DISPARITIES IN WATER AND SEWER SERVICES IN NORTH CAROLINA: AN ANALYSIS OF THE DECISION-MAKING PROCESS

Julia Marie Naman

A technical report submitted to the faculty at the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Science in Public Health in the Environmental Sciences and Engineering Department in the School of Public Health.

Chapel Hill
2014

Approved by:

Jackie MacDonald Gibson

Jamie Bartram

Valerie Flax

ABSTRACT

Julia Marie Naman: Disparities in Water and Sewer Services in North Carolina: An Analysis of the Decision-Making Process
(Under the direction of Jackie MacDonald Gibson)

In North Carolina, a proportion of those using private well and septic systems live in neighborhoods located directly outside cities that have piped water and sewer services. Use of private systems may have adverse health and societal effects compared to public system use. Using a multi-site case study design, this research sought to illuminate the barriers and avenues to extending water and sewer services. Twenty-three interviews were conducted with local key informants from three communities across North Carolina. Financing for water and sewer service emerged as the predominant factor influencing decisions to extend services. Improved health emerged as a minor factor, suggesting that local officials may not realize the health benefits of extending public water and sewer services. Recognition by local officials that septic systems in these communities are failing was found to be a strong catalyst for extending water and sewer services; however, failed systems are often underreported.

ACKNOWLEDGEMENTS

First, I would like to thank my advisor, Dr. Jackie MacDonald Gibson, for her unending support and guidance throughout this research process. Her thoughtful comments, encouragement, and upbeat attitude truly helped make this a positive experience. I'd also like to thank my two other committee members, Dr. Jamie Bartram and Dr. Valerie Flax, for their detailed revisions and advice. I am very grateful to my two research assistants, Mimi Caddell and Mandie Kramer, who were incredibly valuable throughout the data collection and analysis. I'd also like to thank the Center for Civil Rights at UNC for the historical background they provided and their input in the research design. I would also like to express my gratitude to all of my interview participants. Without their stories and insights, this research would not have been possible. I am so grateful for my friends and family, especially my parents, for their ongoing support and encouragement. Finally and most importantly, I am ever grateful to God for His presence and provision in this research and throughout my life.

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EPA	Environmental Protection Agency
WBDO	Waterborne disease outbreak

1. INTRODUCTION

Improvement in water and sanitation infrastructure is arguably one of the greatest public health achievements in twentieth century United States history (Cutler and Miller, 2005). Reduced mortality has been linked to numerous advancements in water and sewer service including improvements in water purification technology (Ferrie and Troesken, 2008) and increased municipal spending on sanitation infrastructure (Cain and Rotella, 2001; Condran and Crimmons-Gardner, 1978). Cutler and Miller (2005) assert that half of the mortality reduction in major cities in the United States during the early twentieth century is attributable to the filtration and chlorination of drinking water.

More recently, use of private water and septic has been associated with increased health risks. While waterborne disease outbreaks (WBDO) in public water systems have declined since monitoring began in 1971, WBDO for private water systems have increased during the same time period (Craun et al., 2010). The Waterborne Disease and Outbreak Surveillance System (national surveillance system led by the U.S. Environmental Protection Agency (EPA), Centers for Disease Control and Prevention, and the Council of State and Territorial Epidemiologists) has attributed this discrepancy to improved water quality regulations and laws for public systems and weak standards and poor monitoring in private systems (Craun et al., 2010). Private septic systems have also been linked to increased health risks. Specifically, increased septic tank density has been associated with greater risks of both bacterial and viral diarrheal illness (Borchardt, 2003).

Despite the success of water and sanitation infrastructure improvements and the potential

health risks associated with private system use, approximately 26 percent of North Carolinians rely on a private water system while 49% of North Carolina residents use private septic systems, compared to national estimates of 14 and 24 percent respectively (Kenny et al., 2009; U.S. Census Bureau, 2011). Many of these people are located in rural areas, where homes are widely dispersed and piped water and sewer services are cost-prohibitive; however, some live in small, dense communities located directly outside cities that have centralized services (Bullard et al., 2007; Gilbert, 2013; Heaney et al., 2011). These unincorporated neighborhoods sometimes share the same street with city residents or are completely surrounded by the city, in what is termed a doughnut hole (Gilbert, 2003). Despite their close proximity and dense populations, these unincorporated communities do not benefit from city services including water and sewer service, as well as, city fire and police protection, municipal voting rights, and trash pickup (UNC, 2006). The historical reasons for the exclusion of these neighborhoods are largely unknown though research has attributed them in part to discriminatory zoning practices including Jim Crow laws that mandated racial segregation and race-restricted covenants in white neighborhoods (Johnson et al., 2004). Today, these unincorporated communities are often made up of politically vulnerable, low-income populations (Kenny et al., 2009; Bullard et al., 2007; Wilson et al., 2008).

In addition to the potential health risks from increased disease outbreaks in private system use, unincorporated communities also cite stench, decreased property value, and high costs of septic tank repairs as adverse effects of relying on wells and septic tanks. These problems are especially exacerbated when individual homeowners lack the financial resources to maintain their private systems (UNC, 2006). In an effort to address these challenges, some unincorporated communities have urged neighboring cities to extend centralized water and sewer

services. Mebane, North Carolina is one example of the many cities with neighboring communities fighting for access to centralized services. Mebane has four historically African American communities, and three of these are located within one-mile of the city limits (Cedar Grove Institute, 2003). Water and sewer pipes directly border these communities but do not extend into them (Figure 1). Instead, residents of these communities primarily use wells and septic tanks. According to a 2002 EPA Environmental Justice Study, numerous septic systems in these three regions have failed or are failing (USEPA, 2002). Failed systems refer to those septic systems that have wastewater backing up into the house or surfacing from the drainage field (USEPA, 2005). Furthermore, many cannot be replaced due to new regulations on soil type and increased size requirements for the drain fields (Johnson et al., 2004). These problems are not unique to Mebane, but rather can be found in many other unincorporated communities across North Carolina.

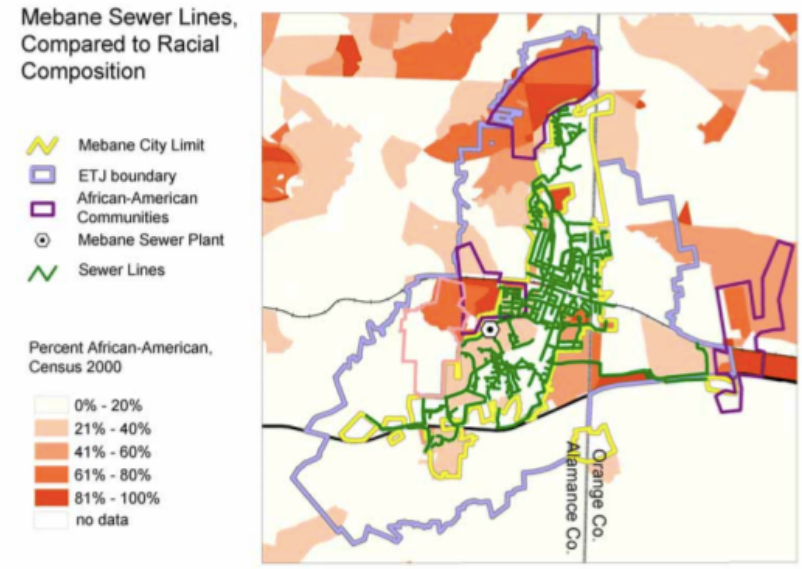

Figure 1. Mebane sewer lines and racial composition as of 2003. The sewer lines (in green) directly border the three African American Communities (in purple) outside of city lines (in yellow). ETJ represents the "extraterritorial jurisdiction," which is a region up to one-mile outside city lines that is under the city's zoning jurisdiction. Source: Cedar Grove Institute, 2003

Considering the potential health and societal ramifications of private well and septic tank use, understanding the factors that influence decisions to extend water and sewer service to underserved communities can provide insights about how to overcome current service disparities and improve overall service quality, not only in North Carolina but also in other states (Kenny et al., 2009; Hoover and Konsler, 2004). Thus far, research in this field has focused primarily on anecdotal evidence of racial disparities in access to water and sewer services (Johnson et al., 2004; Wilson et al., 2008) and has been largely confined to the community perspective (UNC, 2006). The extent of these disparities has not been systematically investigated. Furthermore, little is known about how the major stakeholders and the social, political, and physical environment affect the decision-making processes of water and sewer extension. This research seeks to close this knowledge gap through a series of in-depth, semi-structured interviews with key informants from three unincorporated communities across North Carolina.

The primary objectives of this study are to identify the barriers and avenues to extending water and sewer services to unincorporated communities and to provide recommendations to local decision-makers, policy-makers, and researchers on improving access to water and sewer services across North Carolina.

2. MATERIALS AND METHODS

2.1 Selection of Study Locations

Three North Carolina cities, Brevard, Raeford, and Wilmington, and neighboring unincorporated communities were selected for this study. To capture a wide range of responses based on a variety of factors, these cities represent differing regions, population sizes, economic levels, and progress toward water and sewer extension (Figure 2; Table 1). All of the

unincorporated communities lack centralized water, centralized sewer or both and are located within two miles of a neighboring city.

2.1A Brevard, North Carolina

Brevard is located in the mountains of western North Carolina in Transylvania County. The unincorporated community neighboring Brevard selected for this study lacks centralized sewer service and is predominantly white (Table 1). The Transylvania County Health Department has recognized the unincorporated community as a priority for sewer extension and the city of Brevard has expressed interest in partnering with the county to extend water and sewer services (Hamilton, 2013).

2.1B Raeford, North Carolina

Raeford is located in the central portion of the state in Hoke County. The unincorporated community neighboring Raeford selected for this study lacks centralized sewer service and is predominantly non-white (Table 1). The largest racial group in the city of Raeford is white. Raeford has not made any clear steps to extending sewer services to this unincorporated community.

2.1C Wilmington, North Carolina

Wilmington is located on the coast of North Carolina in New Hanover County. The unincorporated community neighboring Wilmington selected for this study lacks centralized water and sewer services and is predominantly white and elderly compared to Wilmington (Table 1). In 2013, New Hanover County and the Cape Fear Public Utility Authority voted to extend sewer to this unincorporated neighborhood (Cape Fear, 2014).

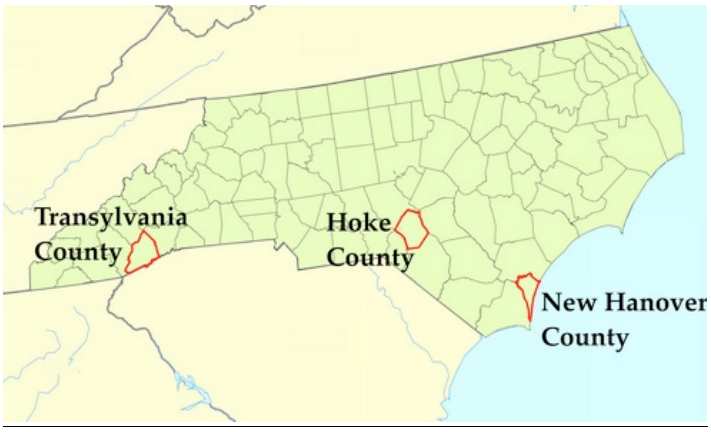

Figure 2. Case study locations in North Carolina

Table 1. Characteristics of case study locations
Source: U.S. Census Bureau, 2010

Characteristics	Brevard, Transylvania County	UC*	Raeford, Hoke County	UC	Wilmington, New Hanover County	UC
Population	7,609	122	4,611	208	106,476	280
Median Age	47 years	37 years	39 years	42 years	35 years	48 years
Percent White	83.3%	99.2%	43.6%	17.8%	73.5%	89.3%
Median Household Income	$37,262	N/A**	$30,235	N/A	$38,900	N/A
Lack of Access to Centralized Services	--	Lacks sewer	--	Lacks sewer	--	Both water and sewer

* UC represents "Unincorporated Community"
**N/A indicates that these data are not available at the community level

2.2 Recruitment of Participants

To understand the decision-making process behind city service extension, key stakeholders (unincorporated community members, elected government officials, and representatives from the health department, planning and zoning department and utility department) affected by or involved in this process were recruited. Potential interview

participants were identified through relevant newspaper articles, government websites, and recommendations from participants. Once identified, potential participants were emailed and/or called to ask for their participation in an interview about water and sewer extension. These emails and calls were conducted using prepared scripts (Appendix 1).

2.3 Data Collection

Twenty-three in-depth semi-structured interviews were conducted from July to September 2013. General interview guides were developed for each stakeholder based on their roles in the water and sewer extension process (Appendix 2). Additionally, the interviewer adapted questions during the interview based on the responses of the participant. The interviews ranged from 30-100 minutes.

Interviews with community members were conducted over the phone (n=3) or face-to-face in their homes (n=3). These participants received $20 as compensation for their time.

Interviews with non-community member participants were conducted over the phone (n=1) or face-to-face in their offices (n=16). These participants were not compensated because the interviews took place during their workday.

The interviews were all audio-recorded and transcribed verbatim, excluding one due to the refusal of the participant to be recorded. Detailed notes were taken and used in the data analysis in place of the recording. The interviewer took thorough hand-written notes during all interviews to supplement the transcripts.

2.4 Content Analysis

The transcribed interviews were first read through in full to identify any recurring factors. These factors refer to any considerations that influenced the decision-making process, whether avenues or barriers to service extension. Using the identified factors as codes, the transcripts

were then coded in ATLAS.ti by three independent coders. The three coders each coded the same three transcripts and compared results. Through this comparison, a common understanding of code meaning was ensured between the three coders before they independently coded the remaining transcripts. Additional codes that emerged following the initial readings were shared with all of the coders and were incorporated in the codebook. Once coded, the factors were grouped by common theme.

2.5 Ethical Approval

Prior to participant recruitment, the University of North Carolina's Institutional Review Board approved the materials and methods of this study (#13-1930).

3. RESULTS

3.1 Characteristics of Interview Participants

Twenty-three key informant interviews were conducted with 25 participants. Two participants were interviewed at the same time during two of the interviews. Eight participants were interviewed in Hoke and New Hanover Counties each and nine participants were interviewed in Transylvania County.

Of the 25 participants, interviews were conducted with utility providers (28%), community members (24%), elected officials (16%), health officials (16%), city or county managers (8%), and planning and zoning officials (8%) (Figure 3).

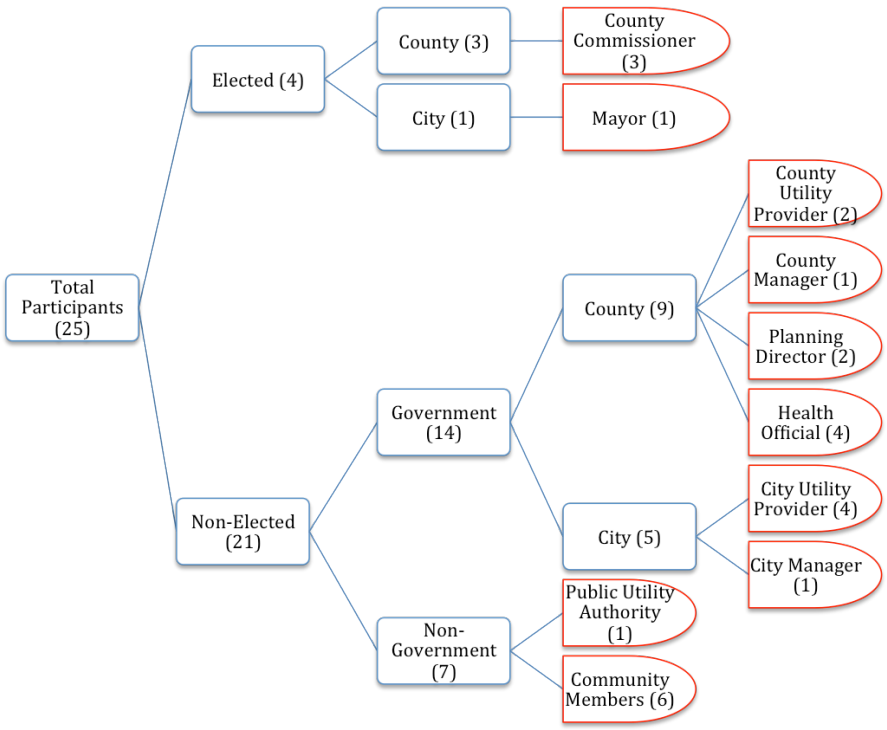

Figure 3. Characteristics of interview participants

3.2 Summary of Major Themes

From the 23 open-ended interviews, 18 factors influencing water and sewer extension emerged and were grouped into five overarching themes: financing for water and sewer services, government impact on service extension, existing and future infrastructure, community impact on service extension and health (Table 2). In the majority of the 23 interviews, all five major themes were mentioned. Two of the interviews did not mention health as a factor for extending services and one did not mention community impact as a factor. Each of these themes and their impact as an avenue or barrier to water and sewer extension is discussed in depth in the following sections.

Table 2. Factors influencing water and sewer extension grouped by major theme

Themes	Factors	Definitions
Financing for water and sewer extension	Local Priorities	Primary focus areas of city and county governments
	Economic Development	Regarding improvements to the city or county's economy
	Outside Funding	Grants and loans to fund water and sewer extensions
	Costs and Benefits	Monetary costs and benefits of water and sewer extension
Community Impact	Community Involvement	Organization, mobilization, or advocacy in unincorporated communities
	Renters	Presence of renters in unincorporated communities
Government Impact	Annexation	Annexation into the city as a prerequisite for water and sewer extension
	Decision-makers	Actors involved in decision-making for water and sewer service extension
	Outside Involvement	Involvement of government officials in the unincorporated community
	Planning/Zoning	Planning and zoning laws and considerations that influence water and sewer extension
	Government Relationships	Influence of interactions between government actors on the decision-making process
Health	Monitoring	Data collection for grants and loans
	Health	Health risks associated with private system use for unincorporated communities or surrounding areas
	Contamination	Contamination of water and soil due to failed septic tanks
Existing and Future Infrastructure	Standards and Laws	Rules governing well and septic tank permitting
	Environmental Factors	Impact of environmental factors (e.g. topography, rainfall) on water and sewer infrastructure
	Piped water and sewer Infrastructure	Capacity, location and ownership of piped water and sewer infrastructure
	Septic Tank Problems	Challenges associated with septic tank use

3.2A Financing for Water and Sewer Extension

The financial consideration behind water and sewer extension surfaced as one of the foremost theme influencing decisions about whether to extend water and sewer lines to unincorporated communities. This broad topic centered largely on the monetary cost-benefit analysis from the city's perspective, the role of economic development in extension, and grants and low-interest loans as funding options.

Participants referred to the high cost of water and sewer extension; however, the interviews illuminated differing opinions on whether or not the investment in water and sewer infrastructure could have an economic return for the investors, namely taxpayers. This was especially true when the service extension for a particular community was compared to other

investments that were seen to benefit the county or city as a whole. The following quotations illustrate this challenge to balance the city's costs and benefits for service extension:

> *With the municipality or county having to pay for all of that, they have to look at how do we get that money paid back over time? Is it feasible to do it and be able to spend taxpayer's moneys to help someone else in an area that everybody's not going to receive the benefits from? (County Commissioner)*

> *You've got to make sure there's a balance there where the return is valued. It goes to educating the public on why this is so important. (County Commissioner)*

From the city's perspective, annexation of the unincorporated community into the city is one of the benefits of extending water and sewer services. In two of the three cities, laws require annexation of the unincorporated community into the city before providing city water and sewer. These new city taxpayers can offset some of the costs of extending services; however, even then, the returns are not always enough to justify the high costs, as this interview participant explained:

> *Most communities like that would ask for annexation. We've got a section in town here that does want to be annexed. The [city] will not do it. We did a study on it, and because of its topography, the payback was like 115 years. (Mayor)*

Another economic incentive that several respondents discussed was the potential for extensions of water and sewer infrastructure to draw in new businesses and industries to the region. The following comments illustrate perceptions among some interviewees that water and sewer extensions could catalyze economic development:

> *I think that once we get water and sewer in those areas we'll see development begin to take place there… (County Commissioner)*

> *I also have another half acre behind my lot that I could develop if it weren't for the septic tank back there. I could put a little efficiency apartment complex back there but I can't do that until I get city sewer. (Community Member)*

> *Gold runs through those utility lines. You don't recognize that but it's gold, economic gold. (Mayor)*

Grants and, to a lesser extent, low-interest loans were the most desired funding options for extending water and sewer services to unincorporated communities. Nevertheless, there were barriers to this type of funding that included lack of availability, lengthy applications requiring extensive data, and the cooperation of a city or county as the grant applicant. This juxtaposition between the benefits and challenges of grant funding is illustrated here:

> *Grants go a long way to easing political negotiations. (Utility Provider)*

> *…That takes grant writing, tests being done, getting environmental people even at the state level involved, and to produce all that data so you could put it in your grant. (County Commissioner)*

> *They used to have money they used to give out for community developments, or at least access to those funds, but…there's no grants, there's no low interest loans, there's nothing available anymore. (Health Official)*

3.2B Government Impact on Water and Sewer Extension

In the three case studies, the city and county government officials were intricately tied to the decision-making process for extending centralized water and sewer services to unincorporated communities. The government holds records on septic tank permits and failures, applies for grants on behalf of the communities, votes on whether or not to make the extension considering costs and capacity, manages the physical extension of pipes, and provides the services for water and sewage treatment. The community has very little capacity to gain access to centralized services on its own, and the government's involvement in this process is critical, as this participant observed:

> *So, despite [the community] overcoming all this lack of organization and sophistication and availability of money, now they still need [the city] to be the [grant] applicant…What [the communities] really need is [the city] to be the patriarch and say, 'Yeah, those folks really need [city water and sewer]. We have the sophistication to do this.' (Utility Provider)*

Despite its importance, there are challenges to government involvement in water and sewer extension. Many of these problems stem from the high cost of water and sewer extension, as this participant noted:

> *Sewer is very, very expensive to run so when you get into a lot of money, sometimes you get into a lot of politics. (Health Official)*

This potential for political conflict in the decision-making process was evident from the interviews as the actors involved shared their differing roles and priorities. The key players were the health officials, who monitor private system use and have an obligation to protect public health; the utility providers, who manage the physical extension and delivery of services and have a responsibility to balance the costs and benefits of service extensions; and the elected commissioners and mayors, who must balance the needs and interests of the electing body, which excludes the unincorporated community members from the city's electorate, and hold the ultimate decision-making power for extension. One health official provides an example of these conflicting interests among the various actors as follows:

> *…They have to do that really from a strong cost-benefit analysis, which is my interpretation. And that leads to a model that doesn't always support the interest of public health. (Health Official)*

In addition to the variability in perspectives stemming from these actors' positions, the interviews also revealed a division of interests between government agencies: county officials versus city officials, and unelected staff members versus elected officials. Each group held different beliefs on the necessity and benefits of water and sewer extension compared to other local priorities. The following quotations illustrate conflicting interests among the agencies:

> *There could be…a relationship between a council member and a community member out there where they are negotiating outside of what staff is doing. It's not illegal. It's not sneaky. It's just separate. And so it can be a frustration for staff, because we're working like technicians, kind of step by step and by the book, and it's not our job to negotiate.*

We just present the technical and the recommendation. The subtleties occur at Council level. (Utility Provider)

I think sometimes [city officials and county officials] build a wall up and they say, "This is my responsibility and on that side of wall is your responsibility." Who gets caught in the middle is the average resident… . The county and city governments all across North Carolina need to have the understanding and a realization that we're all serving the same customer. (Mayor)

We had a very difficult time . . . getting the attention from county commissioners, but the county manager's office, they were 100% behind our recommendations and planning. (Health Official)

The coordination of all of these actors representing cities, counties, staff positions, elected positions, and various departments, is essential to extending services; however, their differing roles, perspectives, and priorities can make the process difficult and lengthy, as these quotations indicate:

It's daunting…there's too many people that have to come together. One dude is not going to get it done. (Utility Provider)

They don't take months or a year. They always take years, because the engineering and the construction is easy. It's straightforward. It's the relationship. It's the intergovernmental relationship. (Utility Provider)

3.2C Existing and Future Infrastructure

The state of the existing infrastructure in the unincorporated communities and the challenges associated with adding new infrastructure emerged as another key theme in the interviews. Across the three unincorporated communities, septic tank maintenance and repair were cited as major problems. This community member's personal experience summarizes a few of the challenges associated with failing septic infrastructure:

When it rains, my septic tank fills up and you can smell it when you open the back door. There's nowhere for the septic tank to drain…The sewage runs into a ditch, which ends up in a creek that flows into the [River]. (Community Member)

In order to address these problems and repair or replace their existing infrastructure, homeowners must apply for a new permit from the health department. Despite the problems associated with their failing septic systems, homeowners are often unwilling to request these permits for new infrastructure, in part due to the high costs of repairs and replacements:

> *…They've been misled by their friends or family members and they'll tell them not to call the health department because [the repair's] going to cost them ten thousand dollars. (Health Official)*

Shifting standards for septic tank permitting has further exacerbated the repair and replacement costs. Systems that met the standards when they were built in the mid to late-1900s, may not meet the stricter regulations that are currently in place. Homeowners struggle to maintain compliance as a result of these increasingly stringent permitting standards:

> *There are systems that go back to the '50's and '60's before there were even any robust system standards. (Health Official)*

> *They were having to do such innovative systems that it was costing them upwards of like $20,000 in order to replace a system that they knew was going to fail eventually. (Planning Manager)*

Though failing septic systems place a burden both financially and otherwise on homeowners, they were also cited as a catalyst for water and sewer service extension. A neighborhood with a high prevalence of failing systems can encourage government officials to consider extension in this area. These interview participants alluded to the influence of multiple failing systems on service extension:

> *All the septic tank systems are going to fail eventually and need repairing. That way [the County] sort of looked ahead and is going to get the [county] sewer to a lot of them. (Health Official)*

> *Not only had the septic lines, the original ones, failed, the repair lines had failed. They were in drastic need of this extension. Because I don't think the city in any other situation would extend their sewer services without annexing those properties. (County Commissioner)*

3.2D Community Impact on Water and Sewer Extension

A fourth theme that emerged from the three case studies was the impact of the unincorporated communities on water and sewer extension. As discussed previously, the government holds much of the power in the decision-making process behind water and sewer extension; however, communities can play a role in raising awareness and pressuring the government to act. The following utility provider acknowledges the communities' role in initiating the conversation:

> *…[Awareness] mainly comes from citizens approaching the commissioners with their concerns. (Utility Provider)*

Communities can more effectively persuade local leaders through unified and organized efforts as opposed to individual complaints, as the following participant observed:

> *They really need to organize and come forward as a group and request support from the city and they have never done that, it has always been one or two individuals. (Planning Manager)*

Despite their potential to effect change, unincorporated communities lack the combination of institutional resources, finances, and political influence needed to persuade neighboring cities to extend water and sewer service:

> *Now, little community is unincorporated. They are not an entity at all. They have no mayor. They have no government. They have no money and sophistication in how to negotiate this situation. (Utility Provider)*

Two important barriers that limit community involvement and impact on water and sewer extension are disunity within the community and perceived futility in community efforts. First, communities can be divided on whether or not piped water and sewer should be pursued over private systems. Some community members facing the consequences of failing septic tanks are eager for centralized services. Others with fully functioning private systems are unwilling to incur the costs of service extensions. This lack of interest in extension by members of the

community does not necessarily reflect a lack of need. Though homeowners may initially resist piped water and sewer service, their views may shift if their own system starts failing:

> *It's a hard sell. Very hard sell…'Why are we spending money on this? My stuff is fine.' And then six months when it's a failure it's like, 'Where are you now? I need you now.' (County Commissioner)*

> *It's kind of 'Out of sight, out of mind', and it's human nature that if you're not having a problem with it, to not do anything. (Health Official)*

In addition to disunity within the community, the perception that community members lack the power to effect change is another barrier to community mobilization:

> *It's not environmental racism but it's hurt us. It's been more of classism and an ignoring of the normal person. (Community Member)*

> *We called [the health department] but they haven't come. But we don't press that button…If you're forced to come in and do it, you're not going to do it with the right mindset. You're going to come in with, 'I'll show them.' So what will happen? You're going to find people that lose their hope. (Community Member)*

3.2E Health

The potential health benefits of water and sewer extension did not emerge as a leading factor in the decision making process for water and sewer extension and in two of the interviews, health was not mentioned as a theme at all. Though all three county health departments acknowledged the potential health risks associated with failing septic systems, only New Hanover County government officials cited public health as a major driver in their decision to extend water and sewer services. Other than those in the health department, the government officials of Hoke and Transylvania counties did not perceive the failing septic systems in their neighboring unincorporated communities to be a public health concern for the communities or neighboring cities.

Interviewees in all three counties discussed the potential health risks of failing septic systems; risks mentioned include disease transmission through surface water contamination, well contamination, and direct contact with fecal waste. One public health official observed:

> *"If we have failures, of course you're going to have sewerage on top of the ground…I've seen it run down the street and people will ride their bicycles through it. I've seen in the backyard where they have puddles of it and children have little toys in it, little floaty toys in the sewerage so that's the big risk is just transmission of disease from the raw sewerage." (Health Official)*

The primary method that health departments use to detect septic tank failures is self-reporting by homeowners or by complaining neighbors. One health director said 90% of their awareness of failing septic systems comes from reports by either septic tank owners or neighbors. This complaint-based method of regulation can lead to underreporting of septic tank failures and inaccurate data. Homeowners fearing the consequences of a failed septic tank may be reluctant to inform health officials of any problems. The high cost of septic tank replacements and repairs is a major concern for failed septic tank owners, but an even larger concern is home condemnation. This community member expresses distrust of the health department for fear of condemnation:

> *…[The health department] would not come in to help, they would condemn your house. (Community Member)*

In addition to underreporting by the homeowners, the health department may also avoid exposing failed septic systems in an effort to protect the homes of their constituents, especially those of lower socio-economic level, as this community member suggested:

> *They had a gentleman from the health department come around and they know that some of the septic tanks are really bad but they're turning a blind eye and trying not to condemn any homes. They're poor people and they're just doing the best they can with what they have. (Community Member)*

Poor monitoring by the health department and self-reporting by homeowners call into question the accuracy of data on septic tank failures under the prevailing monitoring system. Some health officials recognize that failed septic tanks are falling through the cracks:

> *There are a lot of [septic tanks] that are failing now that we don't know about and people just live with them. …they've been misled by their friends or family members and they'll tell them not to call the Health Department because [the repair's] going to cost them ten thousand dollars. (Health Official)*

Officials in New Hanover County recognized the need for accurate, unbiased data. This county moved beyond the complaint-based monitoring system and instead collected data in two innovative ways. First, as one county official explained, to more accurately quantify the number of septic tank failures, the county used an anonymous door-to-door survey design:

> *We hired a company to do the survey for us. It would be anonymous because we actually had concerns that if our health department went door to door, we may not get people to cooperate. (County Official)*

Second, the county monitored surface water quality in a creek neighboring the unincorporated neighborhoods. The county linked high fecal contamination in the creek to septic tank failures and used these data as evidence of the adverse environmental and potential health risks from the septic tanks in the unincorporated area:

> *We monitor surface water quality within the [Creek's] watershed…And we had attributed high bacteria numbers to septic failures…From a public health and an environment perspective, I would say that's our number one concern. (County Official)*

The data gathered through these methods allowed county health officials to present a strong argument to the county commissioners, which ultimately persuaded the commissioners to approve extended services. One county official noted:

> *I think the health director saying this is a community health hazard and I mean you put that label on it, that means you've got to take care of it…That ended the argument. (County Official)*

3.3 Comparison of Case Studies

In addition to exploring the major themes cited throughout all of the interviews, the similarities and differences in the decision-making process in the three case studies were explored. The following sections summarize the responses from each case study.

3.3A Hoke County

Hoke County government officials did not consider sewer extension a local priority for the unincorporated community included in this study. Based on data from the health department, there was not a predominance of septic tank failures or any health concerns as a result of private system use in this community. Conversely, Hoke County and the City of Raeford recently extended sewer service to Silver City, another unincorporated community neighboring Raeford. Silver City residents alerted government officials of serious health concerns from numerous overflowing septic tanks through community advocacy. Because of these health risks, the county secured a grant for the extension of piped sewer service.

The unincorporated community selected for Hoke County was the only community of the three included that had an established and organized community group focused on local issues, including the need for sewer services. Some of the challenges with this community group were recruiting long-term leaders and divisions within the community about their needs and priorities. The community leaders interviewed in this study expressed distrust of the government, particularly the health department. There was an unwillingness to report failed septic systems and a belief that the health department was just a body of codes and standards that would not be willing to cooperate with or help the community.

3.3B New Hanover County

The New Hanover County Commissioners and the Cape Fear Public Utility Authority

voted to extend water and sewer services to two unincorporated communities, including the community included in this study. The major barrier to this decision was the high cost of extension and an unwillingness to use taxpayers' dollars to benefit a small subgroup of the population. The decision was ultimately made to extend services largely due to pressure from the New Hanover Health Department. The two communities were prioritized based on their high septic tank failure rate, the quality of their soils, and water quality data from a nearby river. Using this information, the health department emphasized the potential of a future public health emergency if action was not taken. The Cape Fear Public Utility Authority also supported the decision to extend services as it would bring in new customers and make use of existing capacity. Finally, the decision was aided by financial support through a low-interest loan designated for the improvement of regional water quality.

One defining characteristic of this county is its large population size and wealth compared to Hoke and Transylvania Counties. This may have made possible some of the additional monitoring performed in New Hanover including contracted, anonymous door-to-door surveys for septic tank failures and surface water quality testing. Another characteristic specific to New Hanover County out of the three case studies is their utility authority, which consolidated the city and county utility into one shared entity. One respondent cited this change as a positive factor for extension because through coordination, it grants the utility access to both the city and county resources.

3.3C Transylvania County

As in the other two case studies, financing for extension emerged as a leading theme in Transylvania County. This county, in particular, focused on the benefits that could be gained from investing in water and sewer extension, primarily the benefits from increased economic

development. After the recent loss of three major industries in a period of three years, both the city and county government officials mentioned economic development and the attraction of new manufacturers as major priorities for the region. One of the ways they proposed to address these priorities is by expanding water and sewer services. Though extension into low-income neighborhoods is not the primary goal of this desired expansion of service, it may bring piped services closer to unincorporated communities making it easier and more affordable for future extension into these communities.

The Transylvania Health Department identified the unincorporated community included in this study as an area in need of sewer services; however, the high cost of extension into this area was cited as a primary barrier. Considering strictly the monetary costs and benefits of sewer extension into this neighborhood, the government could not justify this project over other local priorities. At the city level, there was an understanding of the community's need for sewer but a belief that the burden of this extension should fall on the state or county before the city. The county expressed challenges with taking advantage of state or federally funded grants and loans, including a lengthy and burdensome application process.

4. DISCUSSION

The predominant theme influencing access to water and sewer service for all three case studies was financing for extension. The health risks associated with private water and sewer use emerged as the least influential factor for extension. There was a perception gap between public health officials, who are aware of the health impacts of substandard water and sewer service, and other stakeholders, who often did not cite these health impacts as a factor for extension. Evidence of extensive septic system failures can help overcome this perception gap and catalyze decisions to extend infrastructure to unincorporated communities. However, data on the extent

of such failures often are not available due to homeowner concerns about having their home condemned if they fail a septic system inspection and are unable to afford the necessary repairs.

Financial obstacles to extending water and sewer services not only included the struggle to find money to fund extension or repairs, but also the challenges associated with balancing local priorities and grant acquisition. Previous research similarly cites funding as a concern for both cities and communities and indicates that water and sewer extension, specifically for unincorporated communities, is often not considered a local priority deserving of financial investment (Wilson, 2008; UNC, 2006). Cited by government officials from all three counties, the acquisition of grants or low-interest loans was believed to alleviate the high costs of extension and accelerate the decision-making process; however, interviewees mentioned numerous challenges associated with obtaining outside funding including limited availability of funding options, lengthy applications requiring time-consuming data collection, and the inability of non-government entities to apply.

These challenges to obtain funding are historically founded. Under the Clean Water Act of 1972, the federal government managed a large grant program for the construction and improvement of water quality improvement projects (Schmandt, 1988). However, wanting to shift power back to the states and under the constraints of new tax-cuts, the Reagan Administration, in the 1980s, moved from federal grants to revolving-loan funds fed by federal dollars but managed and sustained by the states (Travis, 2004). This change in federal funding for water quality improvements can be seen in North Carolina where funds had reached $110 million in 1976, but dropped to $40 million in 1985 and down to $11 million in 1987 (Schmandt, 1988). In response to the declining federal funding, North Carolina expanded state funding for water and sewer infrastructure; however, this funding was largely not available for projects

whose primary goal was water and sewer extension as opposed to existing system repairs and replacements (N.C. Division, 2014). Though there are five major funding options managed by the North Carolina Department of Environment and Natural Resources, there is only one that is specifically applicable for extension projects, the federally funded Community Development Block Grant (N.C. Division, 2014). Considering the historical decrease in federal funding and the lack of funding options available for water and sewer extension, addressing gaps in service for unincorporated neighborhoods can be a financial challenge not only for the three counties in this study but also for counties across the state.

Previous research has emphasized the high prevalence of failing septic tanks in some unincorporated communities (Wilson, 2008; Heaney, 2011). Similarly, septic tank failures emerged as a major theme in this study. Though this study did not quantify the prevalence of failing septic tanks in unincorporated communities, it did find septic tank failures to be a powerful catalyst for water and sewer extension. Specifically, data on the number of failed septic tanks in unincorporated neighborhoods served as a powerful tool to encourage decision-makers to prioritize water and sewer extension. This may in part be because failed septic tanks can readily affect the surrounding region including the neighboring town through widespread surface and ground water contamination. Septic tank failure data were also useful in building a strong application for grants and loans. Despite the importance of these data, the fear of home condemnation and costly repairs has kept many community members from willingly disclosing this information to health departments, which is corroborated by past research (Cedar Grove Institute, 2003; Heaney, 2011). Poor data on the extent of septic tank failure in a neighborhood can reduce the decision-makers' and funders' perceptions of the public health importance of water and sewer extension.

Interestingly, well failure or contamination did not emerge as a strong incentive for extension. Unlike septic system failures, the health risks associated with well contamination is confined largely to the homeowners and has little effect on the neighboring city. These isolated health risks may be part of the reason that city and county stakeholders did not cite well contamination as a factor in the decision-making process. Though all three communities were questioned generally about the factors that would influence both water and sewer extension, the fact that only one of the three communities used wells while all three relied on septic systems may be an additional reason that well contamination was less influential than septic system failures in the decision-making process.

Public health improvements for both the unincorporated community and the surrounding region are commonly cited as one of the primary drivers for extending water and sewer services (Heaney, 2011; Uhlmann, 2009). Heaney et al. (2011) linked fecal contamination of surface waters and drinking water supplies to areas of high septic tank failure, and Uhlmann et al. (2009) found a higher risk of enteric disease for individuals serviced by private wells. Despite an emphasis on the health effects of water and sewer access in the existing literature, this study did not find health to be a major factor in the local decision-making process. In Hoke and Transylvania counties, interviewees did not perceive a link between health and reliance on wells and septic tanks and health was not identified as a driving factor behind service extension. This lack of concern about health impacts is especially striking because public health officials in these counties described pumping piping sewage directly into creeks and overflowing septic tanks into streets, both of which can increase risks of infectious disease transmission.

Previous literature often attributes disparities in access to the built environment to historical and present acts of racism (Heaney, 2011; Johnson, 2008). Specifically, the literature

primarily focuses on persons of color living in unincorporated communities zoned out of primarily white cities. This study does not discredit the past data, but rather provides evidence that these disparities extend beyond race alone and also affect white unincorporated communities excluded from white cities as well, as was the case in two of the three study locations. Though racial differences were not present in either of these two counties, age and socioeconomic level may have been relevant factors. Though median household income could not be determined at the community level, interviewees indicated that the community residents in Transylvania County were at a lower socioeconomic level than the population in Brevard. Furthermore, the community residents in New Hanover County were older than those of Wilmington (Table 1). In addition to race, it is possible that age and socioeconomic level, which have also been linked to limited political power (Bullard et al., 2007; Cutter, 1995), similarly influence access to water and sewer services. This has been explored in depth in communities outside the United States, where socioeconomic level has a strong effect on access to water and sewer services (UNICEF, 2011).

Through the various participants interviewed, this study illustrated the differences in perception of water and sewer needs among the major stakeholders involved in deciding whether service should be extended. Not only did perceptions differ among the various types of stakeholders interviewed, but they also varied between staff members and elected officials and between city and county officials. Perceptions of the multiple stakeholders involved in water and sewer extension have not been systematically explored in previous research. Diversity in a group's perceived goal or target has been found to adversely affect the group's effectiveness and efficiency (Jehn et al., 1999). Considering this, the variation in awareness and opinion that

emerged from the stakeholders' responses may serve as a barrier in the decision-making process behind water and sewer extension.

5. LIMITATIONS

One limitation of this study is the potential for bias in the responses. Due to the sensitive nature of the topic, it is possible that participants withheld information or volunteered untrue information to protect their own reputation or that of their city, particularly in areas with considerable media attention on inequitable access to water and sewer service. To put respondents at ease and protect against potential bias, the interviewer assured respondents that no identifying information would be used in the data analysis or presentation.

6. RECOMMENDATIONS

Finally, based on this study's findings, I make four recommendations for policy-makers, local stakeholders, and researchers involved in water and sewer access.

Firstly, considering the challenge of financing water and sewer extensions, grants and low-interest loans specifically for unincorporated communities lacking water and sewer service should be expanded. Though there are five major state and federal funding options available, only one is specifically applicable to unincorporated communities neighboring public water and sewer supplies. By expanding the criteria for the four other water and sewer funding options to include extension of service, cities will have more funding options available to address limited water and sewer access. Also, because the preparation for grant and loan applications can be time-consuming, complicated, and prohibitive to obtaining the funding, especially for small cities, more technical support should be given to local governments for the application process,

including training on effective grant applications by state government officials or non-governmental organizations.

Second, local leaders and policy-makers should implement a mechanism for monitoring septic tank problems and failures without the potential of condemnation for the homeowners. This study indicated that problems with the existing infrastructure can be an important catalyst to extending services; however, community members and health officials may not report septic tank problems to avoid the consequences of a failed system. Because of this, the data on failed septic tanks is often inaccurate. To improve monitoring and more accurately present the extent of septic failure, data collection for septic failures must extend beyond self-reporting.

Third, the health effects of septic tank and well use should be more widely disseminated to all key stakeholders involved in water and sewer extension. Though public health is a major factor in the literature, it was largely ignored as a factor in the decision-making processes of the interview participants. Part of this problem is poor dissemination of the existing research to all local stakeholders, especially those outside the health department.

Finally, researchers should include socioeconomic level and age along with race as predictors of disproportionate access to water and sewer service. Past research has focused almost entirely on racial disparities; however, this study indicates that unequal access to water and sewer services extends beyond race. To fully assess and understand poor access to services in unincorporated communities, researchers should widen their scope of communities at risk.

7. CONCLUSION

Based on the three cases, this study identified and ranked the primary themes influencing access to water services (financing, government impact, existing and future infrastructure, community impact, and health). These results informed recommendations for local decision-makers, policy-

makers, and researchers. Access to centralized water and sewer service can have considerable health effects (Craun et al., 2010; Heaney, 2011; Uhlmann, 2009), which makes it critical to understand the factors that affect service extension. Furthermore, unequal access to water and sewer services disproportionately burdens the politically vulnerable (Bullard et al., 2007; Cutter, 1995), which emphasizes the need to have informed stakeholders involved in the decision-making process. Through its findings and recommendations, this study presents the avenues and barriers to extending water and sewer services as well as encourages research dissemination and grant-writing support for local decision-makers. Future research should further quantify the health risks associated with disproportionate access to water and sewer services as this was often overlooked in the decision-making process, despite its potential influence.

APPENDIX 1: TELEPHONE AND EMAIL RECRUITMENT SCRIPTS

Telephone Recruitment Script:

Hello, this is Julia Naman from the Access to Water and Sewer Study at the University of North Carolina. We are conducting a qualitative research study to identify the major factors can lead to improved access to water and sewer services. Because of your position as a key stakeholder in the provision of city services, I would like to invite you to participate in an interview. During the interview, I will ask you about your opinions and experiences on extending city services. There are no right or wrong answers and all of the information collected will be kept strictly confidential. The interview will last approximately 1 hour and will be tape-recorded. The interview can be scheduled at your convenience.

Email Recruitment Script:

Dear [insert name],

My name is Julia Naman and I am from the Access to Water and Sewer Study at the University of North Carolina. We are conducting a qualitative research study to identify the major factors that can lead to improved access to water and sewer services.

Because of your position as a key stakeholder in the provision of city services, I would like to invite you to participate in an interview. During the interview, I will ask you about your opinions and experiences on extending city services. The interview will last approximately 1 hour and will be tape-recorded. There are no right or wrong answers and all of the information collected will be kept strictly confidential. The interview can be scheduled at your convenience.

If you are interested in participating, please respond to this email at jnaman@live.unc.edu or by calling 706-536-3621.

I look forward to hearing from you soon.

Sincerely,

Julia Naman

APPENDIX 2: INTERVIEW GUIDES

Health Officials

1. Tell me about the region that you serve.
    a. What do you consider the major health concerns facing this region?
    b. What role do you play in alleviating these health concerns?
2. Tell me about the [insert name] community.
    a. What do you consider the major health concerns for this community in particular?
3. How do you feel [insert name] community's health concerns differ from or are the same as those of [insert name] county? [insert name] city?
4. Is access to piped/centralized water and sewer services a major health concern for the region that you serve? Why or why not?
    a. In terms of health priorities, where does this rank for the region that you serve?
    b. How is it a health concern for [insert name] community?
    c. How is it a health concern for [insert name] city?
5. How is the health department involved in helping to provide water and sewer services to this community, if at all?
6. Describe the role you believe the health department *should* play in providing these services?
    a. What, if any, are the barriers to playing this role?
    b. Who else should be involved in providing these services?
7. How similar or different do you believe your opinions are from other health departments

Utility Providers

1. Tell me about the process of extending water and sewer services?
    a. How are you involved in providing water and sewer to new communities?
    b. Who initiates the project and orders/pays for the job within the city? Out of the city?
    c. How often do these extensions occur?
2. In what cases does the city pay for extending water and sewer services, if at all?
    a. Why does/doesn't this happen?
3. Is access to water and sewer services a major concern for this utility? Why or why not?
    a. How could extending water and sewer services benefit the utility? Hurt the utility?
4. How concerned are you about the possibility of failing septic systems in close proximity to your service area's water supply?
    a. How can this affect your water quality, if at all? Your treatment strategy? Well water quality?
5. What role do you believe the utility should play in extending water and sewer services to communities, if at all?

Government Officials

1. Tell me about the major priorities for your city.
2. How major or minor of a concern is access to water and sewer services for communities on the outskirts of your city?
    a. What makes it a major/minor concern?
    b. How does it affect the city? The neighboring community?
3. How is the government involved in extending water and sewer services to the [insert name] community, if at all?
4. Describe the role you think the government *should* play in extending access to the [insert name] community.
    a. What are the barriers to playing this role?
    b. Who else should be involved in extending services?
    c. What should their roles be?
5. Walk me through how city lines are extended and redrawn.
    a. What considerations go into redrawing city lines?
    b. How often are lines redrawn?
    c. Who is involved in making these decisions?
6. Tell me about the process of incorporating the [insert name] community.
    a. How would this incorporation be done?
    b. Who would be involved?
    c. How likely is this to happen?
    d. What are the barriers to incorporating this community?
7. In your opinion, what are the reasons why the [insert name] community has not gained access to water and sewer services?
8. What do you consider the factors that would allow the [insert name] community to gain access to water and sewer services?

Community Leaders

1. Tell me about your community.
    a. Approximately how many residents does your community have?
    b. What is the demographic make-up of your community?
    c. How involved are community members in community efforts or activities?
    d. What do you consider your community's most pressing concerns? Least pressing concerns?
2. How major or minor of a concern is lack of access to water and sewer services?
    a. What makes it a major/minor concern?
3. How do you think the rest of your community feels about access to water and sewer services?
    a. Do you think most people would agree with your views or disagree? Why?
4. What role do believe the community should play to gain water and sewer services?

    a. What are the barriers to playing this role?
    b. Who else should be involved?
    c. What role should they play?
5. Describe your current efforts to gain access to water and sewer services.
    a. How often do you have community meetings to discuss this topic?
    b. How many people usually show up to these meetings?
    c. How often do you participate in city or county-wide meetings?
    d. What else do you think your community *should* be doing?
6. What things are standing in your way of gaining access to water and sewer services?
7. What do you consider the factors that would allow your community to gain access to water and sewer services?
    a. Why do you think some communities have managed to gain access to these services?

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