FINAL REPORT

PROJECT H

FEBRUARY 2022

Strategies for Mitigating Congestion in Small Urban and Rural Areas

Dr. Dimitra Michalaka, The Citadel
Dr. Nithin Agarwal, University of Florida
Dr. Kweku Brown, The Citadel
Dr. Michael Hunter, Georgia Institute of Technology
Deborah Postma, Georgia Institute of Technology
Dr. Sivaramakrishnan Srinivasan, University of Florida

STRIDE | Southeastern Transportation Research, Innovation, Development and Education Center

UF | Transportation Institute UNIVERSITY of FLORIDA

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. Project H	**2. Government Accession No.**	**3. Recipient's Catalog No.**
4. Title and Subtitle Strategies for Mitigating Congestion in Small Urban and Rural Areas		**5. Report Date** February 28, 2022 **6. Performing Organization Code**
7. Author(s) Dr. Dimitra Michalaka, The Citadel Dr. Nithin Agarwal, University of Florida Dr. Kweku Brown, The Citadel Dr. Michael Hunter, Georgia Institute of Technology Deborah Postma, Graduate Student, Georgia Institute of Technology Dr. Siva Srinivasan, University of Florida		**8. Performing Organization Report No.** STRIDE Project H
9. Performing Organization Name and Address *The Citadel*, 171 Moultrie Street, Charleston, SC 29409; *University of Florida*, 365 Weil Hall, Gainesville, FL 32611; *Georgia Institute of Technology*, 790 Atlantic Drive; Atlanta, GA 30332		**10. Work Unit No.** **11. Contract or Grant No.** Funding Agreement Number 69A3551747104
12. Sponsoring Agency Name and Address **University of Florida Transportation Institute** **Southeastern Transportation Research,** **Innovation, Development and Education Center (STRIDE)** 365 Weil Hall, P.O. Box 116580 Gainesville, FL 32611 **U.S Department of Transportation/Office of Research, Development & Tech** 1200 New Jersey Avenue, SE Washington, DC 20590		**13. Type of Report and Period Covered** 6/28/2017 to 2/28/2022 **14. Sponsoring Agency Code**

15. Supplementary Notes

16. Abstract

Despite the common perception that congestion is primarily an issue in large urban areas, both rural areas and small urban areas (under 50,000 population) also experience congestion – and they frequently lack the resources needed to address congestion. Lack of expert staff, fewer instrumented facilities, and characteristic differences in rural traffic flow combine to create significant challenges in reducing and managing rural congestion. The southeastern region is particularly sensitive to these challenges as the region contains many small urban centers and agriculture-based communities. The objectives of this study are to: Determine key characteristics of rural and small urban congestion (e.g., recurring and nonrecurring congestion, mode use, freight logistics, and special events); Identify resource constraints pertinent to rural and small urban communities; Determine the best practices to reduce and/or manage these congestion issues; Develop educational material (i.e., webinar, website, flyer) for use by rural and small urban agencies to help ensure successful implementation of developed guidance; Identify future events for promoting educational materials. The research team developed and distributed a detailed survey to small urban and rural agencies in the southeast to gain information regarding congestion characteristics in the area, limitations, best practices and needs. Follow-up interviews were conducted with a subset of survey respondents to gain additional insights. Findings from both the surveys and interviews indicate that in the majority of small urban and rural areas; there is no systematic data collection related to monitoring and measuring traffic congestion; traveler phone calls were the primary source for identifying congestion; day-to-day peak hour traffic is the biggest contributor to traffic congestion; special events and tourism were the next highest traffic congestion contributors; work zones, traffic crashes, and freight are not significant contributors to congestion; limited tools are used to mitigate congestion due to work zones; interagency interaction is needed to help alleviate congestion, but such interaction is sometimes minimal; additional funding would help relieve congestion; and no training related to congestion mitigation was reported.

17. Key Words congestion mitigation strategies, small urban, rural areas, training		**18. Distribution Statement** No restrictions	
19. Security Classif. (of this report) N/A	**20. Security Classif. (of this page)** N/A	**21. No. of Pages** 67 Pages	**22. Price** N/A

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated in the interest of information exchange. The report is funded, partially or entirely, by a grant from the U.S. Department of Transportation's University Transportation Centers Program. However, the U.S. Government assumes no liability for the contents or use thereof.

ACKNOWLEDGEMENT OF SPONSORSHIP AND STAKEHOLDERS

This work was sponsored by a grant from the Southeastern Transportation Research, Innovation, Development, and Education Center (STRIDE).

The research team should like to acknowledge Jasper Masciocchi and Charles Brown from the University of Florida Technology Transfer Center who assisted in the stakeholder engagement task, the stakeholders that participated in the survey, and Liberty Consolidated Planning Commission, City of Union, KY, and Town of James Island that participated in the focus groups.

Funding Agreement Number - 69A3551747104

LIST OF AUTHORS

Lead PI:

Dimitra Michalaka, Ph.D., P.E.
The Citadel
Dimitra.Michalaka@citadel.edu
ORCID Number: 0000-0001-7001-0579

Additional Researchers (in alphabetical order):

Nithin Agarwal, Ph.D.
University of Florida
nithin.agarwal@ufl.edu
ORCID Number: 0000-0001-5032-3236

Kweku Brown, Ph.D.
The Citadel
kbrown16@citadel.edu
ORCID Number: 0000-0001-6497-8479

Michael Hunter, Ph.D.
Georgia Institute of Technology
michael.hunter@ce.gatech.edu
ORCID Number: 0000-0002-0307-9127

Deborah Postma
Georgia Institute of Technology
dpostma6@gatech.edu

Sivaramakrishnan Srinivasan, Ph.D.
University of Florida
siva@ce.ufl.edu
ORCID Number: 0000-0002-9008-0192

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Despite the common perception that congestion is primarily an issue in large urban areas, both rural areas and small urban areas (under 50,000 population) also experience congestion – and they frequently lack the resources needed to address congestion. Lack of expert staff, fewer instrumented facilities, and characteristic differences in rural traffic flow combine to create significant challenges in reducing and managing rural congestion. The southeastern region is particularly sensitive to these challenges as the region contains many small urban centers and agriculture-based communities. The objectives of this study are to:

- Determine key characteristics of rural and small urban congestion (e.g., recurring and nonrecurring congestion, mode use, freight logistics, and special events);
- Identify resource constraints pertinent to rural and small urban communities;
- Determine the best practices to reduce and/or manage these congestion issues;
- Develop educational material (i.e., webinar, website, flyer) for use by rural and small urban agencies to help ensure successful implementation of developed guidance;
- Identify future events for promoting educational materials.

The research team developed and distributed a detailed survey to small urban and rural agencies in the southeast to gain information regarding congestion characteristics in the area, limitations, best practices and needs. Follow-up interviews were conducted with a subset of survey respondents to gain additional insights. Findings from both the surveys and interviews indicate that in the majority of small urban and rural areas; there is no systematic data collection related to monitoring and measuring traffic congestion; traveler phone calls were the primary source for identifying congestion; day-to-day peak hour traffic is the biggest contributor to traffic congestion; special events and tourism were the next highest traffic congestion contributors; work zones, traffic crashes, and freight are not significant contributors to congestion; limited tools are used to mitigate congestion due to work zones; interagency interaction is needed to help alleviate congestion, but such interaction is sometimes minimal; additional funding would help relieve congestion; and no training related to congestion mitigation was reported.

Keywords: congestion mitigation strategies, small urban, rural areas, training

EXECUTIVE SUMMARY

Contrary to popular perception, traffic congestion is not only an issue in large urban areas but also in both small urban and rural areas, with populations under 50,000. Small urban and rural areas often lack the resources necessary to address traffic congestion. The objectives of this project are to broaden the basic understanding of key congestion issues faced by rural and small urban areas and the resources available to agencies in these areas, identify potential congestion mitigation strategies which are achievable given agency resources, and provide rural and small urban agencies with practical advice and/or tools for everyday use in reducing congestion.

After conducting a literature review on congestion in small urban and rural areas, a survey was developed for distribution to transportation agencies in ten states across the southeast: Georgia, Florida, South Carolina, Alabama, Mississippi, Arkansas, Kentucky, Louisiana, North Carolina, and Tennessee. Communities with populations under 50,000 in each state were identified through the 2017 American Community Survey five-year estimates, and a list of the cities with a population under 50,000 was compiled and sorted in descending order. In total, the survey was sent to 445 candidate respondents. Sixty-six complete responses were received, from which 51 responses self-reported populations of 50,000 or below.

An analysis of the results from the quantitative surveys revealed the following key findings:

- There is no systematic data collection related to monitoring and measuring traffic congestion.
- Traveler phone calls were the primary source for identifying congestion.
- Day-to-day peak hour traffic is the biggest contributor to traffic congestion.
- Special events and tourism were the next highest traffic congestion contributors.
- Work zones, traffic crashes, and freight are not significant contributors to congestion.
- Limited tools are used to mitigate congestion due to work zones.
- Interagency interaction is needed to alleviate congestion, but it was acknowledged that such interaction is sometimes limited.
- Additional funding would help relieve congestion.
- Limited training related to congestion mitigation was reported.

The survey results were used to develop questions to solicit additional information from the responding agencies. A subset of the agencies that opted in for a follow-up call were approached for further discussions via phone calls. The responses from the interviews did not provide any additional insights beyond what was obtained from the surveys. The overall effort highlights that there is an interest in information and training related to alleviating congestion, but the staff may not have the time or resources to invest in such endeavors. As a result, a Web-based repository of basic information on congestion management, a flyer including a summary of the information, and a webinar available on YouTube were developed. Additional

training on deployment of specific strategies to mitigate congestion needs to be developed in the future.

1.0 INTRODUCTION

Traffic congestion occurs when demand exceeds capacity. It is most generally characterized by slower speeds, longer trip times, and a significant increase in vehicular queues. Contrary to popular perception, traffic congestion is not only an issue in large urban areas but also in both small urban and rural areas, with population under 50,000. Small urban and rural areas often lack the resources necessary to address traffic congestion. Additionally, lack of expertise and instrumented facilities, as well as the characteristic differences in small urban and rural traffic flow, all contribute to the significant challenges in mitigating traffic congestion.

1.1 OBJECTIVES

In order to identify and mitigate traffic congestion in small urban and rural areas, the overarching objectives of this project are to:

A. Broaden the basic understanding of key congestion issues faced by rural and small urban areas and the resources available to agencies in these areas,
B. Identify potential congestion mitigation strategies which are achievable given agency resources, and
C. Provide rural and small urban agencies with practical advice and/or tools for everyday use in reducing congestion.

1.2 SCOPE

This project focuses on broadening understanding of key congestion issues and providing resources to alleviate congestion issues in small urban and rural areas with population under 50,000. The research includes the following tasks that are expanded in the remaining chapter of the report:

1. Literature Review
2. Survey of Local Agencies
3. Identification of Key Themes, Gaps, and Critical Issue(s)
4. Follow up Surveys and Synthesis of Findings
5. Development of Educational Materials

2.0 LITERATURE REVIEW

This task provides an exhaustive review of existing research information related to congestion issues in rural and small urban areas. It covers the characteristics of small urban and rural congestion, the consequences of congestion, and the strategies for mitigating congestion.

2.1 CHARACTERISTICS OF SMALL URBAN AND RURAL CONGESTION

Previous studies from the Federal Highway Administration (FHWA) and others (Luten et. al, 2004; FHWA 2020; FHWA 2017a; Godavarthy et. al1), have identified seven root causes that directly result in traffic congestion. These seven causes – traffic incidents, work zones, environmental conditions, fluctuations in normal traffic, special events, traffic control devices, and physical bottlenecks ("capacity") – often influence one another and can be grouped into three general categories (FHWA 2020):

2.1.1 Category 1: Traffic-Influencing Events

Traffic incidents, work zones, and environmental conditions are traffic-influencing events. More specifically:

1. **Traffic Incidents** are considered to be any event that disrupts free-flow traffic, either located in travel lanes or on shoulders. Travel lane impedances include vehicular crashes, breakdowns, and debris in the road. Events occurring on the shoulder that influence traffic flow include an arrest, a crime scene, or a fire. These events can heavily influence traffic flow by blocking a travel lane or distracting drivers in open lanes. All of these events influence driver behavior and thus worsen the traffic flow quality.
2. **Work Zones** are construction sites that typically reduce capacity and lower operating speed through reduction in number and/or width of travel lanes, lane shifts or diversions, removing of shoulders, and temporary roadway closures.
3. **Environmental Conditions** can directly influence driver behavior and affect traffic flow. Heavy precipitation, bright sunlight, fog, and smoke can greatly reduce visibility. This causes drivers to typically lower their speeds and increase their headways. Wet, snowy, and/or icy roadway surface conditions often have the same effect on drivers.

2.1.2 Category 2: Traffic Demand

Fluctuations in normal traffic and special events influence travel demand.

1. **Fluctuations in Normal Traffic** – Daily variability in demand often leads to some days having higher traffic volumes than others. With or without category 1 events, fluctuating demand volumes superimposed on a traffic system with fixed capacity can result in unreliable travel times.
   According to the Organization for Economic Cooperation and Development (OECD) (OECD/ECMT, 2007), there are numerous factors that influence travel demand and result in both short run and long run traffic congestion. Such factors include: socioeconomic growth, population increase, car ownership

or dependency, land use, travel patterns, public transport operations, freight transport, and parking.

a) Short Term – As described in the following: travel demand patterns, parking, and public transportation operations all impact congestion on a daily basis.

i. Travel Patterns – Travel demand patterns, implicitly related to land use and a result of necessary mobility, greatly influence the transportation system and thus congestion. In urban areas, travel patterns tend to be complex, with numerous activities resulting in a great number of trips. Where these trips exceed capacity, congestion results.

Urban travel patterns are influenced by activities and their associated trips. Activities impact travel patterns and demands based on type, extent, and distribution in time and space. Travel patterns, and thus congestion, are also related to the availability of selected routes. Furthermore, changes in the spatial distribution of activities can create changes in trip destinations, resulting in changing congestion patterns. Urban areas may have numerous activity centers where demand is scattered throughout the urban environment or a single major activity center where transportation demand is centered. In addition, the suburbs now account for both the origin and destination of many urban area trips. As a result, high levels of demand and congestion can occur anywhere at any time in urban areas.

ii. Parking – Personal vehicles searching for parking spaces can greatly influence the level of traffic on the network and increase congestion. This occurs most especially in dense downtown areas where demand for parking exceeds available resources. Moreover, in some urban areas, the time spent cruising and searching for parking accounts for a relatively large portion of average trip times.

iii. Public Transportation Operations – Transportation system demand is strongly related to the availability, performance, and usage of the various modes serving an area. In many urban areas, public transport plays a large role in managing traffic congestion. However, limited transit availability or low-quality service can turn potential passengers away from public transportation and to the use of personal, private vehicles, thus further contributing to traffic congestion. Passengers have been shown to turn away from public transportation for numerous reasons (real or perceived), such as poor performance, lack of network coverage, low level of personal security and comfort, and low reliability. Despite often significant demand for a public transportation system, these reasons can limit the system's ability to develop market share.

Additionally, public transportation, commonly having limited capacity and funding, provides limited coverage over most urban areas. Thus, public transportation is greatly limited in its role of providing a viable transport alternative for the entirety of an area.

b) Long Term – Long-term trends in socioeconomic growth, car ownership and dependency, population increase, land use, and freight transport are all leading to increasing congestion.

i. Socioeconomic growth – Economic growth and the creation of more jobs, resulting in less poverty, are both signs of productivity; however, this also increases the demand on the roadways. Areas requiring less travel time for employees to get to work are more productive. The cost of traffic congestion includes the value of lost time and fuel costs; thus, more time spent commuting has a direct effect on the economy (Cox, 2009). Work areas distributed over small areas (i.e., sprawl) may result in even longer travel times.

ii. Car Ownership and Dependency – Automobile ownership continues to grow due to the comfort, social status indicator, and convenience of personal vehicles. The rise in fleet growth is in direct relation to the increase in household income, family activities and leisure times thus requiring some households to have more than one vehicle. While this rise in automobiles can be viewed as positive economic growth, it has also had a significant effect on traffic congestion.

iii. Population Increase – Population continues to rise, resulting in more vehicles. As highway expansion projects are completed, the increase in population floods the newly developed areas causing overcrowding and traffic congestion in a short time (Downs, 2004).

iv. Land Use – The goal of transportation is to enhance accessibility and support travel demands generated by the diverse activities available in an environment. In urban areas, especially in small urban areas, the concern of spatial development and circulation of goods and passengers throughout cities creates a few issues contradictory to one another. Such issues include spatial complexity, spatial aggregation, and spatial imprints.
Spatial Complexity: More complex land use patterns are characterized by more complex trip-making patterns. In Europe, historical development of cities has led to mixed uses and more complex trips in urban areas. On the other hand, U.S. and European suburbs, affected by urban spread,

have seemed to promote longer trips and increases in traffic congestion; so much so that recent traffic patterns in the periphery of urban centers have decreased, reflecting the possibility that households have moved to residences relatively closer to workplaces.
Spatial Aggregation: Cities benefit from activities aggregated in the same area, mostly because increases in aggregation lead to decreases in transportation costs. However, aggregating mobility in a small, limited area most often leads to traffic congestion. It is imperative to recall that facility locations are selected based on real estate criteria and not facility cost for goods transportation or user costs for approaching a facility.
Spatial Imprint: Transportation occupies space and thus consists of a spatial imprint. While space is limited in small urban areas, transportation needs most often exceed the spatial limits.

v. Freight Transport – Production within the economy is affected by traffic congestion in several ways. As deliveries require more time or are unreliable, businesses are hiring more employees and spending more money to purchase additional equipment and inventory for deliveries. The delay in market deliveries is also requiring added distribution centers. The restrictions on freight transport caused by the lack of space available for trucks in dense urban areas and restricted delivery schedules are contributors as well (FHWA, 2017b).

2. **Special Events** are a rare case of demand fluctuations. They often cause surges in traffic demand, thus overpowering the current system, with the traffic flow in the area of the event significantly more than typical flow patterns. Major sporting events such as college football games can cause congestion in relatively small university towns. For example, Clemson University, in conjunction with an increasingly popular football program, has experienced an increase in traffic congestion prior to and following football games. Due to the semi-rural nature of the campus and the overwhelming majority of students living in the area, the civil engineering department was tasked with researching and proposing solutions to help alleviate this congestion in an economically viable manner. Proposals included rerouting of traffic to more major thoroughfares, reversing lanes, and creating a dedicated shuttle/bus lane due to the high volume of shuttle/bus traffic moving through that area (Clemson, 2015). Many Charleston Southern University games are attended by 4,000 or more spectators, and the associated congestion can overwhelm the local highway system during home games. There can be a largely significant amount of congestion on home games days; thus, requiring transportation and enforcement personnel to be largely active in planning and management. Numerous DOTs mention that the beginning of the fall semester on college campuses create traffic congestion lasting several days. This issue seems to be more heavily

emphasized in small towns and cities with universities, where the roadways are not equipped to serve large traffic volumes during off-peak hours. Many small urban and rural areas sponsor special events such as festivals, state fairs, and major concerts, each lasting one or several weekends throughout the year. Those who travel to attend these special events, along with daily commuters, space themselves close together and cram roadways not equipped to handle such high traffic volume. Table 1 shows a list of special events taking place in the Southeast that cause traffic congestion.

TABLE 1. EXAMPLES OF SPECIAL EVENTS IN THE SOUTHEAST

Special Event	Location
Alpharetta Arts Streetfest	Alpharetta, GA
Annual North Carolina Blueberry Festival	Burgaw, NC
Bonita Blues Festival	Bonita Springs, FLl
Cape Fear Wildlife Expo	Fayetteville, NC
Florida Strawberry Festival	Plant City, FLl
Folly Gras	Folly Beach, SC
Highway 78/Ladson State Fair	Ladson, SC
Spring Fling -– Roosevelt Days	Warm Springs, GA
Summerville Flowertown Festival	Summerville, SC

Holiday shopping in major shopping areas can be identified as an additional source of traffic congestion for both commuters and non-commuters. The weekends between Thanksgiving and Christmas are when traffic congestion is highest.

a) Event Characteristics

Understanding event characteristics and how they affect transportation operations allows accurate predictions of travel demand and potential transportation system capacity constraints during a special event. It is with this understanding that professionals can classify a planned event, compare the subject event with historically similar events, and thus are able to forecast travel patterns and determine notable transportation impacts. Figure 1 displays operational characteristics involved with a planned special event. Each of these characteristics represent a variable that heavily influences event operations and its potential impact on the transportation system. The variables under discussion include:

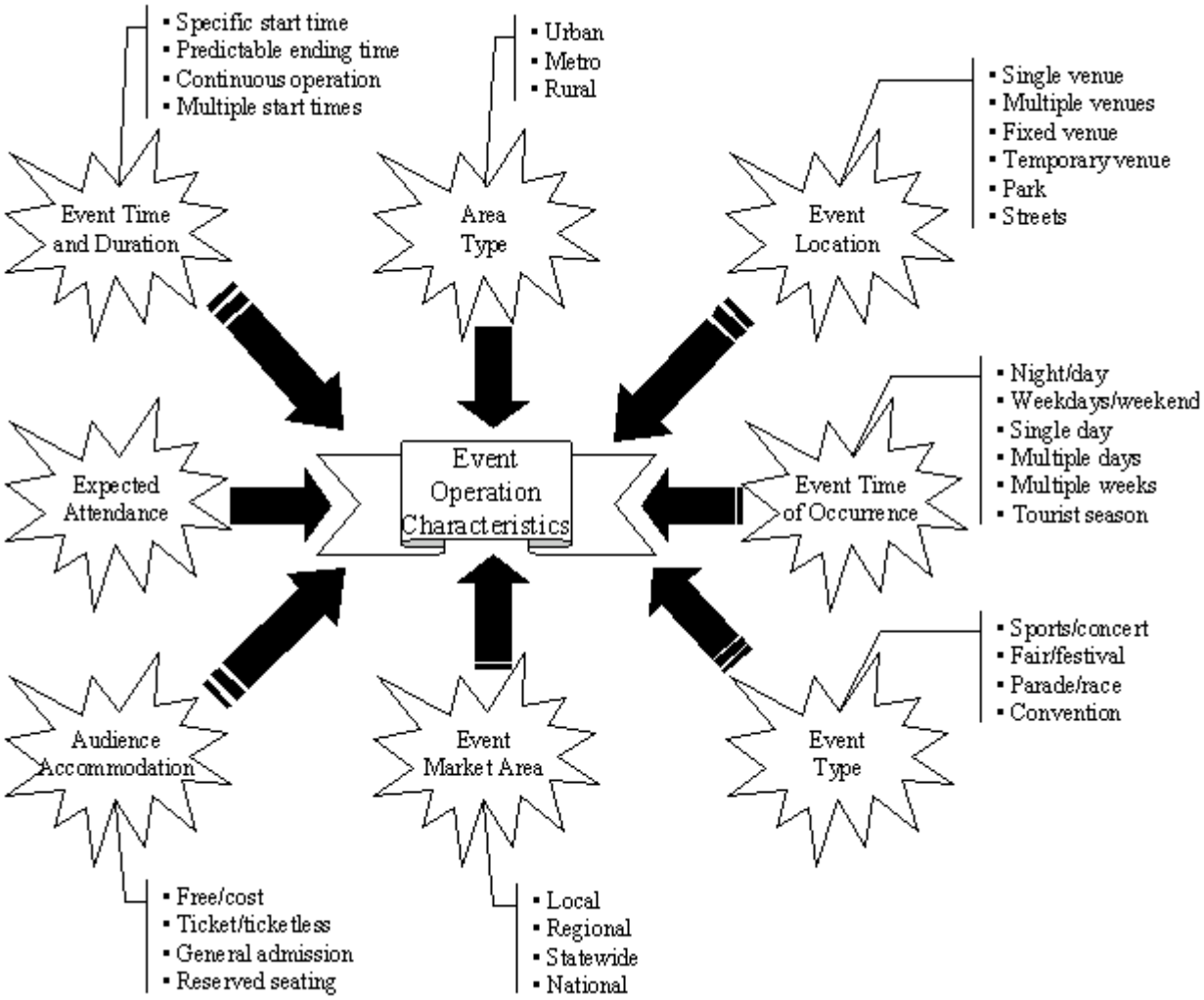

FIGURE 1: EVENT OPERATION CHARACTERISTICS (FHWA, 2017A)

Event Time of Occurrence simply defines operating hours: the time of day the event is open for business. These operating hours are a key variable when comparing event-generated traffic to background traffic.

Event Time and Duration defines whether an event includes a specific main event start time or operates continuously throughout the day. The former is more likely to condense the arrival of event patrons, whereas the latter allows patrons to freely come and go.

Event Location defines the aspects of a venue location and connection to existing transportation infrastructure. Most fixed venues, prime examples being stadiums and arenas, contain high-capacity parking areas adjacent to the venue and reasonable access to and from major streets and freeways. Temporary venues typically lack these features and thus require development of a site access and parking plan in great detail.

Area Type defines the scope of available transportation services, the background traffic in the area, and the various stakeholders that may be

involved in event planning and management. These characteristics, varying across urban, metropolitan, and rural areas, greatly the influence the planning process of event operations, as well as day-of-event travel management.

Event Market Area defines the area where event patrons originate and the scope of event exposure. Some events, such as state fairs and festivals, may have a regional or statewide market area, but the majority of patrons reside in the area of the event. Meanwhile, political conventions and major industry exhibitions have a national market area, and the majority of patrons do not reside in the area hosting the event.

Expected Attendance defines the maximum estimated number of patrons for an event. Attendance may include advance ticket holders, patrons with assigned parking passes, anticipated VIPs, and patrons needing special assistance. When it comes to major sporting events, home team performance and visiting team attraction are key components in estimating attendance. Games involving high-profile teams or performers may sell out far in advance of the event. This allows stakeholders sufficient notice to take appropriate measures.

Audience Accommodation defines the ability to predict the number and origins of event-generated trips in addition to type of trip patrons make. For free events, weather conditions and other day-of-event factors make it difficult to predict attendance. Events featuring advance ticket sales and reserved seating deter patrons from attending the event as a spontaneous decision.

Event Type defines the type of event that must account for special regulations and permit requirements.

b) <u>Event Categories</u>

The event operation characteristics create five categories of planned special events (FHWA, 2017a).

i. Discrete, Recurring Event at a Permanent Venue – A discrete, recurring event at a permanent venue occurs on a regular basis, and it has specific starting times and predictable ending times. These events generate high peak travel demand rates because of patron urgency to arrive by a specific starting time for an event. Additionally, these events create high peak departure rates because they often end abruptly, perhaps upon game time expiration or the conclusion of the final song of a performance.

ii. Continuous Event – A continuous event occurs over single or multiple days. Continuous events do not consist of sharp peak arrival and peak departure rates. Rather, patrons typically arrive and depart throughout the day. Apart from conventions and fairs, some continuous events occur at a temporary venue, a park, or other large open space. As a result, roadway and parking capacity issues may arise in the host area. Additionally, temporary venues may not have a defined spectator

capacity, and because a "sell-out" cap does not exist, forecasting event-generated trips becomes inaccurate.

iii. Street Use Event – A street use event occurs on a street, requiring temporary closure. These events generally occur in a city or town central business district. However, race events and bike rallies may entail temporary closure of main streets or limited-access highways. Regarding parking and access, street use events significantly impact businesses and neighborhoods adjacent to the event site. Street use events close segments of the roadway network, causing both background and event traffic to take alternate routes. This, as a result, increases traffic demand on other streets in the roadway network.

iv. Regional or Multi-Venue Event – Regional and multi-venue events refer to multiple planned special events that occur within a region at or near the same time. The collection of events may differ in classification as well as starting times.

v. Rural Event – Rural events encompass any discrete or recurring event or continuous event occurring in a rural area. Planned special events occurring in rural areas deserve a stand-alone classification category for several reasons: limited road capacity to access the event venue and limited parking capacity, fewer alternative routes to accommodate event and background traffic, lack of regular transit services and hotels near venue, and limited or no permanent infrastructure for monitoring and managing traffic.

2.1.3 Category 3: Physical Highway Features

1. **Traffic Control Devices** – Control devices such as railroad grade crossings and poorly timed signals have a significant contribution on traffic congestion and travel time variability. Also, traffic control devices, especially traffic signals are not always the answer to solve traffic congestion. An unwarranted signal can cause similar problems as a poorly timed signal, such as delays, traffic congestion, air pollution and increased gas consumption, traffic violations, increase use of other streets to avoid traffic signals, and increase in crash rates (WYDOT, 2012; Cambridge Systematics, Inc., 2008).

2. **Physical Bottlenecks ("Capacity")** – Capacity of a roadway is determined by several key factors. Such factors include merge areas on highways, freeways, and interchanges, roadway alignments, and the number and width of lanes and shoulders. Toll booths are also considered to have an effect on capacity because they restrict traffic flow. These traffic restrictions may often be referred to as "bottlenecks." In formal terms, a bottleneck can be described as an event or a physical restriction on or near the roadway which causes capacity to be significantly reduced both upstream and downstream from the relevant location.

In addition to the seven sources of congestion, categorized above, also consider that some events may cause others to occur. In perspective, high levels of traffic congestion can lead to increased traffic incidents due to reduction in vehicle headways. Also, congestion caused by traffic incidents, or drivers distracted by such, can lead to vehicles overheating, especially during the summers, running out of gas, and other mechanical issues. Thus, a continual increase in congestion will be the result.

Overall, almost all rural passenger travel is done by private vehicles. Travel has increased on rural arteries by around 2-3 percent and on rural interstate by 4 percent. These increases are caused by new employment, increase in service trips, and local goods deliveries. Another cause for this increase is also the reduction of freight rail services causing an increase in truck traffic (Henning-Smith et. al, 2017). Agricultural peaks also have influence by introducing much more truck traffic to the flow. Rural congestion has increased at nearly 10 percent (Henning-Smith et. al, 2017), twice the urban rate. In addition, rural sprawl usually involves the purchase of a large tract of land for housing development by an individual than a housing developer, which often causes a long and unorganized process of development.

2.2 CONSEQUENCES OF CONGESTION

Congestion can have major negative effects beyond just inconveniencing drivers. The economy depends directly on the ability to transport commodities quickly and efficiently, civil infrastructure such as emergency responders needs to be able to move quickly, and entertainment venues depend on reliable infrastructure to maximize the inflow of business to their establishments. Congestion has impacts on trucking, safety, businesses, households, and whole regions as mentioned below.

Trucking Impacts – Traffic congestion leads to increased travel times and less reliable loading and delivery times for trucking operations. As a result, motor carriers will often add vehicles and drivers while also extending hours of operation. Research in the trucking industry has conveyed that transit time is valued in a range of $25 to $200 per hour, depending on the product. Unexpected delays can cost an additional 20 to 250 percent (Cambridge Systematics, Inc., 2008). In a study of Alabama EMS providers, traffic congestion accounted for up to 10 extra minutes added to response times. This study was taken in response to the growing dispersion of accidents as a result of urban-to-suburban transition that has taken place over the last 50 years (Griffin and McGwin, 2012).

Impacts on Safety – Fatality rate on non-Interstate rural roads is approximately two-and-a-half times higher than all other roads. Based on a report from the Insurance Institute for Highway Safety (IIHS) in 2018 (IIHS, HLDI, 2018), for every 100 million vehicle miles of travel, the traffic fatality rate on rural roads was 1.68 compared to 0.86 for non-rural roads. Numerous possibilities could contribute to the higher fatality rates, including a lack of desirable roadway safety features, longer emergency vehicle response times, and higher speeds. Some of the safety problems with these rural roads

are the narrow lanes, limited shoulders, sharp curves, and limited clearance along roadsides. The emergency vehicle response time is also increased due to the distance needed to travel the road conditions (Griffin and McGwin, 2012).

Impacts on Businesses – Increased travel times and operating costs incurred by traffic congestion directly result in the increase of costs for delivering goods and services. Additionally, there are other costs influenced by congestion, such as:

1. Costs of remaining open for longer hours
2. Penalties and business revenue lost as a result of missed schedules
3. Costs of spoilage for time-sensitive deliveries
4. Costs of maintaining larger inventory to compensate for the undependability of deliveries.

Household Impacts – Traffic congestion has a significant impact on both financial budgets and "time budgets" of a household. Households plan activities based on the amount of time and money they have available. However, with rising traffic congestion directly causing an increase in vehicle operating and maintenance costs, both the financial and time budgets allocated for certain household activities and expenditures decrease. Additionally, when there is a decrease in the safety, convenience, and reliability of a transportation system, the perceived "quality of life" of a neighborhood diminishes along with it.

Regional Impacts – Specifically, congestion impacts on both households and businesses affect regional economies. The reduced ability to retain, grow, and attract businesses equals a degradation of cost competitiveness and market growth opportunities. Additionally, decreases in air quality, increases in public infrastructure investment requirements, and potential health impacts all result from the redistribution of business and household activities, as well as the direct delay for trips that are not diverted or changed by other means.

2.3 STRATEGIES FOR MITIGATING CONGESTION

Literature recommends the following to help improve rural communities' infrastructure (TRIP, 2017; Kidder, 2006):

- Fix the federal Highway Trust Fund so that it will act as a sustainable long-term source of revenue.
- Fix major two-lane roads and highways so they can accommodate the increased travel.
- Fund rural safety improvements to provide enhanced enforcement, education, and improved emergency response time to help lower the traffic fatality rate.
- Fund local and state transportation programs to help fix the highways and bridges that are needed to support he rural economy.

2.4 RESOURCE CONSTRAINTS

Rural areas, unlike urban ones, usually do not have adequate resources available to invest in mitigating congestion. Some constraints listed in the literature are:

1. Limited Funding – The lower population in rural areas often causes less demand for fixed transit routes and a smaller tax base to be used for maintenance of roads (RHIhub, 2018). Another problem is that many rural areas, especially ones located near large urban areas, cannot fund the much-needed system expansion. Rural projects also struggle to compete against highways of state and national significance (Dye Management Group, Inc., 2001).

2. Long Distance Trips – Due to the spread-out nature of rural communities, people tend to travel longer distances (Ecolane, 2014). These extra vehicle miles traveled (VMT) increase the road conditions and congestion.

3. Traffic Signals – Out-of-sync traffic signals and malfunctioning traffic signals cause traffic congestion. Smaller rural areas do not have the resources to program traffic lights correctly.

4. Public Transit – Sparsely populated areas often create longer routes with fewer riders participating in public transit. This increases the cost (Ecolane, 2014). A traffic study of 85 cities of different sizes showed the increase of traffic congestion if public transit was eliminated. This was done by dividing the number of public transit users by a car occupancy factor. The results showed that if riders did not use public transit, there would be an estimated delay increase of 1.1 billion hours in a year (Aftabuzzaman, Md, et al., 2010). One reason people do not use public transit in rural areas is due to the lack of convenience. This could be caused by lack of service availability, inadequate passenger information, and bad journey experience (Velaga et. al, 2012).

5. Lack of Physical Space – Some small urban areas lack the physical space for the addition of extra lanes. Communities have voiced their concern about the impacts of road expansions on their private rights-of-way (Luten et. al, 2004).

6. Lack of Network Connection – Many travelers of rural areas depend on network connections to establish the best routes and have access to real-time traffic data. This a problem since many rural areas experience spotty network coverage. This may cause more traffic congestion (Velaga et. al, 2012).

7. Lack of Interstate Connection – Most interstates were planned 60 years ago and have evolved largely in response to urban development. Very little has been added to the interstate system to better serve rural communities, causing an increased

drive time for rural users. This also causes more commercial vehicles to spend more time on the already congested rural roads. According to the 2010 AASHTO report, 30,000 lane-miles needs to be added to the interstate system to accommodate rural needs (AASHTO, 2010). The population of the United States has nearly doubled since the Interstate Highway System was designated in 1956 (TRIP, 2017).

8. Personnel – It is estimated that a signalized intersection requires an annual average of 42 hours for preventive maintenance, 15 hours for response maintenance, and 3 hours for design maintenance. Without the required maintenance, the intersection may not operate as time efficiently as possible and may also cause a safety hazard (Dunn Engineering Associates, 2001).

9. Road Conditions – Many rural roads that are in farming areas are deteriorating due to the heavy farm equipment running over the pavement. This causes a slower and more uncomfortable ride for other commuters.

10. Railroad Crossings – Railroad crossings are a major source of congestion in rural areas due to the fact that they are predominantly present over vast swaths of land, in areas that do not have the resources to signalize multiple intersections. As a result, up to 80% of train-traffic collisions occur in rural areas (Ogden and Cooper, 2019).

3.0 SURVEY OF LOCAL AGENCIES

After reviewing the literature on congestion in small urban and rural areas, a survey was developed for distribution to transportation agencies in ten states across the southeast, the states covered by the STRIDE project. These included: Georgia, Florida, South Carolina, Alabama, Mississippi, Arkansas, Kentucky, Louisiana, North Carolina, and Tennessee. To develop the list of candidate survey respondents, communities with populations under 50,000 in each state were identified through the 2017 American Community Survey five-year estimates. For each state in the STRIDE region, the list was compiled and sorted in descending order, with 25 cities selected to receive a survey. However, as the STRIDE project's participating universities include Florida, Georgia, and South Carolina, these states were oversampled, allowing for higher resolution results for the project lead states. For Florida and Georgia, 100 cities were identified. For South Carolina, 68 city contacts were identifiable online. To select the candidate cites from the ranked list for each state, the total number of cities with a population under 50,000 was divided by 25 (or 100 for the oversampled states). Every nth city (where n = number of cities in the state divided by 25) was researched online in order to find the relevant transportation or public works contact. If no information could be found, then the next city on the ranked list was researched, until information could be found for a city. This method was used to sample across the city populations within each state. Communities were sampled from each state until 25 (or 100) contacts were identified for each state, or no additional contacts could be identified.

In total, 445 candidate survey respondents were identified. The survey was sent out on October 17, 2019. The initial response rate was low, with approximately 15 responses. Therefore, two batches of follow-up emails were sent on October 25, 2019, and December 3, 2019. However, the response rate was still low. (The research team was subsequently informed by several contacts that the emails may have not been received because government emails often have stringent filter protection.) In order to reach the intended people, potential respondents were also called on October 29, November 7, and December 5. Approximately 80 phone calls were made, and around 30% of these calls were answered. Voicemails were left when possible.

Sixty-six complete responses were received, from which 51 responses self-reported populations of 50,000 or below. As the population value used to determine which communities to contact was from 2017, the higher self-reported population in the surveys may have resulted from population increases, incorrect data in original population source, or other error sources. As the study defines "rural and small urban areas" as a population of 50,000 or under, only the 51 responses where respondents reported a population 50,000 or under are used in the subsequent analysis, unless otherwise stated.

The survey focused on learning about the congestion challenges, resources, and needs of transportation agencies in these areas. The survey consisted of 31 questions covering congestion causes, collaboration with other agencies, how congestion is tracked, congestion mitigation strategies, and education and training. More specifically, the survey sought the following information:

- Agency name
- Respondent title and position
- Population size of area served by the agency
- Contributing factors to congestion in area (i.e., day-to-day variation, special events, work zones, crashes, weather, freight, etc.)
- Priority of congestion management to agency
- Other agencies the respondent agency interacts with regarding congestion issues
- Methods to track congestion (i.e., duration, citizen phone calls, delay, etc.)
- Has congestion increased over the past five years
- Potential reasons for increase in congestion, if increase occurred
- Degree of special event congestion and special event-related congestion management
- Degree of work zone congestion and work zone-related congestion management
- Degree of incident congestion and incident-related congestion management
- Degree of weather-related congestion and weather-related congestion management
- Degree of freight-related congestion and freight-related congestion management
- Agency access and interest in training materials
- Agency staff dedicated to congestion-related activities
- Congestion mitigation and management resources
- Congestion mitigation and management constraints.

Based on consultation with Georgia Institute of Technology IRB personnel (along with suggested changes to the survey language), it was determined that IRB was not required for this survey because no personal information was requested and the respondent was responding for their agency as part of normal employment duties and not representing their own personal beliefs, decisions, etc. The survey was developed on a Qualtrics platform, and it can be found at: https://gatech.co1.qualtrics.com/jfe/form/SV_9tYUwwyvuhpWsnz It is also provided in Appendix A. The following cities and agencies were represented in the survey responses:

- City of Haskell, AR
- City of Henderson, KY
- City of Hampton, VA
- City of Enterprise, AL
- City of Fairhope, AL
- City of Georgetown, KY
- City of Searcy, AR
- City of Anniston, AL
- City of Norcross, GA (2)
- Town of Signal Mountain, TN
- City of Fort Pierce, FL
- City of Madison, AL
- City of Aventura, FL
- City of Nettleton, MS
- City of Key West, FL
- City of Greer, SC
- Niceville Police Department, FL
- Town of Taylorsville, NC
- City of Starkville, MS
- Village of Clemmons, NC
- City of Gainesville, GA, Public Works Department
- City of Stockbridge, GA
- City of Biloxi, MS
- City of East Point, GA
- Morgan County Transit, GA
- City of Clemson, SC
- Town of Blythewood, SC
- City of Milton, GA
- City of Vienna, GA (2)
- Town of Windermere, FL
- Town of Farragut, TN
- City of Woodstock, GA
- Lake Clarke Shores, FL

- Town of West Union, SC
- Town of Lantana, FL
- Town of Gilbert, AR
- City of Union, KY
- Town of James Island, SC
- Town of Hilton Head Island, SC
- Town of Fort Myers Beach, FL
- City of Beaufort, SC
- City of Flagler beach, FL
- City of Williston, FL
- Liberty Consolidated Planning Commission, GA.

Twenty-five responses were from city, traffic, or transportation engineers (38%), 18 responses were from directors, supervisors, or superintendents of public works (27%), and the remaining were from the following various titles and positions:

- Administrator
- Administrator Assistant
- Analyst
- Assistant Director of PW
- Assistant City Manager
- Business Licensing Official
- Community Development and Planning Director
- Deputy Director of Engineering and Transportation
- Executive Director
- Storm water Engineer
- Sergeant Traffic Division
- Town Manager
- Transportation Coordinator
- Transportation Development Manager.

Generally, it was more difficult to find contact information for smaller areas; therefore, larger areas have a greater representation in this study. Approximately 23% of respondents came from places with a self-reported population of 50,000+, 29% from a population of 25,000–50,000, 21% from a population 10,000–25,000, 9% from population 5,000–10,000, and 18% from population under 5,000 (Figure 2).

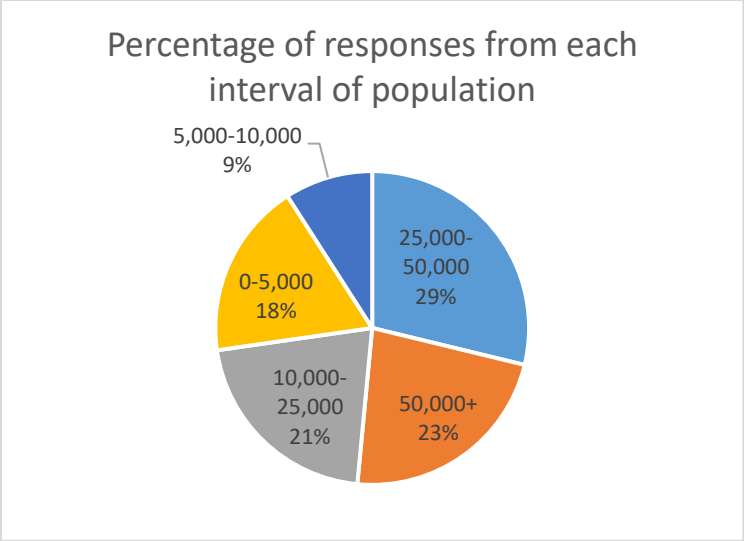

FIGURE 2. PERCENTAGE OF RESPONSES FROM SELF-REPORTED POPULATIONS (0–5,000), (5,000–10,000), (10,000–25,000), (25,000–50,000), AND (50,000+) (N=66).

This survey was intended to reach those places with a population 50,000 or less. Fifteen locations had self-reported populations of 50,000+. These are listed below with their 2017 population. These locations are excluded from the rest of the analysis (unless otherwise stated) because the analysis was intended for those populations with a population less than 50,000. Two locations have a 2017 recorded population of under 50,000. These locations may have experienced population growth since 2017.

TABLE 2. RESPONSES WITH POPULATION INDICATED "50,000+"

Location	2017 Pop.
Polk County, FL	42,085
City of Kannapolis, NC	48,806
Town of Summerville, SC	50,388
City of Apopka, FL	51,564
Floyd County Government, GA	97,613
Coweta County, GA	143,114
Columbia County (FL) Traffic Engineering	151,579
Bay County (FL) Public Works Department	183,563
Hernando County (FL) Board of County Commissioners	186,553
St. Johns County, FL	243,807
St. Johns County (FL) Public Works	243,807
St. Johns County, FL	243,812
St. Lucie (FL) Transportation Planning Organization	313,506
Marion County, FL	343,353
Osceola County, FL	352,180

4.0 SURVEY RESULTS – IDENTIFICATION OF KEY THEMES, GAPS, AND CRITICAL ISSUES

The survey results were analyzed to identify key themes, gaps, and critical issues. Below, a summary of the key points is included. (Responses with n>51 are due to respondent able to select more than one response. Those questions with significantly less than 51 responses are typically sub-questions provided only to those respondents that previously selected a very high degree or high degree of a previous factor.)

The first question related to congestion issues focused on asking participants to rate the degree to which day-to-day, peak-hour traffic (basically, normal traffic fluctuations), special events and tourism, work-zones, traffic crashes, parking, weather, and freight (long-distance or local) contribute to congestion in their agency's area. Participants had the option to also include additional congestion cause factors to the ones provided. There were five rating levels including very high degree, high degree, moderate degree, small degree, and none. The answers to this question are illustrated in Figure 3, where it can be seen that:

- Day-to-day, peak hour congestion was most often rated as a factor that to a "very high degree" or "high degree" contributes to congestion, and
- "Special events and tourism" was the next most highly rated source of congestion.

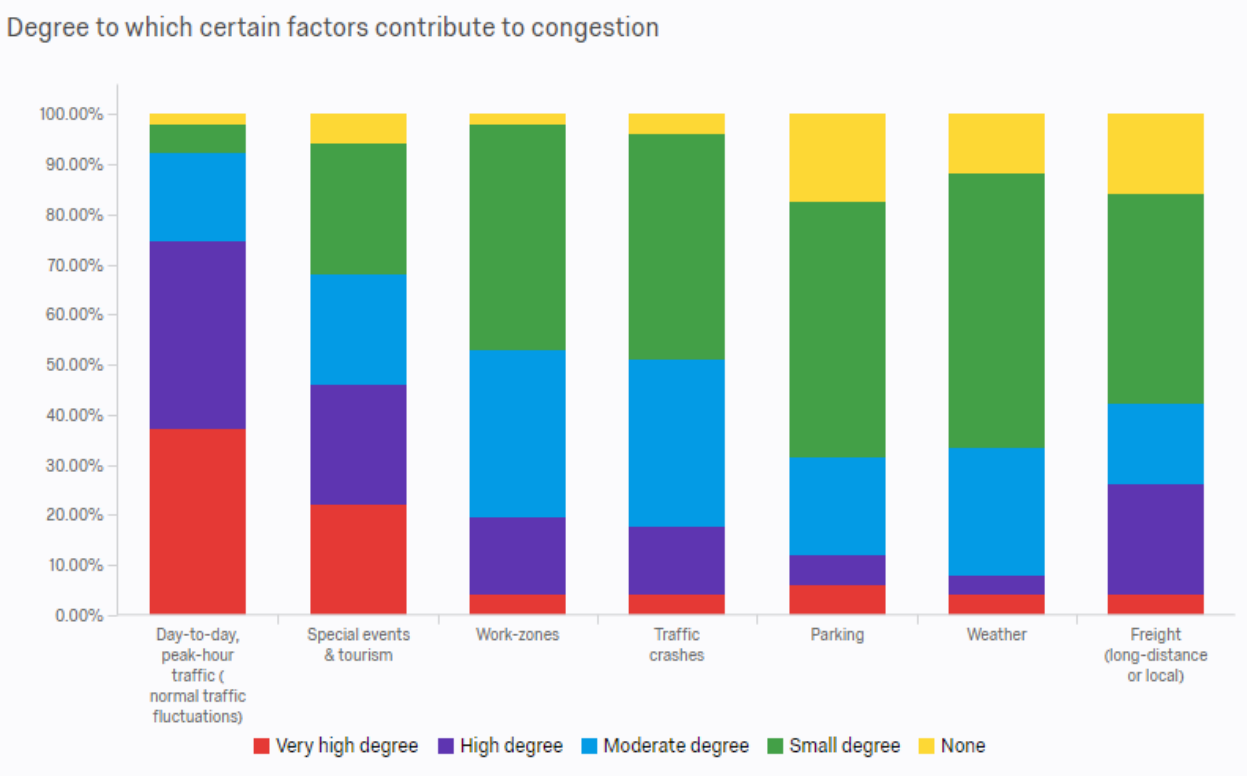

FIGURE 3. THE DEGREE THAT CERTAIN FACTORS CONTRIBUTE TO CONGESTION IN AN AGENCY'S AREA (N=51).

The second survey question was about stating the agency's level of agreement/ disagreement with the following statement: "Congestion management is a high priority relative to all other responsibilities" along with the agency's population. Participants had five levels to pick from when rating the statement and four population categories. The results as presented in Figure 4 and Figure 5 show that agencies with larger populations (10,000+) were more likely to rate that they "strongly agree" that congestion management is a high priority comparably to their other responsibilities.

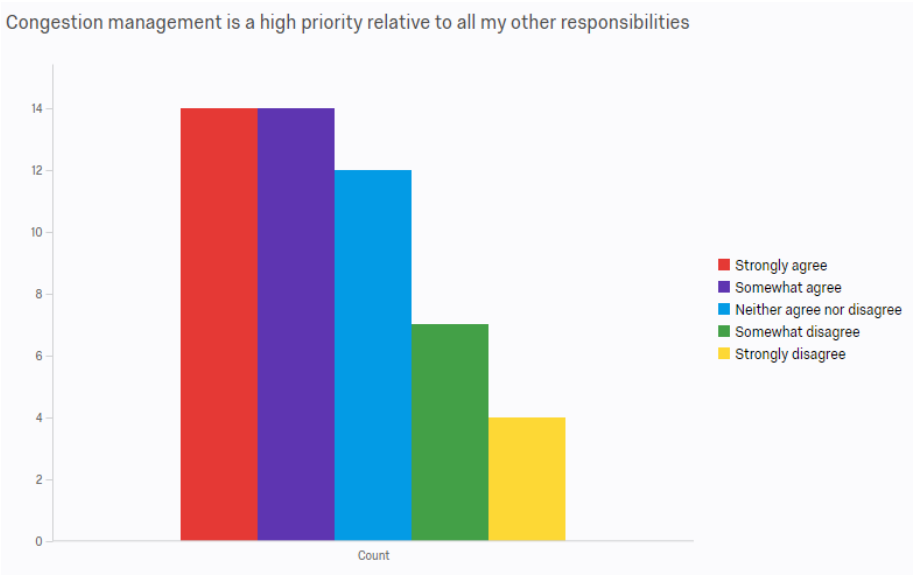

FIGURE 4. THE DEGREE TO WHICH THOSE SURVEYED RATED CONGESTION MANAGEMENT AS A HIGH PRIORITY RELATIVE TO THEIR OTHER RESPONSIBILITIES (N=51).

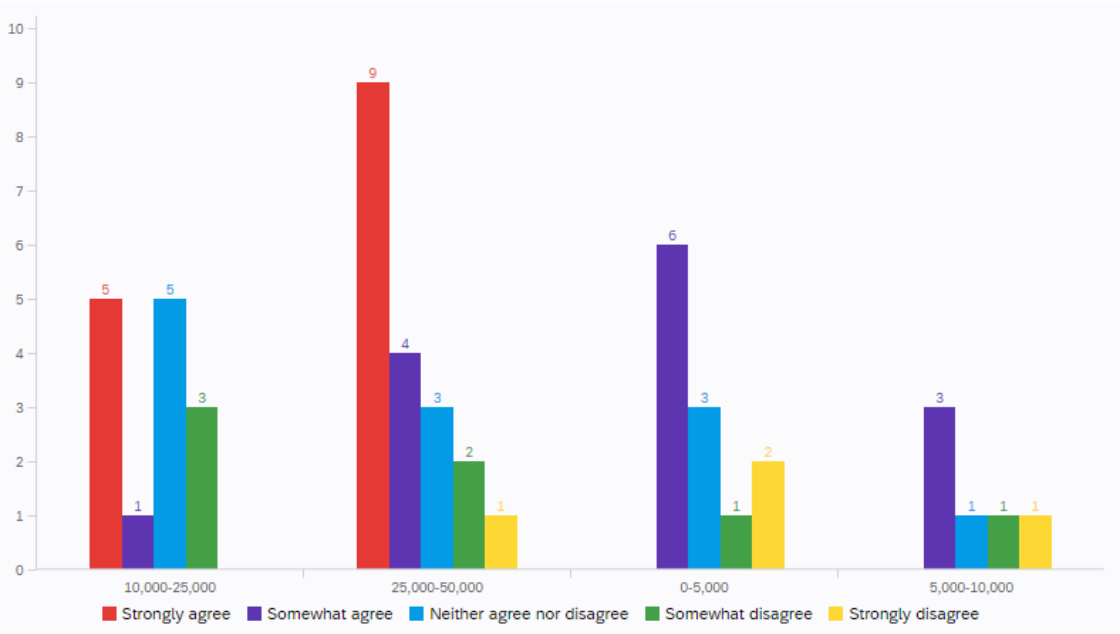

FIGURE 5. THE DEGREE TO WHICH THOSE SURVEYED RATED CONGESTION MANAGEMENT AS A HIGH PRIORITY RELATIVE TO THEIR OTHER RESPONSIBILITIES CONSIDERED BY SELF-REPORTED POPULATION NUMBER (N=51).

Following, participants were asked to what degree their agency interact with state DOT, local DOT, police department, city or county administration, public works department, community improvement (CID), or other, when they have congestion issues. Figure 6 shows that to a very high degree, agencies interact with the Public Works department when they have congestion issues. Extensive interaction also occurs with state DOTs and police departments. A low number of agencies interact with CIDs.

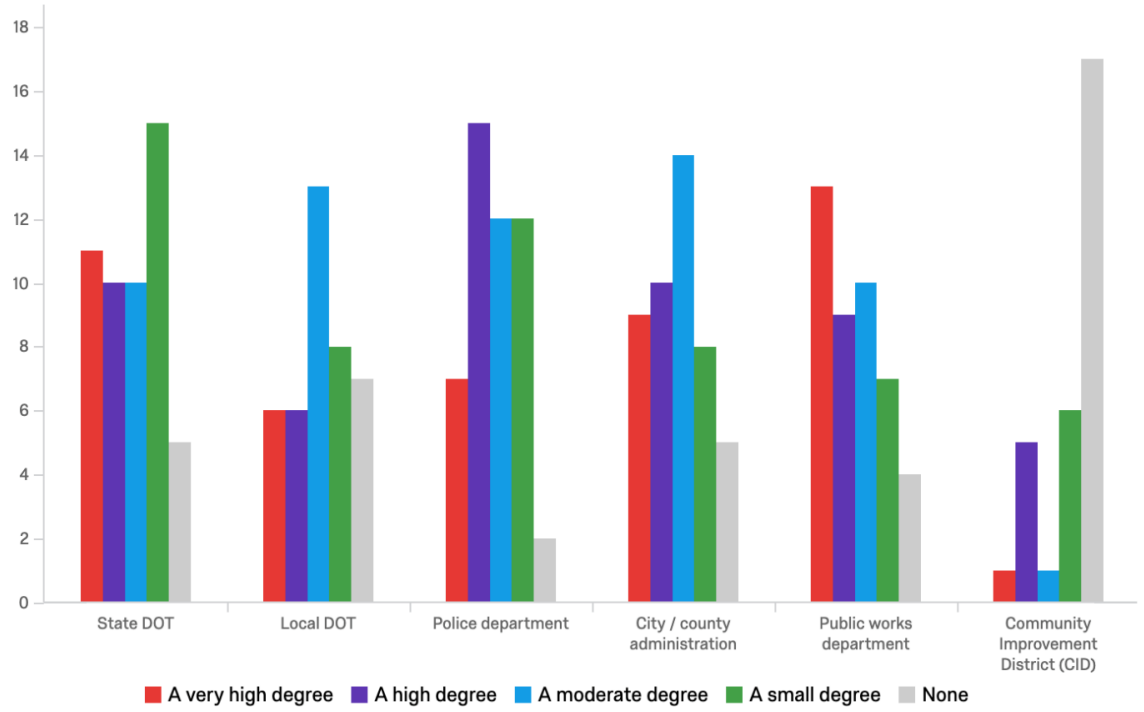

FIGURE 6. THE DEGREE TO WHICH AGENCIES INTERACT WITH VARIOUS AGENCIES WHEN THEY HAVE CONGESTION ISSUES (N=51).

Then, participants were asked how they measure or track congestion. Options provided included looking at traffic incident duration, phone calls from citizens, queuing, delay, and we don't measure congestion or other. Looking at the results, 33% stated not tracking congestion, and 23% primarily receiving information from citizens (see Figure 7).

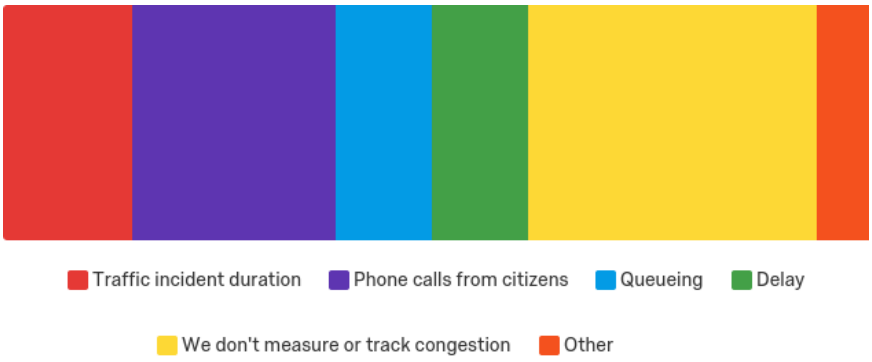

FIGURE 7. HOW CONGESTION IS TRACKED BY TRANSPORTATION AGENCIES (N=90).

When "other" was selected, some options stated were the following:

- ITS related to new development
- Field observation
- Accident reports
- Traffic studies from consultants
- We have video detection on the majority of traffic signals in our system and real-time monitoring in an operations control center.

Some "other" responses were provided from the agencies with more than 50,000 population. Those included:

- Traffic counts
- Level of service
- NCDOT congestion management data
- Traffic studies.

The next question looked at the perception of agencies in terms of day-to-day, peak hour congestion increase over the past five years, where 95% of respondents indicated that they felt day-to-day peak hour congestion has increased over the past five years.

Following, the causes of that congestion increase were asked including but not limited to population increase, employment increase, longer commute trips, and residential and commercial development. Population increase, residential and commercial development, and employment increase were indicated as the top three causes of the recent increase in day-to-day, peak hour congestion (refer to Figure 8).

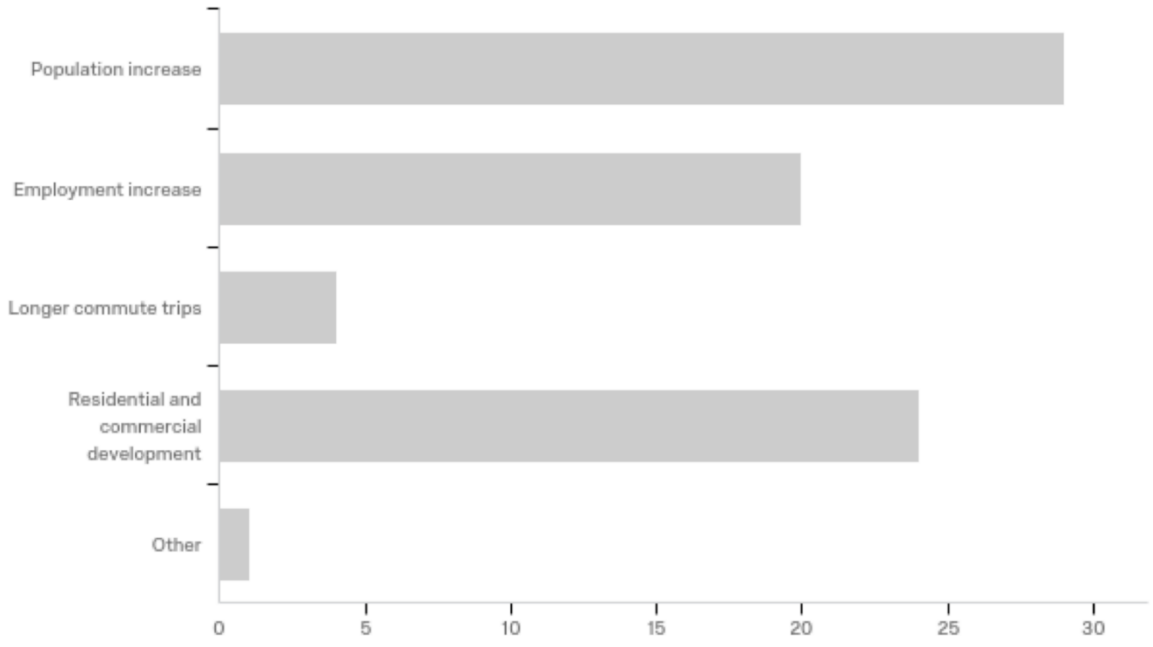

FIGURE 8. WHAT AGENCIES BELIEVE HAS CAUSED THE INCREASE IN DAY-TO-DAY, PEAK HOUR CONGESTION (N=81).

"Other" responses included:

- Railroad traffic
- Seasonal tourism is now year round
- Increased freight movement
- Many employees live off island.

The next survey question focused on special events and if those were a cause of congestion increase. Events listed were; recurring events at a permanent venue (e.g. stadium), continuous events that occur over a single or multiple days (e.g. a festival or fair), street use events, requiring temporary street closure (e.g. motorcycle rallies, bike races, parade), seasonal events (e.g. agritourism such as "u-pick" apples), and holiday shopping (e.g. Thanksgiving and Christmas weekends). Continuous events that occur over a single or multiple day (such as festivals), street use events, and recurring events at a permanent venue were rated as the top special events that cause an increase in congestion, in descending order of rating (see Figure 9).

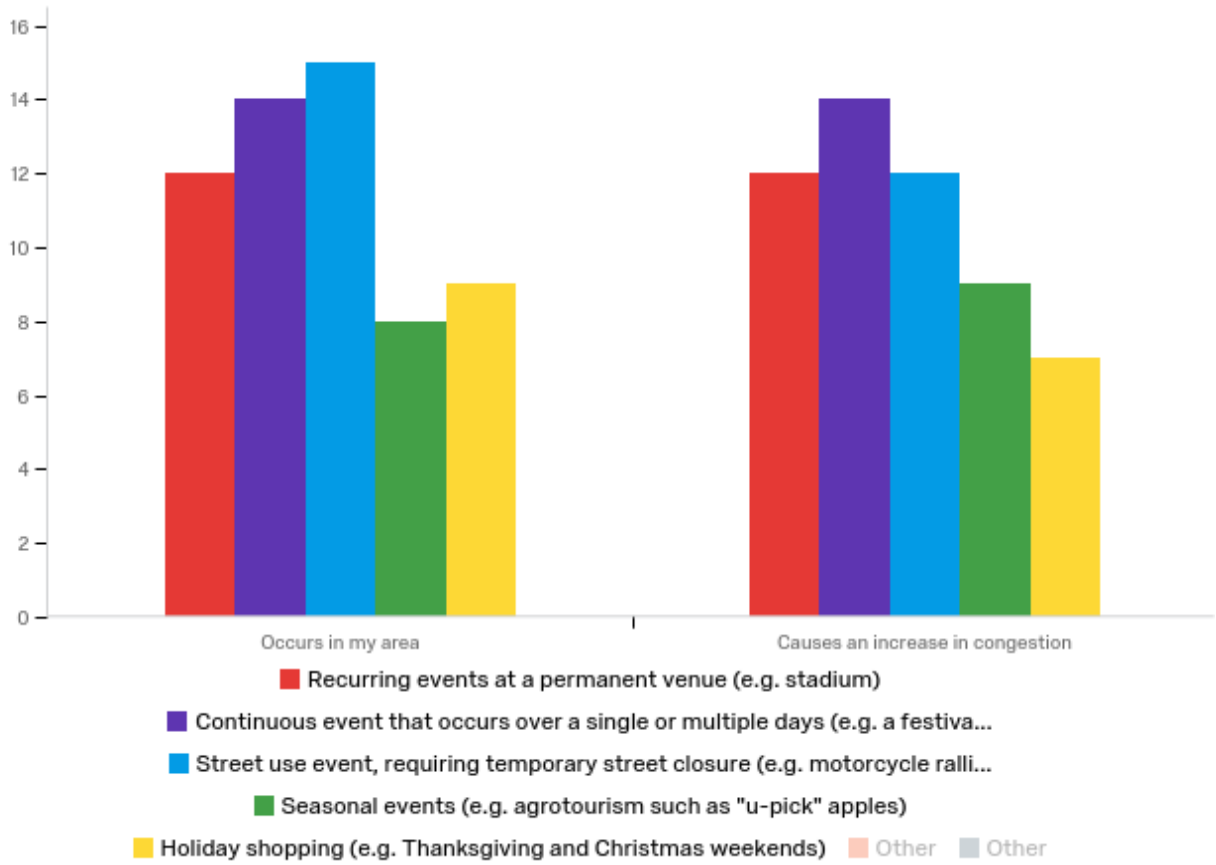

FIGURE 9. THE TYPE(S) OF SPECIAL EVENTS THAT AN AGENCY'S AREA HAS (N=102).

"Other" responses included Mardi Gras, and festivals.

Next, the top metrics to plan for special event congestion were asked. The top three metrics used to plan for special event congestion based on the participant answers were expected event attendance, location of the event considerations, and availability of police.

Table 3 shows the answer options provided and the percent and count of answers received for each.

TABLE 3. PERCENTAGE AND COUNT OF TYPE OF METRICS USED FOR SPECIAL EVENT CONGESTION (N=57).

Metrics used to prepare for special event congestion	%	Count
Expected event attendance	22.81%	13
Location of the event considerations (e.g., whether there is already sufficient parking and arterial infrastructure in place)	22.81%	13
Whether there was initial planning and traffic initiatives from event coordinators	17.54%	10
If the event coordinators ask for assistance	14.04%	8
Availability of law enforcement	22.81%	13

Later, in response to who manages special event traffic planning, the top two responses (equal response) were the police department and a combination of the agency, the event organizers, and the police. Figure 10 presents the results.

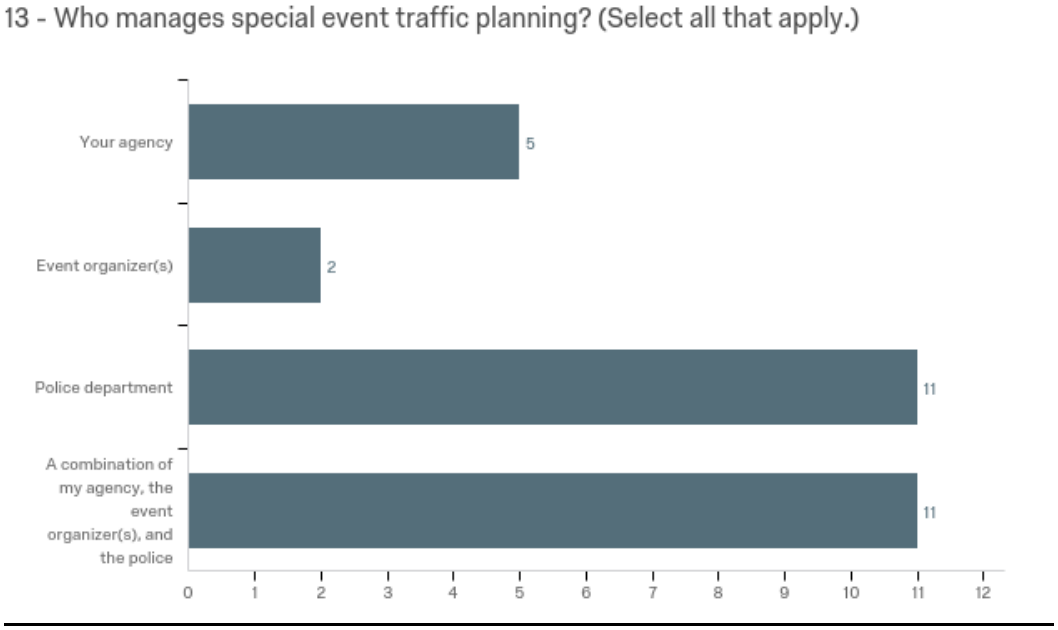

FIGURE 10. COUNT OF WHO MANAGES SPECIAL EVENT TRAFFIC PLANNING (N=27).

Furthermore, as it can be seen in Figure 11, limited parking capacity was rated as the top contributing factor to congestion around special events. Other factors provided are also shown in Figure 11.

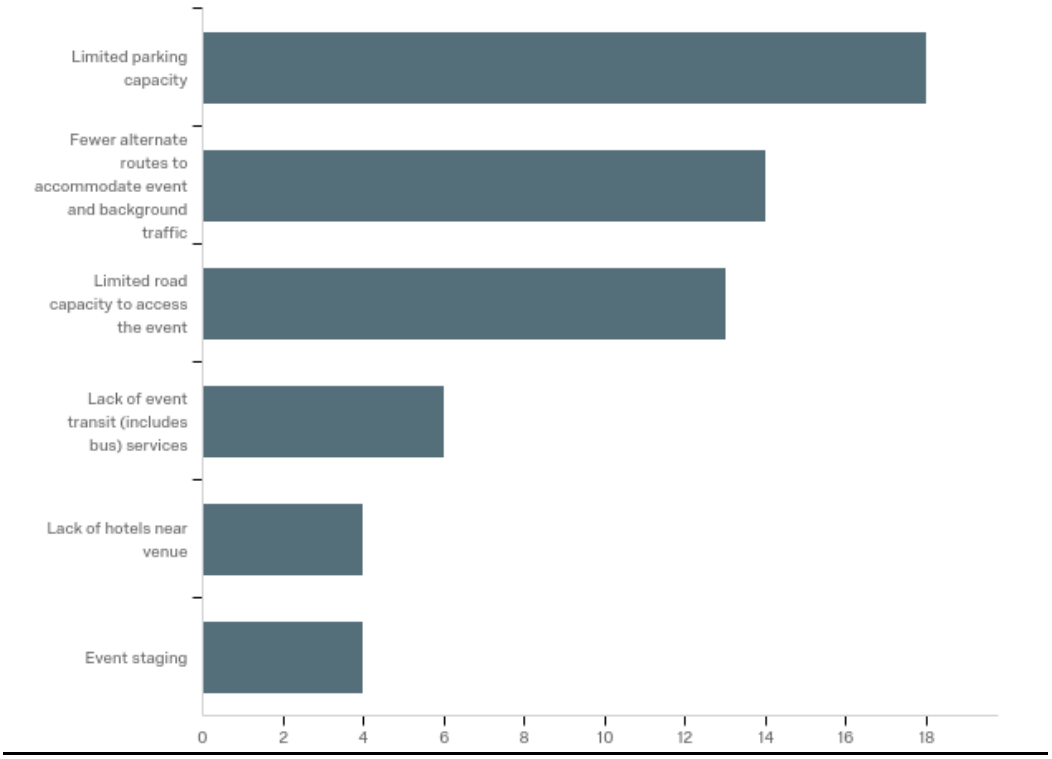

FIGURE 11. COUNT OF WHICH FACTORS CONTRIBUTE TO CONGESTION AROUND SPECIAL EVENTS (N=59).

Nine survey participants answered to what additional resources would help mitigate their agency's parking-related congestion. The majority (5/9) answered additional parking (Figure 12), while two answered transit. Additional parking control, portable changeable message signs, and ride-share services were selected by one participant each.

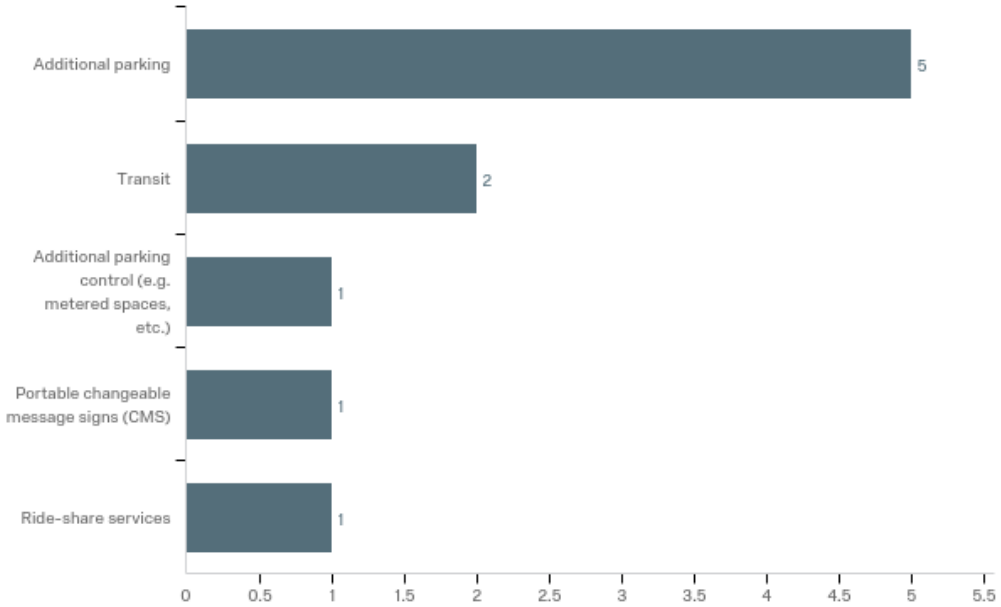

FIGURE 12. THE RESOURCES THAT THOSE SURVEYED THINK MAY HELP MITIGATE PARKING-RELATED CONGESTION (N=9).

The next question focused on asking what weather-related events affect congestion in an agency's area. The most selected response (four) was heavy rain. An equal number of responses (two each) were received for hurricanes, snow, heavy winds, and sun glare (Figure 13). From those, seven responses indicated that weather-related congestion is managed locally, and two indicated that it is managed statewide.

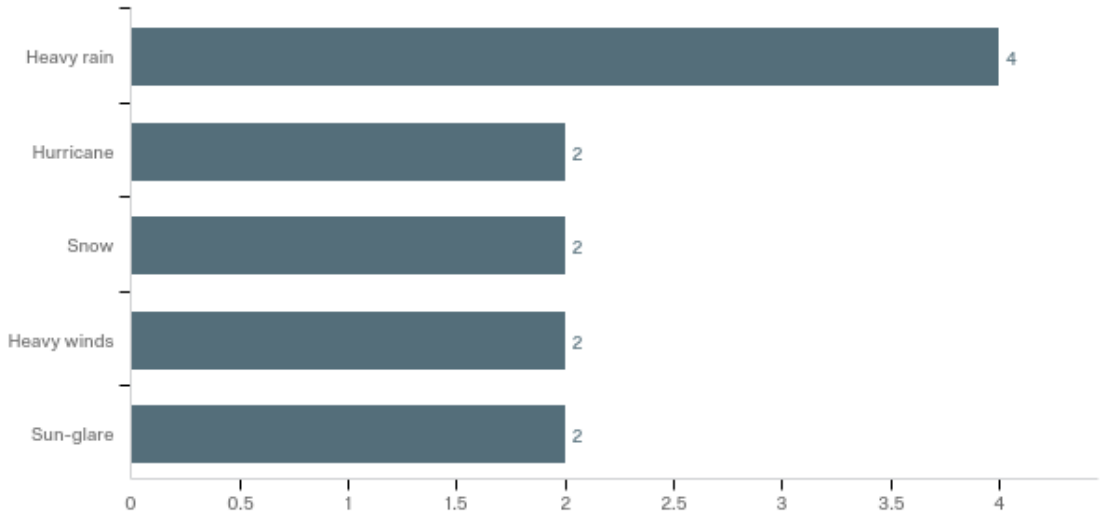

FIGURE 13. THE WEATHER-RELATED EVENTS THAT AFFECT CONGESTION IN AN AREA (N=12).

The next few survey questions focused on freight movements. The first questions asked the degree to which long distance freight movements, local freight movements, delivery vehicles blocking active lanes, bottlenecks between freight hubs, restrictions on freight movement, high percentage of trucks on roadway, high accident locations for trucks, and others, contribute to the freight-related congestion in the agency's area.

Results showed that restrictions on freight movement were indicated as the top contributor to freight-related congestion. Following close behind were high accident locations for trucks and high percentage of trucks on the roadway (refer to Figure 14).

In Figure 15, the responses to what strategies agencies use or planning to use to reduce freight-related congestion. Options provided were road improvements, reduced limitation on freight movement, increased limitations on freight movement, more specific drop-off and pickup locations or less specific drop-off and pickup locations. Road improvements were indicated as the top strategy agencies use or are planning to use to reduce freight-related congestion (Figure 15).

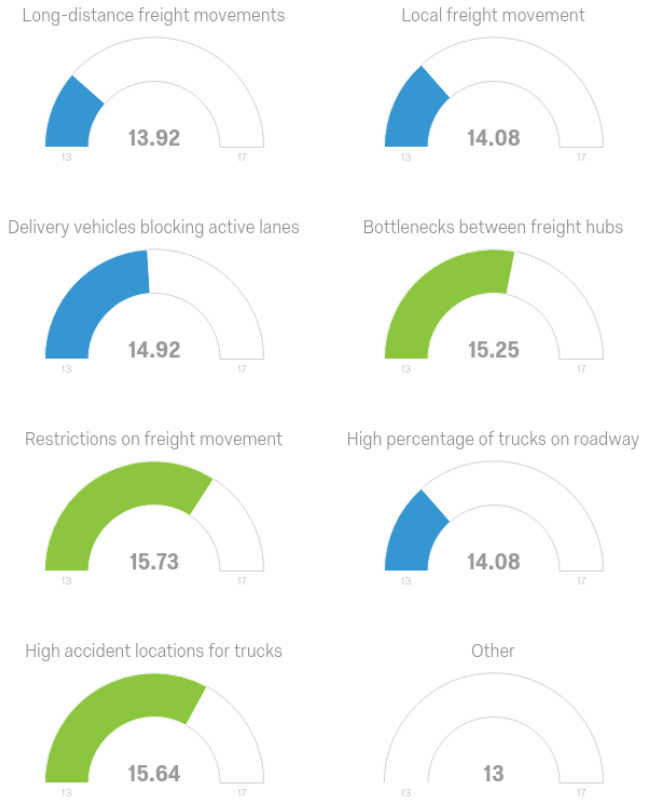

FIGURE 14. A GAUGE CHART OF WHICH FACTORS CONTRIBUTE TO FREIGHT-RELATED CONGESTION IN AN AGENCY'S AREA (N=12).

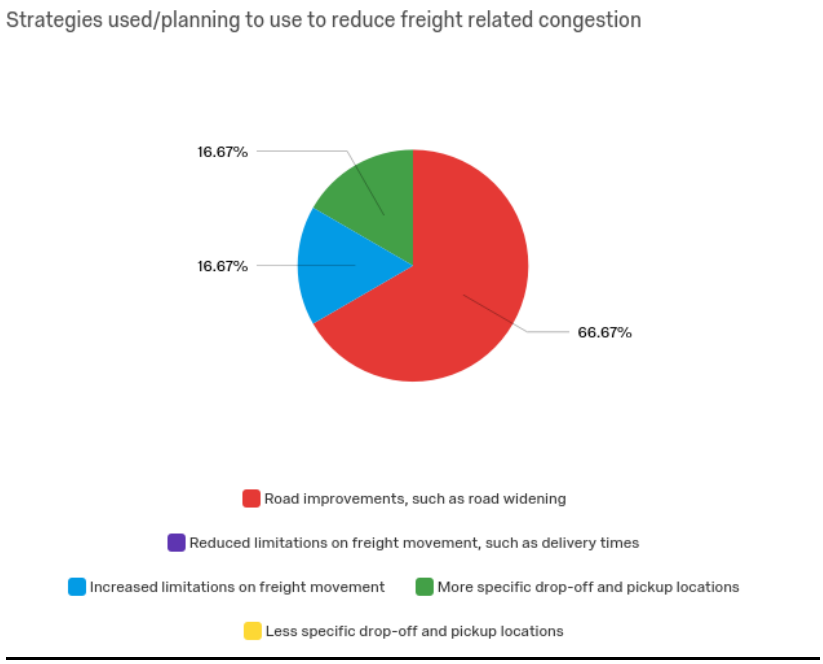

FIGURE 15. STRATEGIES USED OR PLANNED TO REDUCE FREIGHT-RELATED CONGESTION (N=12).

Next, individuals were asked what tools their agency employs to mitigate work zone or traffic incident-induced congestion. In this case, 47% use public communication efforts, 35% limit construction to a specific time of day, 12% provide contractor completion incentives and penalties, and a few, about 6%, use fixed or portable changeable message signs (CMS) (refer to Figure 16).

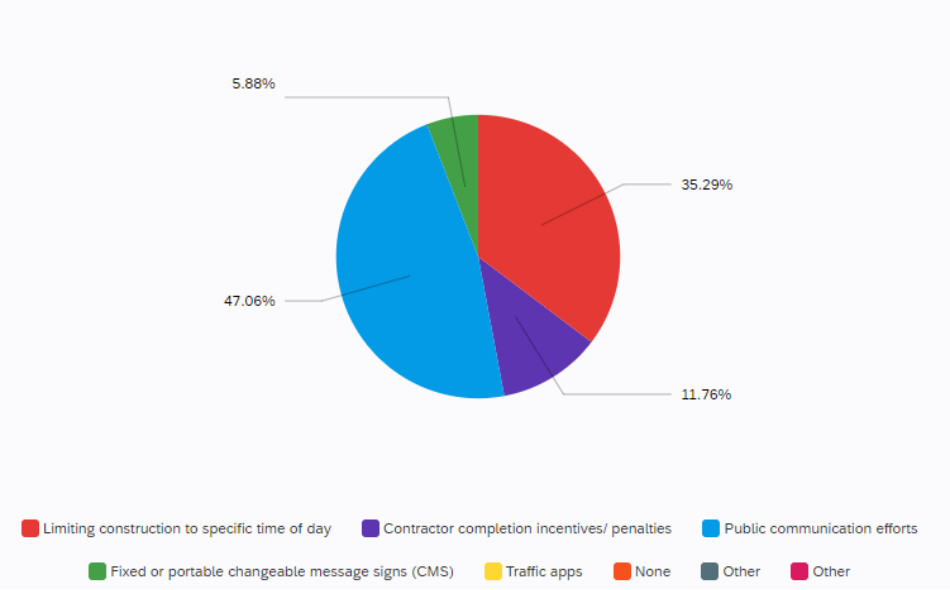

FIGURE 16. TOOLS AGENCIES INDICATED THEY EMPLOY TO MITIGATE WORK ZONE OR TRAFFIC INCIDENT-INDUCED CONGESTION (N=17).

To the question regarding whether agencies had any training materials, manuals, or programs for handling congestion, 42 responded that their agency did not have any training materials, manuals, or programs for handling congestion, while only six respondents indicated that they did have training materials to handle congestion. If you separate the responses by population, only when you get to populations greater than 10,000 do agencies start having training materials, as demonstrated in Figure 17. Similarly, respondents from areas with larger populations (10,000+) tended to be more interested in having specific training materials regarding congestion. Those with congestion training materials indicated that they are usually disseminated by PowerPoint or similar presentation or by paper of PDF manual (Figure 18).

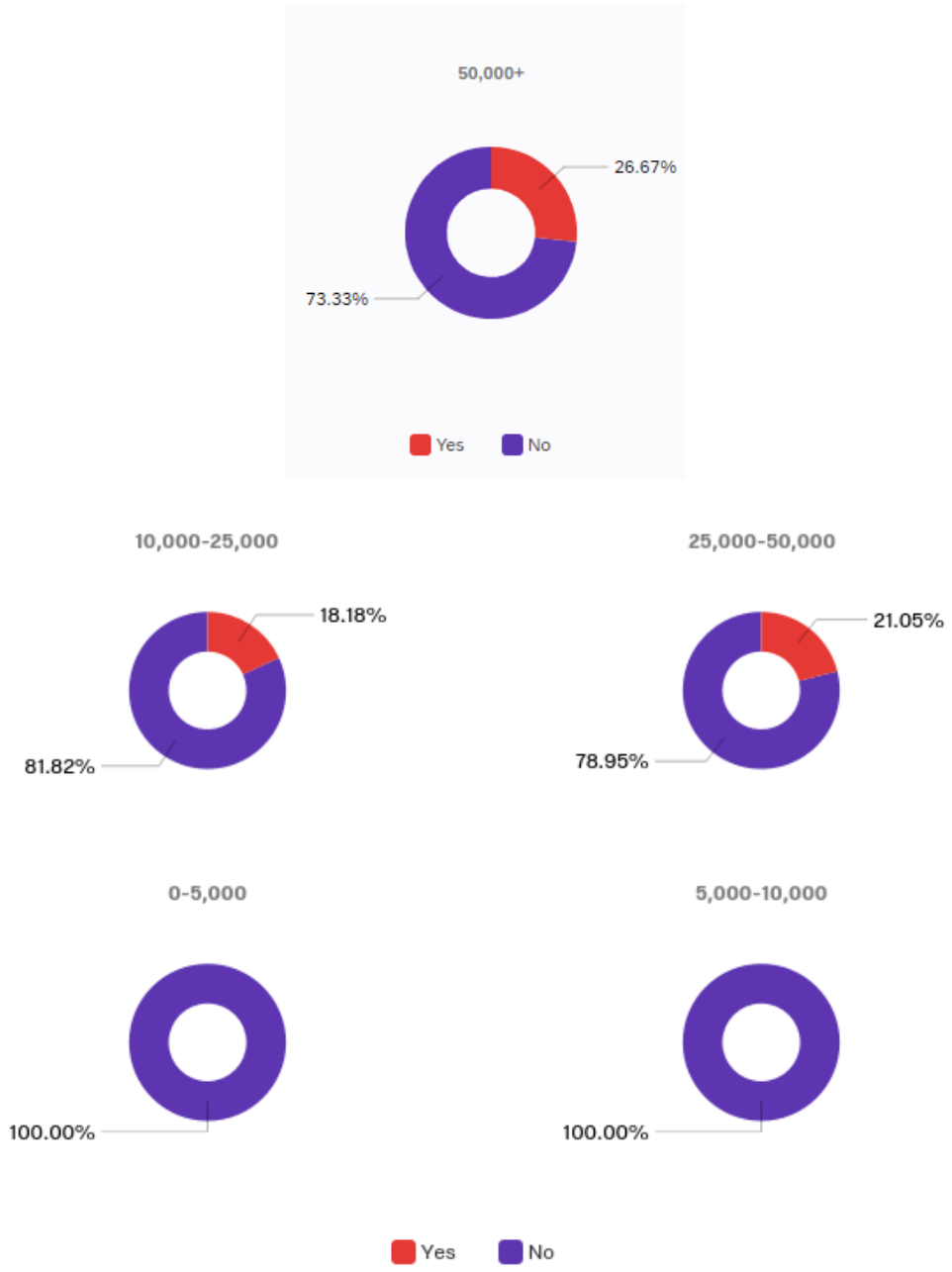

FIGURE 17. SEPARATED BY POPULATION, HOW MANY AGENCIES HAVE CONGESTION TRAINING MATERIALS (N=63).

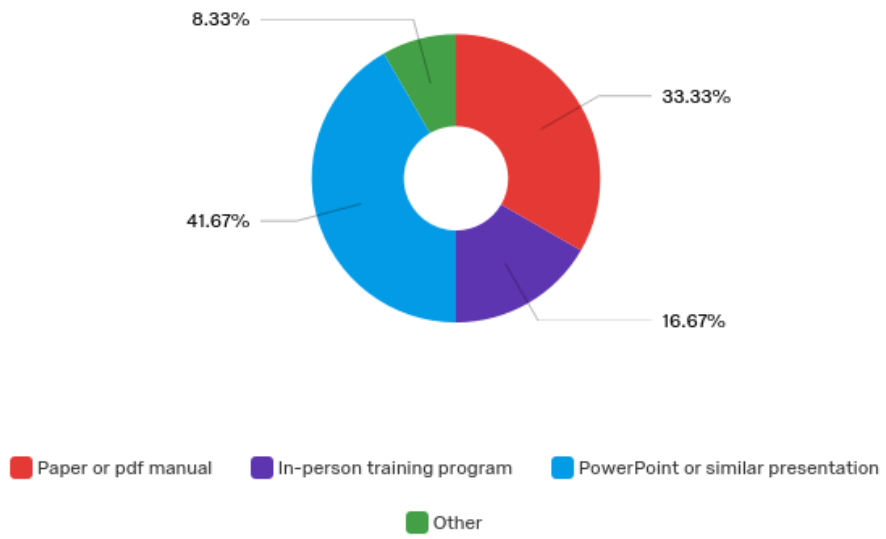

FIGURE 18. HOW CONGESTION TRAINING MATERIALS ARE DISSEMINATED (N=49).

In Figure 19, the interest in having specific training materials, manuals, or programs by the agency's population is illustrated.

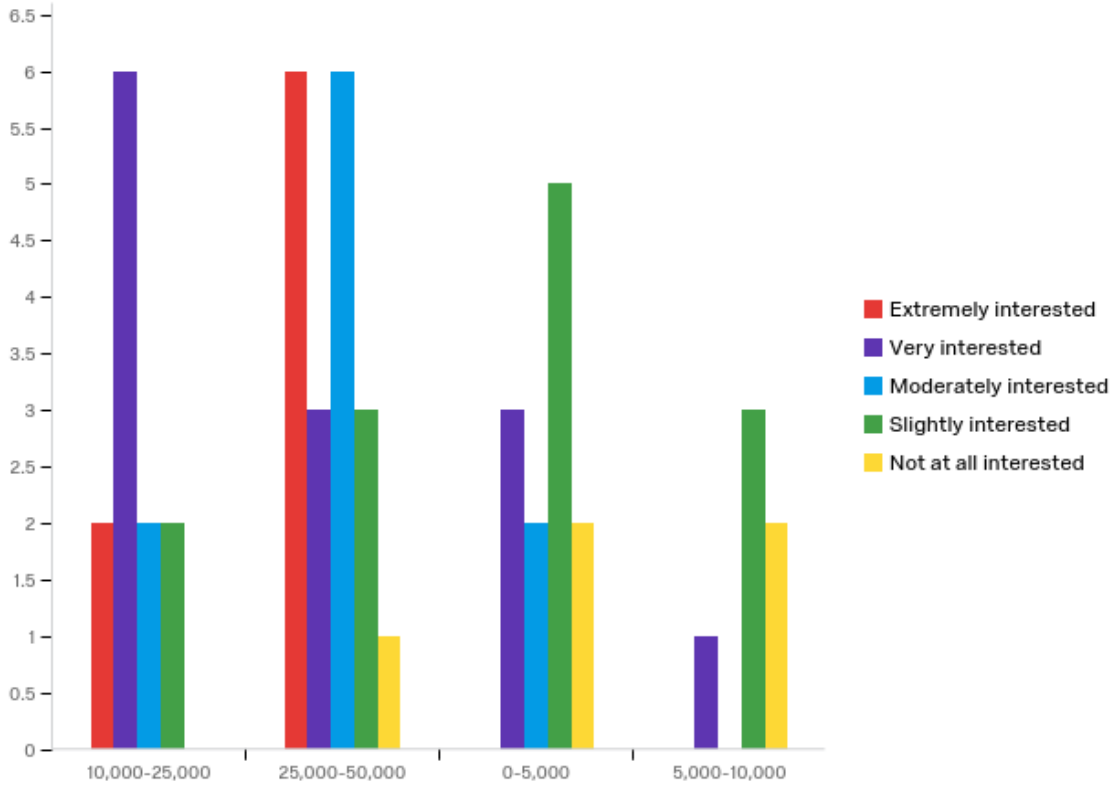

FIGURE 19. INTEREST LEVEL IN HAVING TRAINING MATERIALS REGARDING CONGESTION (N=49).

Figure 20 presents the answers to the survey question on how effective agencies believe these training materials are in helping to manage congestion in the agency's area. Five levels or effectiveness were provided to the participants to select from. Looking at the results, materials are "effective" 50% of the time and no one indicated these materials are "very effective", which clearly shows a need in this area.

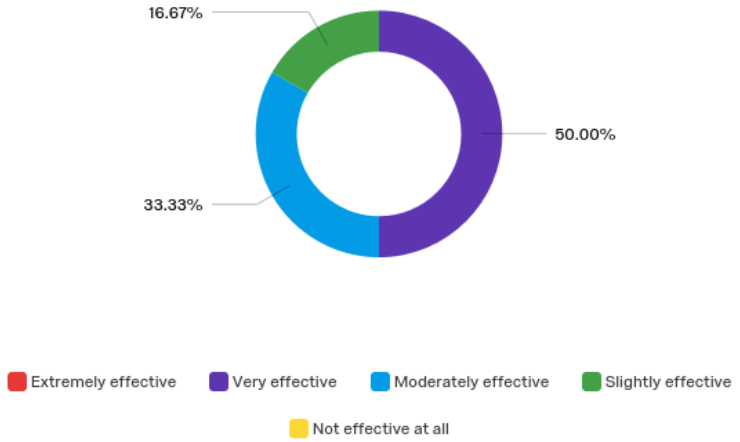

FIGURE 20. THE EFFECTIVENESS OF THE TRAINING MATERIALS THAT AGENCIES DO HAVE (N=6).

The next survey question looked at the constraints in agencies' congestion management programs. Budget restrictions were indicated as the largest constraint to an agency's congestion management program as seen in Figure 21.

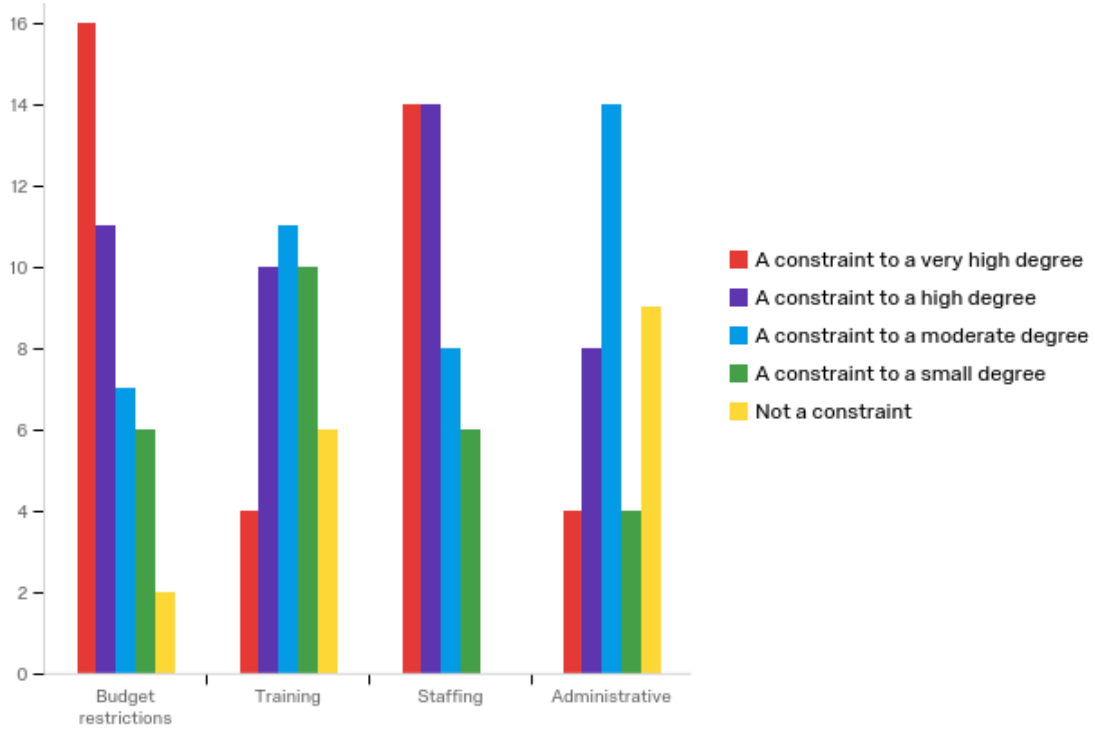

FIGURE 21. THE DEGREE TO WHICH CERTAIN FACTORS ARE CONSTRAINTS TO AN AGENCY'S CONGESTION MANAGEMENT PROGRAM (N=39).

Figure 22 demonstrates the expected effectiveness of different factors including additional funding, greater cell service enabling real-time traffic info, improving signal timing and coordination, training resources, relationships with other agencies, more traffic controls officers, read condition improvements, minor infrastructure improvements, major infrastructure improvements, and other in helping to relieve congestion. Major infrastructure improvements were indicated as the largest (rated the most as "extremely effective") factor in helping to relieve congestion. "Other" responses included railroad overpass (2 responses) and bypass.

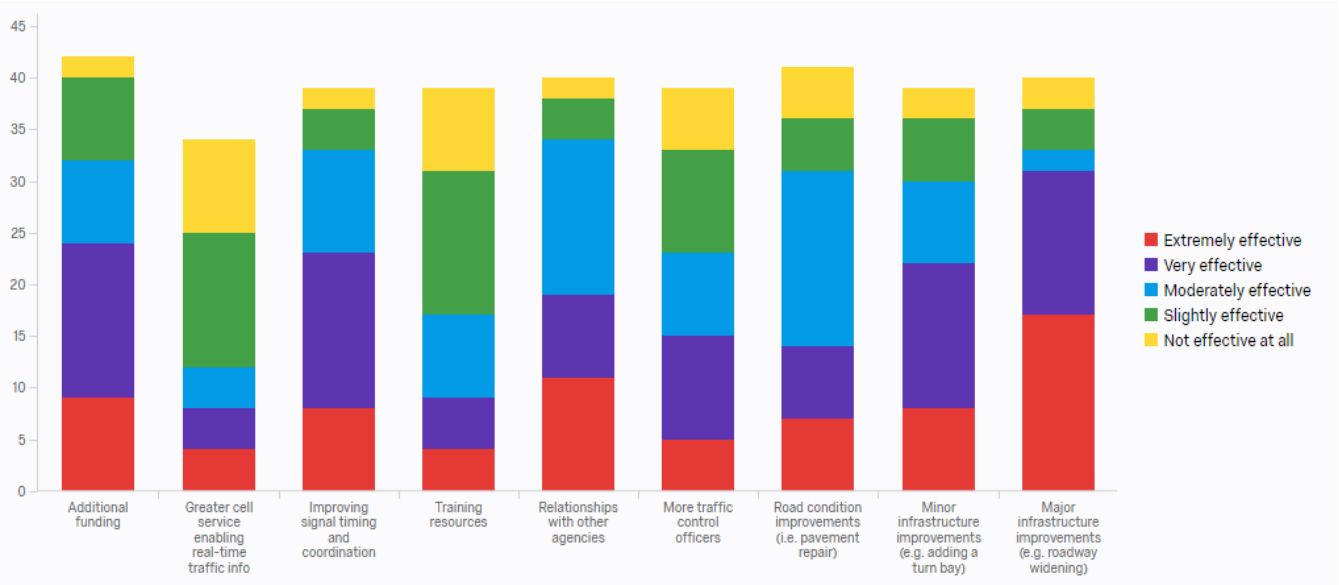

FIGURE 22. THE EXPECTED EFFECTIVENESS OF DIFFERENT FACTORS IN HELPING TO RELIEVE CONGESTION (N=49).

Next, an open-ended question of what a respondent's agency does or has seen done in their agency's town that is successful at managing congestion was asked. All responses and a word cloud of the answers (Figure 23) are below:

- Track traffic volume changes more closely
- Signal coordination
- City roadway improvements and alternative routes for local travelers
- Widening of the major thoroughfares and additions of parallel streets; also the connection of city streets in residential areas
- Traffic circle proposal, wayfinding signage installed, turn lane improvements
- The implementation of the city's "Intelligent Transportation System," including video detection and remote, real-time signal timing adjustment capabilities
- Temporary signal timing adjustments
- Streetscape projects both major and minor
- Signal coordination. We're currently developing an ATMS project for centralized control.
- Signage
- Short- and long-term planning with local and regional transportation agencies to address growth and adequate infrastructure

- Roundabouts, turn lanes, and adaptive ITS
- Pushing out construction and road closure alerts to residents via text or social media
- Intersection realignments and bridge modifications
- Installing medians
- Increase traffic enforcement near schools
- Improving key intersections
- Highway capacity improvements (bypass construction)
- Having LEOs* at strategic points to direct traffic during events
- For big events, we have all hands-on deck procedures to handle expected crowds and are generally prepared.
- FDOT recently re-timed our signals along US-1, and they are now coordinated. Flexible work schedules (9/80) lighten the load on Fridays.
- Additional roadways and loading and unloading zones to keep main highways and roadways clear.

*LEOs stands for law enforcement officers.

FIGURE 23. WORD CLOUD OF THE ANSWERS TO THE OPEN-ENDED QUESTION ABOUT WHAT THINGS HAVE BEEN DONE THAT ARE SUCCESSFUL AT MANAGING CONGESTION (N=22).

The last two questions of the survey regarded the number of staff that agencies have where traffic operations or management are a significant portion of their job responsibilities and how many of them have a Professional Engineering (PE) license. The answers are shown below in

Figure 24 and Figure 25. Most agencies have up to two people working on congestion issues, and about half have a PE license. However, as population increases, the number of PEs also increases.

#	Field	0-5,000		5,000-10,000		10,000-25,000		25,000-50,000	
1	0	63.64%	7	50.00%	3	16.67%	2	0.00%	0
2	1-2	36.36%	4	16.67%	1	58.33%	7	58.82%	10
3	3-5	0.00%	0	16.67%	1	25.00%	3	29.41%	5
4	5-9	0.00%	0	16.67%	1	0.00%	0	5.88%	1
5	10+	0.00%	0	0.00%	0	0.00%	0	5.88%	1
			11		6		12		17

FIGURE 24. THE NUMBER STAFF MEMBERS WHO MANAGE TRAFFIC OPERATIONS AS A SIGNIFICANT PORTION OF THEIR JOBS (N=46).

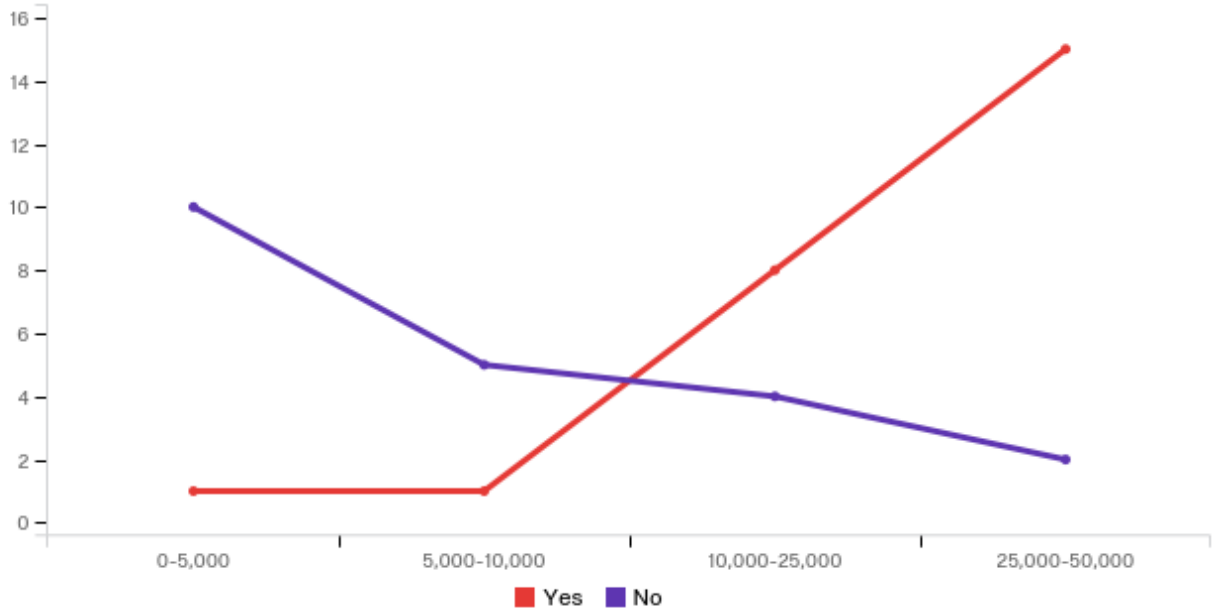

FIGURE 25. THE NUMBER OF PEs IN AGENCY'S STAFF, SEPARATED BY POPULATION (N=46).

5.0 FOLLOW-UP SURVEYS AND SYNTHESIS OF FINDINGS

An analysis of the results from the quantitative surveys revealed several key findings (these were discussed extensively in the previous chapter). For instance, over 98% of the agencies

reported that peak hour congestion is a factor; however, most agencies also indicated that there was no systematic data collection practice to objectively monitor and measure congestion levels. In fact, over 60% reported that phone calls from travelers were a primary source for identifying congestion. About 66% of the agencies responded that traffic crashes were a cause of congestion while about 61% indicated that work zones contributed to congestion. Most (~80%) agencies did not use any tools to mitigate congestion due to work zones. A majority (>70%) of the respondents indicated that interagency interaction is needed to alleviate congestion issues but acknowledged that it barely exists. About 85% of the respondents indicated that additional funding would help relieve congestion. About 78% of the agencies responded that they do not have congestion mitigation-related training and a majority (76%) were interested in having training materials. However, there was no clear preference on how the training could be delivered to them. These results were used to develop an interview or focus group script to solicit more information from the agencies. This script, including main questions and follow-up prompts, is presented in Appendix B.

Following the development of focus group discussion questions, the UFTI team sought and obtained approval from the Internal Review Board (IRB). The intent was to conduct up to three focus groups with up to seven participants each. A subset of agencies that provided feedback to surveys were approached for further discussions via phone calls. Thoughtful consideration was placed in bringing in multiple agencies into a set of conference calls to facilitate further discussions. An initial pool of 21 agencies was identified from the list of agencies who had previously answered the survey. These agencies were approached via email (using the contact information provided in the survey) for participation in the focus groups. Subsequently, follow-up phone calls were also made to the targeted participants to explain the urgency and need for their participation. Given the lack of participation, the survey was released to a secondary target group of individuals who had also completed the Georgia Tech survey. Based on the several days of effort during August 2020, it was evident that assembling a group of agencies at the same time for focus groups was not feasible. Ultimately, three agencies participated in one-on-one “interviews” (August 14 and 21, 2020) that were conducted using the focus group script.

A summary of information provided via these interviews is presented in Appendix C. A review of the responses from the interviews quickly highlighted that no additional insights were being obtained (beyond what was obtained from the surveys). Given the difficulties in reaching small and rural agencies for participation in interviews and the nature of responses received from those who could be contacted, the research team decided to end the efforts to solicit additional qualitative feedback.

The overall effort highlights that while congestion due to peak period traffic, crashes, and work zones are issues in small and rural communities, systematic procedures to monitor, measure, and mitigate congestion are nonexistent. There is an interest in information and training on these topics, but the staff may not have the time to invest in such endeavors. Therefore, the

research team decided to develop a Web-based repository of basic information on congestion management as a "toolkit" that may be accessed by these agencies on demand and for free to understand the basic issues and a flyer including a summary of the information.

6.0 DEVELOPMENT OF EDUCATIONAL MATERIALS

The educational materials developed as part of this project include a Web-based toolkit with information on congestion management, a flyer summarizing the project finding and resource availability, and a webinar.

The Web-based toolkit is hosted by the University of Florida (UF) Transportation Technology Transfer (T2) Center website at https://techtransfer.ce.ufl.edu/tech-transfer/ufti-t2-projects/stride-projectH.
The website includes the research team, the project objectives, the products of this project, and numerous resources categorized in the following sections and subsections:

- Resources: Topic Areas
  - Access Management
  - Parking Studies
  - Additional Capacity
  - Construction Improvements
  - Land Use Planning
  - One-way Streets
  - Intersection Improvements (turn lane, acceleration/deceleration lane)
  - Transit Improvements
  - Signal Timing
  - Bicycle & Pedestrian Facilities
  - Flexible Work Hours
  - Speed Management
  - Data
- Resources: Agencies
  - AASHTO, NCHRP
  - Denver Regional Council of Governments
  - FHWA
  - Institute of Transportation Engineers (ITE)
  - Kentucky Transportation Cabinet
  - Michigan DOT
  - National Association of Counties
  - Texas Transportation Institute
- Resources: Data and Manuals
  - South Carolina
  - Georgia

The website structure mentioned above is dynamic and may change in the future, based on the availability of resources and feedback from users.

The flyer is illustrated in Figure 26. It includes a brief introduction to the project, the survey, a summary of the survey findings, and the link to the Web toolbox.

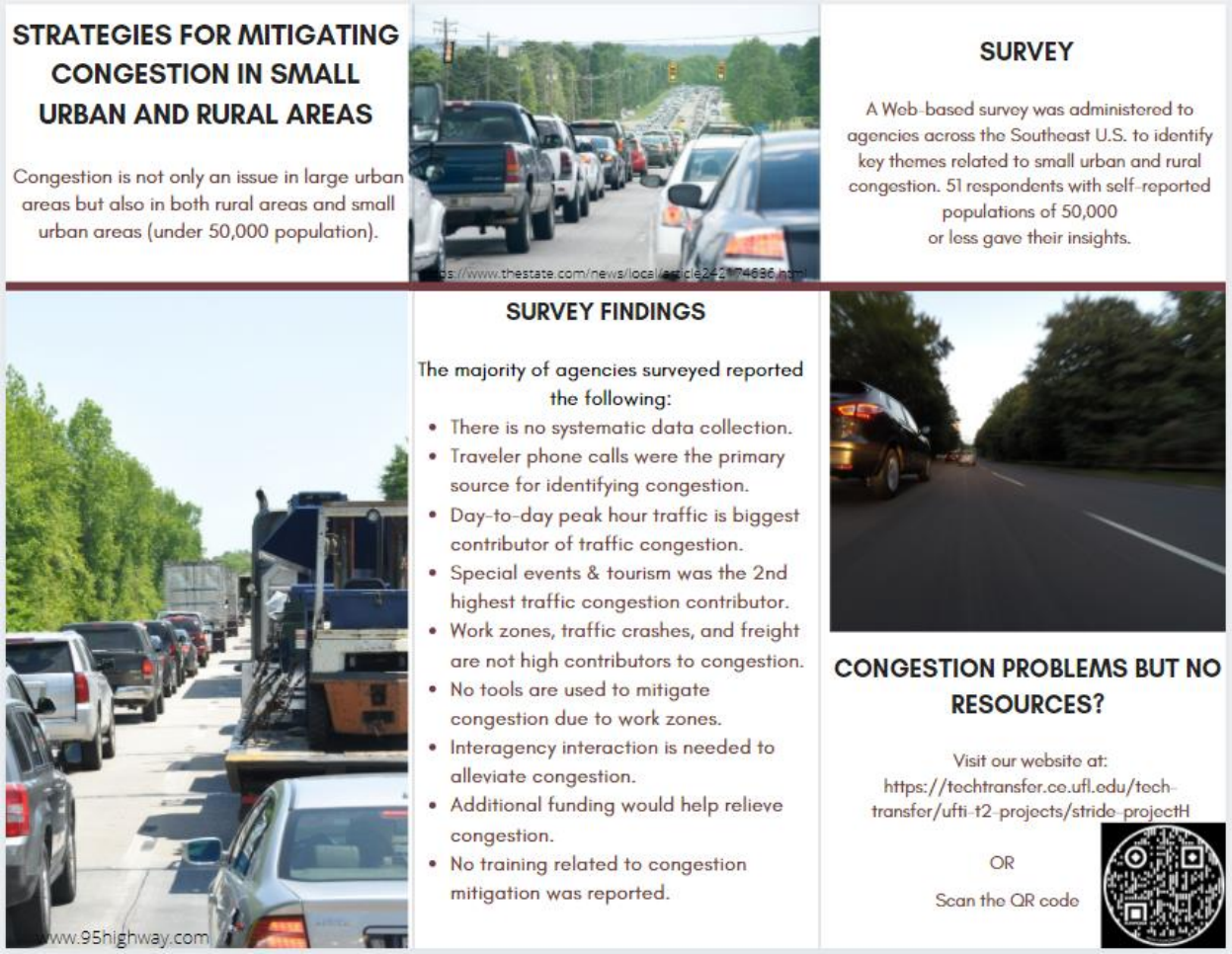

FIGURE 26. PROJECT SUMMARY FLYER

In addition to the above, a webinar was offered on November 4, 2020. The recording of the webinar is available at https://stride.ce.ufl.edu/technology-transfer/workshops-webinars-conferences/ or https://www.youtube.com/watch?v=8ioQV8TeW5s&feature=youtu.be.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Congestion is not only an issue in large urban areas but also in both rural areas and small urban areas with population under 50,000 population. As part of this project, a Web-based survey was administered to agencies across the southeastern U.S. to identify key themes related to small urban and rural congestion. Fifty-one respondents with self-reported populations of 50,000 or less gave their insights. The majority of agencies surveyed reported the following:

- There is no systematic data collection related to monitoring and measuring traffic congestion.
- Traveler phone calls were the primary source for identifying congestion.
- Day-to-day peak hour traffic is biggest contributor of traffic congestion.
- Special events and tourism were the second highest traffic congestion contributor.
- Work zones, traffic crashes, and freight are not high contributors to congestion.
- No tools are used to mitigate congestion due to work zones.
- Interagency interaction is needed to alleviate congestion but it was acknowledged that such interaction is sometimes limited.
- Additional funding would help relieve congestion.
- No training related to congestion mitigation was reported.

The survey results were used to develop interview and focus group questions to solicit more information from the agencies. A subset of agencies that provided feedback to surveys were approached for further discussions via phone calls. The responses from the interviews did not provide any additional insights beyond what was obtained from the surveys.

Although day to day traffic patterns were identified as the top contributor of traffic congestion (Figure 3), this study also revealed that most agencies do not have a systematic approach for data collection to quantify congestion. Therefore, this study first recommends a systematic program for collecting traffic data. One of the strategies to achieve this goal is for agency to have a recurring traffic data collection plan - using modular traffic counter on a rotational schedule on critical arterials in their jurisdiction. The database of historical volume counts and other derived metrics from these counters can serve as macroscopic performance indicators for agencies to identify trends and issues and help develop proactive strategies. Given the impacts of the pandemic on traffic patterns, a systematic count program would be particularly important to determine emerging trends. A second important contributor of congestion is special events. While multiple agencies are typically involved in traffic planning for special events (Figure 10), the survey results also indicate limited interagency interaction at a strategic level. It is recommended that efforts are taken to enhance coordination among various agencies such as State DOT, local DOT, the police, public works, and local government to develop strategic plans for congestion mitigation. During such strategic planning efforts, focus can be directed towards issues such as parking management (lack of parking was identified as one of the reasons for special-event congestion; Figure 11). Such an effort will enhance operational coordination during special events. Training sessions can also be introduced at inter-agency strategic planning meetings to inform the participants about alternate congestion management techniques. Agencies can leverage local technical assistance programs to explore training opportunities related to advanced signal timing programming strategies (survey respondents felt improving signal timing and coordination to be one of the effective strategies for congestion mitigation, Figure 22). In addition, lessons learned from other agencies and partners – such as event plan which includes eliminating left turn phases during special events to minimize conflicts and improve traffic flow, exclusive pedestrian phases, and maximize traffic

controller functions such as volume density functions could maximize existing resources. For corridors with overcapacity issues, several resources including the guidebook from Federal Highway Administration (FHWA-HOP-09-008) can assist agencies in understanding the different stages of congestions and associated mitigation strategies. Finally, that additional funding and infrastructure improvements (major and minor) were perceived as most effective in congestion mitigation (Figure 22). State and Federal agencies should explore mechanisms to expedite infrastructure improvement projects (especially minor) so that the benefits of congestion alleviation are realized sooner.

The overall effort highlights that there is an interest in information and training on alleviating congestion topics, but staff may not have the time to invest in such endeavors. As a result, the research team decided to develop a free Web-based repository of basic information on congestion management that can be accessed on demand, a flyer including a summary of the information, and a webinar available on YouTube. Additional training on deployment of specific strategies to mitigate congestion needs to be developed in the future.

This research showed that small urban and rural areas suffer from congestion and lack of resources to handle the project. Development of supplemental training on deployment of specific strategies to mitigate congestion is identified as an important future effort.

8.0 REFERENCE LIST

1. Luten, K., K. Binning, D. Driver, T. Hall, and E. Schreffler. (2004). *Mitigating Traffic Congestion: The Role of Demand-side Strategies*. Washington D.C.: Federal Highway Administration (FHWA). https://ops.fhwa.dot.gov/publications/mitig_traf_cong/mitig_traf_cong.pdf.
2. Cambridge Systematics, Inc. (2020). "The Nature of Traffic Congestion and Reliability: Causes, How They Are Measured, and Why They Matter" (Chapter 2), In *Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation*. Washington, D.C.: Federal Highway Administration (FHWA). https://ops.fhwa.dot.gov/congestion_report/chapter2.htm Accessed Jan. 2, 2021.
3. Latoski, S. P., W. M. Dunn Jr., B. Wagenblast, J. Randall, and M. D. Walker. (2017a). "Characteristics and Categories of Planned Special Events" (Chapter 2), in *Managing Travel for Planned Special Events*. Washington, D.C.: Federal Highway Administration (FHWA). https://ops.fhwa.dot.gov/publications/fhwaop04010/chapter2.htm Accessed Jan. 2, 2021.
4. Godavarthy, R., J. Mattson, and E. Ndembe. (2014). *Cost Benefit Analysis of Rural and Small Urban Transit*. Tampa, FL: National Center for Transit Research. http://www.nctr.usf.edu/wp-content/uploads/2015/01/77060-NCTR-NDSU03-508.pdf.
5. European Conference of Ministers of Transport (ECMT). (2007). *Managing Urban Traffic Congestion*. Paris, France: Organization for Economic Cooperation and Development. https://www.itf-oecd.org/sites/default/files/docs/07congestion.pdf.

6. Cox, W. (2009). "Traffic Congestion, Time, Money & Productivity." *New Geography*, posted Sept. 18, 2009. http://www.newgeography.com/content/001044-traffic-congestion-time-money-productivity.
7. Downs, A. (2004). *Traffic: Why It's Getting Worse, What Government Can Do* (Policy Brief #128. Washington, D.C.: Brookings Institute. https://www.brookings.edu/wp-content/uploads/2016/06/pb128.pdf.
8. Schmitt, R., E. Strocko, and J. Sedor. (2008). "Freight and Congestion," in *Freight Story 2008*. Washington, D.C.: Federal Highway Administration (FHWA). https://ops.fhwa.dot.gov/freight/freight_analysis/freight_story/congestion.htm Accessed Jan. 2, 2021.
9. Clemson Athletic Communications. (2015). "Plans Announced to Improve Gameday Traffic Flow" (webpage). Clemson, SC: Clemson University. https://clemsontigers.com/plans-announced-to-improve-gameday-traffic-flow/ Accessed Jan. 2, 2021.
10. Cambridge Systematics, Inc. (2008). Effective Practices for Congestion Management. Washington, D.C.: Transportation Research Board. http://onlinepubs.trb.org/onlinepubs/archive/NotesDocs/20-24(63)_FR.pdf.
11. Wyoming Department of Transportation (WYDOT). (2012). *WYDOT Quick Facts: Traffic Signals*. Cheyenne, WY: WYDOT Public Affairs Office. http://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Traffic%20data/Traffic%20Signals.pdf.
12. Griffin R., and G. McGwin, Jr. (2013). "Emergency medical service providers' experiences with traffic congestion." *Journal of Emergency Medicine* 44(2):398–405. DOI: 10.1016/j.jemermed.2012.01.066. https://pubmed.ncbi.nlm.nih.gov/22883716/.
13. Insurance Institute for Highway Safety (IIHS) and Highway Loss Data Institute (HLDI). (2019). *Fatality Facts 2018: Urban/Rural Comparison* (webpage). Arlington, VA: IIHS and HLDI. https://www.iihs.org/topics/fatality-statistics/detail/urban-rural-comparison Accessed Jan. 2, 2021.
14. TRIP. (2017). Rural Connections: Challenges and Opportunities in America's Heartland. Washington, D.C.: TRIP.
15. Kidder, B. (2006). *The Challenges of Rural Transportation*. Logan, UT: Western Rural Development Center. https://pdfs.semanticscholar.org/e605/8d766f2efe97bfa3723dcae79e4216529bda.pdf.
16. Rural Health Information Hub (RHIhub). (2018). "Barriers to Transportation in Rural Areas (webpage)," in *Rural Transportation Toolkit*. North Bethesda, MD: Health Resources and Services Administration (HRSA). https://www.ruralhealthinfo.org/toolkits/transportation/1/barriers Accessed Jan. 4, 2021.
17. Dye Management Group, Inc. (2001). National Transportation Library: Planning for Transportation in Rural Areas. Washington, D.C.: Federal Highway Authority (FHWA). https://rosap.ntl.bts.gov/view/dot/979#.
18. Ecolane. (2014). "Top 5 Challenges Faced by Rural Transit" (webpage). Wayne, PA: Ecolane. https://www.ecolane.com/blog/top-5-challenges-faced-by-rural-transit Accessed Jan. 4, 2021.

19. Aftabuzzaman, M., G. Currie, and M. Sarvi. (2010). "Evaluating the Congestion Relief Impacts of Public Transport in Monetary Terms." *Journal of Public Transportation* 13(1). DOI http://doi.org/10.5038/2375-0901.13.1.1. https://www.nctr.usf.edu/wp-content/uploads/2010/05/JPT13-1Aftabuzzaman.pdf.
20. Velaga, N.R., M. Beecroft, J. D. Nelson, D. Corsar, and P. Edwards. (2012). "Transport poverty meets the digital divide: accessibility and connectivity in rural communities." *Journal of Transport Geography* 21:102–112. https://doi.org/10.1016/j.jtrangeo.2011.12.005.
21. American Association of State Highway and Transportation Officials (AASHTO). (2010). *Connecting Rural and Urban America*, Part Three of *Transportation Reboot: Restarting America's Most Essential Operating System*. Washington, D.C.: AASHTO. https://t2.unh.edu/sites/t2.unh.edu/files/documents/publications/Connecting_Communities_0810.pdf.
22. Dunn Engineering Associates, P.C., and Kittelson and Associates, Inc. (2009). Traffic Signal Operations and Maintenance Staffing Guidelines. Washington, D.C.: Federal Highway Administration (FHWA). https://ops.fhwa.dot.gov/publications/fhwahop09006/fhwahop09006.pdf.
23. Ogden, B. D., and C. Cooper. (2019). *Highway-Rail Crossing Handbook*, Third Edition. Washington, D.C.: Federal Highway Administration (FHWA). https://safety.fhwa.dot.gov/hsip/xings/com_roaduser/fhwasa18040/.
24. Smith, C. H., A. Evenson, A. Corbett, K. Kozhimannil, and I. Moscovice. (2017). Transportation in Rural America: Challenges and Opportunities. Minneapolis, MN: University of Minnesota Rural Health Research Center. http://rhrc.umn.edu/wp-content/files_mf/1518734252UMRHRCTransportationChallenges.pdf.

9.0 APPENDICES

9.1 Appendix A – Survey

1/25/2021 Qualtrics Survey Software

STRIDE

Southeastern Transportation Research, Innovation, Development and Education Center

Survey

As part of an ongoing Southeastern Transportation Research, Innovation, Development & Education Center (STRIDE) project, researchers at the Georgia Institute of Technology, the Citadel, and the University of Florida are seeking to better understand congestion issues in small urban and rural areas in the Southeastern United States. This project is one of several STRIDE initiatives seeking to improve congestion mitigation throughout the southeast.

To better understand congestion issues in small urban and rural areas, we are surveying personnel from agencies across the southeast. We are hoping to learn about the congestion challenges, resources, and needs of transportation agencies in these areas. We envision your feedback informing future congestion mitigation approaches, tools, and training.

The survey is anticipated to take no more than 5 to 15 minutes. Participation in this survey is voluntary. Study participants must be 18 years of age or and work within an agency that addresses transportation and congestion issues. A list of all participating agencies may be included in the final report; however, your responses will not be associated with your name or agency. Your privacy will be protected to the extent allowed by law. If you complete the attached survey it means that you have read -- or have had read to you -- the information contained in this introduction and would like to be a volunteer in this research study.

We thank you in advance for sharing your time and expertise. If you have any questions please do not hesitate to reach out to us.

Michael Hunter
michael.hunter@ce.gatech.edu

Dimitra Michalaka
dmichala@citadel.edu

Siva Srinivasan
siva@ce.ufl.edu

Georgia Tech THE CITADEL UF UNIVERSITY of FLORIDA

What agency do you work for?

What is your title / position?

What is the approximate population of the area served by your agency?

- ○ 0-5,000
- ○ 5,000-10,000
- ○ 10,000-25,000
- ○ 25,000-50,000
- ○ 50,000+

Please rate the degree to which each of the following contributes to congestion in your agency's area.

	Very high degree	High degree	Moderate degree	Small degree	None
Day-to-day, peak-hour traffic (normal traffic fluctuations)	○	○	○	○	○
Special events & tourism	○	○	○	○	○
Work-zones	○	○	○	○	○
Traffic crashes	○	○	○	○	○
Parking	○	○	○	○	○
Weather	○	○	○	○	○
Freight (long-distance or local)	○	○	○	○	○
Other [ ]	○	○	○	○	○
Other [ ]	○	○	○	○	○

Please state your agency's level of agreement / disagreement with the following statement.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Congestion management is a high priority relative to all my other responsibilities.	○	○	○	○	○

To what degree does your agency interact with the following when you have congestion issues? (If your agency is listed, please select n/a for that option)

	A very high degree	A high degree	A moderate degree	A small degree	None	n/a
State DOT	○	○	○	○	○	○
Local DOT	○	○	○	○	○	○
Police department	○	○	○	○	○	○
City / county administration	○	○	○	○	○	○
Public works department	○	○	○	○	○	○
Community Improvement District (CID)	○	○	○	○	○	○
Other [ ]	○	○	○	○	○	○
Other [ ]	○	○	○	○	○	○

How does your agency measure or track congestion? (Select all that apply.)

- ☐ Traffic incident duration
- ☐ Phone calls from citizens
- ☐ Queueing
- ☐ Delay
- ☐ We don't measure or track congestion
- ☐ [ ] Other
- ☐ [ ] Other

Does your agency feel day-to-day, peak hour congestion has increased over the past five years?

- ○ Yes
- ○ No

What does your agency think has caused the recent increase in day-to-day, peak-hour congestion? (Select all that apply.)

- ☐ Population increase
- ☐ Employment increase
- ☐ Longer commute trips
- ☐ Residential and commercial development
- ☐ _____ Other
- ☐ _____ Other

Indicate the kind of special events your agency's area has and if they cause a congestion increase. (Select all that apply.)

	Occurs in my area	Causes an increase in congestion
Recurring events at a permanent venue (e.g. stadium)	☐	☐
Continuous event that occurs over a single or multiple days (e.g. a festival or fair)	☐	☐
Street use event, requiring temporary street closure (e.g. motorcycle rallies, bike races, parade)	☐	☐
Seasonal events (e.g. agrotourism such as "u-pick" apples)	☐	☐
Holiday shopping (e.g. Thanksgiving and Christmas weekends)	☐	☐
Other _____	☐	☐
Other _____	☐	☐

What metrics does your agency use to plan for special event congestion? (Select all that apply.)

- ☐ Expected event attendance
- ☐ Location of the event considerations (e.g. whether there is already sufficient parking / arterial infrastructure in place)

- [ ] Whether there was initial planning and traffic initiatives from event coordinators
- [ ] If the event coordinators ask for assistance
- [ ] Availability of law enforcement
- [ ] [ ] Other
- [ ] [ ] Other

Who manages special event traffic planning? (Select all that apply.)

- [ ] Your agency
- [ ] Event organizer(s)
- [ ] Police department
- [ ] A combination of my agency, the event organizer(s), and the police
- [ ] [ ] Other
- [ ] [ ] Other

Indicate which, if any, factors contribute to congestion around events in your agency's area. (Select all that apply.)

- [ ] Limited road capacity to access the event
- [ ] Limited parking capacity
- [ ] Fewer alternate routes to accommodate event and background traffic
- [ ] Lack of event transit (includes bus) services
- [ ] Lack of hotels near venue
- [ ] Event staging
- [ ] [ ] Other
- [ ] [ ] Other

What tools does your agency employ to mitigate work-zone or traffic incident induced congestion? (Select all that apply.)

- [ ] Limiting construction to specific time of day
- [ ] Contractor completion incentives/ penalties
- [ ] Public communication efforts
- [ ] Fixed or portable changeable message signs (CMS)

- [ ] Traffic apps
- [ ] None
- [ ] [ ] Other
- [ ] [ ] Other

What additional resources would help mitigate your agency's parking-related congestion? (Select all that apply.)

- [ ] Additional parking
- [ ] Additional parking control (e.g. metered spaces, etc.)
- [ ] Portable changeable message signs (CMS)
- [ ] Transit
- [ ] Ride-share services
- [ ] [ ] Other
- [ ] [ ] Other

What weather-related events affect congestion in your agency's area? (Select all that apply.)

- [ ] Hurricane
- [ ] Snow
- [ ] Heavy rain
- [ ] Heavy winds
- [ ] Sun-glare
- [ ] [ ] Other
- [ ] [ ] Other

How is weather-related congestion managed in your agency's area? (Select all that apply.)

- [ ] Locally
- [ ] Statewide
- [ ] Federally
- [ ] [ ] Other

Indicate the degree to which the following contribute to the freight-related congestion in your agency's area. (Select all that apply.)

	A very high degree	A high degree	A moderate degree	A small degree	n/a
Long-distance freight movements	○	○	○	○	○
Local freight movement	○	○	○	○	○
Delivery vehicles blocking active lanes	○	○	○	○	○
Bottlenecks between freight hubs	○	○	○	○	○
Restrictions on freight movement	○	○	○	○	○
High percentage of trucks on roadway	○	○	○	○	○
High accident locations for trucks	○	○	○	○	○
Other [ ]	○	○	○	○	○
Other [ ]	○	○	○	○	○

What strategies have your agency used or are planning to use to reduce freight-related congestion? (Select all that apply.)

- ☐ Road improvements, such as road widening
- ☐ Reduced limitations on freight movement, such as delivery times
- ☐ Increased limitations on freight movement
- ☐ More specific drop-off and pickup locations
- ☐ Less specific drop-off and pickup locations
- ☐ [ ] Other
- ☐ [ ] Other

Does your agency have any training materials, manuals, or programs for handling congestion?

- ○ Yes
- ○ No

How interested is your agency in having specific training materials, manuals, or programs?

	Extremely interested	Very interested	Moderately interested	Slightly interested	Not at all interested
Interest in having congestion training materials	○	○	○	○	○

How are these training materials or manuals disseminated? (Select all that apply.)

- ☐ Paper or pdf manual
- ☐ In-person training program
- ☐ PowerPoint or similar presentation
- ☐ [ ] Other

How effective does you agency believe these training materials are in helping to manage congestion in your agency's area?

	Extremely effective	Very effective	Moderately effective	Slightly effective	Not effective at all
Effectiveness of current training material(s)	○	○	○	○	○

How many staff does your agency have where traffic operations or management are a significant portion of their job responsibilities?

- ○ 0
- ○ 1-2
- ○ 3-5
- ○ 5-9
- ○ 10+

Does your agency have any P.E.'s in your traffic operations or management staff?

Indicate the degree to which the following are constraints in your agency's congestion management program.

	A constraint to a very high degree	A constraint to a high degree	A constraint to a moderate degree	A constraint to a small degree	Not a constraint
Budget restrictions	○	○	○	○	○
Training	○	○	○	○	○
Staffing	○	○	○	○	○
Administrative	○	○	○	○	○
Other [ ]	○	○	○	○	○
Other [ ]	○	○	○	○	○
Other [ ]	○	○	○	○	○

What is your agency's expectation of the effectiveness in each of the following in helping to relieve congestion?

	Extremely effective	Very effective	Moderately effective	Slightly effective	Not effective at all	Not applicable
Additional funding	○	○	○	○	○	○
Greater cell service enabling real-time traffic info	○	○	○	○	○	○
Improving signal timing and coordination	○	○	○	○	○	○
Training resources	○	○	○	○	○	○
Relationships with other agencies	○	○	○	○	○	○
More traffic control officers	○	○	○	○	○	○
Road condition improvements (i.e. pavement repair)	○	○	○	○	○	○

	Extremely effective	Very effective	Moderately effective	Slightly effective	Not effective at all	Not applicable
Minor infrastructure improvements (e.g. adding a turn bay)	○	○	○	○	○	○
Major infrastructure improvements (e.g. roadway widening)	○	○	○	○	○	○
Other [ ]	○	○	○	○	○	○
Other [ ]	○	○	○	○	○	○
Other [ ]	○	○	○	○	○	○

What are some things you do or have seen done in your agency's town which you feel are successful at managing congestion?

[ ]

Can we follow-up with you?

○ Yes

○ No

What is your email and phone number?

Phone [ ]

Email [ ]

Any other comments?

[ ]

Powered by Qualtrics

9.2 Appendix B – Agencies Follow-up Questions/Responses

1) **Main Question:**
Describe the type of traffic congestion your agency deals with the most?

Prompts: (to be used as necessary after reply)

"Does your agency find issues more at a points, i.e., intersections or ramps, or entire sections of roadways or corridors?"
"Is congestion seasonal, such as holidays, agritainment, etc."
"Is it special event driven?"

2) Main Question:
How does your agency prioritize congestion relative to other transportation issues?

Prompts:
For instance, how are transportation funds allocated?
Is congestion a primary factor in project selection?

3) Main Question:
Does your agency have any systematic data collection practices related to monitoring traffic congestion?

Prompts:
For instance, a traffic count program, probe vehicle data collection, etc.?

4a) Main Question, if answer was "yes" to data collection Q2:
Please describe the types of data, frequency, and approximate allocated annual budget for your agency's data collection program.

Prompts:
Does your agency collect traffic counts, probe vehicle, or other data?
Does your agency collect the data using in-house staff or an outside vendor or consultant?

4b) Main Question, if answer was "no" to data collection:
Would it be feasible for your agency to implement a congestion monitoring program? Why or why not?

Prompts:
If yes, what might a reasonable program and total budget look like? (again, pre-COVID)
If no, what are the main reasons your agency would not consider such a program? Such as: the agency does not believe it is needed, budget is not available, etc.

5) Main question:
A majority of respondents we surveyed indicated that phone calls provide primary indicators of congestion. Is this true for your agency, and how does your agency manage phone calls?

Prompts:

Does your agency maintain/have call logs?
Is this data analyzed?
Are phone call reports prioritized?

6) Main Question:
Does your agency retime signal plans every so often to alleviate congestion? Is this done in-house? What does the retiming program look like?

Prompts:
How often does your agency retime?
Do your agency retime at the isolated intersections, corridor, network, or city level?
Does your agency have adaptive traffic signal control in your jurisdiction?

7) Main question
Many respondents indicated that traffic crashes are a cause of congestion. Sometimes congestion and crashes have interchangeable cause-and-effect relationship – Congestion may be the cause for a crash (rear end with erratic or impatient drivers) and other times crashes cause congestion (high speed corridor)? What is your agency's experience with one or the other? What mitigating strategies have you adopted?

8) Main question:
Many responded that work zones contribute to congestion. Does your agency currently (or in the recent past) have congestion related to active work zones? Are there any congestion mitigation strategies your agencies uses to mitigate work zone-related congestion?

Prompts:
Does your agency use, or has it tried, mitigations such as implementing zipper merge, advance notification, collaboration with Waze, DMS (VMS), PSA?
What challenges has your agency experienced in work zone congestion mitigation?

9) Main Question:
Does your agency currently utilize interagency interaction to help alleviate congestion issues? Please describe your agency's experience with such interaction.

Prompts:
What can be done for better interagency coordination?
Does your agency have ad hoc or recurring interagency meetings to discuss congestion issues?
Share best practices for coordination efforts.

10) Main Question:

Please talk about current training your agency has regarding congestion management as well as the training your agency would hope for.

Prompts:
What should the training be about?
Would your agency prefer in-person training, self-learning, online tools, or webinars?

11) Main Question:
If your agency had additional funding to help relieve congestion in your area, how would those funds be used? We are not necessarily looking for a specific project but types of projects or programs.

Prompts:
Would new funds go to construction? What kind of projects?
Transit?
Signal retiming?

12) Main Question:
Is truck traffic a key contributor of congestion in your agency's area?

13) Main Question:
Is there anything else you would like to share about your agency's general thoughts on congestion in small and rural areas? Is there anything important that we missed?

9.3 Appendix C – Follow-up Questions & Responses

1) Describe the type of traffic congestion your agency deals with the most? (2 responses)

One respondent reported seasonal congestion on one route related to summer recreation traffic and a second route related to holiday season activities. Both respondents reported rush hour congestion on primary routes that connect minor urban area and major urban area.

2) How does your agency prioritize congestion relative to other transportation issues? How are transportation funds allocated? (1 response)

The respondent reported that seasonal traffic issues motivate prioritization to assure access for emergency services. Transportation funds are often used to reduce traffic by promoting safer pedestrian and bicycling traffic. The respondent reported successes with redesigning sidewalks, new zoning

ordinances, multiuse paths, and parking in rear. Prioritization can be complicated by the pattern of jurisdictions.

Transportation funds are routed according to a regional plan and priorities. The respondent's city has a part-time city engineer. The city has a small budget for street repair and relies on state DOT for major repairs.

3) Does your agency have any systematic data collection practices related to monitoring traffic congestion? (2 responses)

Both respondents reported that they relied on regional or state agencies for traffic counts. One respondent reported that calls were not logged.

4a) If the answer to question 3 was "yes," please describe the types of data, frequency, and approximate allocated annual budget for your agencies data collection program. (Not applicable)

4b) If the answer to question 3 was "no," Would it be feasible for your agency to implement a congestion monitoring program? Why or why not? (1 response)

The respondent reported that there were no resources available for data collection.

5) A majority of respondents we surveyed indicated that phone calls provide primary indicators of congestion. Is this true for your agency, and how does your agency manage phone calls? (1 response)

The respondent reported that the primary source of information of congestion issues was reports from personnel in the field for other purposes. The respondent reported that crashes are reported to county offices, but the information is not relayed to the respondent's city. The respondent's city knows about work zones in advance and provide public notice. The respondent's office does not record calls.

6) Does your agency retime signal plans every so often to alleviate congestion? Is this done in-house? What does the retiming program look like? (1 response)

The respondent reported that there is no local control over signal timing; it is operated by the major urban area. The respondent's office does not coordinate with the major urban area on signal timing, but they do coordinate on intersection improvements. During seasonal congestion, officers operate signals locally.

7) Many respondents indicated that traffic crashes are a cause of congestion. Sometimes congestion and crashes have an interchangeable cause-and-effect relationship: congestion may be the cause for a crash, and other times, crashes cause congestion (high speed corridor)? What is your agency's experience with one or the other? What mitigating strategies have you adopted? (2 responses)

Both respondents reported experience with both crashes causing congestion. One respondent reported experience with congestion causing crashes and efforts to mitigate by reducing traffic and reducing the speed limit. The respondent's office is attempting to reduce traffic by promoting walking and biking. The speed limit is controlled by the state DOT.

8) Many responded that work zones contribute to congestion. Does your agency currently (or in the recent past) have congestion related to active work zones? Are there any congestion mitigation strategies your agency uses to mitigate work zone related congestion? (2 respondents)

Both respondents have experienced congestion caused by work zones, especially on major routes. One respondent mentioned limited alternative routes that make it difficult to mitigate this congestion.

9) Does your agency currently utilize interagency interaction to help alleviate congestion issues? Please describe your agency's experience with such interaction. (1 response)

The respondent reported participating in several groups to discuss congestion issues.

10) Please talk about current training your agency has regarding congestion management as well as the training your agency would hope for. (1 response)

The respondent reported no training for congestion mitigation. The respondent would be interested in more information.

11) If your agency had additional funding to help relieve congestion in your area, how would those funds be used? We are not necessarily looking for a specific project but types of projects or programs. (1 response)

The respondent was not aware of what programs might be available. Funds might be used to promote walking and biking,

12) Is truck traffic a key contributor of congestion in your agency's area? (1 response)

The respondent reported that truck traffic was not a congestion issue.

13) Is there anything else you would like to share about your agency's general thoughts on congestion in small and rural areas? Is there anything important that we missed? (1 response)

The respondent discussed using roundabouts as a means of congestion mitigation and also mentioned local drivers adapting to roundabouts.

9.4 Appendix D – Summary of Accomplishments

Date	**Type of Accomplishment** *(select from drop-down list)*	**Detailed Description** *Provide name of person, name of event, name of award, title of presentation, location, and any links to announcements, if available.*
4/20/2018	Other	Dimitra Michalaka, Statewide SC ITE Section meeting, presentation on STRIDE UTC research projects, Charleston, SC
5/11/2018	Other	William J. Davis, ASCE Eastern Branch Meeting, presentation on STRIDE UTC research projects, Charleston, SC
1/14/2019	Conference Presentation	William Curran Hickey, TRB Conference, UFTI Reception, Strategies for Mitigating Congestion in Small Urban and Rural areas, Baby Wale, 1124 9th Street NW, Washington, D.C., 20001
10/8/2019	Conference Presentation	Dimitra Michalaka, 3rd annual C2M2 Conference, presentation on The Citadel and transportation engineering activities at the CEE department, Clemson University, SC
9/24/2020	Educational Product	Development of Webpage on congestion in small urban and rural areas. Available at: https://techtransfer.ce.ufl.edu/tech-transfer/ufti-t2-projects/stride-projectH
10/28/2020	Educational Product	Development of Educational Flyer on congestion in small urban and rural areas.
11/4/2020	Other	Dimitra Michalaka and Michael Hunter, STRIDE Webinar on the project. Available at:

		https://stride.ce.ufl.edu/technology-transfer/workshops-webinars-conferences/
11/18/2020	Conference Presentation	Dimitra Michalaka to present at the virtual 2021 SDITE Annual Meeting to be held April 11–16, 2021
	Choose an item.	
	Choose an item.	