NC State University Center/Institute Annual Report

2021

**Institute for Transportation Research and Education (ITRE)**

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**Mission and Vision Statement**

Institute for Transportation Research and Education (ITRE)carries out research, training and technical support activities in the areas of surface and air transportation for a host of national, state, and local clients to address the nation's critical transportation issues.

**Research Impact**

The research program at ITRE continues to have a significant impact on the transportation practice both locally and nationally. Highlights from ITRE’s research and related activities in FY 2021 include:

2021 TRB ANNUAL MEETING PRESENTATIONS

ITRE maintains an ongoing, high-profile presence and role in the Transportation Research Board (TRB), a division of the National Academy of Sciences, Engineering, and Medicine. ITRE research staff and affiliated faculty serve as active full members of nearly 20 standing TRB committees. Much of the important business of setting national transportation research direction is done by these committees at the TRB annual meeting held annually in January. This was true in January 2020 even though the meeting was held virtually due to the ongoing COVID pandemic. In addition to critical committee work, ITRE researchers and affiliated faculty this year presented research papers in virtual lectern and poster sessions.

STRIDE CONSORTIUM

The Southeastern Transportation Research, Innovation, Development and Education Center (STRIDE) completed its fourth year of research projects under a five-year University Transportation Center (UTC) grant from the U.S. Department of Transportation. STRIDE is the Region 4 (Southeast U.S.) UTC, a multi- university research consortium including NC State and led by the University of Florida Transportation Institute (UFTI). The UTC grant provides the consortium with up to $14 million over five years towards developing novel strategies for reducing traffic congestion. STRIDE research efforts are addressing congestion through new in-vehicle technologies, telecommunications advances, and the rise of shared mobility and autonomous vehicles. STRIDE is also working to strengthen the regional transportation workforce and practice through educational and technology transfer activities.

A project titled “Locating and Costing Congestion for School Buses and Public Transportation” which began in January 2020 is concluding this year. The project is led by Kai Monast, manager of ITRE’s Public Transportation Group and involves a multidisciplinary research team of School Planning and Transportation, Public Transit, and ITS/CAV staff. The project spatially locates congested areas and quantifies how much this congestion impacts public transit and school buses. Meetings with local planners in North Carolina and Florida are scheduled for June and a national webinar is scheduled for late summer 2021 to present the research findings.

STRIDE research on “Identifying and Mitigating Congestion Onset” (G. List, PI; with B. Williams) continued this year. This project aims to help transport agencies use “big data” to help mitigate congestion and manage system performance, for both freeways and especially arterials, which have seen less attention. The research is scheduled to conclude in December 2021.

The above-mentioned projects also involve researchers at other member universities in the STRIDE consortium. For more information on STRIDE visit: <https://stride.ce.ufl.edu>

INTELLIGENT TRANSPORTATION SYSTEMS / CONNECTED AUTONOMOUS VEHICLES

Research for NCDOT on the “Impacts of Autonomous Vehicle Technology on Transportation Systems” (E. Bardaka, G. List, N. Rouphail, B. Williams, C. Frey, and M. Cummings, Co-PIs) concluded in July 2020. Autonomous vehicle (AV) technology is expected to fundamentally change transportation systems. The Transportation Planning Branch at NCDOT, which is responsible for the state’s long-range transportation plan, needs state-of-the-art information and predictions on AV technology and its potential impacts on transport to be better prepared for the upcoming changes and maximize the social benefits that this technology will enable. The Transportation Systems group faculty (Drs. Bardaka, List, Rouphail, and Williams) and Dr. Frey (Environmental Engineering) in the Department of Civil, Construction, and Environmental Engineering at NCSU as well as Dr. Cummings, the Director of the Humans and Autonomy Laboratory at Duke University worked together to leverage existing research in the area of AV technology to evaluate impacts and provide policy and future research recommendations to NCDOT. The study included a comprehensive literature review on AV technology and its impact on transportation demand, capacity, mobility, traffic safety, emissions, energy use, and land use. The results of previous research were analyzed to provide predictions and recommendations specific to North Carolina. As part of this study, the researchers worked closely with the Transportation Planning Branch to provide guidance on how existing models (such as the statewide demand model) could be adapted to account for the presence of AVs.

PORT & FERRY

An “Investigation of Technology to Allow the Tracking of Wait Times and Traffic Points of Origin for Users of the Ferry System” (D. Findley, PI; G. List, Co-PI) continued this year for the North Carolina Ferry Division. This project is seeking to understand, test, and implement technology solutions that will reliably measure and track truck wait times at North Carolina ferry terminals. The Ferry Division operates vessels on seven routes along the state’s coast which serve diverse populations, ranging from routes with substantial tourist/visitor customers to routes with primarily daily commuters. Wait times and queue lengths are important considerations of customers. However, measuring and communicating wait times and queues is not simple and not currently available to customers. Hence, the Ferry Division wants to implement a technology that helps measure and track wait times. The research is scheduled to conclude in December 2021.

RAIL

Policymakers often underestimate the costs of rail incidents and are thus less inclined to allocate scarce resources to rail safety countermeasures. As part of its “Comprehensive Cost of Rail Incidents” study effort, ITRE provided the North Carolina Department of Transportation (NCDOT) Rail Division with a cost tool that can be used to estimate the broad spectrum of costs that occur on North Carolina’s rail network. The tool evaluates costs associated with property damage, casualty, and delay, rerouting, and supply chain events. It also analyzes upstream effects, emissions costs, railroad operating costs, and emergency responder costs. In the study ITRE found that there were 187 rail incidents in North Carolina in 2019, imposing a total estimated cost of approximately $258.3 million. Of the costs incurred, casualties comprised the largest cost component valued at a cost of $252,816,000. Property damage costs were approximately $3,651,000; costs associated with delay, rerouting, and supply chain disruptions were approximately $1,572,000; emissions costs were $131,000; operating costs were $73,000; and first and emergency responder costs were an estimated $60,000. From 2010-2019, rail incident costs in North Carolina totaled an estimated $2.4 billion. For more information on the study and the cost tool visit: <https://connect.ncdot.gov/projects/research/Pages/ProjDetails.aspx?ProjectID=2020-44>

ITRE recently completed research to quantify and describe the universe of pedestrian trespassing activity along the railroad network in North Carolina through the development and testing of static (fixed base) thermal camera systems. Quantifying the number of pedestrian trespassers in North Carolina is necessary to better understand the true count of trespassers that do not involve an injury or death. Railroads report incidents to the Federal Railroad Administration (FRA) where people are killed or injured on railroad property, but there is no database for and little research on the true number of North Carolinians putting themselves in harm’s way walking along or across the tracks. In addition, this research studied the behaviors of trespassers. Identifying these behaviors is very important when applying effective treatment and mitigation efforts. Measuring the scale of trespassing and understanding the behaviors of trespassers are paramount to informing and educating community stakeholders, policy makers, and enforcement and safety officials. Based on an analysis of trespassing events captured across study locations in 11 North Carolina cities — Charlotte, Durham, Elon, Gastonia, Greensboro, Lumberton, Mebane, Raleigh, Rocky Mount, Salisbury, Shelby — the magnitude of pedestrian trespassing is much greater than indicated by FRA incident reporting which only captures events involving injury or death. Most trespassing events were short in duration and involved crossing the tracks rather than movement along the right-of-way. Variability in time-of-day, day-of-week, and month-of-year patterns appear to be influenced by local environmental and population factors. Most trespassing activity occurred during daylight hours and volumes were generally consistent across the days of the week and month to month. The research team hypothesized that most trespassing events captured at the study locations are the result of people trying to reach their destinations through the shortest, most direct route. The trespassing hot spots tend to be in locations with greater densities of pedestrian attractors such as schools, universities and colleges, housing, social services, and restaurants and other eating places in proximity to the railroad right-of-way. For someone walking, a desire line across the railroad right-of-way often represents the shortest path between an origin and destination. The desire line may be the most easily navigated route where gaps exist in the sidewalk network or where the nearest authorized at-grade crossing is via a longer or more circuitous route.

ITRE is currently developing a trespass awareness and education outreach workshop based on the research findings through a technology transfer project supported by NCDOT. The site-specific data and analyses will be shared with the research communities’ policy and decision makers through short case study summary reports and outreach workshops to provide information about the state level modeling results and the community level profiles. Additional outreach will include a description of urban rail environments, known trespass attractors, quality of life considerations, and an introduction to successful trespass countermeasures in the education, environmental, and enforcement sectors.

ITRE was awarded an FRA Broad Agency Announcement (BAA) grant in early 2021 to deploy the thermal video data collection and analysis framework developed that we developed in communities with high risk for pedestrian trespassing outside of North Carolina to 1) collect and summarize a representative sample of trespassing events, 2) develop trespasser profiles, and 3) refine predictive models. ITRE expects to select study locations in high-risk communities in South Carolina and Georgia. This follow-on research will validate the methodology developed by ITRE for event-based data collection and analysis of pedestrian trespassing at hot spot locations. Expanding the deployment of the thermal video camera systems in new states will allow us to build on our modeling dataset to produce multi-state or regional comparisons and estimates.

ITRE with support from NCDOT is extending the current hot spot detection to detection of pedestrian trespassing events from moving trains. The effort seeks to examine a more complete picture of the safety issue pedestrian trespassing poses by capturing counts, “close calls,” and understanding pedestrian behaviors on the approach of a train in addition to actual strike data captured at the national level.

BICYCLE AND PEDESTRIAN PROGRAM

The Bicycle and Pedestrian Program at ITRE continues to support NCDOT with establishing and managing the North Carolina Non-Motorized Volume Data Program (NC NMVDP). The NC NMVDP began as a research project to test a bicycle and pedestrian count protocol for replication across the state. The program currently includes one of the most extensive statewide networks of continuous bicycle and pedestrian counting sensors. 71 individual loggers or 141 unique bicycle and pedestrian sensors were installed across seven NCDOT Divisions installed under Phase 1 and 2 of the program and represent 48 screenline counting locations. The program provides data management and reporting support for multiple local agency partners.

In early 2019, ITRE worked with NCDOT to develop a scope of work to opt in data from municipally- owned counters that are not currently included in the NC NMVDP. ITRE has onboarded 16 additional screenline counting locations to date under this new scope with plans to onboard dozens more counters over the next three years. This effort will allow the program to more rapidly scale while ensuring that all data are rigorously evaluated for accuracy and validity based on a standardized process and stored in a centralized reporting platform that is publicly available. New collaborators under this effort include the City of Raleigh Parks, Recreational, and Cultural Resources Department, Isothermal Planning and Development Commission, City of Greenville, and NC Department of Human and Health Services Division of Public Health (NC DHHS). ITRE is assisting the NC DHHS with managing the data collected from its Pedestrian Counter Loaner Program. This program was launched in late 2019 and allows communities to borrow pedestrian counters for up to 12 months to support walking in their community. Partnering with NC DHHS will enable the NC NMVDP to include rural communities more effectively while also leveraging the data to evaluate public health outcomes.

ITRE has also collaborated with the NC NMVDP’s count equipment vendor to produce new research investigating count data validation methods and to engage in ongoing evaluative discussions to enhance the services that the vendor provides to local agency partners in support of the NC NMVDP. Through this partnership, ITRE has established an annual workshop co-led by the count equipment vendor to provide the latest guidance on counter maintenance and data use for local agencies participating in the NC NMVDP. The first workshop was held in early 2020 with over 30 participants and the second workshop will be held in June 2021. ITRE also partnered with the U.S. DOT Federal Highway Administration (FHWA) on a pilot project for testing non-motorized data submission to the national Travel Monitoring Analysis System (TMAS). This project resulted in a web-based tool that improves the efficiency of the NC NMVDP’s established QA/ QC processes and generates data reports formatted to FHWA’s Traffic Monitoring Guide (TMG) standard. ITRE continues to develop this tool to gain efficiencies in programmatic data monitoring and review, as well as to produce high quality datasets for reporting to our local agency partners and the public.

In addition to managing the NC NMVDP, the Bicycle and Pedestrian Program assisted NCDOT in collaboration with East Carolina University to evaluate state of the art approaches to bicycle and pedestrian counting by testing the latest counting technologies including machine vision and depth cameras. The outcomes of this research will assist NCDOT with augmenting the capabilities of current statewide counting efforts and provides guidance on alternatives to supplement the current systems with newer, more cost- effective, and more efficient data collection components or systems. ITRE is involved in additional research projects that leverage the count data from the NC NMVDP, including collaborating with the University of North Carolina at Charlotte to develop models for estimating bicycle volumes and bicyclist injury risk and to refine count data validation practices and working with NCDOT Integrated Mobility Division to understand the impact of COVID-19 on biking and walking in the state. ITRE is also collaborating with the University of North Carolina Highway Safety Research Center (UNC-HSRC) to assess the operational and safety outcomes of separated bicycle lanes (SBLs) in the state.

TRANSIT PROGRAM

The Public Transportation Group (PTG) continues to provide its annual technical support, data analysis, and operational advice to the NCDOT Integrated Mobility Division as well as all transit systems across the state. PTG support each year includes annual operating statistics compilation, National Transit Database reporting, transit asset management planning, policy and operational support, and other tasks as needed by NCDOT.

In addition, ITRE’s Transit Program staff this year are being relied upon to assist NCDOT and transit systems with the COVID-19 pandemic response and influx of federal funds from the Coronavirus Aid, Relief, and Economic Security (CARES) Act, the Coronavirus Response and Relief Supplemental Appropriations (CRSSA) Act, and the American Rescue Plan Act (ARPA) as well as funding from the NC Department of Health and Human Services for providing public transportation to access medical services and vaccines. One example of the Transit Program staff efforts was assisting NCDOT with an emergency procurement of technologies to assist transit providers in responding to the pandemic and overcoming challenges to vaccine access. Since January 2021, vaccine transportation efforts have come to the forefront. Program staff have been instrumental in setting up vaccine transportation funding and analyzing results. The staff produces weekly statistics and maps that are included in emails distributed statewide. The entire vaccine effort has been celebrated by Governor Cooper, the Federal Transit Administration, and many other state and national parties.

Transit Program staff assisted NCDOT with proposal development and writing which resulted in a U.S. DOT Mobility for All grant being awarded to North Carolina. To implement the grant, program staff authored a Request for Proposal (RFP) for innovative transit scheduling software with same-day on-demand capabilities and participated in the proposal response evaluations. The RFP was awarded in spring 2021 and the project is expected to be implemented with ITRE assistance in summer 2021. Additionally, ITRE supported a Real Time Passenger Information RFP issued in Watauga County and scheduling software purchasing in Iredell County.

In related research, the Demand Response Planning and Visualization research project was finalized in December 2020. This project has transitioned from design to production, beginning with multiple small group training sessions. With Medicaid Transformation beginning July 1, Transit Program staff expect the need for these online planning resources to increase substantially.

AVIATION

North Carolina’s Research Triangle region has been selected for a $24 million NSF grant over five years to host one of these wireless networks called Aerial Experimentation Research Platform for Advanced Wireless, or AERPAW. On today’s 4G networks, fixed nodes enable signals to connect to wireless devices. On the AERPAW platform, nodes will be mobile, with the ability to transmit and receive radio waves from user devices while moving on demand. For example, in the aftermath of a natural disaster such as a hurricane, existing cellular networks may be damaged. As a result, aerial base stations can position themselves to provide the best wireless coverage to victims and first responders who would otherwise have no cellular connectivity. The platform also has the potential to help pilots fly drones beyond line of sight, allowing for improved air traffic control under Federal Aviation Administration (FAA) regulations. NC State University is leading the AERPAW research. Thomas Zajkowski, flight operations manager for the ITRE Aviation team, is a co-principal investigator (PI) on the project. Ismail Guvenc, NC State associate professor of electrical and computer engineering, is the project PI. Additional NC State faculty and project co-PIs are Rudra Dutta, professor and interim associate head of computer science; Brian Floyd, professor of electrical and computer engineering; and Mihail Sichitiu, professor of electrical and computer engineering.

NC State has been named a partner on three new FAA research projects, aimed at continuing and enhancing the safe, successful integration of drones into our airspace. ITRE recently received a portion of the $5.8 million worth of research, education and training grants that the FAA awarded in its first round of funding this fiscal year to the universities that comprise its Air Transportation Center of Excellence for Unmanned Aircraft Systems (UAS), also known as the Alliance for System Safety of UAS through Research Excellence (ASSURE). The first round of ASSURE grants focuses on eight research areas — three of which NC State will study in partnership with other universities.

The ITRE Aviation team also manages the state’s UAS Working Group which meets two or three times per year to engage North Carolina’s public sector, private sector, and academic institutions who are interested in UAS.

ECONOMIC AND POLICY ASSESSMENT GROUP

A study this year by ITRE’s economic and policy assessment researchers examined state funding issues for weight-restricted bridges. Current legislation in North Carolina restricts the use of State bridge funds to “Functionally Obsolete” or “Structurally Deficient” bridges. Meanwhile, weight-restricted bridges — which are only allowed to transport vehicles or trucks of limited weights — do not meet the requirements for being categorized as “Functionally Obsolete” or “Structurally Deficient.” Additionally, North Carolina funding targeted for improving weight and clearance restrictions is currently limited to higher traffic volume routes. This combination of occurrences makes it possible for bridges restrictive to heavy loads to fail to qualify for State bridge improvement programs and funding targeted for improving weight and clearance restrictions. As a result, bridges that are critical nodes in North Carolina’s agricultural freight network are unable to receive dedicated sources of funding for improvements or long-term viability.

North Carolina has almost 3,000 bridges classified as weight-restricted spread across the state, some of which could have significant economic value if improved. Bridges heavily traversed for agricultural and commerce purposes, and which do not have many convenient alternative routes that would make the bridges redundant, are considered to be important bridges. However, if the bridge has a weight restriction, agricultural and commerce freight vehicles may be forced to take longer alternative routes, costing farms and businesses potential significant time costs. To address this issue, ITRE developed a ranked list of weight- restricted bridges through a Geographic Information System (GIS) process that expressed bridge criticality as a score derived from a comprehensive and systematic travel model to consider the frequency of demand across weight-restricted bridges (traversals) and the necessary detour to avoid the weight-restricted bridge. This GIS process offers a system-wide, objective evaluation of weight-restricted bridges. Based on the funding availability to improve or replace the bridges with the highest composite scores, a validation of the scores should be considered based on local input and confirmation of the importance of the bridge for local, impacted businesses.

A separate study by ITRE and sponsored by the NC Chamber Foundation this year culminated in a new report titled, “Modernizing North Carolina’s Infrastructure Through Sustainable and Diversified Revenue Streams,” which outlines potential pathways for securing a more sustainable stream of transportation revenue for North Carolina. The report identifies four of the most viable options to reduce our state’s reliance on the motor fuels tax. To demonstrate the multiplying effects strategic transportation investments can impart on local economies, the report also provides economic impact snapshots for several transportation projects that have been completed across the state in recent years.

SYSTEMS PLANNING AND ANALYSIS

NC Moves 2050

After several years of study, stakeholder engagement, analysis, and planning, North Carolina’s long-range multimodal transportation plan was adopted by the Board of Transportation. ITRE took a lead role on stakeholder outreach and process management/facilitation.

Triangle Regional Model

FY 2021 kicked off a new work program year for the TRM that reflects a change in direction from years past with the sub-contracting of model development for a new generation model, and a renewed focus on model applications, enhanced reporting tools, data management, and data analytics. The TRM Team supported the update of the Metropolitan Transportation Plans (MTPs) for the region, through the validation of the TRMv6 model to a 2016 base year (named TRMv6.2). Work on the second generation of the TRM (TRMG2) is well underway with expected delivery in late 2021. TRMG2 reflects state of the art in trip-based modeling and will include several microsimulation components that better reflect travel decisions and travel behavior.

A data repository of historic and current TRM data was developed and several interactive tools were developed for exploring the data. Part of this effort included the processing of historic and current household survey data into a combined survey database to support current and future work program data analytics. The team completed and published data analytics related to travel metrics for Communities of Concern (CoC), Active Transportation, and Travel Trends across the region. Fact sheets summarizing this effort are published to the newly overhauled TRM web page.

Collection of the third wave of travel behavior data was initiated in the third quarter of FY21 with good press coverage. Data collection yields travel behavior for over 1,100 households in the Triangle region. This data will be informative of how travel behavior changed during COVID in comparison to previous waves of data collection.

A TRM User Forum was initiated. The goal of the User Forum is to create a space where model users (consultants and agency staff) can share ideas and views related to the TRM. The benefits of a TRM Users Forum include:

* Improved customer service between the TRM and member agencies and/or the consultants that support their work program.
* Increased trust though enhanced transparency by providing a platform where members can share constructive suggestions and praise.
* Increased TRMSB program success through knowledge sharing and identification of resolutions to common problems.
* Driving model enhancement ideation through an open discussion of big ideas, next best things, and improved model features or capabilities.
* Removing barriers between the TRM and end users by providing a stronger presence in the Triangle modeling community.
* Two meetings were held virtually. Both had strong attendance and received positive feedback from users who welcome the opportunity to be a partner in the TRM process and to be more involved in decision making related to the model.

Training

In partnership with the LTAP program, a training survey was administered to help inform the expansion of course offerings to cover topic areas in Systems Planning and Analysis. Over 50 responses were received. Initial course offerings are planned for:

* Introduction to Travel Modeling
* Introduction to TransCAD
* Travel Modeling with TransCAD

MODELING AND COMPUTATION

Research on “Deep Learning Software for Traffic State Prediction” (S. Bhattacharya, PI; G. List, Co-PI) launched in August 2020. This project aims to develop edge computing and deep learning software to improve estimation of traffic state parameters on arterials by fusing video, loop detector and Bluetooth sensor data. It is testing software with traditional signal control and a CV-enabled signal control algorithm in VISSIM. These capabilities will assist in a) improved performance measures for integration into existing tools like ATSPM, b) temporary deployment for signal retiming or loop detector calibration, and c) driver information through connected vehicle applications. The research is scheduled to conclude in July 2022.

Research for the NC Department of Transportation (NCDOT) on “Traffic Analysis Tools: Assessment, Comparison and Validation Study” (N. Rouphail, PI; G. List, Co-Pi) continued this year. The objective of this study is to consider the trade-offs between the four models’ accuracy, reliability and cost effectiveness when compared to empirical data benchmarks. Should NCDOT move towards the exclusive use of micro or macro tools, those tradeoffs will need to be quantified on a range of evaluation criteria. The project will not focus on qualifying or disqualifying certain software, rather it will identify potential use cases for each of the tools considered. The research is scheduled to conclude in December 2021.

SCHOOL TRANSPORTATION SAFETY

Other reports and projects in this report contain elements of school transportation safety such as the Locating and Costing Congestion for School Buses and Public Transportation and Rail Trespass projects. Although there were no projects this fiscal year dedicated to the concept of school transportation safety, ITRE continues to build capacity in this important research area. In addition to bringing school transportation safety perspectives to related projects, staff are also taking active roles in the pupil transportation industry including participating in the National Highway Transportation Safety Administration’s Pupil Transportation Toolkit, the American Planning Association’s Public Schools Interest Group, and the Transportation Research Board’s Safety Management Systems Committee and its School Transportation subcommittee.

PUPIL TRANSPORTATION INFORMATION MANAGEMENT

The Pupil Transportation Information Management System (TIMS) at ITRE is an ongoing statewide project focused on maintaining and improving upon efficiency in school bus transportation at the district level. In FY 2021, TIMS staff provided technical assistance and training for operating computer-assisted school bus routing and scheduling software to school district personnel. This routing system allows school districts to create effective bus routes, maintain student, transportation and street network data at the local level, which provides district personnel with access to the most accurate and current information related to pupil transportation. To support these efforts, TIMS staff provide dozens of training classes per year as well as daily software and technical support to TIMS routing managers from school districts across the state. See Appendix B of this report for a listing of TIMS training classes delivered in FY 2021.

Following the sudden closure of schools in March 2020 in response to the COVID-19 pandemic, the TIMS program was called into action to assist school districts. During the summer months, TIMS experts helped develop, implement and manage school bus routes to deliver meals to vulnerable populations, distribute education materials to students, and identify strategic locations to park buses to serve as Wi-Fi hotspots for remote learning. These efforts continued for some North Carolina school districts well into fall 2021 as many schools delayed their return to face-to-face instruction.

TIMS staff were highly involved with the NC Department of Public Instruction (DPI) School Reopening Task Force this year in providing bus routing support services to school systems as they explored multiple scenarios for limiting student capacity on school buses while also examining irregular split scheduling for student cohorts across the district. Working with PowerSchool, a leading K-12 education technology company, TIMS staff helped develop custom student pages and data collection methods for school districts reopening under NC Plan B Social Distance Guidelines. Using these methods, North Carolina school systems were able to more effectively manage the variety of irregular student ridership information across the state including multiple ABC Cohort Groups, Staggered Return Dates by Grades and Cohorts, Hybrid Face-To-Face/Virtual Learners and some irregular routing needs for standardized testing of fully remote students. As the circumstances surrounding the pandemic improved over the school year, TIMS staff assisted many school systems in redeveloping new bus routes based on a full reopening under NC Plan A Operations or a reduced number of student cohort groupings.

In addition to helping with a variety of irregular routing operations during the year, TIMS staff have also been key players in helping finalize data collection and information for Summer School 2021. North Carolina is expecting the largest and longest summer school programs in state history, with more planning and effort being needed to properly develop and implement efficient summer school bus routes in all 100 counties. TIMS staff are not only highly involved with Summer School planning, but considerable efforts are being made to better prepare for back to school in August as many children will return to in-person classes and require bus transportation for the upcoming school year.

OPERATIONS RESEARCH AND EDUCATION LAB (OREd)

OREd assists public school systems with complex student enrollment forecasting, attendance zone analysis and facility optimization decision support. In FY 2021, OREd assisted an increasingly diverse mix of growing and shrinking school systems across North Carolina. For growing districts, this includes interviewing land developers and planners, and identifying optimal areas to consider for new school construction. For shrinking districts, this includes evaluating which schools may have the least impact on the community and operations if closed.

HIGHWAY SYSTEMS TRAINING

In addition to highway systems research described earlier in this report, ITRE delivers a wide range of training workshops and courses in the areas of highway engineering, operations, geometrics, and safety. Training is designed for engineers, technicians, maintenance and operations staff working in the United States, with some ongoing courses tailored specifically to NCDOT personnel. ITRE’s Maintenance Operations and Safety Program is an established leader throughout the southeastern U.S. for training transportation department employees on Work Zone Safety, Flagging Operations, and related safety and maintenance topics. Highway Systems staff at ITRE trained over 730 practitioners through 29 course offerings this year. See Appendix B of this report for a listing of the Highway Systems training courses delivered in FY 2021.

NORTH CAROLINA LOCAL TECHNICAL ASSISTANCE PROGRAM (NC LTAP)

NC LTAP is one of the 51 Local Technical Assistance Program (LTAP) centers nationwide. There is an LTAP center in each state and in Puerto Rico. LTAP was established by the U.S. DOT Federal Highway Administration in 1982. North Carolina’s center at ITRE was one of the first organized in 1986. The mission of LTAP is to help local agencies tap into new technology, information, and training so they can operate more efficiently and safely. LTAP centers provide access to training and information that may not have otherwise been accessible. Centers are able to provide local road departments with workforce development services, resources to enhance safety and security, solutions to environmental, congestion, capacity and other issues, technical publications, and training videos and materials. NC LTAP in FY 2021 trained 1670 practitioners statewide through 80 course offerings after pivoting to providing courses online. See Appendix B of this report for a listing of NC LTAP training courses delivered this fiscal year.

NORTH CAROLINA AIRPORT TECHNICAL ASSISTANCE PROGRAM (NC AIRTAP)

NC AirTAP is a joint effort of ITRE and the NCDOT Division of Aviation, with support from the NC Airports Association, to provide educational offerings, information resources and related assistance to the state’s public- and private-sector airport professionals. NC AirTAP helps North Carolina airports improve the safety, quality and efficiency of their operations and increase the use of new aviation materials and technology. The program also helps airport staff build a community network for exchanging best practices.

NC AirTAP in FY 2021 continued work on its “NC Airport Leadership and Management Program” (ALMP), a 12-part training course series for the state’s airport officials, managers and operations staff. Four new ALMP courses were developed as blended online courses — combining live instruction via webinar with on-demand content — and taught to over 230 participants:

* Course 7: The Fixed Based Operator — Examines the role of a FBO, its services and management options, and how to create a good customer service climate at the airport.
* Course 8: Airport Public Relations and Communications — Discusses how to create and update communication, marketing and public relations plans for the airport.
* Course 9: Airport Design and Construction — Examines the many aspects of airport design and construction including architecture, engineering, environmental issues and program management.
* Course 10: Airport Leadership and Management Skills — Presents concepts, tools and techniques for building success as an airport manager.

ALMP participants must complete at least 9 of the 12 courses to earn their “North Carolina Airport Professional” (NCAP) certification. Thirteen participants were awarded NCAP certificates this year. See Appendix B of this report for more details on the NC AirTAP training courses delivered in FY 2021.

Program staff this year also supported the NCDOT Division of Aviation with producing and hosting several virtual meetings:

* Quarterly meetings of the NC Airport Community including administrators of the state’s 72 public airports and their engineering/planning consultants.
* Briefings on the NCDOT Aerospace Business Development Plan for stakeholders in various economic development regions of the state.
* Virtual presentation by NCDOT Division of Aviation director Bobby Walston and colleagues for the National Association of State Aviation Officials conference.

**Personnel**

# Number of faculty members currently affiliated with the Center/Institute:

29

# Number of staff members currently affiliated with the Center/Institute:

# 56

**Educational Impact**

|  |  |
| --- | --- |
| NC State Undergraduate students: | 47 |
| NC State Master’s students: | 25 |
| NC State PhD students: | 13 |
| Non-NC State Undergraduate students: | 5 |
| Non-NC State Master’s students: | 1 |
| Other (Postdocs, industry professionals, etc.): | 4312 |

**Publications**

# Total number of annual publications:

45 (see Appendix A for a complete listing)

# Noteworthy publications:

* ***Identifying Bridges Critical to North Carolina Agriculture and Commerce***

Nicholas, C.; Dudley, T.; Bert, S.; Norboge, N.; List, G.; and Findley, D.

Report for the North Carolina Department of Transportation

Under current legislation, weight-restricted bridges that are critical nodes in North Carolina’s agricultural freight network are unable to receive dedicated sources of funding for improvements or long-term viability. Some of these bridges could have significant economic value if improved. This research developed a ranked list of the state’s weight-restricted bridges, through a GIS process, that offers a system-wide, objective evaluation to improve or replace the bridges.

* ***Modernizing North Carolina’s Infrastructure Through Sustainable and Diversified Revenue Streams***

Bert, S.; Head, W.; Norboge, N.; Odom, S.; Dorn, L.; and Findley, D.

Report for the North Carolina Chamber Foundation

This report outlines potential pathways for securing a more sustainable stream of transportation revenue for North Carolina. It identifies four of the most viable options to reduce our state’s reliance on the motor fuels tax. To demonstrate the multiplying effects strategic transportation investments can impart on local economies, the report also provides economic impact snapshots for several transportation projects that have been completed across the state in recent years.

* ***NCHRP Report 959: Diverging Diamond Interchange Informational Guide – Second Edition***

Cunningham, C.M.; Pyo, K.; Chase, T.; and S. Warchol

Report for the National Cooperative Highway Research Program

This latest edition of the guide—produced by ITRE, in collaboration with Kittelson and Associates and Kimley Horn and Associates, for the National Cooperative Highway Research Program— includes major updates on signal timing options, geometric considerations, and a nationwide safety evaluation. The research team developed much-needed guidance for transportation engineers on the geometric and traffic signal design of DDIs as well as safety and operational analysis of design alternatives.

* ***Rail Network Trespass Statewide Severity Assessment and Predictive Modeling***

Searcy, S.; Vaughan, C.; Coble, D.; Poslusny, J.; and Cunningham, C.

Report for the North Carolina Department of Transportation

This research quantifies and describes pedestrian trespassing activity along North Carolina’s railroad network through the development and testing of thermal camera systems. Quantifying trespassers is necessary to better understand the true count that do not involve an injury or death. This research also studied trespasser behaviors for applying effective treatment and mitigation efforts, and better inform and educate community stakeholders, policy makers, and enforcement and safety officials.

* ***State of the Art Approaches to Bicycle and Pedestrian Counters***

Ozan, E.; Searcy, S.; Carter Geiger, B.; Vaughan, C.; Carnes, C.; Baird, C.; and Hipp, A.

Report for the North Carolina Department of Transportation

This research determines the state of practice for bicycle and pedestrian counting technologies to inform the enhancement and future growth of the NC Non-Motorized Volume Data Program. The results provide a menu of counting technologies with a cost analysis and data integration plan that NCDOT can draw on to enhance the NC NMVDP. This project provides guidance on alternatives to supplement the current systems with newer, more cost-effective and efficient data collection components or systems.

**Activities Supported by the Center/Institute**

ITRE offered 89 training courses and related activities this year. See Appendix B for a complete listing.

**Financial Report**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Funds Received and Expended | Academic Affairs | Agricultural Research | Agency Funds | Auxiliary Sales and Services | Contracts and Grants | Endowments | F and A Receipts | Foundations | Gift and Loan Funds | FYTDActivity: Total |
| Total Revenues | $0 | $0 | ($12,411) | ($791,486) | ($6,423,843) | $0 | $0 | ($13,334) | $0 | ($7,241,073) |
| Personnel Expenditures | $515,794 | $0 | $0 | $585,038 | $3,808,231 | $0 | $119,445 | $0 | $464 | $5,028,972 |
| Operating Expenditures | $452 | $0 | $3,962 | $245,576 | $634,002 | $0 | $48,484 | $16 | $1,159 | $933,649 |
| Student Aid | $0 | $0 | $0 | $0 | $67,132 | $0 | $0 | $0 | $0 | $67,132 |
| Stipend Student | $0 | $0 | $0 | $510 | $13,028 | $0 | $0 | $0 | $0 | $13,537 |
| Stipend Non- Student | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Subcontracts | $0 | $0 | $0 | $0 | $678,074 | $0 | $0 | $0 | $0 | $678,074 |
| Transfers & Reserves | $0 | $0 | $0 | $0 | $1,223,376 | $0 | $0 | $0 | $0 | $1,223,376 |
| Total FYTD Expenditures | $516,246 | $0 | $3,962 | $831,123 | $6,423,843 | $0 | $167,928 | $16 | $1,623 | $7,944,743 |

**Organizational Chart**



**Appendix A: Annual Publications**

| **Title of Journal Paper or Report** | **Author(s)** | **Name of Journal or Publisher** | **Date Published** |
| --- | --- | --- | --- |
| A Skid Resistance Prediction Model for an Entire Road Network | Pérez-Acebo, H.; Gonzalo- Orden. H.; Findley, D.; and Rojí, E. | Construction and Building Materials | 2020 |
| ACRP Research Report 229: Airport Collaborative Decision Making (ACDM) to Manage Adverse Conditions | Le Bris G.; Nguyen G.; Tagoe B.; Churchill A.; Vail S.; Benaman H.; Fleet D.; Zajkowski T.; and Krieger J. | The National Academies Press | 2021 |
| An Optimization Model for Selecting Sample Days | Tao Li | Asia-Pacific Journal of Operational Research | 2021 |
| Assessing and Addressing Deficiencies in the HCM Weaving Segment Analyses | Rouphail, N.; Aghdashi, B.; Elefteriadou, L.; Amini, E.; and Xu, D. | University of Florida Transportation Institute / STRIDE Center | Mar 2021 |
| Bikes, Pedestrians, & the Pandemic: Analysis of Impacts on Bike and Pedestrian Traffic by the Pandemic with Data from the North Carolina Non-Motorized Volume Data Program (NC NMVDP) | Thomas, A.; Currier, B.; Rayner, A.; Turner, J.; Roberts, B. | ES 400 - Analysis of Environmental Issues Capstone Project (Project Mentors: Dr. George Hess & Sarah Searcy) | Apr 2021 |
| Capacity Modeling of Permitted Left-Turn Signalized Intersections with Probabilistic Priority | Wang, D.; Yang, G.; Tian, Z.; Liu, W.; and Wei, D. | Transportation Research Record: Journal of the Transportation Research Board | Jul 2020 |
| Capitalizing on Drone Videos to Calibrate Simulation Models for Signalized Intersections and Roundabouts | Samandar, S., G. Chun, G. Yang, T. Chase, N. Rouphail, and G. List | Traffic Simulation and Connected and Automated Vehicle Modeling, a special issue of the Journal of the Transportation Research Board | May 2021 |
| Collision Mitigation at Signalized Intersection Using Connected Vehicles Data and Technologies | Tajalli, M., G. List, and A. Hajbabaie | 100th Annual Meeting of the Transportation Research Board | January 2021 |
| Comprehensive Cost of Rail Incidents in North Carolina | Bert, S.; Keller, C.; Parsons, O.; Randall, M.; Poslusny, J.; Ashtankar, P.; Lahare, A.; Salunke, M.; Searcy, S.; and Findley, D. | NC Department of Transportation | Dec 2020 |
| Crash Risk Assessment for Heterogeneity Traffic and Different Vehicle-Following Patterns using Microscopic Traffic Flow Data | Shen, J.; and Yang, G. | Sustainability | Nov 2020 |
| Delivery of Automated External Defibrillators via Drones in Simulated Cardiac Arrest: Users' Experiences and the Human-Drone Interaction | Zègre-Hemsey, J.; Grewe, M.; Johnson, A.; Arnold, E.; Cunningham, C.; Bogle, B.; and Rosamond, W. | Resuscitation | Dec 2020 |
| Designing In-Vehicle Message Delivery with Manual and Highly Automated Driving | Feng, J.; Kaber, D.; Cunningham, C.M.; Deng, Y.; Cauffman, S.; Lau, M.; Liu, Y.; Johnson, E.; and K. Pyo | NC Department of Transportation | June 2020 |
| Driver Logo Sign Detection and Hazard Responses under Partial Vehicle Automation | Cauffman, S.; Feng, J.; Kaber, D.; Liu, Y.; Cunningham, C.M., and Y. Deng | Human Factors and Ergonomics Society | Feb 2021 |
| Driver Visual Behavior and Vehicle Control with In-Vehicle and On- Road Deliveries of Service Logo Signs | Deng, Y.; Cauffman, S.; Liu, M.; Johnson, E.; Cunningham, C.M.; Kaber, D.; and J. Feng | Transportation Research Record: Journal of the Transportation Research Board | Feb 2021 |
| Dynamically Collected Local Density using Low-Cost Lidar and its Application to Traffic Models | Avr, A.; Tanvir, S.; Rouphail, N.; and Ahmed, I. | Transportation Research Record: Journal of the Transportation Research Board | May 2021 |
| Effects of Pedestrian Crossing on Minor Road Capacity at Two-Way Stop-Controlled Intersections | Yue, R.; Yang, G.; Zheng, Y.; and Tian, Z. | Transportation Research Record: Journal of the Transportation Research Board | Apr 2021 |
| Evaluating the Effect of Incidents on Freeway Facilities and Updating the Incident Capacity Adjustments for HCM | Addison, J.; Aghdashi, S.; and Rouphail, N. | Transportation Research Record: Journal of the Transportation Research Board | Jan 2021 |
| Evaluation of the Monroe Expressway Wrong Way Vehicle Detection Program | Chase, T.; Cunningham, C.M.; Ahmed, I.; Yang, G.; Poslusny, J.; and D. Xu | NC Department of Transportation | March 2021 |
| Evaluation of United States Army Corps of Engineers Asphalt Pavement Quality Data Collection and Analysis | Carter Geiger, B.; Vaughan, C.; Searcy, S.; Bert, S.; Arnold, E.; Parkan, J. | United States Army Corps of Engineers; FHWA Eastern Federal Lands Highway Division | May 2021 |
| Guidelines for Implementation of Right Turn Flashing Yellow Arrows and Leading Pedestrian Intervals | Cunningham, C.M.; Pyo, K.;Baek, J.; Byrom, E.; and S. Warchol | NC Department of Transportation | May 2020 |
| Guidelines for Left Turn Signal Phasing Options by Time-of-Day: A Safety and Operational Study. | Cunningham, C.M.; Rouphail, N.; Lee, T.; and B. Kearns | NC Department of Transportation | Nov 2020 |
| Identifying and Prioritizing Bridges Critical to Commerce: A Case Study of Weight-Restricted Bridges in North Carolina | Nicholas, D. C.; Dudley, T.; Head, W.; Bert, S.; Norboge, N.D.; List, G.; Findley, D. | International Journal of Transportation Science and Technology | June 2021 |
| Identifying Bridges Critical to North Carolina Agriculture and Commerce | Nicholas, C., Dudley, T., Bert, S., Norboge, N., List, G., and Findley, D. | NC Department of Transportation | Feb 2021 |
| Impacts of Private Autonomous and Connected Vehicles on Transportation Network Demand in the Triangle Region, North Carolina | Hasnat, M.; Bardaka, E.; Samandar, M.; Rouphail, N.; List, G.; and Williams, B. | American Society of Civil Engineers, Journal of Urban Planning and Development / Volume 147 Issue 1 - March2021 | Mar 2021 |
| Integrated Implementation of Innovative Intersection Designs | Rouphail, N.; Cunningham, C.; Davis, W.; Warchol, S.; and Ahmed, I. | University of Florida Transportation Institute / STRIDE Center | May 2020 |
| Investigating the relationship between freeway rear-end crash rates and macroscopically modeled reaction time | Ahmed, Ishtiak, Billy M. Williams, M. Shoaib Samandar, and Gyounghoon Chun | Transportmetrica A: Transport Science | April 2021 |
| Mobility Assessment of Pedestrian and Bicycle Treatments at Complex Continuous Flow Intersections | Ahmed, I.; Warchol, S.; Cunningham, C.; and Rouphail, N. | American Society of Civil Engineers, Journal of Transportation Engineering, Part A: Systems / Volume 147 Issue 5 - May 2021 | May 2021 |
| Modeling and Validating Traffic Responsive Ramp Metering in the HCM Context | Aghdashi, B.; Davis, J.; Chase, T.; and Cunningham, C. | Transportation Research Record: Journal of the Transportation Research Board | May 2021 |
| Modeling the International Roughness Index Performance in Semi-Rigid Pavements in Single- Carriageway Roads | Pérez-Acebo, H.; Pitxitxi, R.; Gonzalo-Orden. H.; and Findley, D. | Construction and Building Materials | Feb 2021 |
| Modeling the Modal Shift Effects of Converting a General Traffic Lane to A Dedicated Bus Lane | Yang, G.; Wang, D.; and Mao, X. | Promet – Traffic and Transportation | Sep 2020 |
| Modernizing North Carolina’s Infrastructure Through Sustainable and Diversified Revenue Streams | Bert, S., Head, W., Norboge, N., Odom, S., Dorn, L., and Findley, D. | NC Chamber Foundation | Aug 2020 |
| Moral and Social Ramifications of Autonomous Vehicles | Dubljević, V., S. Douglas, J. Milojevich, N. Ajmeri, W. Bauer, G. List, and M. Singh | arXiv | 2021 |
| NCHRP Report 959: Diverging Diamond Interchange Informational Guide – Second Edition. | Cunningham, C.M.; Pyo, K.; Chase, T.; and S. Warchol | NCHRP | 2021 |
| North Carolina County Seat Belt Use Rates | Searcy, S.; and Kearns, B. | NC Governors Highway Safety Program | Jan 2021 |
| North Carolina Non-Motorized Volume Data Program (NC NMVDP) Phase 2 Final Report | Searcy, S.; Carter Geiger, B.; Baird, C.; Carnes, C.; Kearns, B.; and Worth O'Brien, Sarah | NC Department of Transportation | Nov 2020 |
| Operational Application of Signalized Offset T-Intersections | Cunningham, C.; Warchol, S.; Baek, J.; and Yang, G. | NC Department of Transportation | Jul 2020 |
| Post-Implementation Evaluation of Integrated Corridor Management (ICM) in NC. | Chase, T.; Samandar, S.; Gopi, S.; Li, T. and C.M. Cunningham | NC Department of Transportation | June 2021 |
| Predicting Lane Change Intensity within Urban Interchange Influence Areas (IIA) | Rouphail, N.; Ahmed, I.; Karr, A.; and Chase, T. | NC Department of Transportation | Nov 2020 |
| Rail Network Trespass Statewide Severity Assessment and Predictive Modeling | Searcy, S.; Vaughan, C.; Coble, D.; Poslusny, J.; and Cunningham, C. | NC Department of Transportation | Dec 2020 |
| Reasonable Alternatives for Grade- Separated Intersections. | Chase, T.; Cunningham, C.M.; Warchol, S.; Vaughan, C.; andT. Lee | NC Department of Transportation | July 2020 |
| Rural Freight Transport Needs | List, G., Findley, D., Bert, S., Chittilla, R., and Morsali, A. | NC Department of Transportation | Feb 2021 |
| State of the Art Approaches to Bicycle and Pedestrian Counters | Ozan, E.; Searcy, S.; Carter Geiger, B.; Vaughan, C.; Carnes, C.; Baird, C.; and Hipp, A. | NC Department of Transportation | Mar 2021 |
| The 2020 North Carolina Observational Survey of Seat Belt Use | Searcy, S.; and Kearns, B. | NC Governors Highway Safety Program | Nov 2020 |
| Toward a Rational and Ethical Sociotechnical System of Autonomous Vehicles: A Novel Application of Multi-Criteria Decision Analysis | Dubljević, V., G. List, J. Milojevich, N. Ajmeri, W. Bauer, M. Singh, E. Bardaka, T. Birkland, C. Edwards, R. Mayer,I. Muntean, T. Powers, H. Rakha, V. Ricks, and M. S. Samandar | arXiv | 2021 |
| Traffic Signal Retiming to Improve Corridor Performance | Yue, R.; Yang, G.; Lin, D.; Wang, A.; and Tian, Z. | American Society of Civil Engineers, Journal of Transportation Engineering, Part A: Systems | Jan 2021 |

**Appendix B: Activities Supported by the Center/Institute**

| **Title of Course or Activity** | **Description** | **Instructional Format** | **Sessions Offered 7/1/20 to****6/30/21** | **Contact Hours per Session** | **Total Participants 7/1/20 to****6/30/21** |
| --- | --- | --- | --- | --- | --- |
| **AVIATION (NC AIRTAP; NGAT; UAS)** |
| ALMP Course 7: The Fixed Based Operator (Synchronous) | This course examines the role of a FBO, its services and management options, and how to create a good customer service climate at the airport. | Online | 1 | 6.00 | 56 |
| ALMP Course 7: The Fixed Based Operator (On-Demand) | This course examines the role of a FBO, its services and management options, and how to create a good customer service climate at the airport. | Online | 1 | 6.00 | 13 |
| ALMP Course 8: Airport Public Relations and Communications | This course discusses how to create and update communication, marketing and public relations plans for the airport. | Online | 1 | 6.00 | 50 |
| ALMP Course 9: Airport Design and Construction | This course examines the many aspects of airport design and construction including architecture, engineering, environmental issues and program management. | Online | 1 | 6.00 | 55 |
| ALMP Course 10: Airport Leadership and Management Skills | This course presents concepts, tools and techniques for building success as an airport manager. | Online | 1 | 6.00 | 63 |
| **GEOGRAPHIC INFORMATION SYSTEMS** |
| Introduction to ArcGIS I: GIS Fundamentals | This course is for those who are new to geographic information systems (GIS) and wish to learn what GIS is and the basics of what it can do. | Online | 2 | 16.00 | 9 |
| Learning ArcGIS Pro 1: Maps and Projects | This beginner course teaches how to use ArcGIS Pro to create maps. Students will learn terminology associated with ArcGIS Pro and GIS in general. They will gain an understanding of ArcGIS Pro projects and how to manage them. | Online | 3 | 16.00 | 9 |
| Learning ArcGIS Pro 2: Editing, Analysis & Automation | This intermediate course will teach student how they can use ArcGIS Pro to edit data, create 3D maps, perform GIS analysis and automate processes using ModelBuilder and Python. | Online | 1 | 16.00 | 2 |
| Learning ArcGIS Pro 3: Converting Linking & Analyzing Data | This class covers advanced data concepts. Students will learn how to convert data from various formats such as CAD or Shapefiles to Geodatabase feature classes. They will also learn how to link data using joins, relates and relationship classes.Students will then explore how to use topologies to edit and validate GIS data to ensure it is clean as well as how to create and edit 3D data. From there students explore more advanced types of spatial analysis. | Online | 1 | 16.00 | 1 |
| Learning ArcGIS Pro 4: Sharing your Maps & Data | This class teaches you how you can leverage the integration of ArcGIS Pro with ArcGIS Online and Portal to easily and effectively share your maps and data with others both inside and outside your organization. Students start with an introduction to Esri’s new expression language ArcGIS Arcade. This new language allows you to create expressions for labeling, symbology and more that work across the entire ArcGIS platform. From there we introduce the students to ArcGIS Online. They will learn the basics of how to connect and access content. Then we move into how you can publish content from ArcGIS Pro to ArcGIS Online. Lastly, they will learn how to share that content as web maps and web applications. | Online | 2 | 16.00 | 4 |
| Introduction to Python for ArcGIS Pro | This two-day course teaches introductory level Python skills with ArcGIS Pro required to begin automating geoprocessing tasks, also how to script various functions such as layer control, managing layouts, updating data sources and more. | Online | 1 | 16.00 | 1 |
| Introduction to ModelBuilder ArcGIS Pro | This class teaches ModelBuilder ArcGIS Pro | Online | 1 | 16.00 | 3 |
| **HIGHWAY SYSTEMS (PE/FE REVIEW; FEP; HEC; MAINTENANCE OPERATIONS & SAFETY; BIKE/PED)** |
| Applied Roundabout Design | This course presents the key geometric principles and guidelines used to develop and design a roundabout. The differences between older traffic circles and rotaries and new roundabout design features are highlighted. The course also addresses the typical questions of why, where, when and how roundabouts should be considered as an appropriate intersection solution. | Online | 1 | 16.00 | 12 |
| Flagging Instructor Training | This workshop teaches participants the basics of flagging operations and then instructs them how to teach their own personnel these concepts | Online | 2 | 4.00 | 52 |
| Fundamentals of Engineering Principles (FEP) Program | The FEP Program is a series of courses offering introductory engineering education for transportation technicians. FEP courses build a deeper conceptual understanding of transportation design, inspection, and field practices. | Online | 2 (Fall & Spring) | 366.00 | 348 |
| Fundamentals of Engineering (FE)- Self-Paced | This is a review course for the civil engineering exam only and covers approximately 16 topics. | Online | 1 | 130.00 | 8 |
| Fundamentals of Engineering (FE)- Self-Paced - NCDOT | This is a review course for the civil engineering exam only and covers approximately 16 topics. | Online | 1 | 130.00 | 19 |
| Fundamentals of Engineering (FE)- Self-Paced - NCSU | This is a review course for the civil engineering exam only and covers approximately 16 topics. | Online | 1 | 130.00 | 2 |
| Fundamentals of Engineering (FE)- Tues/Fri | This is a review course for the civil engineering exam only and covers approximately 16 topics. | Online | 1 | 130.00 | 3 |
| Fundamentals of Engineering (FE)- Tues/Fri - NCDOT | This is a review course for the civil engineering exam only and covers approximately 16 topics. | Online | 1 | 130.00 | 7 |
| Professional Engineering (PE) - Self-Paced | This is a civil engineering professional engineering exam review course which covers breadth and depth topics in construction, geotechnical, transportation, and water resources and environmental. Only breadth topics are covered in the structural discipline. | Online | 1 | 66.00 | 43 |
| Professional Engineering (PE) - Quiz Bank - NCDOT | This is a civil engineering professional engineering exam review course which covers breadth and depth topics in construction, geotechnical, transportation, and water resources and environmental. Only breadth topics are covered in the structural discipline. | Online | 1 | 40.00 | 1 |
| Professional Engineering (PE) - Study Aid | This is a civil engineering professional engineering exam review course which covers breadth and depth topics in construction, geotechnical, transportation, and water resources and environmental. Only breadth topics are covered in the structural discipline. | Online | 1 | 66.00 | 3 |
| Professional Engineering (PE) - Study Aid - NCDOT | This is a civil engineering professional engineering exam review course which covers breadth and depth topics in construction, geotechnical, transportation, and water resources and environmental. Only breadth topics are covered in the structural discipline. | Online | 1 | 66.00 | 3 |
| Professional Engineering (PE) - Tuesday Synchronous Online | This is a civil engineering professional engineering exam review course which covers breadth and depth topics in construction, geotechnical, transportation, and water resources and environmental. Only breadth topics are covered in the structural discipline. | Online | 1 | 66.00 | 35 |
| Professional Engineering (PE) - Tuesday Synchronous Online NCDOT | This is a civil engineering professional engineering exam review course which covers breadth and depth topics in construction, geotechnical, transportation, and water resources and environmental. Only breadth topics are covered in the structural discipline. | Online | 1 | 66.00 | 19 |
| Professional Engineering (PE) - Wednesday Live (converted to synchronous online for 2021) | This is a civil engineering professional engineering exam review course which covers breadth and depth topics in construction, geotechnical, transportation, and water resources and environmental. Only breadth topics are covered in the structural discipline. | Online | 1 | 66.00 | 31 |
| Site Development & Highway Access – Introductory Level | This class is meant to be a comprehensive introduction to highway access principles discussed in the NCDOT Driveway Access Manual and associated manuals. | Online | 4 | 8.00 | 60 |
| Site Development & Highway Access – Practitioner Level | This class looks at more complex case examples with discussions on government/developer involvement/interaction. The course is intended for TIA preparers; NCDOT district and traffic engineering staff; local government planning, transportation and traffic staff; and site developers. It is recommended that you complete the Introductory Level before you enroll in the Practitioner Level. | Online | 4 | 8.00 | 62 |
| Traffic Signals Workshop: Principles, Detection, and Timing of Traffic Signals | This two-day workshop is designed to provide participants with an introduction to the fundamentals of individual traffic signals and traffic signal systems | Classroom | 1 | 16.00 | 13 |
| Unconventional Intersections | This one-day workshop provides an overview of the various alternative intersection and interchange designs that an engineer or planner may consider during the planning or design stages of a project. The class provides a fundamental understanding of how the various designs function under an array of conditions, the trade-offs of each design alternative, and other pertinent information. This class covers material relevant to any staff member looking to learn more about this area. | Online | 1 | 8.00 | 7 |
| Unconventional Intersections Lab | This laboratory provides hands-on examples for applying the principles discussed at the "Unconventional Intersections" workshop. The session includes at least one challenging surface- street example, one difficult grade-separated intersection example, and one constrained interchange example. Attendees will work together in small teams to develop potential solutions and then will discuss their potential solutions with the larger group. The laboratory should again be of interest to any planners, designers, and operations professionals who work on intersections and interchanges. | Online | 1 | 8.00 | 4 |
| **NC LOCAL TECHNICAL ASSISTANCE PROGRAM (NC LTAP)** |
| ADA in Temporary Traffic Control | This workshop describes the challenges faced by individuals with disabilities as they travel in the built environment, and includes a discussion of the relevant legal authorities (ADA, PROWAG, MUTCD). The basic requirements of the Pedestrian Access Route are reviewed including width, protruding objects, cross slope, grade, surfaces and curb ramps/detectable warnings. The requirements for the alternate pedestrian access route are reviewed. Tools to minimize the impacts of construction/maintenance/utility operations on pedestrians will be discussed. The session will conclude with an interactive review/discussion of various work zone scenarios and best practices. | Online | 2 | 2.00 | 57 |
| ADA Self Evaluations/Elements of PROWAG | With the 25-year anniversary of the passage of ADA, it is critical that local governments recognize their obligation to upgrade streets, sidewalks and facilities for accessibility. ADA requires that public agencies perform self-evaluations and prepare transition plans. They were to have been completed by July 26, 1992 and be updated periodically. The morning portion of the workshop examines the background to, contents of and enforcement of the self-evaluation and transition plan requirements. Several landmark court cases are also highlighted. A case study is presented to illustrate these items. Participants will leave the session with a “To Do” list of next steps they need to take and a toolkit of helpful resources. The afternoon session overviews the current criteria for accessible public rights-of-way including the pedestrian access route, curb ramps and detectable warnings, accessible pedestrian signals, street furniture, on-street parking and temporary traffic control requirements for pedestrians. | Online | 1 | 6.00 | 18 |
| Asphalt Pavement Maintenace | This workshop covers pavement evaluation, asphalt mix materials, hot plant mix production and pavement construction methods, routing pavement maintenance techniques, and pothole patching. | Classroom | 1 | 6.00 | 12 |
| Asphalt Pavement Maintenace | This workshop covers pavement evaluation, asphalt mix materials, hot plant mix production and pavement construction methods, routing pavement maintenance techniques, and pothole patching. | Online | 2 | 6.00 | 73 |
| Basic Concepts of Supervision | The Basic Concepts of Supervision focuses on the elements that new supervisors should be aware of: tasks of a leader, being a role model, motivation techniques, communication skills, problem solving and decision making, conflict and time management, customer service and stress management. The workshop is interactive with lecture, small and large group exercises and skill practices. Participants will have opportunities to ask and answer questions related to the subjects as described. | Online | 3 | 6.00 | 57 |
| Basic Drainage/Roadway Drainage Maintenance | There are three things you need to have a good road: drainage, drainage, and drainage. This program covers drainage principles, drainage policy, ditches, pipes, and other drainage features, including installation maintenance and construction of drainage components. | Classroom | 1 | 7.00 | 12 |
| Basic Drainage/Roadway Drainage Maintenance | There are three things you need to have a good road: drainage, drainage, and drainage. This program covers drainage principles, drainage policy, ditches, pipes, and other drainage features, including installation maintenance and construction of drainage components. | Online | 1 | 6.00 | 22 |
| Basic Work Zone Installer Online | This workshop teaches the basics of work zone traffic control. The course covers short-term operations (no longer than one work shift) and focuses on daytime activities. This course must be completed before taking Intermediate Work Zone Safety Training. | Online | 9 | 6.00 | 170 |
| Basic Work Zone Installer Safety | This workshop teaches the basics of work zone traffic control. The course covers short-term operations (no longer than one work shift) and focuses on daytime activities. This course must be completed before taking Intermediate Work Zone Safety Training. | Classroom | 2 | 8.00 | 25 |
| Chain Saw Safety | Use of a chain saw requires a whole host of special personal protective equipment, including special glasses, gloves, chaps, and more. This hands-on class will cover basic chain saw operational safety awareness (e.g. proper protective wear, starting, kick back prevention, cutting do’s and don’ts) as well as body position during cutting and a few advanced topics. Each attendee will don the proper PPE for a routine sawing operation of felled trees, inspect the condition of the saw, check fluid levels, crank the saw and perform a successful cutting operation. | Classroom | 2 | 4.00 | 18 |
| Confined Space Entry and Lockout/Tagout | This workshop is a follow-up to the Trenching Competent Person workshop. It is a must for any field supervisor who has crews working in confined spaces, such as: manholes, catch basins, meter vaults, and excavations deeper than four feet. | Classroom | 4 | 8.00 | 43 |
| Confined Space Entry and Lockout/Tagout | This workshop is a follow-up to the Trenching Competent Person workshop. It is a must for any field supervisor who has crews working in confined spaces, such as: manholes, catch basins, meter vaults, and excavations deeper than four feet. | Online | 2 | 6.00 | 44 |
| Designing Pedestrian Facilities for Accessibility | Facilities in the public right-of-way (including walkways, ramps, curb ramps and landings, crosswalks, and pedestrian overpasses and underpasses) must be designed, constructed and maintained to serve all users. This course identifies the applicable laws, regulations, guidelines and standards pertaining to accessibility for persons with disabilities. Requirements for ensuring accessibility in existing facilities versus work in new construction and alternations will be discussed. Design elements necessary for achieving accessibility in the public right-of-way will be reviewed. Best practices will be identified. | Online | 2 | 6.00 | 53 |
| Effective Leadership Skills | Leadership involves effective communication with organizational members to build successful teams and achieve organizational goals. This course will include ideas for communicating clear goals, helping groups negotiate clear communication expectations, motivating employees, assessing team progress, and providing effective performance feedback. Furthermore, this course will provide an opportunity to prepare for a supervisory or leadership role by learning management concepts, tools, and techniques to build personal influence and succeed as a leader. Topics include ethics, organizational self- assessment, defining excellence, and team development. | Online | 2 | 6.00 | 53 |
| Emergency Management | This course covers how to develop, practice, and maintain emergency management plans that reflect what must be done before, during, and after a disaster. Participants will receive an overview of FEMA guidelines. | Online | 1 | 6.00 | 32 |
| Flagger Certification | This workshop is designed to train participants to be effective flaggers by teaching the basics of flagging operations and procedures. | Classroom | 2 | 4.00 | 22 |
| Flagger Training Online | This workshop is designed to train participants to be effective flaggers by teaching the basics of flagging operations and procedures. | Online | 7 | 4.00 | 135 |
| Flagging Instructor Training Online | This workshop teaches participants the basics of flagging operations and then instructs them how to teach their own personnel these concepts. Portions of this course are conducted outside in a ‘walk thru’ traffic setting. | Online | 1 | 8.00 | 13 |
| Flagging Instructor Training RECERTIFICATION | This workshop teaches participants the basics of flagging operations and then instructs them how to teach their own personnel these concepts. Portions of this course are conducted outside in a ‘walk thru’ traffic setting. | Online | 1 | 4.00 | 6 |
| Fundamentals of Government | This course provides an overview of the American federal system with a focus on local government in North Carolina, particularly municipalities, including the organization and operation of municipal governments and their interactions with the community and in the intergovernmental system. | Online | 2 | 6.00 | 36 |
| Guard Rail Design, Installation and Maintenance | This workshop addresses decision making criteria for engineers such as guardrail warrants, length of need, maintenance planning and damage assessment. Also covers: various types of guardrail hardware and focuses on the various end treatments designed to meet the FHWA 350 crash tests. | Online | 1 | 6.00 | 23 |
| How to Keep Yourself and Your Agency Out of Court | This workshop provides an understanding of the importance and implications of tort liability risk for road agencies. The class will cover risk management principles, review risk management activities, and identify ways to reduce risk. Students will study examples that show the importance of considering human behavior when planning for their city or town. | Online | 1 | 6.00 | 15 |
| Intermediate Work Zone Safety | This workshop builds on the information covered in the Basic Work Zone Installer course, with particular emphasis paid to multi-lane urban streets. Multi-lane intersection work zones, detours, and mobile operations are covered in detail. Basic Work Zone Installer Training is a prerequisite for this course. | Online | 4 | 6.00 | 74 |
| Management Techniques for Experienced Managers | The Management Techniques for Experienced Managers is for supervisors and managers with some years of experience in their positions. Subjects include: resource management, negotiation skills, ethics, delegation, coordination with other units, team building, planning, setting priorities. A variety of instructional strategies is used: lecture, large group discussions, small group exercises and skill practices. The final activity brings all of the elements discussed earlier into focus by having the small groups complete a case study. | Online | 3 | 6.00 | 85 |
| Managing Conflict with the Public and Employees | This class focuses on three primary topics: conflict styles, strategies for de-escalating conflict, and steps for negotiating a mutually beneficial resolution to conflict. Participants will have the opportunity to practice conflict management strategies in role-play situations. | Online | 1 | 6.00 | 18 |
| Municipal Success in a Coronavirus Environment | This webinar will explore how towns, cities, and counties are dealing with the coronavirus. Examples specific to NC municipalities will be discussed. | Online | 1 | 2.00 | 79 |
| OSHA 10-Hour | This workshop is an important tool in meeting the Occupational Safety and Health Administration (OSHA) requirements to provide employees with an awareness of the basic hazards that exist in the field. Over a 10-hour period, this workshop covers many important basic safety requirements that field employees must know that are in OSHA’s Standards for the Construction Industry. OSHA inspectors can enforce these safety rules for field employees working in the public or private sector. | Classroom | 1 | 10.00 | 10 |
| Plan Reading | Learn Blueprint reading, one of the foundational skills essential to a successful career in construction. Gain an elementary level of understanding of blueprint reading and how to apply it to construction projects. | Online | 3 | 4.00 | 70 |
| Silica Standards – Strategies for Municipal Compliance | The Occupational Safety and Health Administration (OSHA) limits the permissible exposure level (PEL) for workers exposed to respirable crystalline silica to be 50 micrograms per cubic meter over an average 8-hour period. Municipalities and construction contractors are particularly impacted by this regulation because of the variety of tools that are routinely used on concrete pavement, sidewalk and curbing, asphalt pavement and other concrete related products in their day-to-day work activities. This seven-hour program helps large and small organizations plan for, implement and comply with this workplace standard. | Classroom | 1 | 8.00 | 17 |
| Silica Standards – Strategies for Municipal Compliance | The Occupational Safety and Health Administration (OSHA) limits the permissible exposure level (PEL) for workers exposed to respirable crystalline silica to be 50 micrograms per cubic meter over an average 8-hour period. Municipalities and construction contractors are particularly impacted by this regulation because of the variety of tools that are routinely used on concrete pavement, sidewalk and curbing, asphalt pavement and other concrete related products in their day-to-day work activities. This seven-hour program helps large and small organizations plan for, implement and comply with this workplace standard. | Online | 2 | 6.00 | 35 |
| Traffic Calming | Traffic engineers, street supervisors and other public officials face a growing number of complaints about high motor vehicle speeds and volumes in residential neighborhoods. This can occur on classifications from local streets to minor arterials. The issue can also occur on state highways passing through small- and medium-size communities. This workshop will discuss typical traffic problems in neighborhoods and their causes.Geometric design features and traffic control strategies to provide safer and more livable neighborhoods will be described, including residential area traffic circles, curb extensions (bulb- outs), median islands, realigned intersections, speed humps, chokers and diverters. Impacts of these features on roadway users (pedestrians/bicyclists, emergency vehicles, transit and maintenance and related vehicles) will be reviewed along with legal and liability issues. Attention will also be given to the process of traffic calming, including public participation, identification of the problem and plan development, approval and implementation. | Online | 1 | 6.00 | 29 |
| Traffic Sign Retroreflectivity/Pavement Markings | Traffic signs provide an important means of communicating information to road users. They need to be visible to be effective. The nighttime environment presents many sign visibility challenges. Since drivers cannot see as many visual cues as they can during the day, this places greater reliance on signs and other traffic control devices. To provide nighttime sign visibility, most signs are made from retroreflective sheeting. Retroreflectivity is the property of a material that re- directs light back to the originating source. Since the retroreflective properties of signs deteriorate over time, road and street officials should assess their schedules for inspecting, cleaning and replacing signs to ensure that these maintenance activities meet the objectives of the Manual on Uniform Traffic Control Devices and, more importantly, the needs of drivers at night. This workshop will help practitioners gain a better understanding of sign retroreflectivity issues in order to improve the overall nighttime visibility of traffic signs. | Online | 1 | 6.00 | 27 |
| Trenching Competent Person | The Occupational Safety and Health Administration (OSHA) safety regulations for trenching and other types of excavations require a trained “competent person” to be at the excavation whenever any employees are involved working in or near the hole. This course teaches required OSHA technique for proper hands-on classification of soils that trained competent persons must be able to perform in order to meet the requirements of OSHA for soil types A, B and C. | Classroom | 3 | 8.00 | 38 |
| Work Zone Traffic Control Supervisor Safety Training Online | This three-day course is designed for NCDOT, larger municipalities, and highway contractors that work on all highway systems, including two-lane roads, multi-lane roadways, and high-volume, high-speed, controlled access facilities. This course covers traffic control plan reading and development, positive protection, work zone capacity, night work, and inspection. Part 6 of the MUTCD and state DOT “Roadway Standard Drawings” are used as the text for this course. Additional handouts are used to supplement thesematerials. All work zone durations are covered in this course. Participants will be tested at the conclusion of the workshop for NCDOT Work Zone Supervisor certification. Certification for the Basic and Intermediate Work Zone Safety Courses are both included in this course. | Online | 5 | 15.00 | 139 |
| Work Zone Traffic Control Supervisor RECERTIFICATION - online | This workshop is intended for people who have completed ITRE’s ‘Work Zone Traffic Control Supervisor’ course andnow need recertification. With NCDOT requiring recertification every 4 years, this course will address updates in work zone safety, including any changes to NCDOT Roadway Standard Drawings and Part 6 of the Manual on Uniform Traffic Control Devices. All participants who successfully complete the course will be certified for another 4 years as a Work Zone Traffic Control Supervisor. | Online | 4 | 6.00 | 110 |
| **PUBLIC TRANSPORTATION / TRANSIT** |
| Enterprise Asset Management (EAM) Training | Specific training on how to use the AssetWorks EAM software for maintenance tracking. | Online | 2 | 2.00 | 18 |
| Operating Statistics Reporting | How to collect and report transit operating statistics. | Online | 6 | 1.00 | 126 |
| Medicaid Direct Miles Billing Models |  | Online | 3 | 1.00 | 155 |
| Transit Skills - Building and Maintaining Effective Organizations through Good Employees | For Public Transportation Services Directors and Administrators—If you want to build your skills at attracting and retaining qualified, committed and motivated employees at all levels of your mobility services organization, this course will assist you in delving into the causes and cures for high turnover, lack of teamwork, and ineffectiveness within your operation. | Online | 1 | 16.00 | 4 |
| Demand Response Planning and Visualization | Introduction to the web-based mapping, planning and visualization capabilities of the Demand Response Planning and Visualization Tools. | Online | 4 | 3.00 | 21 |
| Implementing the Transportation Requirements of the Americans with Disabilities Act (ADA) Part 1- ADA Requirements for All Types of Agencies | ADA is a Federal Transit Administration (FTA) compliance area. The purpose of the training is to review ADA transportation requirements with public transportation agencies (public and non-profit) involved in providing public transit, human services transportation, or general public demand responsive transportation in North Carolina and to discuss key implementation issues. | Online | 8 | 2.00 | 148 |
| Implementing the Transportation Requirements of the Americans with Disabilities Act (ADA) Part 2- ADA Requirements for All Types of Agencies | ADA is a Federal Transit Administration (FTA) compliance area. The purpose of the training is to review ADA transportation requirements with public transportation agencies (public and non-profit) involved in providing public transit, human services transportation, or general public demand responsive transportation in North Carolina and to discuss key implementation issues. | Online | 8 | 2.00 | 142 |
| Implementing the Transportation Requirements of the Americans with Disabilities Act (ADA) Part 3- Additional ADA Requirements for Public Fixed Route Service Providers | ADA is a Federal Transit Administration (FTA) compliance area. The purpose of the training is to review ADA transportation requirements with public transportation agencies (public and non-profit) involved in providing public transit, human services transportation, or general public demand responsive transportation in North Carolina and to discuss key implementation issues. | Online | 4 | 3.00 | 52 |
| Implementing the Transportation Requirements of the Americans with Disabilities Act (ADA) for NCDOT Staff | ADA is a Federal Transit Administration (FTA) compliance area. The purpose of the training is to review ADA transportation requirements with public transportation agencies (public and non-profit) involved in providing public transit, human services transportation, or general public demand responsive transportation in North Carolina and to discuss key implementation issues. | Online | 1 | 1.50 | 18 |
| **TRANSPORTATION INFORMATION MANAGEMENT SYSTEM (TIMS)** |
| Plan B Bus Routing | Back to School Training for Socially Distanced Bus Routes by Student Cohort | Online | 1 | 1.25 | 140 |
| eSQL Vets | This course covers the newer eSQL Bus Routing Module. The course is designed for veteran TIMS Operators to become familiar with the more modern interface. | Online | 4 | 4.00 | 41 |
| Reports & Worklist | Training on TIMS Report Module. Also more advanced using and creating worklists within the Routing Systems that can be linked to Reports | Online | 4 | 8.00 | 87 |
| New Users | Introduction to TIMS: Basic Students, Stops, Runs, Routes and Reports | Online | 2 | 12.00 | 24 |
| UPSTU & EMU | Training on the TIMS UPSTU Process from PowerSchool. Overview of other EMU Functions that are helpful for TIMS projects or tasks and at certain times during the school year. | Online | 3 | 4.00 | 102 |
| Maris 1 | Part 1 of TIMS Geocode Course | Online | 2 | 12.00 | 14 |
| Maris 2 | Part 2 of TIMS Geocode Course | Online | 2 | 12.00 | 12 |
| Maris 3 | Part 3 of TIMS Geocode Course | Online | 3 | 4.00 | 31 |
| Launchpad TIMS | Training for newer users about tools and tasks available within the older module of TIMS. | Online | 1 | 4.00 | 7 |
| Transfers & Middays | TIMS Class on creatining and managing transfer stops as well as mid-day runs\routes for Special Needs | Online | 3 | 8.00 | 31 |
| New TIMS Extract | Training about changes to the methods for downloading the TIMS Extract | Online | 1 | 2.00 | 113 |
| FALL & Summer Planning | Training about preparing for expanded Summer School Programs and the return to School in August | Online | 1 | 2.00 | 204 |
| 2021 TDTIMS | Training about 2020-2021 Springtime TDTIMS Process | Online | 1 | 1.00 | 154 |
| **TOTAL PARTICIPANTS FOR ALL ACTIVITIES** |
|  |  |  |  |  | **4312** |