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Implementing the Sponge City Concept on North Carolina's Federal Emergency Management Agency's Acquired Properties

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
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Abstract

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MPA, Walden University, 2006

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Professional Administrative Study Submitted in Partial Fulfillment

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Doctor of Public Administration

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Abstract

In North Carolina, the U.S. Federal Emergency Management Agency (FEMA) offers a grant program to assist communities with purchasing flood–prone, private properties to decrease the effects of flooding within flood–prone communities. In flood management, incorporating the Sponge City concept within federally acquired properties is not widely considered by flood management professionals as an effective means to manage floods. The purpose of this qualitative single case study was to explore the feasibility of incorporating the Sponge City concept on federally–acquired properties to reduce significant flooding within designated flood–prone communities. The concept of disaster recovery, which focuses on the process of restoring, rebuilding, and reshaping a community to enhance its adaptability to disasters, and the theory of resilience and stability in socio–ecological systems, which explores the economic and social functioning of a community immediately after a disaster and long–term recovery, were used as the conceptual framework in the study. The case study analysis was conducted via video conferencing, teleconference, and in–person interviews of three municipal flood management professionals and three private flood management professionals; scholarly articles and government documents were analyzed thematically. The study results showed that each participant believed that more education on the concept would be necessary to facilitate the onset of future flooding. Recommendations for future studies include educating flood management professionals on the concept, and an endorsement by FEMA and the North Carolina Department of Public Safety can help with flood mitigation efforts, which is an implication for positive social change.

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Dedication

First and foremost, I dedicate this study to God, who gave me strength when I felt I had none left. I also dedicate this study to my children, Lei'Lanni Askew–Holt, Ta'Liyah Kirchner, and Christopher 'CJ' Kirchner, Jr. Please remember, by the grace and mercy of God and determination, you can accomplish anything! Also, to SFC Christopher Kirchner (Ret.), my best friend, cheerleader, and confidant. You have supported and encouraged me throughout this process, so I give you my gratitude and love. Also, to my loving mother, Ida Askew, and father, MSgt William Askew (Ret.), thank you for believing in me. Last but not least, I would like to dedicate this study to my little brother MSgt William Askew, Jr., who encouraged me to pursue this endeavor. I love all of you!

Acknowledgments

I extend my gratitude to my committee members, Dr. Mark Starik and Dr. Ross Alexander, for their guidance and mentoring throughout this process. I also want to thank Dr. Karen Shafer (URR) for your unwavering feedback, which significantly improved the quality of my study.

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Section 1: Introduction to the Problem

Introduction

Between 1990 and 2019, North Carolina experienced 36 tropical cyclone storms (Paerl et al., 2019). Tropical cyclone storms are significant contributors to compound flooding because of their combination of intense rainfall and storm surge from high winds (Gori et al., 2020; Paerl et al., 2019). Worldwide, flooding is considered one of the worst natural disasters in terms of financial and societal devastation, costing the United States an average of $24 billion each year (Gori et al., 2020) and causing more than 220,000 deaths since 1980 (Winsemius et al., 2016). Moreover, climate change has increased the occurrence of flooding disasters because of frequent heavy tropical precipitation (O'Donnell et al., 2017; Paerl et al., 2019). Flooding is caused by storm surges from tropical cyclones and tsunamis, excessive rainfall, and rapid snowmelt; furthermore, 80 to 90% of flood damage is caused by tropical cyclones and extreme precipitation (World Health Organization, 2020). Although many urban areas along the coastlines of the United States are prone to flooding, coastal communities in North Carolina are particularly impacted by flooding because of low elevation, high–density rural development, and flat landscape (Pricope et al., 2019; van de Lindt et al., 2018).

In its efforts to minimize the impact of natural hazards, the federal government established the Hazard Mitigation Grant Program (HMGP). The HMGP provides federal assistance to municipalities to mitigate the impact of flooding (Keegan, 2009). The HMGP is widely disseminated through different project types serving as an avenue to reduce the effects of future disasters. One such project administered through HMGP is

the Property Acquisition/Buyout Program. This project administers funds to states and local municipalities through a federal grant to acquire high–risk properties to develop as open spaces (2009). Incorporating the Sponge City concept within the guidelines on using the acquired properties may serve as a pilot for use by flood management professionals to improve mitigation efforts.

Problem Statement

The general problem is that the high prevalence of flooding in North Carolina affects its sustainability and results in short– and long–term consequences, such as death, property loss, damage to roadways, loss of power and communication, water pollution, decreased property value, damage to farmlands, and decreased physical and mental health, some of which impede individuals' capacity to recover from flooding disasters (Deniz et al., 2019; Peng & Liu, 2019; van de Lindt et al., 2018). Philadelphia (Hackert & Rosen, 2018), Baltimore, Phoenix, Portland (McPhillips & Matsler, 2018), and Chicago (Mell, 2017) are minimizing the occurrence of disastrous flooding by adopting the Sponge City concept, also known as green infrastructure in the United States.

The Sponge City concept, first introduced by Chinese President Xi Jinping at a conference in Beijing, China, in December 2013, was invented due to the increased flood risks associated with rapid development in China (Zevenbergen et al., 2018). A Sponge City is a city in which permeable roads and gardens are constructed to route the water to ponds and lakes or in which water is collected and used in irrigation systems to regulate stormwater overflow (Kelleher et al., 2020). To be considered a Sponge City, at least 20% of the city must be designed to absorb, clean, and reuse surface water (Chan et al.,

2018). A sponge lot is similar to a Sponge City, the difference being that, with a sponge lot, the permeable material is installed on an individual lot, and the total permeable surface area of the city falls below the 20% threshold to be considered a Sponge City (Chan et al., 2018) (see figure 1).

Figure 1

Sketch of Sponge City

Note. This sketch illustrates the concept of a Sponge City. From *The Collective Strategies of Key Stakeholders in Sponge City Construction: A Tripartite Game Analysis of Governments, Developers, and Consumers.* By Chen, Y., & Chen, H., 2020, Water, 12(4), 1087. CC–BY 2.0.

Flood–prone communities have adopted green infrastructure initiatives for stormwater management in lieu of investing in more gray infrastructures, such as retention basins, seawalls, and pipes for stormwater management. These cities use natural

systems, such as permeable pavements, gardens, parks, trails, open spaces, and tree trenches for water infiltration (Hackert & Rosan, 2018). According to a study conducted by Kelleher et al. (2020), vacant lots, including parking lots, were recognized as useful spaces that can be transformed into landscapes (i.e., sponge cities and sponge lots) to alleviate the increasing overflow of wastewater and stormwater.

The specific problem was that it is unknown whether incorporating the Sponge City concept, using the land acquired under federal post–disaster mitigation grants in North Carolina, would be feasible, appropriate, or effective in improving stormwater management in its flood–prone communities. A report from North Carolina State University recommended the use of greenspace concepts, such as Sponge Cities and sponge lots, by incorporating pocket parks into the development of the federally granted properties (The University of North Carolina at Chapel Hill, 2018). Currently, this recommendation has yet to be implemented, and the reasons the North Carolina Department of Public Safety (NCDPS) has not adopted guidelines for implanting this form of green infrastructure on HMGP's acquired properties have not been found in the literature.

In this project, I explored whether implementing the Sponge City concept on North Carolina's HMGP–acquired properties would be an appropriate and effective means of addressing floods in the state. Discovering the appropriateness is important because incorporating the concept on flood–prone acquired properties may help alleviate much of the stormwater risks and enhance social and physical resilience in flood–prone communities. Information from this study may be used by North Carolina city managers,

planners, and other flood management professionals to develop land–use strategies that mitigate flood risk and enhance public safety and sustainable environmental performance.

Purpose

Advancements in knowledge and technology within the field of flood management can bridge the gap between new ideas and current methods used to reduce community flooding. My goal in this study was to determine the feasibility, appropriateness, and perceived effectiveness of adopting the Sponge City concept in North Carolina to improve stormwater management in flood–prone communities. The unit of analysis in this study was the Sponge City concept, and the location of the study was North Carolina. I collected data using confidential interviews with six North Carolina flood management professionals, federal, state, and local government documents, and available data on land acquired under federal post–disaster mitigation grants in North Carolina. I evaluated the feasibility of adopting the Sponge City concept using interviews and observation data, appropriateness was evaluated using interviews, government data on federally granted properties, and document data, and the potential effectiveness was evaluated using interview data. Discovering the feasibility, appropriateness, and potential effectiveness of implementing the Sponge City concept on federally granted properties may enhance North Carolina's resilience and adaptive capacity to address flooding.

Nature of the Administrative Study

Advancements in flood risk mitigation can improve sustainability and resilience within a community. The purpose of this study was to determine the effects of the Sponge

City concept on a flood–prone community if implemented on HMGP–acquired properties. Appropriate strategies to support the Sponge City concept may facilitate the reduction of flood risks; however, given the gap in information regarding the feasibility, appropriateness, and perceived effectiveness of adopting the Sponge City concept, many administrators may not know the practice exists.

I used a qualitative research methodology and a single case study design. I analyzed the Sponge City concept for use in the state of North Carolina. The qualitative single case study approach aligned with the problem statement because the problem involved a phenomenon that occurs within a bounded system and with the research question because they necessitate multiple data sources to answer.

The data of interest included existing scholarly articles and government documents obtained from government archives, and the population of interest was flood management professionals in North Carolina. I used a purposive sampling technique to select participants who are knowledgeable about the phenomenon, which is the flooding in North Carolina's flood–prone communities. The sample for this study included six North Carolina flood management professionals familiar with stormwater management. My sample range was between five and seven, and based on the recommendations of Vasileiou et al. (2018) and Fusch & Ness (2015), the sample range should be determined by saturation.

I acquired the secondary data from government agencies' databases using the Freedom of Information Act (FOIA), which I requested after obtaining Walden Institutional Review Board (IRB) approval. I obtained other data from research

institutions and scholarly articles. Additionally, this study's outcome included data on incorporating the Sponge City concept on HMGP–acquired properties, providing another avenue for flood management professionals to improve stormwater mitigation efforts.

Significance

The significance of this study is that it may contribute to the advancement of scientific knowledge by bridging the gap in research on the feasibility, appropriateness, and perceived effectiveness of adopting the Sponge City concept on North Carolina's HMGP–acquired properties to improve stormwater management in flood–prone communities. The results of this study support the professional practice of flood management by providing information on how the Sponge City concept could be implemented on the local level.

Furthermore, future practitioners may find the results of this study helpful in developing uniform guidelines or resources that encourage the adoption of the Sponge City concept's implementation on HMGP–acquired properties. Finally, this study's results may contribute to positive social change by enhancing existing flood management procedures in participating flood–prone communities. The results of this study support the professional practice of flood management by providing information on how the Sponge City concept could be implemented on the local level. Furthermore, future practitioners may find the results of this study helpful in developing uniform guidelines and resources that encourage the adoption of the Sponge City concept's implementation on HMGP–acquired properties. Finally, this study's results may contribute to positive

social change by enhancing existing flood management procedures in participating flood–prone communities.

According to Li (2017), “to implement social change and improve the quality of life for citizens within special flood hazard areas, communities must address the underlying issue: repeated flooding and its hampering of the socio–economic needs of a community” (p. 11). In this study, I determined that administering the Sponge City concept on HMGP–acquired properties is a viable method for stormwater management, climate change adaptation, and community resilience in North Carolina.

Summary

The HMGP–Acquisition/Buyout Program is an initiative started to assist flood–prone communities with flood management to improve sustainability. Although this program has made gains in reducing structures damaged by flooding, looking at other ways to further reduce the impact of flooding on vulnerable communities, namely incorporating the Sponge City concept, will result in a positive impact on the community. The next section of this study will address the relevant concept for incorporating flood management systems on FEMA–acquired properties to help improve sustainability within flood–prone communities.

Section 2: Conceptual Approach and Background

Introduction

The problem faced by flood–prone communities is the impact flooding has on a community's sustainability and resiliency. The high prevalence of flooding in North Carolina results in short and long–term consequences, which impede individuals' capacity to recover from flooding disasters (Deniz et al., 2019; Peng & Liu, 2019; van de Lindt et al., 2018). My goal in this study was to gather data to determine the feasibility of incorporating the Sponge City concept on the HMGP–acquired properties within North Carolina to improve stormwater management in flood–prone communities.

The Sponge City concept was created to improve a community's resilience and promote sustainable living through disaster recovery. Encouraging the adoption of the concept on HMGP–acquired properties may promote innovations in flood management and contribute to positive social change. The feasibility of adopting the Sponge City concept within flood mitigation efforts to support the sustainability of the community and its potential contribution to positive social change was explored.

Concepts, Models, and Theories

The conceptual framework of this study included the concept of disaster recovery and the theory of resilience and stability in socio–ecological systems (Holling, 1973). According to Smith et al. (2017), disaster recovery is,

> The differential process of restoring, rebuilding, and reshaping the physical, social, economic, and natural environment through pre–event planning and post–event actions that enhance the resilience and adaptive capacity of assistance

> networks to effectively address recovery needs that span rapid and slow–onset hazards and disasters. (p. 12)

A community's resilience is dependent upon economic, social, and public organization functioning and the natural environment, which are collectively and individually necessary for responding immediately to disasters and recovering in the long–term (van de Lindt et al., 2018). Folke et al. (2002) explains,

> Resilience, for social–ecological systems, is related to (i) the magnitude of shock that the system can absorb and remain within a given state, (ii) the degree to which the system is capable of self–organization, and (iii) the degree to which the system can build capacity for learning and adaptation. (p. 438)

I used the theory of resilience in social–ecological systems in this study to explain the association between North Carolina's capacity and resilience and the state's physical means of resilience.

Resilience in social–ecological systems involves an equilibrium between change and constancy in a continual practice of learning and reacting to social motivations for change through coping mechanisms, adaptability, and transformability (Akamani, 2012). Coping mechanisms are generally considered initial reactions to adverse situations as a short–term resolution to threats and are significant because they can either initiate vulnerability or the capability to adapt (Adger, 2000; Berkes & Jolly, 2001). Adaptability, in this context, refers to how individuals, families, and communities revise area structures and establishments and alter their building procedures to promote sustainable living (Berkes & Jolly, 2001). Transformability refers to the system's capability to generate

innovative systems or untested developments when social, ecological, or financial circumstances cause the current system to become indefensible (Folke, 2006; Walker et al., 2004). Adger et al. (2005) asserted that perspectives of resilience are profoundly distinct from the perspectives of sustainability because they strive to construct the "adaptive capacity of social–ecological systems to respond to future surprises," while perspectives of stability focus on controlling already stable systems (p. 1037). When using the theory of resilience in social–ecological systems as a lens, community resilience may function as a universal foundation for working toward the sustainability of flood–prone communities during unpredictable future climate change consequences, with coping mechanisms, adaptability, and transformability as distinctive characteristics of community resilience (Akamani, 2012).

Relevance to Public Organizations

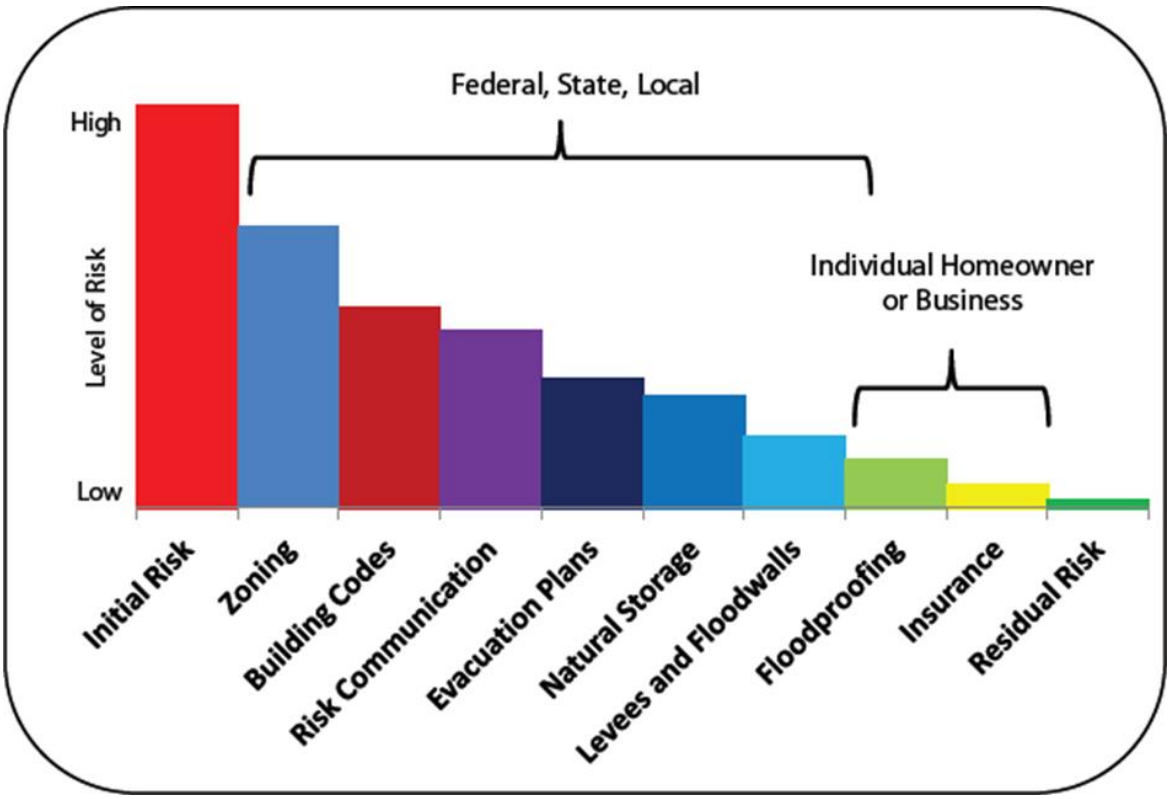
Historically, there has been consistency in the training of flood management administrators, with little change. Since the creation of the Hazard Mitigation Grant Acquisition/Buyout Program in 1993, more than 92 storms (tropical depressions, tropical storms, or hurricanes) have made landfall in North Carolina. From the program's inception through 2018, North Carolina has received over 5,600 homes (excluded are Hurricane Matthew acquisition/buyouts) through the Hazard Mitigation Grant Acquisition/Buyout Program and 55,000 across the United States (Salvesen et al., 2018). These acquired properties are strategically located within high–risk areas and must remain as open spaces, making them prime locations for administering the Sponge City

concept. The potential benefits of incorporating the Sponge City concept may prove instrumental in further reducing the possibility of flooding.

Various types of flood management systems with diverse outcomes, designs, and costs have been proven effective in eliminating standing water. Floodplain management ordinances (zoning) are more commonly used, as represented in figure 2 (National Research Council, 2013), which addresses flood management systems.

Figure 2

Examples of Flood Management Systems



Note. The illustration shows the several types of flood management systems and their respective level of risks. From *Levees and the National Flood Insurance Program: Improving Policies and Practices*, by National Research Council, 2013. (https://doi.org/10.17226/18309). CC–BY 2.0.

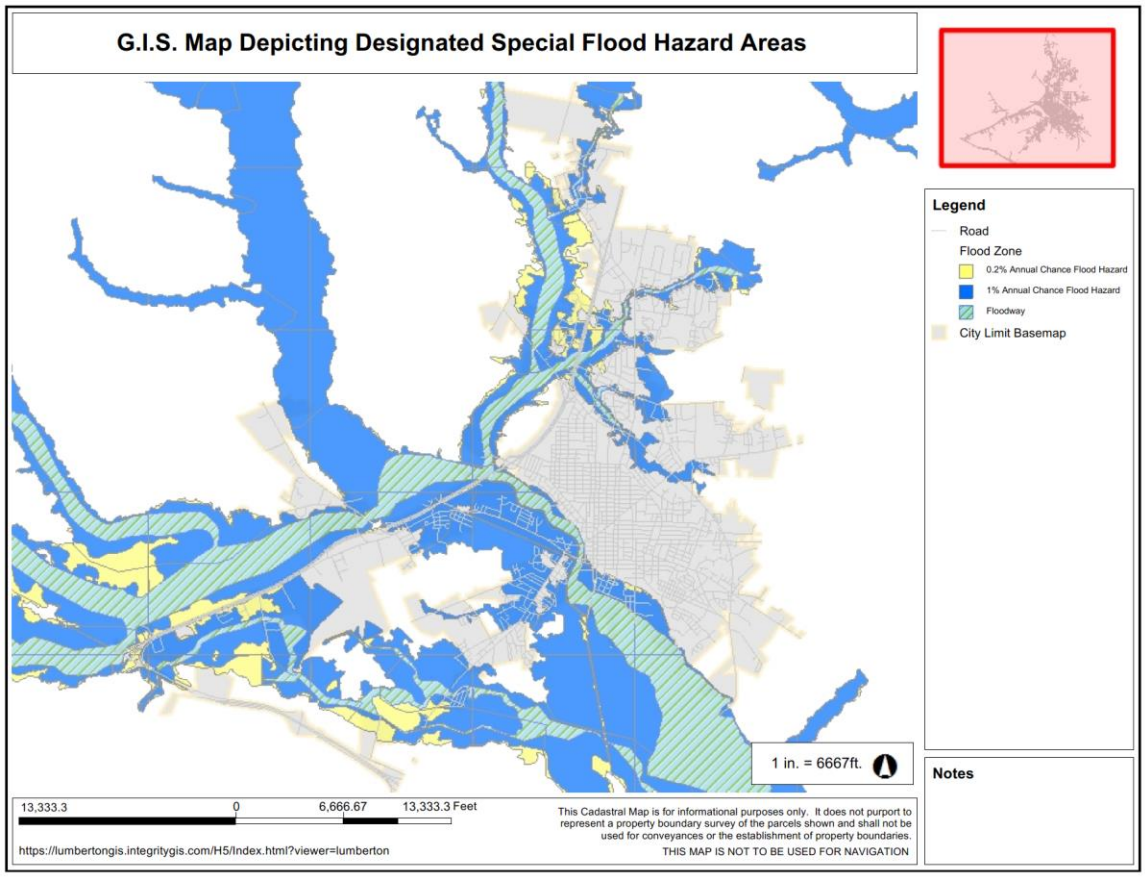
Retention and detention systems are widely used and considered the norm when it comes to modern–day flood management. Stormwater management systems control stormwater runoff by regulating the collection, storage, and movement of stormwater. These systems are widely used to improve drainage and are typically required during new residential, commercial, and other types of developments (National Academies of Sciences, Engineering, and Medicine, 2016).

Floodplain management ordinances, typically outlined in the zoning code, rely on stormwater management approaches that require added restrictions on new buildings and renovation of existing buildings within a federally designated Special Flood Hazard Area (SFHA; see Figures 3 and 4). The intent of the specific construction guidelines is to assist communities in preparation for and recovery from flood disasters (National Research Council, 2013). However, in recent years, climate change due to global warming has been a topic of discussion among politicians, both foreign and domestic (Lindsey & Dahlman, 2021).

Climate change is the change in the Earth's climate due to natural and/or human influences (Wuebbles et al., 2017). Evidence for a changing climate is seen in the increase in natural disasters such as tornadoes and hurricanes. Over the past 52 years, scientists have researched profound changes in temperature in the United States (Jayawardena & Herath, 2018) due to an increase in human influences, such as the continual production of greenhouse gases. With the environmental changes and the potential for increased flooding, supplemental concepts are needed to address the changes.

Figure 3

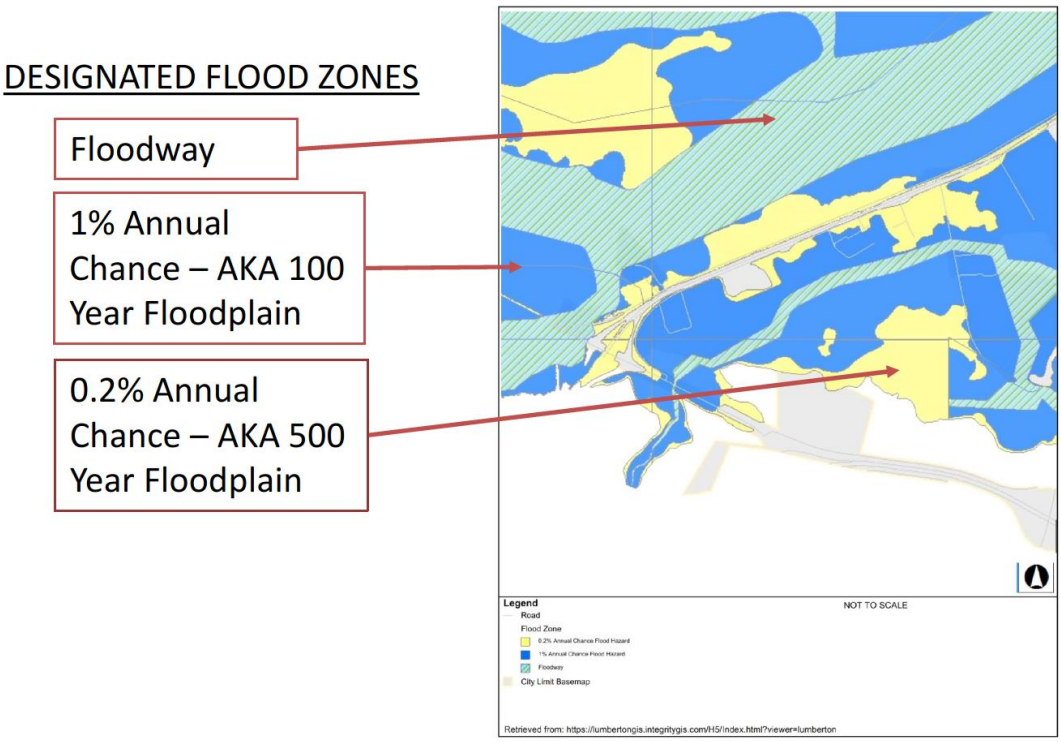
G.I.S. Map Depicting Designated Special Flood Hazard Areas



Note. G.I.S. map depicting the locations of the Special Flood Hazard Areas for a North Carolina FEMA–designated municipality. FEMA engineers thoroughly studied the community and determined these areas to be high–risk areas for flooding.

Figure 4

G.I.S. Map Descriptions of Designated Special Flood Hazard Zones



Organization Background and Context

Over the last 10 years, North Carolina communities have witnessed several debilitating hurricanes and tropical storms. These storms caused property damage, lost wages, and death. Some communities suffered back–to–back losses from Hurricane Matthew, which occurred in 2016, Hurricane Florence in 2018, Hurricane Dorian in 2019, and Hurricane Isaias in 2020 (U.S. Dept. of Commerce).

Hurricane Matthew

Hurricane Matthew made landfall in North Carolina on October 8, 2016, as a tropical storm, bringing historic rainfall and massive flooding. It came on the heels of Tropical Storms Julia and Hermine, which left the soils saturated (U.S. Dept. of Commerce).

Floodwaters inundated large portions of Interstate 95, rendering them impassable. The flooding of water treatment plants shuttered the municipal water supply for weeks, thousands were displaced from their homes, and access to lifesaving food and medical treatment was disrupted (The National Weather Service National Oceanic and Atmospheric Administration, 2016). Furthermore, Hurricane Matthew's destruction caused $4.8 billion in damages to North Carolina alone (North Carolina Department of Public Service, 2018a).

FEMA obligated North Carolina a total of $60,869,540 for the acquisition of 472 properties through the Hurricane Matthew Hazard Mitigation Grant Program (North Carolina Department of Public Service, 2018b).

Hurricane Florence

Hurricane Florence made landfall on the Wrightsville, North Carolina shore on September 14, 2018, bringing high winds, 10–foot storm surges, record–breaking rainfall, and severe flooding to many communities devastated by Hurricane Matthew 2 years prior. Hurricane Florence caused in excess of $22 billion in damages statewide and 50 deaths of North Carolina residents (North Carolina Department of Public Service, 2020).

FEMA obligated North Carolina a total of $24,857,390 for the acquisition of 172 properties through the Hurricane Florence Expedited Acquisitions – Hazard Mitigation Grant Program (North Carolina Department of Public Service, 2019).

Hurricane Dorian

Hurricane Dorian formed on August 24, 2019, and dissipated on September 10, 2019 (The National Weather Service National Oceanic and Atmospheric Administration, 2019). Eastern North Carolina felt the impact of Hurricane Dorian on September 5, 2019, and was declared a major disaster by the state of North Carolina on October 4, 2019. From this declaration, North Carolina was obligated $3,325,190.71 through the HMGP (Federal Emergency Management Agency, n.d.) for the acquisition of eight residential structures (U.S. Department of Homeland Security FEMA Region IV., 2022b).

Hurricane Isaias

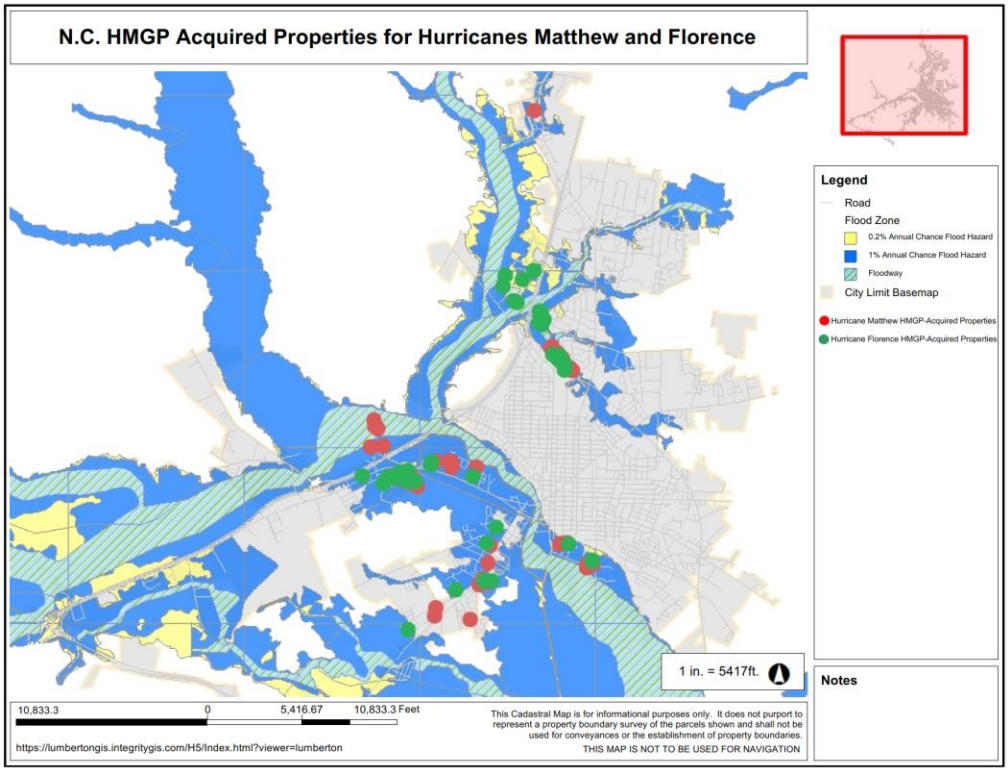
Hurricane Isaias made landfall on Ocean Isle Beach, North Carolina, on August 3, 2020, bringing high winds near 85 miles per hour (The National Weather Service National Oceanic and Atmospheric Administration, 2020). FEMA obligated $498,835.20 in HMGP funds to assist with damages caused by Hurricane Isaias (North Carolina Department of Public Service, ND).

Many communities affected by the hurricanes received HMGP–Acquisition/Buyout Program grants to acquire and redevelop properties, within a designated SFHA, into low–impact development. Under the HMGP–Acquisition/Buyout Program, one North Carolina community, notably, received funds for Hurricane Matthew, Hurricane Florence, and Hurricane Dorian.

For this study, I identified the locations of HMGP–acquired properties for two major hurricanes (Hurricane Matthew and Florence). Figure 5 illustrates the strategic locations within the designated floodplain that are ideal for implementing the Sponge City concept.

Figure 5

G.I.S. Map of N.C. HMGP–Acquired Properties for Hurricanes Matthew and Florence



Note. The map reflects where acquisitions occurred within a North Carolina FEMA–designated municipality, prime locations for the administration of the Sponge City concept. Locations retrieved from Hurricane Matthew Hazard Mitigation Grant Program (HMGP) Project 4285–0052–R, by U.S. Department of Homeland Security FEMA Region IV. (2018) and Hurricane Florence Hazard Mitigation Grant Program (HMGP) Project 4393–0033–R, by U.S. Department of Homeland Security FEMA Region IV. (2022a).

Role of the D.P.A. Researcher

Profession

I am an urban planner trained and certified in public administration, floodplain administration, and zoning administration. My early contributions to flood management were as an assistant to the Planning Director, the floodplain administrator at that time. After 21 years as an assistant to the floodplain administrator, I was promoted to Planning Director and floodplain administrator. Witnessing the devastation of Hurricanes Matthew, Florence, and Dorian, firsthand, I realized there is more that could be done to minimize the risk of flooding. Combined with my love of learning and desire to help the community, I decided to further my education beyond the Master of Public Administration. Now finalizing my doctoral project and the knowledge I have gained, I will continue to be a wealth of knowledge and continue my efforts to be a positive asset to the community.

Role in the Doctoral Project

My role in this study was to act as the primary instrument for collecting data. The data collection procedures involved three sources of data to meet the requirements of triangulation: interviews, public domain government publications and documents, and scholarly articles. Primary data was collected from professional interviews and secondary data was collected from government publications, government documents, and scholarly articles.

Primary data was collected through interviews delivered to North Carolina flood management professionals and existing scholarly articles. Access to participants was

gained through my personal connections; as such, no signed participant agreement with any client organization was required. Secondary data was collected through public domain government publications and acquisition documents from a North Carolina municipality participating in the HMGP. The data was used to observe potential suitability for their use as sponge lots.

Motivations

My primary motivation for the study was to find an alternative way to prevent future devastation from flooding. Witnessing the destruction flooding had on the people of the community, the feeling of helplessness that overcame me was the motivating factor in my decision to continue my education and garner a better understanding of the history, cause, and prevention mechanisms available to further mitigate the risk of flooding. Continuing my education, researching alternative flood mitigation tools, and implementing the Floodplain Management Program have improved me professionally and personally.

Potential Biases

At the start of the doctoral program, I identified any potential bias that may be present. My most prominent potential bias is my empathy for others and willingness to try to walk the same path as those families that lost everything twice within two years. Therefore, to eliminate bias, I approached this study using a research technique that eliminated the need for member checking. The research techniques I chose were analyzing governmental archives, conducting interviews, and researching independent peer–reviewed publications. Conducting interviews and researching existing data

provided in public domain government publications and documents, and peer–reviewed publications eliminated the need for member checking, significantly eliminating potential researcher bias (Yin, 2018).

Summary

Officials in North Carolina, like many other states, are constantly looking for ways to improve their current flood management systems to increase their long–term sustainability. More research is needed on incorporating the Sponge City concept on federally granted properties. North Carolina is uniquely positioned to provide data that may be used to provide a needed service to other flood–prone communities. This service may assist with the community's continued growth and improve sustainability and resiliency.

Section 3: Data Collection Process and Analysis

Introduction

The problem faced by flood–prone communities is the lack of data available to municipalities related to using federally granted properties to reduce flooding by implementing the Sponge City concept. The purpose of this qualitative case study was to gather data through thematic analysis to determine the feasibility, appropriateness, and perceived effectiveness of adopting and incorporating the Sponge City concept within the flood management policies of flood–prone communities. The thematic analysis is the method I used to gather data from flood–prone communities within North Carolina, using interviews, scholarly articles, and government documents. I conducted interviews, consisting of seven questions, with six North Carolina flood management professionals. Additionally, I gathered data relevant to and supportive of the problem statement from several databases and various federal, state, and local government documents. I used triangulation by analyzing three sources of data and combining the results into one comprehensive report. The following pages outline the steps I took to complete this Professional Administrative Study, adhering to Walden University's guidelines.

Practice Focused Questions

Community resilience is when the community utilizes resources available to address and recover from natural flooding disasters. In this study, I aimed to address the knowledge gap between incorporating the Sponge City concept on federally granted properties within conventional flood management systems to further enhance resilience within the community.

Research Question

My intention for this study was to obtain data from the research question to explore if implementing the Sponge City concept on HMGP–acquired properties within North Carolina's flood–prone communities will reduce the amount of flooding within these communities. The research question was: What is the impact of administering the Sponge City concept on North Carolina's HMGP–acquired properties have on lessening the severity of flooding?

I asked participants these questions to collect data from professionals experienced in flood management and identify the gaps in the knowledge about the concept and its implementation on HMGP–acquired properties, a critical step to the completion of this case study.

Interview Questions

1. What is the extent of your understanding of the Sponge City concept for flood management?
    a. What is the extent of your understanding of the federally administered Hazard Mitigation Grant Program (HMGP)–Acquisition/Buyout Grant?
2. What strengths do you associate with adopting the Sponge City concept to manage flooding in North Carolina's flood–prone communities?
3. What weaknesses do you associate with adopting the Sponge City concept to manage flooding in North Carolina's flood–prone communities?

4. What opportunities do you foresee with administering the Sponge City concept on properties acquired through the federally funded HMGP–Acquisition/Buyout Grant in North Carolina?
5. What threats/barriers do you foresee with adopting the Sponge City concept using the land acquired under the federally funded HMGP–Acquisition/Buyout Grant in North Carolina?
6. What are your thoughts on the appropriateness of incorporating the Sponge City concept on federally funded HMGP–Acquisition/Buyout Grant properties in North Carolina, given the current flood risk management systems and floodwater projections?
7. Do you believe incorporating the Sponge City concept on federally funded HMGP–Acquisition/Buyout Grant properties will further reduce the impact of flooding on vulnerable communities?
    a. Please explain why or why not.

Sources of Evidence

I used interviews, government archives, and several databases (i.e., EBSCOhost, ProQuest, Google Scholar, and JSTOR) to search for relevant sources of scientific or published sources of data, including academic publications within scientific journals, to include case studies regarding environmental management, environmental planning, publications on federal floodplain management and geoscience independent peer–reviewed publications. My use of a qualitative single case study design was suitable for gathering data on the problems faced by flood–prone communities, the lack of data

available to municipalities on incorporating the Sponge City concept on acquired properties, and the flood management professional's lack of knowledge related to the adoption of the Sponge City concept. Additionally, with my 23 years of experience as an urban planner for a municipality that has experienced exponential flooding and my knowledge as a member of the North Carolina Association of Floodplain Managers, I addressed the need for advanced methods to further reduce flooding within flood–prone communities.

Furthermore, I designed this study to collaborate the participants' perspectives and the data gathered from literature reviews, peer–reviewed articles, internet sites, government documents, books, and journals. For this study, I recorded, transcribed, and analyzed data to provide evidence–based scholarly feedback on the administration of the Sponge City concept on HMGP–acquired properties.

Published Outcomes and Research

I coordinated the research method and questions by collecting the data necessary to explore the potential of implementing the Sponge City concept on HMGP–acquired properties. I combined data from government documents, interviews, and other relevant research sources to proactively provide flood management professionals with the tools needed to address flooding using HMGP–acquired properties.

The keywords I entered into the databases individually or in combination included *sponge cities, Sponge City concept, Sponge City model, sponge lot, HMGP, North Carolina Hazard Mitigation Grant Program, Hazard Mitigation Grant Program, FEMA grants, acquisition, buyout, green infrastructure, pocket parks, rain gardens, permeable*

pavements, green spaces, stream daylighting, spongy soils, low impact development, flooding, floods, floodplains, flood management, stormwater, stormwater management, North Carolina, flood–prone communities, resilience, floodwater management, gray infrastructure, and *social–ecological systems*. The scope of the literature review spanned from 1973 to 2022 and included peer–reviewed articles, internet sites, government documents, books, and journals.

Archival and Operational Data

I collected qualitative data from federal, state, and local officials and private administrators regarding their knowledge and thoughts on effectively addressing flooding within North Carolina's flood–prone communities. In addition to interviews, I gathered various federal, state, and local government documents, case studies of Sponge City implementation and the HMGP–Acquisition/Buyout Program, flood risk and stormwater management systems, property location demographics, and property evaluations.

I accessed the following studies that are relevant to and support the problem statement:

- Li et al. (2018) conducted a case study of Changzhou City, China's implementation of the Sponge City concept. The authors of this case study discussed the objectives and strategies for implementing Sponge Cities. The process control strategy the authors recommended included improving urban drainage and flood control capabilities, regulating accumulative runoff, reducing storm flow, and ecological monitoring of lakes and rivers. The authors recommended objectives for sponge cities to perform as green

infrastructures, which include water quality and security improvements, enhanced water ecosystems and infiltration, and more efficient water use.

- Hampshire & Sipes (2019) discussed the potential benefits of using green infrastructure in urban flood–prone communities and their impact on flooding. The results of the study showed that green infrastructures would likely enhance the functioning of current urban drainage systems, reduce flood occurrence in the communities, promote accessibility to isolated areas by improving roads and trails, and encourage outdoor activities.
- Lieberherr & Green (2018) argued that green infrastructure could promote sustainable stormwater management. Based on an empirical analysis of case studies, the authors asserted that adopting green infrastructure produces ecological and social benefits, including more access to green space, improved public health and water quality, restoration of natural hydrology, and improved habitat for beneficial organisms.
- Nguyen et al. (2020) assessed opportunities for existing urban stormwater management models to integrate the Sponge City model. Based on their assessments, the authors proposed a new, simulated Sponge City model framework that integrated economic, environmental, and social characteristics of Sponge City infrastructure alternatives. The new Sponge City framework included multiple layers to show how implementation could occur for different stormwater drainage systems with different urban watershed criteria. The authors proposed future opportunities to increase the efficacy of spatial

data–sharing systems and improve collaboration in designing Sponge City models.

- Zuniga–Teran et al. (2020) acknowledged green infrastructure as an encouraging approach to assisting flood–prone communities to adapt to climate change. However, the authors also acknowledged that the use of green infrastructure as a method to enhance urban resilience is not well understood, and several implementation challenges still exist. The challenges with implementing green infrastructure effectively include: (a) design criteria, (b) regulatory channels, (c) socio–economic characteristics, (d) funding, and (e) innovation. Based on these challenges, the authors proposed a context–dependent and people–centered approach to promoting the integration of green infrastructure into urban planning.

Evidence Generated for the Administrative Study

Participants

I gathered data from six North Carolina flood management professionals. The participant selection process was based on the following criteria: (a) each participant worked with or had extensive knowledge of flood–prone communities within North Carolina, and (b) all participants lived and worked in the study area (see Appendix A). Participants included women and men of all ages, and their national origin, race, color, religion, disability, sex, and familial status were not factors. No incentives were offered.

Procedures

Before beginning this study, I obtained permission from Walden University IRB (#10–07–22–0030486) to conduct my research. This study included interviews conducted via video conferencing, teleconference, or in person, consisting of seven questions intended to engage their knowledge and thoughts on adopting the Sponge City concept on HMGP–acquired properties to address flooding in North Carolina's flood–prone communities.

I collected individual participants' data relating to their perspectives on the Sponge City concept initiation and the HMGP–Acquisition/Buyout Grant within North Carolina. The data I researched included tenure within federal, state, and local flood mitigation. Other items I researched included their knowledge of the keywords searched in the database (sponge cities, Sponge City concept, Sponge City concept, sponge lot, HMGP, North Carolina Hazard Mitigation Grant Program, Hazard Mitigation Grant Program, FEMA grants, acquisition, buyout, green infrastructure, pocket parks, rain gardens, permeable pavements, green spaces, stream daylighting, spongy soils, low impact development, flooding, floods, floodplains, flood management, stormwater, stormwater management, North Carolina, flood–prone communities, resilience, floodwater management, gray infrastructure, and social–ecological systems). Furthermore, the sample size was not random, and I used inductive reasoning to analyze the results.

Protections

I will not share the identities of the participants, and I will keep the identities of individual participants in this study private. Furthermore, I will not use the participants' personal information, such as name, address, and organization, outside of this research. Any identifiable information will only be used for data analysis and is not published in this study's results. I documented each response in a journal, where their responses will remain confidential and locked in a secure location. The data collected will be kept in an obscure location for a minimum of five years, the duration outlined by the requirements of Walden University. With every interview, there was a disclaimer stating that the participant's identity or agency, outside of my own, would only be used to conduct research and remain confidential.

Analysis and Synthesis

To enhance the validity of this project, I used triangulation by analyzing three sources of data and combining results into one comprehensive report. NVivo, a data analysis software, was used to categorize, code, and analyze data. The NVivo software "searches, organizes, categorizes, and annotates textual and visual data. Programs of this type also frequently support theory–building through the visualization of relationships between variables that have been coded in the data." (König, n.d.). Using the NVivo software, the coding procedures I performed included a combination of strategies in first–cycle coding: descriptive coding for interviews and evaluation coding for documents (Saldaña, 2016). Pattern coding was used during second–cycle coding to group first–cycle codes into themes (Saldaña, 2016). These coding procedures apply to thematic

analysis (Braun et al., 2014), which is the chosen analytical strategy for this study. The thematic analysis involved six steps: (1) becoming familiar with the data; (2) developing initial codes; (3) creating themes; (4) re–assessing themes, merging similar themes, and discarding irrelevant themes; (5) naming retained themes; and (6) reporting results (Braun et al., 2014). To ensure the confirmability of the study's findings and to mitigate the influence of researcher bias, I developed an audit trail during the analysis process. Such a trail enables a researcher to establish reasoning for each step taken during analysis in a manner that can be reviewed and assessed by others (Scharp & Sanders, 2019).

Analysis of the results concludes with a well–researched and supported synthesis for implementing the Sponge City concept on HMGP–acquired properties, the intended purpose of this qualitative single case study.

Summary

In summary, the data collection process and analysis were used to provide ways to improve the community's flood management practices, build sustainability and improve resiliency. The individuals selected to participate in this study were North Carolina flood management professionals. The scholarly literature was obtained from EBSCOhost, ProQuest, Google Scholar, and JSTOR, and the government documents were obtained from various government archives. The use of the data gathered was to provide evidence–based scholarly feedback intended to provide flood management professionals with the tools needed to proactively improve flood mitigation and influence positive social change.

Section 4: Evaluation and Recommendations

Introduction

The purpose of this case study was to determine if administering the Sponge City concept on strategically located North Carolina HMGP–acquired properties would be feasible, appropriate, and effective in improving stormwater management in flood–prone communities. The motivation behind this research was to address the problem that flood management professionals face with the increased risk of flooding due to climate change causing frequent and substantial tropical precipitation. To adequately address the increased risk requires flood management professionals to find alternative means to reduce flooding risks within flood–prone communities. Administering the Sponge City concept on federally granted properties is another lesser–known avenue to provide flood–prone communities critical protection to build sustainability.

The genesis of this research surfaced from witnessing many North Carolina communities experience massive and frequent flooding that resulted in many residents fleeing their homes and communities. A few studies have demonstrated the effectiveness of administering the Sponge City concept; however, its incorporation into HMGP–acquired properties have yet to be discovered.

I obtained the sources of evidence from interviews with six North Carolina flood management professionals, government documents, and scholarly articles. The sources of evidence comprised information I used to thoroughly address the incorporation of the concept on federally granted properties. During my analysis, I identified data that

highlights the gap in the knowledge of North Carolina's flood management professionals assigned to manage North Carolina's stormwater and flood management systems.

My purpose for this study is to answer the research question, what is the impact of administering the Sponge City concept on North Carolina's HMGP–acquired properties on lessening the severity of flooding? In the next sections, I will discuss my findings and provide recommendations for the potential implementation of the Sponge City Concept on the HMGP–Acquisition/Buyout properties within North Carolina's flood–prone communities.

Findings and Implications

Data Collection

During the study's data collection, I obtained archival data through public records request from a North Carolina FEMA–designated municipality that has acquired properties under the Hazard Mitigation Grant Program (HMGP). To assess the knowledge of the concept and the HMGP–Acquisition/Buyout Program, I interviewed six North Carolina flood management professionals with varying backgrounds and experiences within the practice. Recorded interviews ranged from nine to 20 minutes, and I used NVivo, a data analysis software, to code, transcribe, interpret, and analyze the content of the data. This software identified patterns within the qualitative data based on the study's research question.

During my research, I found unexpected limiting factors that enabled me to conduct confidential interviews. One initial volunteer agreed to provide their input but would not agree to be recorded, and providing Walden University's guidelines on

confidentiality did not change their feelings. However, I gathered information from six North Carolina flood management professionals through the confidential interview protocol (see Appendix B). As stated in the previous section, I was able to gather a majority of the information from public information sources.

Document Analysis

I conducted research for this case study by interviewing participants directly involved or impacted by the phenomenon of flooding and who have worked or are familiar with the HMGP–Acquisition/Buyout Program. According to Marrelli (2007), interviewing participants grants them an opportunity to provide their input based on their knowledge and understanding of the events they experienced. Prior analysis of government documents obtained from a community within North Carolina presented background into the study topic and was beneficial to understanding and substantiating the data obtained from the interviews.

This community was chosen because it represents a typical flood–prone community within North Carolina, according to the results of a flood inundation analysis (Musser, Watson, & Gotvald, 2017). Two main factors I used to choose the community were: (a) its participation in the HMGP and (b) its acquisition of properties through the HMGP. In this study, I analyzed federal, state, and local documents and policies that further substantiate the strategies for administering the program, obtaining properties, and the current state of the acquired properties. Analyzing secondary data helped me, as a researcher, understand and substantiate the participants' data about the phenomenon and the factors associated with the program and the Sponge City concept.

I also researched other documents to conduct a cost–effectiveness analysis of administering the Sponge City concept on the acquired properties. I analyzed documents pertaining to the installation of green and grey infrastructures, soil types, lot sizes, existing impervious surfaces, and estimated maintenance costs. Data from a case study conducted by Ma et al. (2017) showed the cost of construction of the Sponge City concept could be reduced by 15% and the maintenance cost reduced by 5% compared to traditional grey infrastructure construction and maintenance (see Figure 6).

Figure 6

Construction Cost and Maintenance of Cost of Sponge City

Table 1. Construction cost and maintenance cost of sponge city.

Content of Sponge City Construction	Investment cost (10,000 RMB/y)		Maintenance cost (10,000 RMB/y)	
	Conventional model	Sponge city model	Conventional model	Sponge city model
Total	**21,860**	**18,426**	**876**	**831**
1) Construction and operation maintenance in residential area	3960	5576	96	144
a) Roof greening	0	200	0	18
b) Pavement (hard/ permeable)	1440	2160	15	30
c) Green space (traditional/ecological)	2160	2520	65	72
d) Green belt (traditional/grass planting ditch)	360	396	16	18
e) Rainwater storage device	0	300	0	6
2) Construction and maintenance of rainwater pipe network and pump station	6500	3900	360	340
3) Watercourse ecological construction and maintenance	5100	4500	270	250
4) Construction and operational maintenance of wastewater pipeline and wastewater treatment plant	4500	3250	141	91
5) Construction and operational maintenance of waterlogging prevention facility	1800	1200	9	6

Note. This illustration provides a comparison of the construction and maintenance costs of a Sponge City vs. conventional model. From *Assessment of Climate Technology Demands in Chinese Sponge City*, by Ma et al., 2017. doi:10.4236/gep.2017.512008. CC–BY 2.0.

Research Question

The qualitative research question was: What is the impact of administering the Sponge City concept on North Carolina's HMGP–acquired properties on lessening the severity of flooding? I researched and compared data obtained from government documents, interviews, and scholarly articles. The primary source of data was in–depth interviews with six North Carolina flood management professionals. Additionally, I

reviewed documents related to FEMA, the HMGP–Acquisition/Buyout Program, and various documents related to a specific municipality's acquired properties. Additional information regarding the function, sustainability, and flood reduction capabilities of the Sponge City concept was obtained from peer–reviewed articles.

The primary data source for this qualitative single case study consisted of six flood management professionals who worked or have worked in the field of flood management for a community within North Carolina. I used pseudonyms to ensure the complete confidentiality of the participants. Participant demographic data from flood management professionals who have participated in the public and/or the private sector within North Carolina, appear in Table 1. Three participants (50%) were public flood management professionals who work or have worked for a municipality within North Carolina, two (33%) worked for private companies, and one (17%) worked for both public and private sectors throughout their career. The years of experience ranged from 4 to 35 years. Two participants (33%) were male, and four participants (67%) were female. The average interview time was 13 minutes and 9 seconds.

Table 1

Participant Demographic Data

Participant	Position	Location	Years of Experience	Public or Private Organization	Length of interview
P–1	Flood management professional	North Carolina	22	Public	10.14 minutes
P–2	Flood management professional	North Carolina	8	Private	14.23 minutes
P–3	Flood management professional	North Carolina	4	Private	11.58 minutes
P–4	Flood management professional	North Carolina	4	Public	11.56 minutes
P–5	Flood management professional	North Carolina	25	Private	20.17 minutes
P–6	Flood management professional	North Carolina	35	Public/Private	8.51 minutes
				Total:	76.19 minutes

I asked each participant the same seven semistructured questions. I analyzed the data from the interview questions, government documents, and peer–reviewed articles, and I revealed some participants lack knowledge of the Sponge City concept and its influence on flood management efforts. In the following subsections, I will discuss key data that was instrumental to the outcome of this study.

Interview Questions

The purpose of Interview Question 1 was to gauge the participants' knowledge of the Sponge City Concept and the HMGP–Acquisition/Buyout Program. Interview

Question 1 was: “What is the extent of your understanding of the Sponge City concept for flood management? And what is the extent of your understanding of the federally administered Hazard Mitigation Grant Program (HMGP) – Acquisition/Buyout Grant?” Two participants stated they were familiar with the Sponge City concept, and four expressed unfamiliarity with the concept. However, all six expressed their in–depth knowledge of the HMGP–Acquisition/Buyout Grant.

Interview Question 2 was: “What strengths do you associate with adopting the Sponge City concept to manage flooding in North Carolina's flood–prone communities?” One participant stated that the program would alleviate costs associated with flood damage to the homeowner and reduce flooding in other areas. One participant stated that it would alleviate flooding and keep the residents in the community. One participant stated that the concept would decrease flooding within the flood hazard areas and reduce flooding within an entire community. One participant stated that the concept would show the difference between being proactive and reactive. The participant continued to state that the concept could prove to be efficient in improving long–term resilience and sustainability. And two participants declined to answer due to their unfamiliarity with the concept.

Interview Question 3 was: “What weaknesses do you associate with adopting the Sponge City concept to manage flooding in North Carolina's flood–prone communities?” One participant stated the only weakness they foresee is the loss of tax revenue with the acquired properties due to the maintenance of the infrastructure. One participant stated that the most significant weakness is the cost of implementing the concept. They

continued to mention grants available to assist with the costs. One participant stated that a weakness of the concept would be the timing and funding associated with implementing the model. Three participants expressed their desire not to comment further on the concept.

Interview Question 4 was: "What opportunities do you foresee with administering the Sponge City concept on properties acquired through the federally funded HMGP–Acquisition/Buyout Grant in North Carolina?" One participant stated that an opportunity would be to install the infrastructure and alleviate massive flooding. One participant stated that an opportunity would be the construction of public parks that will improve social connections and bring the community outdoors to be more active. Both aspects would benefit the health of individuals and the community. One participant stated that the opportunities with its administration are that most of the resources needed to reduce flooding within these vulnerable communities are available. Furthermore, it will improve sustainability. One participant stated that it has the potential to bring jobs, traffic, and beautification to the community if done correctly. One participant stated that it should bring about many opportunities since many properties and people still need assistance. One participant expressed their desire not to comment.

Interview Question 5 was: "What threats/barriers do you foresee with adopting the Sponge City concept using the land acquired under the federally funded HMGP–Acquisition/Buyout Grant in North Carolina?" One participant stated that the funding and time required to implement the concept would be a barrier. One participant stated that two potential barriers that come to mind are if the land is too wet or the community might

not want it. One participant stated that the unfamiliarity of the concept and potentially having to hire more staff to maintain the properties could be a significant barrier. One participant stated that the lack of information, education, and the implementation process would be barriers to adopting the concept. Two participants expressed their desire not to comment.

Interview Question 6, "What are your thoughts on the appropriateness of incorporating the Sponge City concept on federally funded HMGP–Acquisition/Buyout Grant properties in North Carolina, given the current flood risk management systems and floodwater projections?" One participant stated that it is needed to reduce the amount of flooding in flood–prone areas as well as those areas outside of the flood hazard zones. One participant stated that it could reduce flooding and eliminate people having to leave the community due to the destruction flooding has caused and potentially can cause. Two participants stated that it has the potential to reduce flooding disasters and may have a significant impact on the well–being of the residents and improve the future growth of the community. One participant stated that if the local government approves of the concept, they do not anticipate any problems with its implementation. One participant expressed their desire not to comment.

Interview Question 7, "Do you believe incorporating the Sponge City concept on federally funded HMGP–Acquisition/Buyout Grant properties will further reduce the impact of flooding on vulnerable communities? Please explain why or why not." One participant stated that the concept could significantly reduce flooding within flood–prone and surrounding communities. One participant stated that the concept would further

reduce the impact of flooding and improve sustainability. One participant stated that it would further reduce flooding and its impact on the community. One participant stated that incorporating the model would assist flood management professionals with accepting new technology and new ways a community can withstand future flooding events. Two participants expressed their desire not to comment.

After further discussions, all six participants showed interest in learning more about the concept. The interview questions were intended to gauge the flood management professional's understanding of the Sponge City concept, the HMGP–Acquisition/Buyout Program, and their thoughts on merging the two to decrease the impact of flooding within venerable communities.

Coding

This case study involved my exploration of North Carolina's flood management professionals' knowledge of a new stormwater management concept that would reduce flooding within flood–prone communities. The data evaluation suggests that many of North Carolina's flood managers need to familiarize themselves with the concept and have expressed their desire to learn more. Establishing a general guideline for the education and administration of the Sponge City concept on acquired certified flood–prone properties will enhance mitigation efforts, further reducing the amount of flooding within flood–prone communities.

The participants responded to the seven open–ended questions I developed and provided their understanding of the HMGP–Acquisition/Buyout Program and the Sponge City concept. I analyzed and coded each participant's responses to each interview

question separately, followed by a second analysis of all responses combined. Both garnered the same major themes (see Table 2): (a) familiarity with HMGP–Acquisition/Buyout Program, (b) potential to reduce flooding, (c) unfamiliarity with the Sponge City concept, and (d) concern with the cost and time.

To identify the themes, I used two coding methods for data analysis. The first method was manual coding to group the responses into themes and codes. During this process, I looked for recurring words or phrases regarding their relevance to the research question. A ledger was used to document the hierarchical framework of the codes into top, mid and third–level codes. The second method I used was the NVivo Qualitative Research Data Analysis Software to code, transcribe, interpret, and analyze the interview data and identify themes within the data. The frequency of keywords assisted with formulating themes that uncover the knowledge and understanding of flood managers on administering the Sponge City concept on HMGP–acquired properties.

The first theme indicated the flood management professional's familiarity with HMGP's various programs and specific familiarity with the Acquisition/Buyout Program. The second theme indicated the concept's potential to reduce flooding. The third theme indicated the unfamiliarity with the Sponge City concept in stormwater management. The fourth theme indicated the concern with the cost and time associated with implementing the concept.

Table 2

Top Four Major Themes

Number	Groups and Keywords	Participant
1	Familiarity with HMGP–Acquisition/Buyout Program	P1,P2,P3,P4,P5,P6
2	Potential to reduce flooding	P1,P2,P3,P5,P6
3	Unfamiliarity with the Sponge City concept	P3,P4,P5,P6
4	Concern with the costs and time	P1,P3,P5,

Another analysis I conducted included a most common word count. The most common keywords allowed me to identify the major themes in Table 2. Table 3 identifies the top twenty frequently occurring words related to content and context. Table 4 combines the results of Tables 2 and 3 to identify the most frequently occurring words or Groups mentioned most frequently by participants.

Table 3

Top 20 Frequently Occurring Words and Groups Related to Content and Context

Number	Groups and Keywords	Frequency
1	Flood(ing)	34
2	Property(ies)	17
3	Community	15
4	Reduce/alleviate	11
5	Unfamiliar/not familiar	9
6	Sponge City	7
7	Funds(ing)/money	6
8	Barriers	5
9	Maintain(ance)	5
10	Implement	5
11	Acquire(ing)(ed)	4
12	Potential	4
13	Time	4
14	Hurricane	4
15	Resources	3
16	Tax	3
17	Familiar(arity)	3
18	Administer	3
19	Damage	3
20	Impact	3

Table 4

Nine Frequently Occurring Words and Groups Mentioned Most Frequently by Participants

Groups and Keywords	P1	P2	P3	P4	P5	P6	Frequency	Theme
Maintain(ance)	2	0	3	0	0	0	5	1,4
Implement	1	0	2	0	1	1	5	2,4
Funds(ing)/money	3	0	2	0	1	0	6	4
Sponge City	3	1	2	0	0	1	7	2,3,4
Unfamiliar/not familiar	0	0	2	6	0	1	9	3
Reduce/alleviate	3	1	6	0	1	0	11	1,2
Community	0	6	2	0	7	0	15	1,2,4
Property(ies)	4	1	9	0	0	3	17	1,2,4
Flood(ing)	8	10	14	0	0	2	34	1,2,3,4

Theme 1: Familiarity with HMGP–Acquisition/Buyout Program

Participant 1 (P1) indicated the HMGP–Acquisition/Buyout Grant provides funding to acquire properties within areas prone to flooding. Participant 2 (P2) also stated that property owners could sell their property to the federal government and the federal government will demolish the house. Participant 3 (P3)'s understanding of the grant program mirrors P1 and P2's, P3 also described the program as a way for the federal government to reduce the amount of flood–damaged properties and the elimination of potential HMGP funds that would be paid in the future.

Theme 2: Potential to Reduce Flooding

P1's position on the opportunities of administering the Sponge City model is it will help alleviate costs to homeowners due to repeated flooding events. Furthermore, the concept has the potential to reduce flooding within the surrounding areas. P2's expressions mirrored P1's and added that it would eliminate people having to leave their homes and eliminate the environmental concerns associated with flooding. P3 believes

that the potential to reduce flooding can have a significant impact on future growth and the well–being of its residents. P5 believes the concept would beautify the community, and bring jobs and traffic to the area. P6 stated that it would be a positive way to treat flooded properties.

Theme 3: Unfamiliarity with The Sponge City Concept

P3 explained their unfamiliarity with the Sponge City concept, however, they liken the concept to a typical sponge, where land is like a sponge and absorbs stormwater to reduce standing water and flooding. Participant 4 (P4) stated that they had never heard of the concept. Participant 5 (P5) also stated they are not aware of the model or its functions. Participant 6 (P6) stated although they have heard of the concept, it is unfamiliar to them.

Out of six participants, a majority (four out of six) have either never heard of the concept or heard of the concept but are not familiar with the functions, benefits, or risks to provide further comment. P1 indicated that the model assists with reducing flooding disasters. And P2 stated that the concept is a method where the ground is used to soak up the water to eliminate flooding in an area.

Theme 4: Concerns with The Costs and Time

P1 stated that the only weakness they foresee is the loss of tax revenue to the municipality due to the resources needed to maintain the lots without assistance from the federal government. P3's concerns also include a concern regarding lost tax revenue to the city. P3 further indicated their concerns about the cost associated with implementing the concept.

P1 and P3's concerns regarding the community's loss of tax revenue associated with implanting the concept contrasted with the focus of this study. The participant's lack of understanding of the Sponge City concept leads the participant to believe that the concept would reduce the community's tax base. On the contrary, the properties are purchased by the HMGP and granted to the municipality, therefore, the reduction of tax revenue was eliminated during the HMGP acquisition process. Furthermore, because the lots are granted to the municipalities, the cost of purchasing the property to implement the concept is also eliminated.

Additionally, research indicates the availability of funding opportunities through various federal and state grants. For instance, the United States Environmental Protection Agency (EPA) offers various grants for developing green infrastructure and managing, reducing, treating, or recapturing stormwater (U.S. Environmental Protection Agency, 2022). Another grant program offered to reduce the effects of climate change, assist communities with mitigation activities, and enhance resiliency to natural hazards is the Building Resilient Infrastructure and Communities (BRIC) grant program (Federal Emergency Management Agency, 2021). These programs are available to offset the cost of building resilient communities and improve pre–disaster mitigation efforts throughout the United States.

Analysis of Themes

Lack of education on the Sponge City concept was the controlling factor in the participants' responses. A primary concern amongst the participants was lost tax revenue and the costs of implementing the concept; however, the loss of tax revenue would

predate the concept's implementation, and federal and state funding is available to offset the costs.

Flood management professionals must familiarize themselves with the Sponge City concept and its potential contribution to their flood mitigation efforts. Implementing the concept on the available resource (acquired properties) will improve the community's health, safety, and welfare, further improving the community's sustainability and resiliency to flooding. Education, endorsements, specific guidelines, and implementation are the mitigating factors in the success of administering the concept on HMGP–acquired properties and influencing positive social change.

Recommendations

This qualitative single case study involved understanding North Carolina's flood management professional's knowledge of the Sponge City concept and the potential benefits of its incorporation on federally granted properties. Many flood management professionals are unaware of the concept and the benefits it can have on communities inundated by flooding events. Analysis of the interviews, government documents, and peer–reviewed articles, the costs associated with the aftermath of flooding disasters far outweigh the costs associated with administering the concept on federally granted properties.

While the Sponge City concept has resulted in improvements in a community's resilience to flooding, when introducing a new public policy that incorporates a new concept administered on federally granted properties, the concept must be vetted and outlined in a manner that will not conflict with the federal program's guidelines. The

HMGP–Acquisition/Buyout Program's guidelines are explicit and require strict administration. One prohibition is that the property must be cleared of all permanent structures and maintained as low–impact, environmentally friendly development, such as pocket parks, lakes, and rain gardens. Incorporating low–impact flood management systems will not infringe on the federal program's strict development guidelines and should be considered an effective means to flood mitigation.

I provide the following recommendations for incorporating the Sponge City concept on North Carolina's HMGP–acquired properties without infringing on the program's development restrictions:

Endorsement

I recommend that FEMA and the NCDPS endorse the administration of the Sponge City concept on HMGP–acquired properties as an alternative means of flood hazard mitigation. An endorsement by federal and state flood management organizations will encourage the administration of the concept and provide an additional avenue to improve pre–disaster mitigation and influence continued studies within stormwater and flood management.

Equitable Engagement

Based on the data, I recommend that FEMA and the NCDPS develop an implementation strategy that provides opportunities to involve all stakeholders: including federal, state, and local administrators, private companies, and the community, to participate in decisions made that will affect their community. Public engagements

enhance the quality and legitimacy of the decision–making process and improve the relationship between the government and the community (Schoch–Spana, 2015).

Develop A Guideline

Developing community–specific guidelines consistent with federal policies for the HMGP–Acquisition/Buyout Program will encourage implementation. I recommend including input from community stakeholders during the development stage. The specific guidelines should include the flow of mitigation as indicated in Figure 7:

Mitigation

Planning and design are essential to the systematic implementation of the Sponge City concept. Property and drainage system design must be analyzed to ensure proper functioning:

- *Property due diligence:* Identify the property's location, conduct property evaluations: space layout; drainage; hydrology; and meteorology (Ma et al., 2017), and identify any abatements that must be addressed.
- *System design:* Based on the property evaluations, the drainage system must be systematically designed to ensure proper functioning to accomplish the intended outcome.

Administration

The administration process consists of identifying public or private administrators to allocate available funds, monitor timelines, oversee the maintenance of the infrastructure, and ensure compliance with the guidelines of the HMGP–

Acquisition/Buyout Program. This step will also include construction details, such as the demolition of existing structures, planning, design, and construction of the infrastructure.

Flood Hazard Reduction

The flood hazard reduction process ensures the infrastructure maintains proper functionality. Furthermore, continuous inspections of the infrastructure will confirm that the infrastructure meets the requirements of the HMGP and necessitates flood hazard reduction.

Figure 7

Conceptual Framework for the Sponge City Concept

Note. Figure 7 shows the flow of mitigation from risk to recovery. The conceptual framework for the Sponge City concept consists of three main steps: Mitigation, administration, and flood hazard reduction.

Education

The North Carolina Department of Public Safety (NCDPS), the authority that administers the program on behalf of FEMA, educates flood management professionals on the Sponge City concept. The NCDPS could add a continuing education course on the

benefits of the Sponge City concept and how to implement the concept on the HMGP's acquired properties.

Describe the Method

Outline the method from risk to recovery – Provide adequate guidelines that will not conflict with federal policies for the HMGP–Acquisition/Buyout Program. During this process, any associated costs and available grants to offset the costs to the municipality should be addressed.

Effectively educating flood management professionals on the benefits of incorporating the Sponge City concept on HMGP–acquired properties, in collaboration with an endorsement from FEMA and the NCDPS and specific guidelines for administration, can influence positive social change by improving sustainability and the community's resilience to flooding.

Strengths and Limitations of the Project

I conducted and limited this study to North Carolina; however, the findings may apply to other states that administer the federal Hazard Mitigation Grant–Acquisition/Buyout Program. The data within this study provides recommendations on how to develop a guideline that flood management professionals can use to initiate the concept within their communities.

The strength of this case study is its contributions to the literature on incorporating an advanced, innovative method of stormwater reduction within conventional flood management programs that uses strategically located federally granted properties to enhance a community's resilience to flooding. A potential limitation of this

study was the sample size. Per contra, the interviews provided sufficient data on North Carolina's flood management professional's lack of knowledge of the Sponge City concept and the potential benefits of its incorporation on the federally granted properties.

The literature on incorporating the Sponge City concept into the HMGP–Acquisition/Buyout Program was scarce. Therefore, I recommend further qualitative research on incorporating the concept into the HMGP's Acquisition/Buyout Program within North Carolina. Furthermore, a broader study on communities outside of North Carolina may build upon the qualitative findings of this study. I also recommend that flood management professionals expand their knowledge of this innovative approach to stormwater management to reduce the disastrous consequences of community flooding.

Summary

In Section 4, I presented the findings of this study and identified the four major themes from the interviews of the study's participants. Limitations to the study and recommendations for incorporating the Sponge City concept on North Carolina's HMGP–acquired properties were described. Limitations of this study include the participant size due to the lack of participation and knowledge of the concept. Some flood management professionals were reluctant to participate because of fears that their organization would see their participation as going against the organization's regulations and policies. Further education of the concept and an endorsement by FEMA and the NCDPS will narrow the knowledge gap and provide an additional avenue to improve pre–disaster mitigation and influence continued studies within the stormwater and flood management field.

In Section 5, I present the plan for disseminating the study to the NCDPS, FEMA, floodplain managers, flood management professionals, Hazard Mitigation specialists, and municipalities participating in the Hazard Mitigation Grant Program in North Carolina.

Section 5: Dissemination Plan

Introduction

In Section 4, I discussed the results of my study. No partner organization was required during my research, and the research was conducted based on Walden University's policies and procedures. I gained in–depth knowledge of the concept's benefits and the conceptual framework required to administer the concept effectively. I used documents and interviews to develop a better understanding of the gap in knowledge flood management professionals, including myself, have of an innovative concept that would provide additional protections against the rapid and slow onset of flood hazards and disasters.

Through this study, I improved my ability to distinguish between facts and beliefs, improved my critical thinking skills, refined my duties as a floodplain administrator, and improved my stormwater mitigation efforts. The information within this study and its recommendations will be pertinent to the evolution of flood management by recommending developing and disseminating educational materials and guidelines for incorporating the Sponge City concept on HMGP's acquired properties.

I hope to present the study's results to the NCDPS, FEMA, floodplain managers, flood management professionals, Hazard Mitigation specialists, and municipalities participating in the Hazard Mitigation Grant Program in North Carolina. Furthermore, the Association of State Floodplain Managers conducts an annual conference, inviting flood management professionals to submit abstracts of innovative solutions for managing flood risks. Appendix C contains a memorandum of research findings that I plan to distribute at

professional conferences, trainings, and seminars. I will provide all participants with a copy of the research memo or a full copy of the study, including the results and findings.

Summary

Success with administering the Sponge City concept on HMGP–acquired properties depends on education, endorsement, and proper guidelines on implementation. These aspects may improve a community's sustainability to future natural disasters and improve the community's resiliency. FEMA and the NCDPS may encourage the concept with a comprehensive plan outlining the incorporation of the conceptual framework of the Sponge City concept and the established guidelines of the HMGP–Acquisition/Buyout Program.

Education, endorsement, specific guidelines, implementation, and sustained action are essential to mitigating the disastrous consequences of community flooding. Administering the Sponge City concept on federally granted properties can improve designated flood–prone communities' sustainability and resilience to flooding, consequently influencing positive social change.

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Appendix A: Summary of Research Participants' Demographics and Proceedings

Respondent Code	Years of in Field	Manner of Interview	Location	Date of Interview	Duration of Interview
P–1	20 years	Telephone	Lumberton, NC	10/14/2022	10 minutes
P–2	9 years	Telephone	Fayetteville, NC	10/28/2022	14 minutes
P–3	3 years	In Person	Lumberton, NC	10/31/2022	12 minutes
P–4	8 years	Telephone	Lumberton, NC	10/12/2022	11 minutes
P–5	20+ years	Telephone	Lumberton, NC	10/31/2022	9 minutes
P–6	30+	In Person	Lumberton, NC	11/1/2011	9 minutes

Declined Recorded Interview (NOT INCLUDED IN THE STUDY)					
M.W.	15 years	Telephone	Raleigh, NC	Declined Recorded Interview but provided insight on grants that may be available.	45 minutes

No Response				
Respondent Code	**Years of in Field**	**Manner of Request**	**Location**	**Date of Request**
F.E.	Unknown	Telephone and email request–left message	Raleigh, NC	10/17/2022
C.M.	Unknown	Telephone and email request–left message	Raleigh, NC	10/17/2022
I.D.	30+	Telephone and email request–left message	Lumberton, NC	10/21/2022
M.H.	10+	Telephone and email request–left message	Lumberton, NC	10/21/2022

Appendix B: Interview Introductory Statement

Firstly, my name is Ar'Triel Kirchner and I want to thank you for your participation. I am a Walden University Doctoral Candidate and as a part of my studies in public policy and administration, for my dissertation I am conducting a research study about the potential of adopting the Sponge City concept on the U.S. Federal Emergency Management Agency's acquired properties within North Carolina's flood–prone communities.

So, this interview should take no more than 30 to 60 minutes and I would really appreciate for you to try to elaborate when you answer the questions and if you do not understand let me know!

Again, your participation is completely voluntary, and you can skip any questions that you do not feel comfortable answering and no personally identifying information is being collected.

Did you have a chance to go over the consent form? (Review the consent form regardless of answer)

Completion of Interview:

Thank you for your participation in this study! This study is anticipated to be over by December 1, 2022. After that time all the research collected will be reviewed per the consent form and to my discretion and then I will send you a two–paragraph summary of how your participation aided in the research!

Thank you again!

Appendix C: Implementing the Sponge City Concept on North Carolina's Federal Emergency Management Agency's Acquired Properties (Memorandum)

Implementing the Sponge City Concept on North Carolina's Federal Emergency Management Agency's Acquired Properties

This memo was researched and written by Ar'Triel Askew Kirchner, a Doctoral student at Walden University, as partial fulfillment of the requirements for the degree of Doctor of Public Administration.

Introduction:

This memo summarizes research undertaken between 2019 and 2022 to introduce another lesser–known flood management concept, the Sponge City concept. Furthermore, implementing the concept on North Carolina's HMGP–Acquisition/Buyout properties has the potential to advance flood mitigation efforts within designated flood–prone communities. The Sponge City concept, also known as green infrastructure, has great potential to minimize the occurrence of disastrous flooding. Administering the concept on federally acquired land–land with known flood risks– will make use of vast untapped properties to protect against short– and long–term consequences of flooding, such as death, property loss, damage to roadways, loss of power and communication, water pollution, decreased property value, damage to farmlands, and decreased physical and mental health, and improve a community's capacity to recover from flooding disasters.

While the HMGP–Acquisition/Buyout Program presents an attractive option for reducing flood hazards, especially in cases where the community has a history of flooding, added efforts are vital to sustainability and resilience. The federally acquired properties can be redeveloped with low–impact flood risk management systems that can improve flood–prone communities' sustainability and resilience to flooding, consequently influencing positive social change.

Project Considerations:

The federally acquired properties may be more conducive to sustaining the Sponge City concept than privately owned properties outside the designated flood hazard due to several factors, including: the extensive research conducted by FEMA engineers, the costs to the community associated with locating and acquiring properties, and timing associated with revising development ordinances. The HMGP–Acquisition/Buyout Program provides funding to designated flood–prone communities to purchase hazard–prone homes and businesses to reduce the risk of flooding and the potential impact of future disasters. The program's policies require the properties acquired under this program to remain open spaces. However, natural flood management systems can be developed, such as permeable pavements, gardens, parks, trails, and tree trenches for water infiltration. These natural systems can benefit flood–prone communities by

advancing flood management efforts and remain in compliance with the HMGP development guidelines.

The unfamiliarity of the concept amongst flood management professionals can present a significant obstacle to incorporating the Sponge City concept. Therefore, flood management professionals must familiarize themselves with the concept and how to effectively implement it in a manner that will be consistent with the federal program's guidelines.

State and federal agencies like FEMA and the North Carolina Department of Public Safety can play a vital role in helping educate flood management professionals by developing general guidelines and endorsing this innovative form of flood management.

Models for Familiarization, Education, and Endorsement:
My research points towards recommendations for incorporating the Sponge City concept on North Carolina's HMGP–acquired properties without infringing on the program's development restrictions: endorsement, equitable engagement, development of specific guidelines, and continuing education.

Endorsement:
My research recommends that FEMA and the NCDPS familiarize themselves with the benefits and costs of incorporating the Sponge City concept on North Carolina's HMGP–acquired properties. Furthermore, based on the reduces cost and increased benefits of incorporating the concept, the research recommends that an endorsement by federal and state flood management organizations will provide an additional avenue to improve pre–disaster mitigation and influence continued studies within the field of stormwater and flood management.

Equitable Engagement:
A practical implementation plan endorsed by FEMA and the NCDPS will offer an accessible process that involves many stakeholders: Federal, state, and local floodplain administrators, private companies, and the community in decisions made about how to remediate and use federally acquired properties and how to structure a low–impact flood mitigation project developed on site.

Develop A Guideline:
Developing community–specific guidelines consistent with federal policies for the HMGP–Acquisition/Buyout Program will encourage implementation. I recommend including input from community stakeholders during the development stage. The specific guidelines should include:

- **Mitigation**: Planning and design are essential to the systematic design of the Sponge City concept. Property and drainage system design must be analyzed to ensure proper functioning.

- **Administration:** The administration process consists of identifying public or private administrators to allocate available funds, monitor timelines, oversee the maintenance of the infrastructure, and ensure compliance with the guidelines of the HMGP–Acquisition/Buyout Program. This step will also include construction details, such as the demolition of existing structures, planning, design, and construction of the infrastructure.
- **Flood hazard reduction**: Provide continuous inspections of the infrastructures to ensure continued functionality.

Continuing Education:
The NCDPS, the authority that administers the program on behalf of FEMA, could add a continuing education course on the benefits of the Sponge City concept and how to implement the concept on the HMGP's acquired properties.

Recommendations for the courses include:

- Outlining the method from risk to recovery.
- Providing general guidelines that will not conflict with federal policies for the HMGP–Acquisition/Buyout Program.
- Address associated costs and benefits of administration, and
- Provide available grants that will offset the costs to the community.

Next Steps:
My research points towards an exciting potential for flood mitigation by implementing the Sponge City concept on HMGP–acquired properties. This concept will help burdened communities by further reducing the possibility of flooding while using existing resources–federally acquired properties. Federal, state, local, and private organizations can make incorporating the Sponge City concept on HMGP–acquired proprieties possible by endorsing the concept and providing continuing education on successful implementation.

The strategies outlined in this memo and sustained actions are essential to mitigating the disastrous consequences of community flooding. Implementing the Sponge City concept on HMGP–acquired properties can improve designated flood–prone and surrounding community's sustainability and resilience to flooding, consequently influencing positive social change.

Project Interviewees and Acknowledgements:
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