

# Defining North Carolina's Transportation Disadvantaged Populations

## FINAL REPORT

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16. Abstract <p>This study details the research team's approach and findings for mapping transportation-disadvantaged populations and holding interviews with local practitioners and vulnerable groups. The study provides a straightforward and practice-ready outreach process that can be used by transportation practitioners to better address the needs of populations facing significant mobility challenges. Underserved groups in six North Carolina counties (Beaufort, Chatham, Graham, Wake, Warren, Wilson) are identified and mapped with GIS applications. Most often those protected under Title VI requirements – low-income and minority populations – but also the elderly, disabled, children, and those with language barriers have mobility needs that are often unmet.</p> <p>Interview findings demonstrated that policy provisions, such as restrictive eligibility requirements for paratransit, prohibitive monetary and time costs, and insufficient public transportation offerings, among other reasons, pointed to why certain groups suffer transportation disadvantage.</p> <p>This study also provides transportation practitioners with a step-by-step process to identify and map transportation-disadvantage populations in a user-friendly <i>Practitioner Guide</i>. The guide serves as a companion to the research and is included in the appendix of this report.</p>			
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## EXECUTIVE SUMMARY

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This study was undertaken on behalf of the North Carolina Department of Transportation (NCDOT) as a research project to better understand the characteristics of populations that are considered transportation-disadvantaged. Numerous statutes, regulations and executive orders such as EO 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) provide guidance on what comprises the traditionally underserved; however, to be transportation-disadvantaged includes not only socio-demographic characteristics but also where these populations live and what travel options are available to them. Consequently, NCDOT wanted a comprehensive review of vulnerable populations that may be transportation-disadvantaged. The purpose of this project was to provide NCDOT with a detailed, practice-ready methodology to identify the location and needs of transportation-disadvantaged populations across the state.

This project was undertaken as a joint effort of the Institute of Transportation Research and Education (ITRE) at NC State University and the Institute for the Environment (IE) at the University of North Carolina at Chapel Hill. It included five primary tasks: (1) literature and data review, (2) creation of transportation-disadvantaged population maps, (3) outreach with local transportation practitioners and vulnerable populations and analysis of outreach findings, (4) map revisions, (5) creation of practitioner guide and final report. To achieve these tasks, a mixed-method approach was employed by the research team including both quantitative and qualitative data collection and mapping. Six counties (Beaufort, Chatham, Graham, Wake, Warren, Wilson) representing a range of different contexts including urban, rural, mountain, piedmont and eastern regions were used as case studies to test the mixed-method approach. The methodology and findings are included in the following pages.

A comprehensive literature review pointed to several demographic characteristics that have a propensity to indicate transportation-disadvantage. Seven transportation-disadvantaged indicators (low-income households, households with mobility impaired individuals, households with youth of non-driving age, households with seniors, ethnic minority households, limited-English proficiency, and carless households <sup>1</sup>) derived from census data were initially used to develop base maps of potentially disadvantaged populations. These indicators were combined into one map (a compilation map) to show “hot spots” of potentially disadvantaged populations. Next, a two-pronged outreach approach using both focus groups and key informant interviews were utilized to gather additional information on the characteristics of transportation-disadvantaged as well as vet the initial base map of where these populations may be located. The outreach results lead

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<sup>1</sup> Prior to outreach, carless households were removed from the base map because although carelessness may be a transportation disadvantage, it may also reflect transportation advantages granted by a strong public transportation system or access to private transportation services. Because age and poverty are also strongly correlated with carelessness, including carelessness as an indicator could lead to a double-counting of results.

to the identification of additional indicators of transportation-disadvantaged that are dependent on the uniqueness of the area of concern (i.e. County). These “non-traditional” groups included community college students, itinerant farm-workers, Mennonites, and widows who do not drive to name a few. These groups of people share common traits that make mobility more difficult, but those traits are not reported in common data sources and; therefore, require outreach into communities to identify these transportation-disadvantaged populations. Based on the input from the outreach process the compilation maps were revised to better reflect both the traditional (demographic characteristics) and non-traditional populations which have a propensity to be disadvantaged.

In addition to locating potentially transportation-disadvantaged populations, numerous issues and needs surfaced through the outreach. Challenges encompassed issues related to affordable transportation services, access to a range of amenities, availability of public transportation, and transportation facilities that are perceived as safe and reliable. While this research project proved to be an excellent starting point to spatially define and identify population groups with a propensity to be transportation-disadvantaged additional research is needed to fully understand the type and degree of their specific transportation needs. This requires a closer examination of how the built environment and transportation supply interacts to create transportation challenges. Fortunately, this research project uncovered a potentially useful framework of which NCDOT could explore through further research to continue the foundational findings of this research project.

The process utilized during this research project has been documented in a practitioner’s guide such that NCDOT can replicate the process for plans, projects and activities so that the location and needs of transportation-disadvantaged populations can be better understood and incorporated into decision-making processes.

# INTRODUCTION

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To ensure that transportation investments are serving North Carolina's most vulnerable residents, transportation professionals need valid, reliable, and efficient methods to identify individuals whose mobility needs are not being met. Low-income and minority populations, protected under Title IV, often struggle to get to work, medical appointments, and groceries. Other groups outside Title IV protection may also be left out, including the elderly, disabled, children, and those with language barriers. These groups' travel needs often go unmet primarily because transportation agencies struggle to identify vulnerable groups' specific needs and physical location.

This study identifies and maps underserved populations in six counties (Beaufort, Chatham, Graham, Wake, Warren, Wilson), and the methodology used to identify those groups. This methodology has been expanded into an approach that can be employed by transportation professionals seeking to better meet the needs of disadvantaged populations. For the purposes of this study, underserved or disadvantaged groups will be referred to as *transportation-disadvantaged populations*.<sup>2</sup>

## PROBLEM STATEMENT

The North Carolina Department of Transportation (NCDOT) requested a comprehensive review of vulnerable populations that may be transportation-disadvantaged. The purpose of this project was to provide NCDOT with a detailed, practice-ready methodology to identify the location and needs of transportation-disadvantaged populations across the state. The results of this study are documented in this report for the use of NCDOT and local transportation practitioners.

## METHODOLOGY

This project is a joint effort of the Institute of Transportation Research and Education (ITRE) at NC State University and the Institute for the Environment (IE) at the University of North Carolina at Chapel Hill. It includes five main tasks: (1) literature and data review, (2) creation of transportation-disadvantaged population maps, (3) workshops between local transportation professionals and community members who self-describe as transportation-disadvantaged (and analysis of this outreach effort), (4) map revisions, (5) creation of practitioner guide and final report. To achieve these tasks, a mixed-method approach was employed.

In order to complete the literature review, the team reviewed over 100 sources. The literature review includes a bibliography documenting 65 of the most relevant journal articles, reports, conference papers, web documents, and other sources.<sup>3</sup> These sources

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<sup>2</sup> For the purposes of this project, a *transportation disadvantage* indicates impeded or limited access to employment, education, health care, and healthy food. In addition, transportation-disadvantaged populations may experience greater exposure to other impacts and risks not limited specifically to transportation infrastructure or services, such as poor health status, poor access to fresh food or lack of opportunities for social activities.

<sup>3</sup> The literature review is included in the appendix of this report.

Transportation-disadvantaged indicators suggested by the literature:

1. Low-income households
2. Households with mobility-impaired individuals
3. Households with youth of non-driving age
4. Households with seniors
5. Ethnic-minority households
6. Limited-English proficiency
7. Carless households

were used to determine demographic characteristics that tended to also indicate a transportation disadvantage. After indicators of transportation disadvantage were identified, a data review was undertaken to determine what data was available to describe these indicators. Using US Census data, six transportation-disadvantaged indicators were then mapped. For this study, carless households was not used as an indicator because, in some urban contexts, carlessness may be both a cause of transportation disadvantage and an effect of

transportation *advantage*. Further, age and poverty characteristics are strongly correlated with carlessness; therefore, adding carlessness as an indicator to age and poverty could skew mapping results.<sup>4</sup>

The data were then used to create two types of GIS maps that demonstrated, at the Census block level, where transportation-disadvantaged populations were most likely to live. The first set of maps mapped each indicator at the county level. The next set of maps compiled all transportation-disadvantaged indicators to identify ‘hot spots’ of potentially transportation-disadvantaged populations. The two map types are exhibited below.

Exhibit 1 – Transportation-Disadvantaged Populations Indicator Map (Beaufort County – Income)

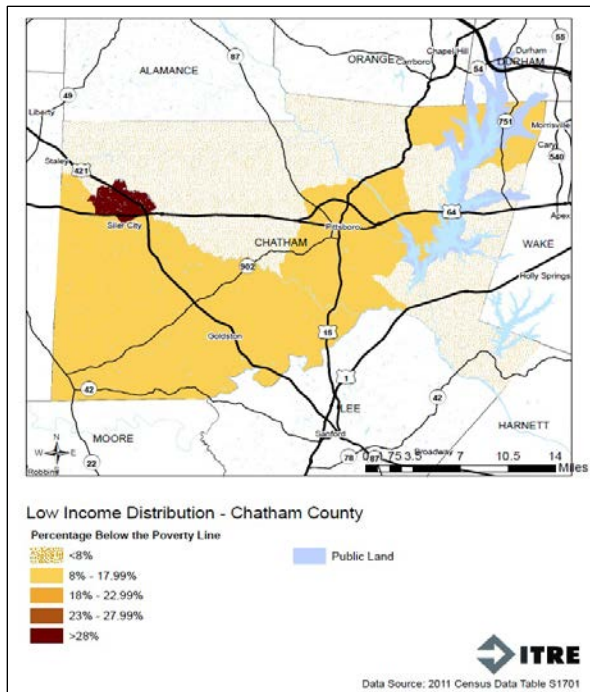
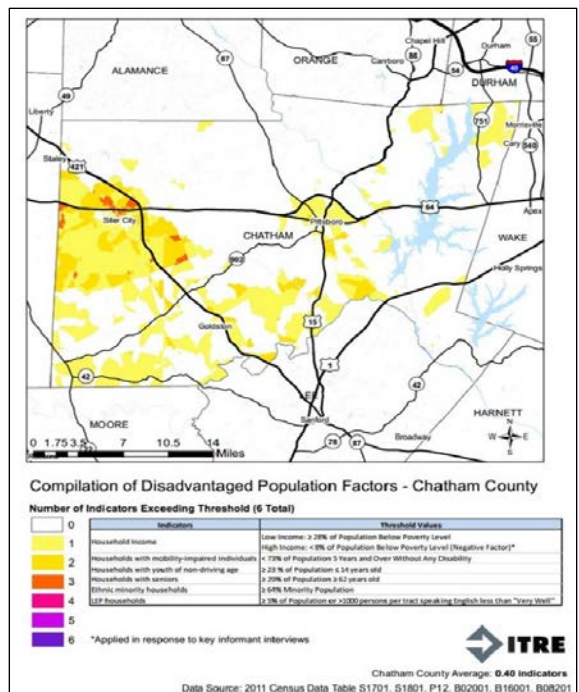
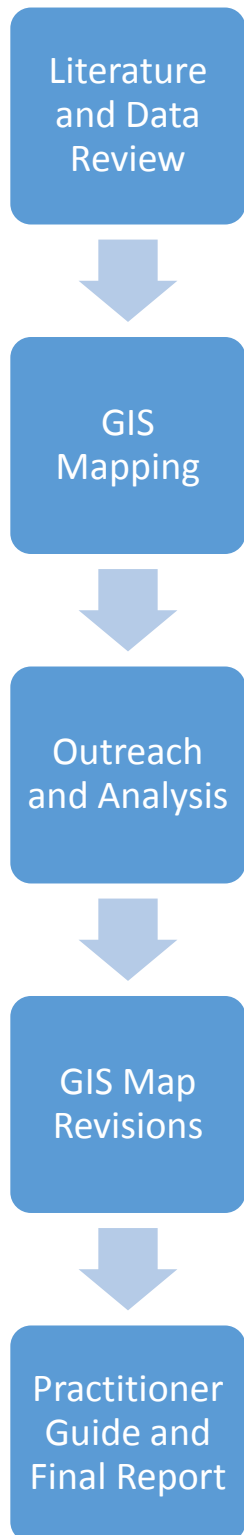


Exhibit 2 – Transportation-Disadvantaged Compilation Map (Beaufort County – Six Factors)



<sup>4</sup> Carlessness was included in the *Practitioner Guide* at the request of the NCDOT.





The validity of the maps were then tested in six counties: Beaufort, Chatham, Graham, Warren, Wake, Wilson. These study sites were chosen to ensure a range of development patterns (urban, small urban, and rural), geographic regions (Mountain, Piedmont, Coastal Plain, Coast), and socio-demographics. In particular, the team sought out counties where local officials and practitioners expressed strong interest in participation, and where the research team had established contacts. The selected counties ranged from very rural with no scheduled transit (Graham, Warren), to rural with very limited scheduled transit (Beaufort), to mixed urban/rural with scheduled transit (Chatham, Wilson). Raleigh (Wake County) was included to provide urban context.

Spatial data on socio-demographics from the Census was combined with expert knowledge of local practitioners and the personal experience of residents. Local practitioners included planners, elected officials, paratransit directors, emergency managers, social service providers, health workers, and others. The Institute for the Environment conducted on-site interviews with local practitioners and convened focus groups with groups of residents who were willing to talk about their transportation challenges. Overall, the Institute for the Environment conducted 38 interviews with 53 key informants and facilitated eight focus groups.

Conversations with local practitioners enabled the research team to revise the maps to more precisely describe the county's transportation-disadvantaged populations. In Chatham County, this outreach process revealed that wealthy seniors in the Governor's Club, Carolina Meadows, and the Preserve at Amberly were not at a disadvantage because of residents' wealth. The team modified the wealth indicator so that, unlike other indicators, it may signify an advantage or disadvantage. Because wealthier residents may be able to purchase private transportation services that are beyond the means of residents who otherwise share important demographic characteristics, a correction factor of -1 was applied in very wealthy areas.<sup>5</sup>

The entire mapping and outreach process has been documented in a user-friendly practitioner guide with step-by-step instructions.<sup>6</sup> Following the guide, this final report serves as the capstone of the study to identify North Carolina's transportation-disadvantaged populations.

<sup>5</sup> A correction factor of -1 was applied to populations that were beyond two standard deviations of the statewide county average for mean household income.

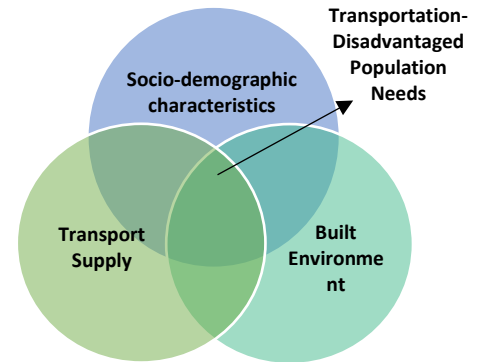
<sup>6</sup> The practitioner guide can be found in the Appendix.

# FINDINGS

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## INTRODUCTION

Transportation-disadvantaged populations are likely to strongly correspond to other groups traditionally labeled as ‘vulnerable’. However, transportation disadvantage is determined by factors beyond merely the socio-demographic. Factors that would, initially, seem to indicate the presence transportation disadvantage may be mitigated by other considerations that are not easily revealed. In part, this is a result of a familiar challenge to those in the field of transportation, which is identifying not only the socio-demographic characteristics that transportation-disadvantaged groups have in common, but to ensure that transportation supply meets the needs of their physical and built environment.



This section discusses findings from the outreach process, which involved interviews with local transportation planners (hereafter referred to as ‘key informants’), and focus groups that included members of transportation-disadvantaged populations. The process combined indicator maps with qualitative data to better understand transportation-disadvantaged populations and the degree to which their transportation needs are addressed.

## INTERVIEW PROCESS

Key informants were interviewed, individually or in small groups, with a semi-structured interview instrument that was reviewed and approved by the UNC-Chapel Hill Institutional Review Board and piloted with a transportation planner in Carrboro, North Carolina. The questions probed the key informants’ knowledge about transportation supply and services, the level of unmet transportation demand and possible explanations for any gaps.

Key informants represented a wide range of transportation-relevant occupations and organizations, including:

- Councils of governments
- Economic development professionals
- Emergency management coordinators
- Community planners
- Health and human service employees
- Social service workers
- Elected officials
- Police departments
- Citizen advisory committee members
- Human relations officer Councils on Aging members
- Adult education coordinators
- Transit directors

Interviews began by presenting participants with a nearly blank map of each county in the study. Key informants were asked to locate and discuss areas of potential transportation disadvantages on the maps. The maps—which included the main roads and cities or towns, but no illustration of transportation disadvantage—were intended to ‘prime’ the informants, and encourage them to think broadly about their community and its residents. This exercise provided valuable information and was synthesized with material gathered from case studies. Next, informants were asked a series of questions about the local population and their travel patterns, and about local transport services. Finally, informants were asked to review the county maps of potential hot-spots, with darker colors indicating a greater likelihood of transportation disadvantage. The interviews concluded by asking informants how well the map reflects their version of reality in their communities.

Key informants in all six locations were generous with their time and expertise, and provided both insightful comments on the local population and environment. Informants also provided useful critiques of the current transportation disadvantage maps. Interviews were audio-taped, then transcribed and coded for content analysis using ATLAS.ti software. Codes reflect a specific topic, theme or issue identified or expressed in an interview, such as access to work, limited transit service or (long) distance to major destinations. The team duplicated the coding for several interviews to establish major ‘theme families.’ These recurrent themes were then used to establish patterns within and across counties, in addition to patterns within and across professional roles.

#### **FOCUS GROUP PROCESS**

The focus groups were intended to reach a diverse set of populations in each of the counties selected. Two focus groups were conducted in Graham County: one with representatives of the Eastern Band of the Cherokees and another with senior citizens. In Warren County, the focus group consisted of residents from Soul City, while in Wilson County the focus group consisted primarily of migrant farm workers from Mexico. Two focus groups were held in Chatham County: one with residents who relied on public transit to travel to jobs in Chapel Hill, and another with Chatham County residents who had participated in a morning workshop with TARPO (Triangle Area Rural Planning Organization). Finally, focus groups in Wilson County and Beaufort County unfortunately captured residents who did not completely meet the protocol’s target of non-expert non-practitioners. These residents had some expertise in transportation and social services, either through their employment or by virtue of active citizen involvement in local government. Still, the focus groups in Beaufort and Wilson counties provided critical insights, including suggested revisions of the recruiting protocol. A focus group was not conducted in Wake County.

Each focus group began by distributing small, a nearly blank maps of the county or community to group members. Participants were asked to sketch and describe their daily travel patterns. The maps were intended to encourage participants to think about how they traverse and interact with their environments. Participants contributed anonymous socio-demographic information about themselves to the maps, including household size, number of children and adults, number of vehicles, age of participant, and language spoken at home.

This data was also reviewed during focus groups' content analysis of qualitative data. The map exercise led to a group discussion about travel patterns and travel needs, including suppressed travel demand (trips that are desirable but currently impossible). Focus group participants also provided brief written responses to a few follow-up questions, and provided additional information they did not want to share publicly with the group.

Unlike the interviews, the focus groups were not audio-recorded, as specified by the protocol. Discussions were intended to be open, without participants fearing any loss of anonymity. The materials collected ultimately included participants' maps and written comments, easel notes, and a discussion log. Because the collected materials were generally very concise, those materials were not coded, but rather reviewed for differences and similarities with interviews.

### OUTREACH RESULTS

The outreach process conducted by the Institute for the Environment team was used to further develop an understanding of the environmental and social factors that may create a transportation disadvantage. The central findings from the outreach process are discussed in this section. Meanwhile, a more in-depth analysis of county-specific findings can be found in the *Case Studies* section of the appendix of this report.

**Table 1: Frequency of Codes (across all interviews)**

Dominant Codes	Frequency	Dominant Codes	Frequency
Ped/bike	103	(continued from bottom of left column)	
Vulnerable populations (SV)	91	Map agree	20
Transit supply	73	Demographic changes	19
Informal solutions	69	Isolation	18
Long distance	50	Economic development	17
Transportation planning	49	Wealth gap	17
Access to health care	43	Connections and corridors	16
Built environment & land use (BE/LU)	36	Access to school	16
Paratransit challenges	35	Transit challenges	13
Access to amenities	34	Road conditions	13
Governance	30	Hazards	13
Community resources	30	Map mixed feelings	13
Access to work	30	Nontraditional vulnerable populations	12
Cost of travel	28	Rural self-sufficiency	11
Politics	28	Trip-chaining	11
Transit demand	27	Rural vs. urban	7
Map	25	Map disagree	7
Decline	23	Community identity	6

### CODE SIGNIFICANCE TO PRACTITIONERS

If a code was discussed more frequently during key informant interviews, it indicated which transportation challenges were prevalent in a region. However, the number of occurrences alone does not fully reflect the significance of the issue. For example, bicycles and pedestrians were the subject of several questions, which allowed all key informants to comment on the topic. Many of those interviewed emphasized that walking and biking are neither prevalent nor a priority in their county. For these counties, the frequency of codes related to bicycling and pedestrianism may be higher, but does not indicate a strong support system or culture for those modes. Inevitably, the codes may be biased toward issues raised in scripted questions. Individual interviewers may also have biased the codes by asking leading questions over the course of a free-flowing dialogue. However, this freeform interviewing technique is an important part of the process of encouraging key informants to think about mobility issues. Table 1, on the previous page, introduces some of the most frequently occurring codes, and serves as an overview of the themes. It does not necessarily reflect a ranking of the issues raised by key informants. Figure 1, on the following page, demonstrates this information on a county-by-county basis.

The research team also documented cases where codes' frequencies varied according to the occupation or professional role of key informants (see "Figure 2" on page 9). Not all occupations were highly correlated with higher frequencies (e.g. economic development professionals, police); however, the professional categories that have emerged illustrate how interview subject matter may vary based on key informant occupation. Some of the trends that have emerged when grouping informants by occupation are discussed below.

- Planners and transportation planners (and to some extent, emergency managers) were more likely than other officials to bring up, focus on, or provide information on "transportation planning," possibly because this is included in their field of "expertise." "Transportation planning" includes the present availability of transportation services and facilities, and corresponding supply and demand. It also includes short- and long-range plans to design for improvements to services and infrastructure.
- Accordingly, planners, transportation planners, and emergency managers also discussed transit supply, demand, and transportation planning.
- Officials working in senior services brought up "elderly" and "challenges of paratransit" most often. This is important because, unlike planners, their field is more narrowly focused on one sub-set of social vulnerability (the elderly).
- Similarly, Social Services officials tend to work with vulnerable populations, which may have resulted in social vulnerability becoming more implicit in the exercise. Informal solutions and challenges of paratransit were the most common discussion areas.
- Specialists in public health, senior services and social services focused on access to health care and amenities. This may imply an association between their clientele (typically more disadvantaged) and their primary transportation concerns.

- There is evidence that specialists across all fields were able to identify and describe informal solutions in their communities.

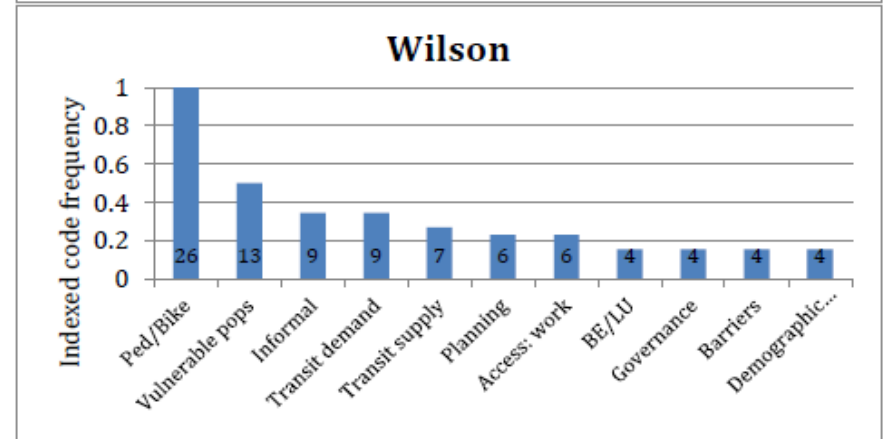
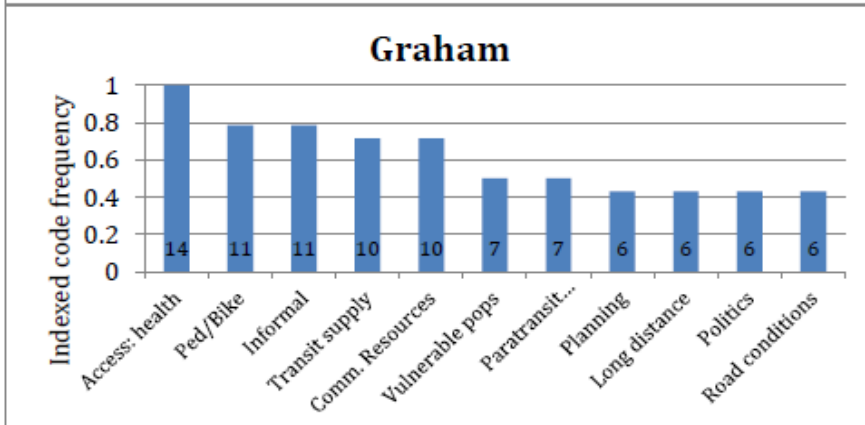
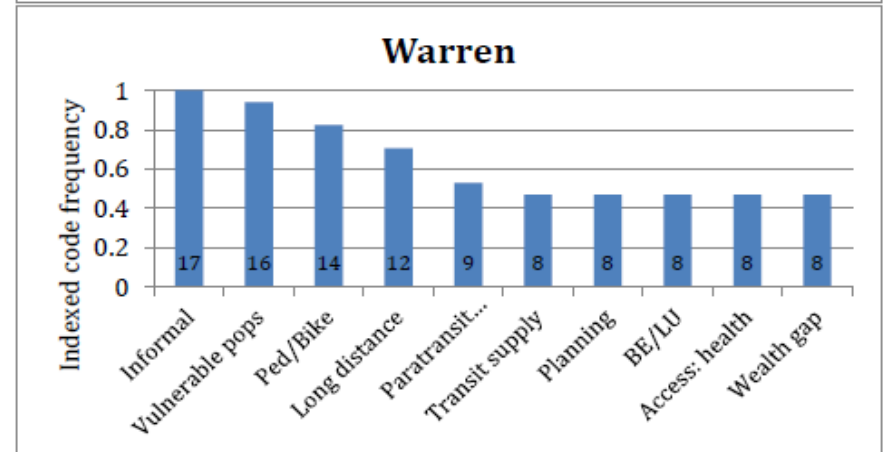
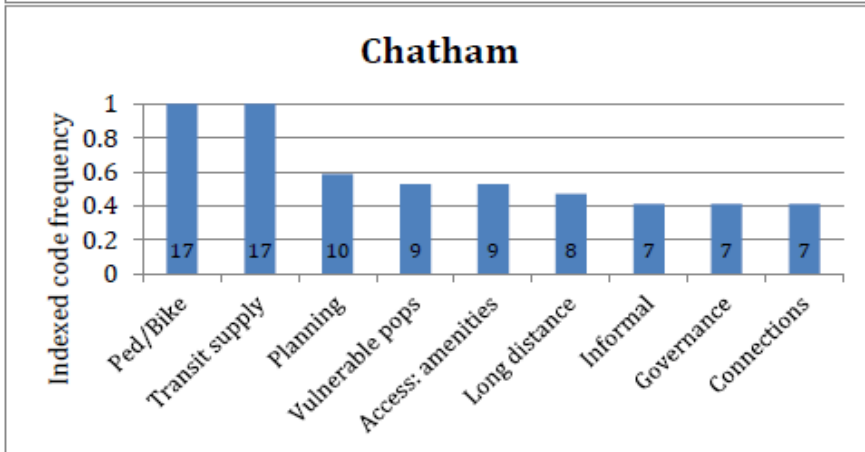
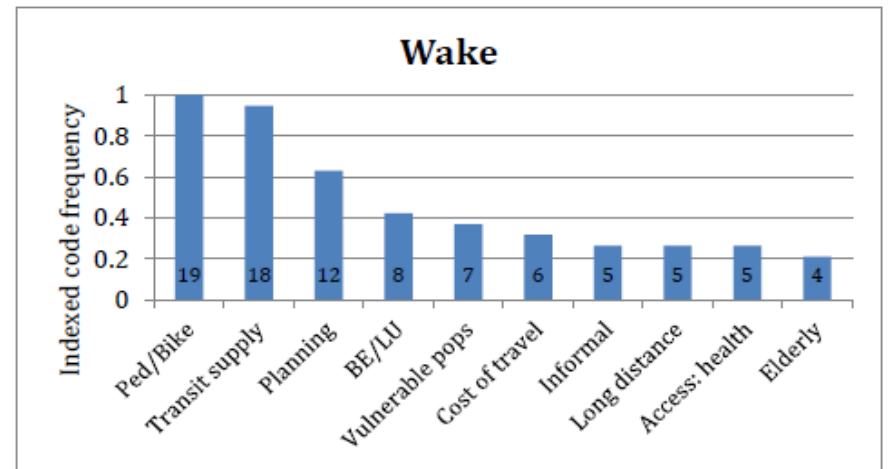
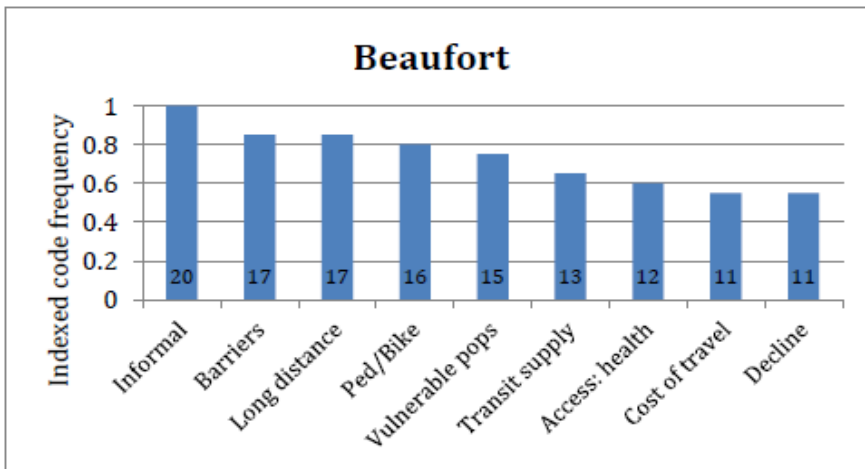


Figure 1. Relative code frequency in six counties

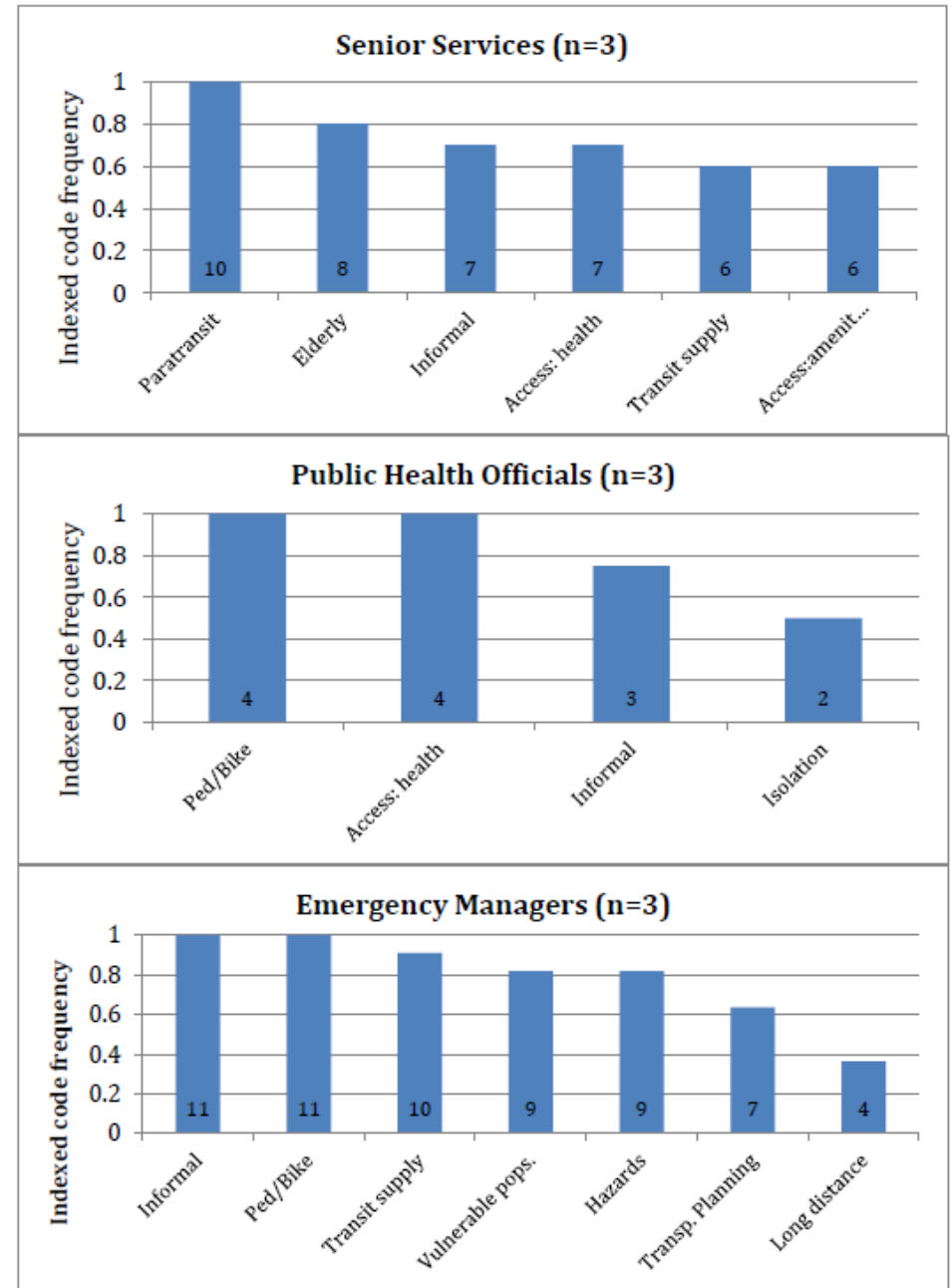
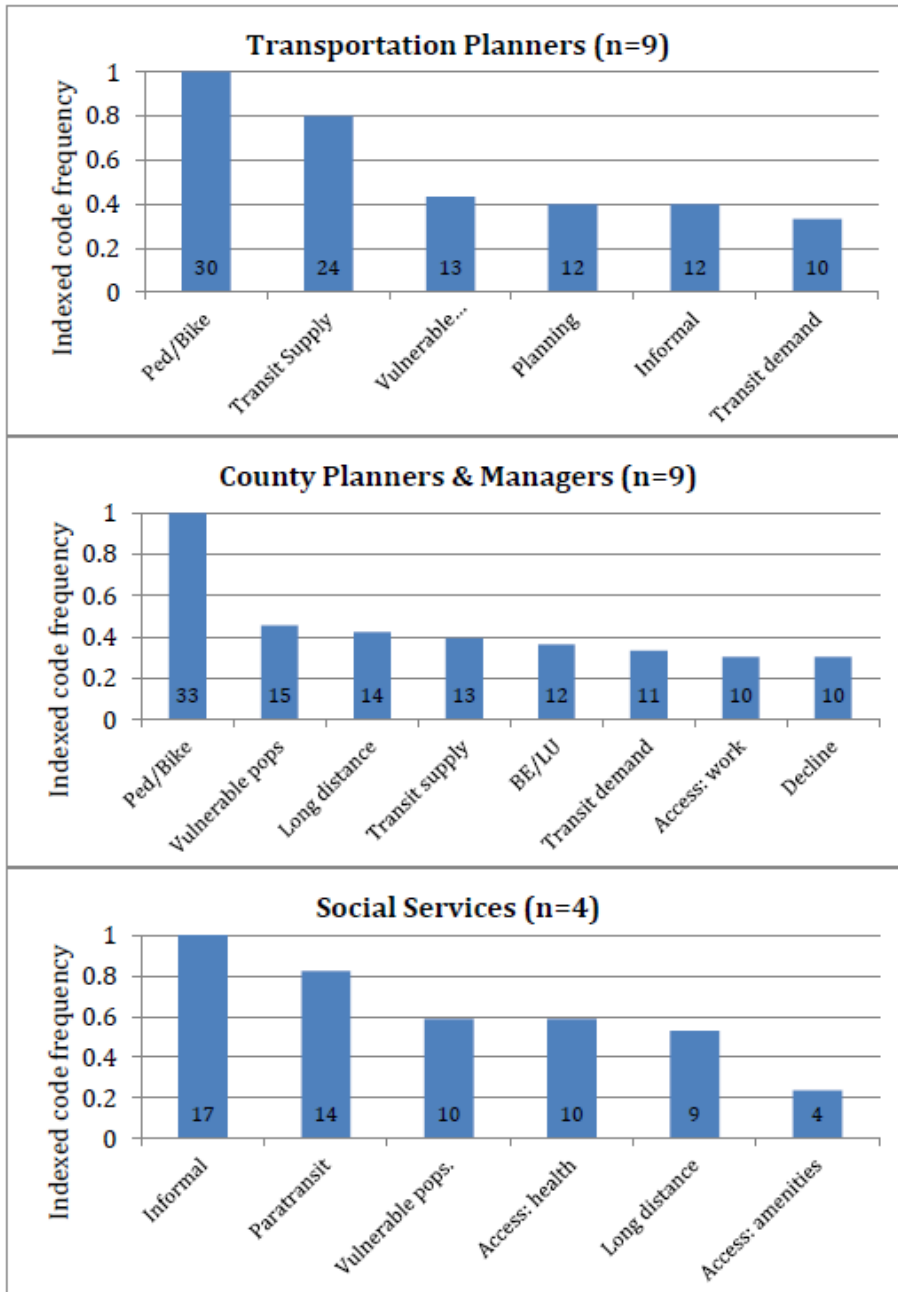


Figure 2. Relative code frequency across professional roles



In this study, the research team used ATLAS.ti software to code topics discussed during interviews. These codes were then used to create broad themes that illustrated the needs and limitations faced by transportation-disadvantaged populations. This software expedited the process of drawing themes from key informant interviews, but it is not essential for transportation practitioners. Similar results can be achieved by using documenting common issues identifying over the course of outreach, and can be used to isolate important themes that occur across a geographic area. (For step-by-step guidance on conducting the outreach process, see the *Practitioner Guide* in the appendix.)

### **COMMON THEMES IDENTIFIED THROUGH OUTREACH**

This section describes some of the major challenges observed in all counties and methods for overcoming these challenges. The section also details government-provided services designed to support socially vulnerable populations, and a discussion of what seems to be working well and not working at all. Finally, informal solutions to transportation challenges, which represent unmet demand, is discussed. This section goes over the salient themes that emerge in key informant interviews.<sup>7</sup>

#### *Transportation challenges*

Key informants identified the types of transportation challenges socially vulnerable populations face. These challenges include accessing grocery stores, work, school, and health care providers. Other challenges include:

- Restrictive eligibility requirements for paratransit (reserved for people with disabilities, only for Medicaid or Medicare recipients, etc)
- Limitations on trip purpose for paratransit (difficult to trip-chain with medical appointments)
- Understanding of paratransit services—for example, one key informant in Warren County explained:
  - It can be a little confusing. Just overall in trying to remember—ok, they only make this drive on this day, and remembering as you schedule appointments.*
- Frequency and reliability of scheduled service
- Cost
- Long distances and time commitment to using public transportation
- Amenities can be far from home

How do transportation-disadvantaged populations overcome these challenges?

Transportation-disadvantaged populations rely on formal and informal solutions to their mobility needs. Formal solutions include public transportation, paratransit, and policies that reimburse users or programs from different agencies that offer ride services. Some people are still left out of the formal system, and either cannot use the services or cannot afford the services. Active networks of informal transportation solutions were found in all of the NC communities the research team visited. A few examples are provided below.

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<sup>7</sup> For in-depth county-by-county case studies, see the Appendix.

In Wilson County, a sense of rural self-sufficiency rooted in trusting relationships with neighbors removes the need for many trips:

*And it goes back to the old saying. If you live outside the city, the country folks are going to take care of themselves. And that's pretty much what happens there. They say "hey neighbor, if you're going to the store do you mind picking up this that and the other one." And most people do that.*

In Beaufort County, people without cars use social networks to coordinate rideshares:

*Well, they can go to the Piggly Wiggly and the bank that are here. And pretty much they rely on friends and relatives, and they kind of ride share with each other. Like one of them will say "I'm going to town" and five or six of them will pile up in one vehicle just to go to Washington.*

Some social networks have earned a reputation for their transportation support to the community, like this group of women who play bridge together:

*There is a women's club down here in Aurora. And I'll be honest, they're almost all widows. Because of the different churches, but they go there and they play bridge. Every Tuesday. And so when one church says "Hey Ms. So-and-so doesn't have a way to get up to the Walmart, the Piggly Wiggly isn't carrying some of the specialized food she needs." So those ladies plan it out to where they go pick these people up and race is not an issue. I mean, there's a group like this, there's another one in Belhaven, another one down here in the Bath area; they take it on themselves. If they need a few dollars for gas, they might ask them, but otherwise there is nothing. No charge.*

And finally, in Graham, one official concisely explained how many transportation-disadvantaged populations gain transport:

*Your thumb.*

### *Public services*

All of the NC counties we visited operated a paratransit system to support TD populations. While this assists many who need transportation, there are still many challenges.

Some of the challenges include:

- Long waits or all-day trips to medical providers, which is a burden for the frail and elderly:

*Occasionally, it's really up to them, for the patients to coordinate it. And a lot of patients say that once they get on KARTS it's sometimes their time to get where they need is all day for one appointment. And it's really not a convenience for them; that's what I hear. (Warren County)*

- Slow reimbursement for paratransit taken for Medicare-related medical trips

*As far as, we have people that need transportation medical appointments that are not Medicaid eligible. And they do have to be on Medicare to receive services from us. There are other funding sources that are limited and if they don't fit in that bracket for that particular funding source. So there are a lot of*

*people. And people will call and say they need to go to Piggly Wiggly or something and we have to tell them we don't do that. (Beaufort County)*

- Barriers to trip-chaining: linking up multiple trips for efficiency, convenience, and frugality.

*Our current, only options for transportation has a lot of rules and restrictions as to when they can take particular trips. And it's not just geared around shopping—or I guess as much around shopping—as it's geared towards medical transportation. (Warren County)*

*I also learned something very interesting which is that they have silo-ing of their reimbursement. So there's a pot of money, which runs out every year, that can be used for medical trips but residents can't trip chain; they can't say "I gotta go to the doctor and I'd like to go to the grocery store" because they can't mix the money. (Beaufort County)*

*I'm positive that there are still a lot of unmet needs here, one of them being shopping. If you call me today and say hey I live over here in Snowbird and I want you to take me Murphy Wal-Mart so I can go shopping, I'm probably not gonna do that. I'm gonna tell you hey, we've got a run going to dialysis in the morning and we can drop you back off, and we can pick you back up after the dialysis patients are done in four hours. That gives you four hours to shop, and you want to do that? I mean that's how we're going to handle that. (Graham County)*

- High cost for non-Medicare/Medicaid users

*Many vulnerable people may be poor, but have a household income that falls above the Medicaid eligibility threshold. Some paratransit is specifically designed for Medicare and Medicaid recipients, so such people would be completely ineligible for the services, and in other cases, the paratransit would become prohibitively expensive. Wake County has a program targeted specifically at low-income patients who fall just above the Medicare/Medicaid cut-off and who need access.*

#### *Informal solutions*

Public transportation, including paratransit, is an important but incomplete solution. As one key informant in Beaufort County stated, "rural people just make it work." This attitude is certainly part of the innovative, do-it-yourself attitude the research team heard about in all of the NC counties visited.

The code "informal solutions" appeared 69 times. In Wake County, one official summed it up nicely:

*We found that people just figure out a way to make it work.*

The research revealed that many communities use creative coping mechanisms when no formal solution is available.

- In all of the counties, any of the informal solutions involves family and friends. These could be casual and infrequent, or a regular arrangement.
- Informal solutions can also include semi-institutionalized solutions. For example, church vans and other community vehicles may be repurposed for additional trips. Some individuals pay neighbors for regular travel. In Warren County:  
*It seems as if some of the people that work in construction have their own little kind of transportation pools because I see vans picking up workers for that.*
- Finally, informal solutions may include formal organizations, including non-profits and employers. In Beaufort County, one of the major employers helps meet the challenges of relying on the ferry service:  
*Yeah one of the people we talked to this morning said that people park at one end of the ferry, ride across, and when they get to the other side there's a shuttle service there, run by the Phosphate company, that will pick them up and take them to the plant.*
- In Wilson County, the farm-worker employer provides transportation for workers:  
*The seasonal workers that come in are largely in some labor camps but they also have their transportation because they have buses. Go to Wal-Mart on Sunday afternoon and you can see them lined up in the parking lot.*

### *Transportation-disadvantaged populations are diverse*

Outreach suggests that transportation-disadvantaged populations include the traditional groups discussed earlier (low-income, minorities, disabled, elderly, children, and households with a language barrier), as well as “non-traditional” groups such as community college students, itinerant farm-workers, Mennonites, and widows who do not drive. These groups of people share common traits that make mobility more difficult, but those traits are not reported in common data sources. Outreach to these communities is essential in order to identify these transportation disadvantaged populations.

## **GIS MAP SUMMARY FINDINGS**

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### **OVERVIEW**

The purpose of the maps was to provide a visual tool, using readily-available data, to identify locations within each county in which we were likely to find transportation-disadvantaged populations. The research team had initially hoped to map both locations with high proportions of people with socio-demographic characteristics that suggest they are at risk of TD and locations in which transport supplies and land use were unlikely to meet the demands of at-risk populations. In theory, where these locations overlap would be areas of actual transportation disadvantage—and thus candidates for intervention by transportation professionals. However, the necessary data to comprehensively map transport supplies and land use patterns were rarely available. Since a primary goal of this

study was to develop a method that could be employed by local experts with a limited budget, the research team limited mapping to readily available data.

### **MAPS AS TOOLS FOR PROBING TRANSPORTATION DISADVANTAGE**

Each interview began with a discussion of county characteristics, using the basemap to identify areas most likely to have transportation-disadvantaged populations. Informants were encouraged to mark hotspot areas and other areas of particular interest on the basemap. The reasons for doing this were: (1) get the key informants thinking about transportation-disadvantage in their community, and (2) to serve as a check against bias (to avoid positive responses from key informants trying to be helpful).

Near the end of the interview, the transportation-disadvantaged indicator maps were revealed, with a brief explanation of how the colors were meant to represent hotspots of TD. Key informants commented on how well the map matched their own impression of locations of TD within their counties, and marked up the threshold maps, noting places where they agreed or disagreed with the colors on the map.

### **SUMMARY FINDINGS**

Overall, informants tended to say that they thought the indicator maps were useful starting points for identifying Transportation-disadvantaged populations, but many informants also saw room for improvement.

Within counties, informants were often in agreement with each other over the accuracy of the maps. Informants generally felt the maps were more accurate in counties with more homogenous development patterns that were neither extremely rural nor extremely urban. For example, the maps seemed to accurately reflect local conditions in Warren and Beaufort Counties.

Several limitations were identified with the mapping process during the outreach. While we are able to suggest ways of working around some of these limitations, they underscore the importance of complementing the data-driven mapping process with field work. The main limitations are described below:

- Lack of environment (transport supply and land use) data: In nearly all of study counties, informants pointed out that darker colors (hotspots) in urbanized areas—indicating higher social vulnerability—may be misleading, as those areas tended to have more travel options that offset vulnerabilities based purely on socio-demographic profiles.
- Limitations of Census data: In the more rural counties examined, Census geographies were so large that they masked variations in socio-demographic characteristics across the county. Also, as is discussed in greater detail in the case study profiles (see appendix), Census data fail to capture certain kinds of vulnerabilities, many of which do not necessarily have a spatial component. While some socio-demographic characteristics are likely to be clustered together (for

example, low-income households tend to be located in neighborhoods with low housing costs; ethnic communities often form neighborhoods), other attributes may not be spatially linked. For example, informants described mobility challenges faced by community college students and elderly widows with limited driving skills. Other populations failed to show up in Census data altogether, for example, migrant workers and certain religious communities.

Overall, the maps proved to be useful starting points for discussion. However, it must be remembered that the maps are only able to depict areas where, based on average socio-demographic characteristics, there is a greater relative potential for transportation disadvantage. The maps by themselves do not include built environment, transportation supply, or fully account for other factors that may improve transportation access. For example, Chatham County's older residents may be mapped in rural areas known to be low-income and relatively underserved by transportation; however, older residents may also appear in affluent retirement communities with few unmet transportation needs.

## CONCLUSION AND FURTHER RESEARCH

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This research identified socio-demographic indicators that suggested the presence of a transportation-disadvantaged population. These indicators were mapped and, where indicators overlapped, a higher probability of transportation disadvantage was calculated. This research provided a strong starting point; however, built environment and transport supply data were not available in time for this research. Future efforts should further explore built environment and transport supply data in conjunction with socio-demographic data.

This study uncovered an analytical framework that practitioners may use to identify and serve transportation-disadvantaged populations. The *4A Framework*, adapted from Konstantinos Panou's research (2013), assesses how an existing transportation system meets the needs of a given population based on the affordability, availability, accessibility, and acceptability of components in that system. Embedded in this framework is a fundamental understanding of the interdependencies that exist between the built environment and transportation supply. This framework sheds light on why certain populations are transportation-disadvantaged and how best to meet their needs.

North Carolina would benefit from future research that explores its transportation system according to the system's affordability, availability, accessibility, and acceptability; particularly with regard to the State's transportation-disadvantaged populations. The approach included in this report combines both local expertise with publicly-available Census data, and would provide a useful lens for showcasing the North Carolina Department of Transportation's commitment to serving all residents—even the most vulnerable.

## APPENDIX OVERVIEW

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Up to this point in the report, the research's team methodology and key findings from the outreach process have been discussed. The appendix of this report provides more information about transportation-disadvantaged populations and includes all of the research instruments used in this study. The appendix includes:

- Case studies of Beaufort, Chatham, Graham, Wake, Warren, and Wilson counties
- An annotated bibliography of the 65 of the most relevant journal articles, reports, conference papers, web documents, and other sources
- A dictionary that defines the codes that emerged during outreach
- A step-by-step practitioner guide that shows practitioners how to identify transportation-disadvantaged populations
- Interview instruments used for key informant interviews and focus groups
- Census data used to generate GIS maps
- GIS maps