of the resue enabled by the WaterHub. As well, Emory University's status as a private institution was more conducive to developing the WaterHub as opposed to public projects that might require consultation with multiple departments and different regulatory rules. As one of the primary stakeholders mentioned, private funded projects have "less red tape to go through". There is more control on how the funds will be used, quicker turn-around from planning to implementation phase of the project, and specific targeted goals outlined ready to be implemented.

5 CONCLUSION

The hydrosocial cycle creates a niche to explore the relationship between people who have the power to manage natural resource use and people who deal with the impacts of this empowered groups decisions. Often, these people are stakeholders that possess decision-making power to create or recreate technology systems to properly manage natural resources. Examining how organizations and institutions manage water develops a narrative of transparency in wastewater management, technological processes, and innovation. Furthermore, a qualitative approach towards small-scale wastewater management builds subjectivity and identifies benefits and

drawbacks of wastewater technology and design, which can be applied to other models on the same scale.

Wastewater stakeholders hold key knowledge about water processes, water technologies, and water governance. Educational institutions more so private, have the ability to produce power and resources required to build wastewater treatment technologies delineating from traditional centralized facility designs such as decentralized and water reuse facilities. More water reclamation literature contributes to existing research in sustainable water resource management literature that often times is obscure due to lack of examples and models in governmental, nongovernmental, and academic institutions in the U.S. The perception of decentralized WWTFs in the context of institutions examines the stigmatization of wastewater facilities in close proximity to people. Institutions are situated amid cities and towns and possess power to drive public opinions and offer opportunities for innovation locally. Institutions have more control to develop individual value, vision, and perspective that shape perception among students and university stakeholders and in turn drive change in the embedded community. It is apparent from this research study that sustainable concepts and projects favor professionals in environments that value setting goals for innovative technology and quick turnovers.

This research shows small-scale WWTFs stakeholders are successful by creating professional environments aimed towards innovation and collaboration amongst a diversity of stakeholders. The planning process for sustainable projects involves integrative governance management that captures opinions and recommendations from a community of stakeholders to build rapport, trust, and support. By incorporating all potential stakeholders in the beginning process, support for project increases. This process diffuses the strong top bottom governance

model and not only shifts power among stakeholders but also create more inclusive risk governance that encourages a diversity of stakeholder perspectives and collaboration.

Small-scale wastewater facilities such as the WaterHub are individually designed and driven by stakeholder goals. Ultimately, the goal should be to build a wastewater treatment system that produces more benefits than drawbacks. For example, in the case of the WaterHub, water conservation technology was the main focus. More specific goals narrow down the opportunities available for innovation and collaboration to occur on private projects; however, a small group of stakeholders allowed for quick transition from one phase of the project to the next. In terms of power over design and construction, cost of the facility, primary stakeholders have full power in the decision-making process. Like primary stakeholders, secondary stakeholders' contributed recommendations are valued; however, these groups are not able to influence change and cannot drastically stir the outcome of the project.

Although institutionally driven projects, like university projects, do not negatively impact the surrounding community at large, socioeconomic, sustainability footprint, water consumption rates, water balance effects on surrounding domestic water source or inter-basin transfer rates, and financial reduction goals are vital to consider. Along with the benefits package offered by small-scale WWTFs, some drawbacks that might hinder the progression or implementation of the project early on is a lack of thorough evaluation of the financial package and availability of land in relation to the scale of the project. Stakeholders collaborating to build small-scale WWTFs on private property must consider the specific county's domestic water rate and reach an agreement with the county. This step cannot be by skipped. Negotiating with the county the WWTF details ensures that planning process is not delayed. This step all feeds back into the transparency of the project. More successful small-scale examples, specifically in the U.S., that reinforce sustainable water

management and technology practices reinforce to the good perceptions of these systems. More small-scale WWTF research geared towards stakeholder perceptions adds relatable outcomes that are understandable and applicable to city officials. The goal to incorporate decentralized WWTFs in water or wastewater management does not nullify or seek to dominate the narrative of traditional centralized WWTFs. However, this research contributes to human-environment scholarship by adding effective and applicable designs, technology, financial, and governance structures to the already existing discussion towards urban water management while also creating opportunities to build on sustainable urban wastewater management literature.

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