

WORK ZONE SAFETY & MOBILITY PROCESS REVIEW

For the Federal Highway Administration

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EXECUTIVE SUMMARY

The North Carolina Department of Transportation (NCDOT) is committed to providing safe work zones for all workers and road users while minimizing traffic congestion and adverse impacts on road users and local communities. In response to changes to the Federal Highway Administration's Work Zone Safety and Mobility Rule 23 CFR 630 Subpart J, NCDOT developed its Work Zone Safety and Mobility Policy in 2007. We continue working to fulfill the intent of this policy, which is to support the systematic consideration and management of work zone impacts related to safety, mobility, operations, and training.

This report is an update to the Process Review that was submitted to FHWA in December 2019. Since then, NCDOT has continued to implement strategies found to be effective and added additional measures to fulfill all the goals and intent of the Rulemaking and NCDOT's Safety and Mobility Policy. In addition, NCDOT continues to enhance some pre-existing process elements while still working on improving others such as the collection and usage of work zone data.

PURPOSE AND OBJECTIVE

In 2007, the North Carolina Department of Transportation (NCDOT) committed to systematic consideration and management of work zone impacts related to safety, mobility, operations, and training through the Work Zone Safety & Mobility Policy. The purpose of this review is to assess the effectiveness of the current practices in managing work zone impacts and to determine where improvements can be made. In addition, the process review will ensure compliance and adherence to FHWA's Work Zone Safety and Mobility Rule.

APPROACH

A process review meeting was held on November 9, 2021 with staff from the NCDOT Work Zone Traffic Control (WZTC) Group and the FHWA NC Division Operations Engineer to review the results of the 2019 report and to discuss recent updates and/or improvements. Following that, State Traffic Management Engineer Hummer and staff from the WZTC Group began editing the 2019 report and adding new and relevant material.

RESULTS AND RECOMMENDATIONS

The process review meeting reviewed the results of the 2019 report and evaluated whether any improvements or innovations have resulted in safer or better mobility in our work zones. The highlights of the successes and areas for improvement are described below, along with recommendations to overcome these challenges.

New Practices

Expansion of Interdisciplinary Teams. In the past couple years, WZTC staff have coordinated closely with our colleagues in the Traffic Systems Management and Operations Unit (TMSO) and others in our efforts to use technology in work zones to motorists' advantage. Our focus has been on particularly long (time and distance) work zones on freeways where work would be intense and detours not necessarily easy or apparent. These efforts are multi-disciplinary because in these difficult circumstances we are trying to use all available tools to reach motorists with timely and important information. In mid-2021, our focus turned to I-95, since beginning in late-2021 and extending for several years there will be significant construction with lane closures on almost the entire length of the road in NC. Later in 2021, another task force formed to tackle I-40 in Haywood County, in the Great Smoky Mountains near the Tennessee border, where a series of bridge projects starting this fall will mean lane closures for the next few construction seasons in an area with little room to work and few viable alternate routes. The list of actions being considered and taken is long, including static signs, changeable message signs, dynamic signs, traveler information apps, social media, websites, billboards, welcome center and rest area handouts, and others.

Work Zone Installer Training--A New Requirement. Effective July 1, 2021, at least one member of every crew responsible for the setup, installation, and removal of traffic control devices within any highway

right of way is required to be trained and certified as a work zone installer. The work zone installer should serve as the crew leader and shall be on site and directing the installation and removal of temporary traffic control. All other members of the crew installing and/or removing traffic control must be flagger certified, at minimum, even if flagging is not part of the traffic control work.

The work zone installer was initially a requirement of all personnel in the crew responsible for the traffic control. However, with COVID there were reduced resources available for training across the board, so WZTC went with this approach. It is our intent to eventually require all individuals that are working in the right of way to be installer trained.

Work Zone Education Verification App. The Work Zone Education Verification app (WZ-EVA) launched in March 2021 and allows inspectors and Resident Engineers to quickly verify the training credentials of work zone flaggers, installers, and supervisors in the field. Approved trainers upload training certifications to WZ EVA and issue official wallet cards generated by the WZ EVA system. Rollout has been successful, and we have just over 10,000 records entered as of 11/23/21. We're still enrolling new training providers every week and assisting them with uploading their records to the database. WZ-EVA also provides us with an easy way to disseminate changes to standards to training providers because we will always have up-to-date email contact information for each trainer registered to upload certifications.

Our next steps along these lines are to determine a process and schedule for performing training class audits to ensure materials match the latest NCDOT standards. We are also working on a process to suspend and then re-train individuals or training providers who repeatedly score poorly on WZ field audits.

Pedestrian Accommodations. Strengthened guidelines for pedestrian accommodations in work zones were signed by the Chief Engineer of the Division of Highways in July 2018. In October 2020, WZTC completed and began circulating a draft revision to those guidelines that clarified and further strengthened them. Our goal is to have consistent application of the guidelines on all NCDOT highway projects, from the smallest temporary encroachment to the largest major highway reconstruction over several years, so that pedestrians of all abilities can safely and efficiently negotiate the work zone. We held a training webinar in the summer of 2020 to increase awareness of the guidelines and over 200 professionals from across the state attended. We also added a chapter to the Maintenance/Utility Traffic Control Guidelines (MUTCG) manual to address short term sidewalk disruptions. NCDOT has put extra emphasis on pedestrian maintenance for the past couple of years, but it is mostly relevant to our long term construction projects. Chapter 6 lists appropriate measures to take when a sidewalk will be closed or blocked for durations of 1 hour up to 7 days. After a 7-day disruption in a single location, a TMP is necessary.

New Prequalification Code for Significant Projects. In 2018 WZTC established a new code and set of criteria to prequalify engineers who can then lead the design of traffic control plans in significant work zones. During the past two years we have implemented the new code and criteria. Significant work zones involve lane closures and speed reductions on high-speed facilities, often freeways. Engineers applying for prequalification at the new, higher, level must show significant previous experience on at least a couple of those large projects or must show experience on a large number of simpler work zone projects indicating that they are ready to move up. The new prequalification code is helping to insure, even in the decentralized system of project development employed at NCDOT these days, that only qualified and experienced engineers are designing traffic control in our most complex situations.

Improvements to Current Practices

Mobility Measurements using Intelligent Technology. Over the past several years, WZTC been monitoring the mobility in all major freeway work zones in NC using ClearGuide, a third-party system that collects and processes vehicle probe data. Weekly, single-page snapshots are compiled and distributed to personnel in the NCDOT Traffic Management Unit and to the NC Division FHWA Operations Engineer. We are able to see the ebb and flow of the work zones' mobility throughout the phases of construction. Over the past two years our monitoring system has been of consistent high quality and we have expanded the scope of the reporting. We have also begun collecting data months before a work zone is deployed, which provides a helpful baseline against which to compare once the work zone is active.

Work Zone Reviews. The Work Zone Traffic Control Section implemented procedures and or guidelines for the review of work zones in 2013. We also established a work zone scoring system that objectively evaluates the work zones by scored categories and providing an overall score. In 2018, we began regular nighttime work zone reviews, and during the past two years we have increased the number of reviews we have conducted to about 25 per year. Most interstate construction operations happen during the night hours between 9 pm and 5 am. Reviewing work zones at night provides opportunity to evaluate the nighttime work operations procedures including the use of sequential flashing warning lights and work zone presence lighting, as well as review the visibility of the pavement markings and work zone signs. Conclusions made from the work zone review are provided to the contractor, division personnel, and the NCDOT Construction Office. We use this information to determine if there is any correlation between work zone crashes and the type of work, entity performing the work, and the possibility of training requirements. During most reviews we find that the NCDOT and contractor personnel are operating good quality work zones, but occasionally we see large issues that need immediate attention.

Smart Work Zones. Smart and connected technology has been implemented in an increasing number of projects throughout North Carolina over the past couple of years. Traveler information systems on I-5111 (I-40 in Wake and Johnston Counties) and on I-3306A (I-40 in Orange County) use a combination of sensors and message boards to notify drivers of traffic conditions in the work zone. Typical messages are "Travel Times Normal", "Delays Exceed xx minutes", or "Major Delays – Follow [Alternate Route]". Due to significant device reliability issues on the I-5111 project, the Department has instituted liquidated damages into the contract for the I-3306 project for any device not repaired within 72 hours after notification to the contractor.

Dynamic Zipper Merge. In 2019, NCDOT introduced Dynamic Zipper Merge Systems to our work zone strategy toolkit. Dynamic Zipper Merge Systems are similar to the previously used Portable Queue Warning Systems in that they automatically detect traffic conditions, namely slow/stopped traffic, and change the messages on portable changeable message signs to warn drivers before they reach the back of the traffic queue. To take it one step further, Dynamic Zipper Merge Systems are capable of driver merge instructions. Once congested conditions are met and the traffic queue reaches a specified length, the system will no longer tell motorists which lane is closed in advance. This forces the motorists to use all open lanes up to the merge point and then take turns to merge into a single lane. Once congested conditions are no longer present, the system will revert back to standard lane closure messaging. The Dynamic Zipper Merge System has been a key solution to reduce long queue lengths in effort to decrease the risk of back of queue crashes. NCDOT has only used Dynamic Zipper Merge Systems for projects that require long term lane closures and the final design does not increase roadway capacity.

Three projects used these systems during 2020-21. Two of those projects required long term lane closures on four-lane divided highways to complete full depth concrete replacement that could not be reopened to traffic within one work period, while the third was a permanent lane drop location. The first Dynamic Zipper Merge System was installed and in operation in May 2019 on I-77 in Surry County near Elkin and has been aiding operations in that work zone for over two years. The project is almost complete now. NCDOT was able to observe the traffic in real time the moment the system was turned on. Drivers immediately began to use both lanes to the merge point, thus reducing the traffic queue length significantly. The second project is on I-40 in Davie County between Winston-Salem and Statesville and is now complete. In 2018 and 2019, this project utilized a Portable Queue Warning System. It was a straightforward process replacing a couple of devices and upgrading that system to a Dynamic Zipper Merge System. Again, the dynamic zipper merge system helped reduce queues for over two years. The permanent lane drop location is on NC-58 on the approach to the Emerald Isle Bridge. NCDOT attempted a static zipper merge at this same location in 2016 but was unsuccessful. The dynamic system installed with the help of the WZTC Group seems to be more effective and may lead to a permanent system being installed there.

Anticipated upcoming installations of dynamic zipper merge systems include B-6054A in Haywood County on I-40 at Exit 7, I-6003 in Davie County on I-40 between NC-801 and SR-1436, and 15BPR.20 in Henderson County on I-26.

Nighttime Work Operations. Daily time restrictions for construction activities continue to play a large role in the way we build our roadways and bridges. Working during the night limits the number of motorists exposed to the work zone and limits the number of motorists exposed to the construction hazards. To continue NCDOT's commitment to mobility and safety during construction operations occurring at night, Sequential Flashing Warning Lights and Digital Speed Limit Signs are now standard practice for interstate and/or primarily nighttime construction operations.

We continue to see overwhelmingly positive feedback from the construction industry and our regional traffic partners on the Sequential Flashing warning lights. We have seen several more manufacturers produce these lights as they see the demand for them rise.

Work Zone Presence Lighting. Work Zone presence lighting has been used on many nighttime construction projects in the past two years to supplement the Contractor's portable tower lighting already onsite. NCDOT management and field staff support WZTC's effort to increase the amount of light in active work zones, not only for worker safety, but for motorist awareness. Several years ago, WZTC was made aware of two constraints:

1. Motorists did not pass the first presence light until after they were already in the active work area.
2. During certain operations, the presence lights presented some challenges for the contractor including space conflicts with equipment and the requirement to reposition the lights throughout the night as work progressed.

To address both issues, presence lights are now used in advance of the lane closure. Motorists now see the first presence light approximately a mile and a half in advance of the lane closure merge taper and at regular intervals between 500' and 1000' depending on the light fixture size and distance from the merge taper. As the motorist gets closer to the lane closure merge taper the spacing between the lights decrease to create the effect of traveling at a faster speed than their actual travel speed. These changes

went into effect statewide October 2019 and have been a part of all contracts with presence lighting since, with positive results in our experience. Presence lighting is standard practice, and will likely soon be a requirement, for interstate resurfacing projects that typically have long lane closure lengths and large gaps of dark/unlit areas within the lane closure.

Digital Speed Limit Signs. Digital signs continue to display the speed limit brightly and clearly to motorists during the night and day. These signs are regulatory speed limit signs with LED displays for the speed limit numbers. The speed limit is changed remotely and immediately by personnel depending on the operation. NCDOT was finding that there were inconsistencies across projects whether the digital speed limit signs were only visible to motorists during nighttime lane closures or whether they were left visible to motorists throughout the day as well. The idea is that the digital speed limit signs completely take the place of existing stationary speed limit signs for the duration of the work in that area. This has been communicated to our area construction staff for current and upcoming projects. Over the past two years we have had no major issues with digital speed limit signs and think they have been working well.

WZTC also began testing the effect of presence lights and digital speed limit signs on motorist speeds in the fall 2019. Six projects were selected across the state to capture speed data for three different conditions:

1. No Presence Lighting and no Digital Speed Limit Signs
2. No Presence Lights and with Digital Speed Limit Signs
3. With Presence Lighting and with Digital Speed Limit Signs

Data collection was completed on four of the six projects, but then Covid emerged and the project was suspended. We hope to get that research restarted and then completed in the next couple of years.

Significant Projects Appearance. NCDOT WZTC remains committed to safe and efficient work zones and continues to improve the appearance of significant work zones. As introduced in the 2017 WZ Process Review, work zone performance pavement markings and high visibility devices have been used on many projects, mostly with success. Work zone pattern masking has continued to have some highs and lows.

Work zone performance pavement markings are long life markings (polyurea, epoxy, thermoplastic, polymer, and cold applied plastic - removable tape) to provide a more durable and higher performing work zone pavement marking, compared to traditional paint, for temporary traffic patterns that will be in place for 12 months or more. The markings are required to last the full duration of a traffic pattern without replacement or reapplication for a period of 12 months. The markings are also required to meet certain retroreflectivity numbers to improve nighttime work zone visibility. Work zone performance pavement markings will also be essential when automated vehicles become common and sensors are used to detect lane and edge lines. NCDOT has an on-call contract with a private company to perform mobile retroreflectivity readings across the state. These scans are completed at typical driving speeds without having to exit the vehicle. Retroreflectivity scans of work zone performance pavement markings across the state have yielded various results. Yellow and white marking retroreflectivity has not always met the numbers required by the contract, but the nighttime visibility is far greater than what we experienced before we began this practice. WZTC is still evaluating whether these mixed results should result in changes to any of our requirements.

High visibility devices are all new drums and stationary and portable work zone signs required for projects on interstates and freeways with durations of 24 months or more. New devices enhance visibility to improve both safety and mobility through a high-speed work zone. Fluorescent vertical sign post reflector strips were added as a requirement to stationary signs in 2019 to further enhance sign conspicuity. We will continue the use of high visibility devices to enhance our high profile, long duration interstate and freeway projects.

Work zone pattern masking is a flat, black, liquid material applied by spray mechanism to conceal the entire existing pavement surface, and it continues to be used on projects with both successes and failures. Many factors must come together for a successful application including the product makeup, application equipment and methods, roadway surface preparation and the weather. NCDOT is learning that very high humidity or low temperatures cause long dry times and affect the setup of the material, and thus the overall performance of it. Work zone pattern masking has been applied within the last two years to projects on I-40 in Burke County, I-40 in Wake County (twice), I-40 in Iredell County, I-77 in Iredell County, I-440 in Wake County, and I-485 in Mecklenburg County. WZTC has been in constant coordination with NCDOT construction personnel and vendors to yield the best results of this product, but more applications are still necessary to fine tune it. Some of our findings to this point include:

- We had one successful installation on I-40 in Burke County but other applications have been riddled with issues such as the masking material flaking off of existing thermoplastic lines within 30 days of application and excessive fade out of the material long before the expected duration.
- Contractors have struggled with the application process and dislike the liability it presents to them if the material doesn't have the expected longevity.
- A successful application requires many different things to go completely right. The dry times have been far too long as the material is very sensitive to high humidity and low temperatures. This has been limiting contractors to put down the material only under the best conditions which isn't practical from a construction timeline standpoint. This affects the timeline of shifting traffic and therefore the project timeline itself.

Moving forward, we've been asked by the Construction Unit and other Department personnel to continue to work on the formula and application practices and, in the meantime, only to use the material in low profile projects, short areas, and bid build (reducing our risk). We included pattern masking in several high profile, significant projects that led to supplemental agreements and additional costs and time to remove pattern masking from the contract and add traditional line removal methods.

We are also considering changing the method of application so that the pattern masking material is placed after traffic is shifted. This means that the contractor completes the traffic shift using traditional line removal methods and paint pavement markings and then the next night or a short time later applies the pattern masking and performance pavement markings. Keeping the operations separate helps timing issues and liability on the contractor.

We are confident that at some point we will arrive at the correct material specification and application methods to be able to eliminate traditional pavement marking removal methods.

Review of Ongoing Successful Practices

Connected Lane Closure Devices. These devices were introduced on projects in 2018. Connected lane closure devices are essentially small GPS transmitters attached to or adjacent to the merge taper flashing arrow board and attached to or adjacent to the last traffic control device in the lane closure. These devices transmit their location to navigational companies and the NCDOT State Traffic Operations Center (STOC). The goal is to allow motorists to see active lane closure information in any navigational software they are using. This is one of many efforts to increase our vehicle-to-infrastructure resources and prepare NCDOT for automated vehicles. These devices have been on many projects over the past couple of years; however, we have found that the communication languages between the devices, the navigational companies, and NCDOT are incompatible at times. NCDOT has had and will continue to have correspondence with navigational companies, the STOC, and the device manufacturers to bridge this gap.

WZTC has also seen issues with the connected lane closure devices not being used due to them being integrated into flashing arrow boards without a clear distinction between a regular arrow board and connected arrow board. Traffic control installers see an arrow board in the yard and use it without necessarily knowing whether it's a connected one or not. We need a better way of identifying which arrow boards are equipped with connected technology.

We also know that we will need to work with contractors to turn off arrow boards. Standard industry practice is to leave them flashing 24/7 and just fold them up, which will cause false positives once connected devices become more common.

WZTC is working towards connected lane closures becoming a standard on interstate resurfacings first.

Traffic Safety & Operations Meetings. Safety & Operation Meetings continue to be added and utilized on most design-build and significant projects. These are held on a biweekly or monthly basis and are planned and executed by the Division Incident Management Engineer. Law enforcement, emergency services, construction staff, traffic engineering staff, contractor staff, public information officers and the TMP design team meet to discuss recent traffic issues including WZ crashes, upcoming schedule, traffic shifts, lane and road closures, incident response issues, etc. In addition, they discuss specific solutions to these traffic related issues to improve the congestion and traffic operations in and around the project. We will continue this practice with all upcoming design-build and significant projects.

Active Construction Project Discussions and Let List Meetings. These meetings are held on a semi-monthly basis and continue to provide valuable information. The participants of the meeting include WZTC, which is responsible for the development and/or oversight of the transportation management plans (TMPs), and TSMO, which is responsible for statewide coordination of incident management and intelligent transportation systems efforts. These meetings also help establish early communication between what goes in the TMP and how the work zone operates in the field. We have been able to discuss projects two to three years in advance of the let date to foster early involvement by TSMO and prevent last minute issues. We also use the results of these meetings to select candidate projects for our "HAWKS" program (see below).

Helping All Work Zones Keep Safe (HAWKS). HAWKS is a joint initiative between NCDOT and the North Carolina State Highway Patrol (NCSHP) to utilize off-duty law enforcement officers to monitor and patrol

work zones. This initiative provides dedicated enforcement in a specific work zone to improve safety and mobility. NCDOT prioritizes the work zones using crash rates, existing congestion, average speeds, and roadway tier classification (statewide, regional, sub regional) as the scored criteria. Projects with the higher scores are selected for the program and notifications are sent to the Resident Engineer and the State Highway Patrol Office for staffing and scheduling assignments.

Work Zone Speed Limit Reductions. The Work Zone Traffic Control Section is continuing to apply speed limit reductions in most cases during high-speed lane closures and other traffic control situations that warrant a lower speed. All speed limit reductions still require an ordinance once the project and/or operation meets certain criteria. The advantage of variable speed limit reductions has been evident on interstate and freeway resurfacing projects, subject to primarily nighttime lane closure operations, with normal traffic patterns existing during the daytime. We continue to implement variable speed limit reductions easily with the use of digital speed limit signs. The speed displayed on the signs can be changed throughout the work area immediately and simultaneously from a device. As soon as the operation concludes, the speed limit can again be changed back immediately.

Longer term speed limit reductions in work zones have separate criteria and are used when highway geometrics have been altered and/or usable shoulders have been eliminated. When these types of conditions exist, the reduced speed limits are displayed on standard regulatory speed limit signs.

\$250 Work Zone Speeding Fine. This practice has been used in North Carolina for over 20 years. The NC general statute for \$250 speeding fine was revised to allow the penalty to be used in sections of a work zone where the actual work is taking place. Previously, the wording of the law required the penalty to be applied for the entire work zone. The public was frustrated that fines were levied in areas where no work was taking place, particularly with long Interstate resurfacing projects. To date, we have experienced few concerns from the law enforcement community and frustrated drivers. The lesson learned was that if we use this technique judiciously the compliance rates will dramatically improve, along with the willingness of law enforcement to apply this fine.

Work Zone Supervisor. North Carolina requires a work zone supervisor for each company that performs work within our right of way. We also require it for each division within NCDOT. Contractors and NCDOT divisions are allowed to determine how many work zone supervisors they need based on their work loads, but they must have at least one. The requirements are based on years of experience (work zone experience and supervisory experience) as well as the successful completion of an approved Work Zone Supervisor course. Once a person is qualified as a work zone supervisor, they have two major responsibilities:

1. They must be available to work crews to assist and answer work zone set up questions.
2. They are also responsible for making sure all their employees have adequate work zone training to safely carry out their tasks.

On significant projects, we require a work zone supervisor to be staffed directly to the project. A project special provision is added to the contract that stipulates the duties and responsibilities of this requirement. The purpose of this position is to provide NCDOT with a point of contact that is responsible for safety and mobility in the work zone. This position is also responsible for ensuring coordination between projects in the same network, monitoring queues, and coordinating with traffic management centers. This practice has provided better communication between the traffic management centers and project personnel.

Upcoming Improvements to Current Practices

Formalize Interdisciplinary Teams. We mentioned above how in the past couple of years NCDOT has been more active in forming large interdisciplinary teams to tackle getting optimum motorist information out during particularly large interstate construction projects. In the next few years we expect those efforts to increase and improve as we gain experience with what works. The biggest and toughest one on our radar for the next couple of years is the reconstruction of I-85 in Gaston County west of Charlotte. That is a desperately-needed project on a vital corridor with growing demands, no good obvious detour routes, very little space available in the current right of way. We anticipate that in 2022 we will settle on some sort of formal staffing arrangement for such interdisciplinary teams to ensure that the process is a routine and continuous one rather than an ad hoc process that must be reinvented with each looming reconstruction project.

Areas for Improvement

Work Zone Fatal Crashes. This is by far the main concern of WZTC as of this writing. From reviewing WZ crash data over the past several years, the number of reported WZ crashes has been steady in recent years, but the number of fatal crashes increased in 2020. This is despite the fact that in 2020 overall traffic demand was down due to Covid and undoubtedly demand in NC work zones was down as well. The relevant statistics include:

5 year avg. (2016 - 2020) = 6,852 WZ crashes
 5 year avg. (2016 - 2020) = 27 WZ fatal crashes
 2020 = 5,942 WZ crashes
 2020 = 38 fatal WZ crashes (43 fatalities)
 2021 (as of 11/5/21) = 21 fatal WZ crashes (22 fatalities)

We monitor and analyze these data regularly to determine whether the work zone directly contributed to the occurrence and/or severity of a given crash. Often, the work zone had no impact on the occurrence and/or severity. Impaired, distracted, and speeding motorists continue to be a concern in work zones. However, if work zone safety is improved for the average motorist it will also improve for the impaired, distracted, or speeding driver.

We concentrate on fatal crashes that were within the limits of a work zone due to limited staff and time. Other work zone crashes are reviewed on a project-by-project basis. As technology improves and government silos are reduced, being able to review more of this information will allow us to be timelier in the assessment of the crashes and may also help drive the content of our work zone training.

Work Zone Data. Work zone data collection and usage is still an area where improvements can be made. As noted above ClearGuide data are being used regularly to monitor speeds in our major freeway work zones on a weekly basis. The next improvement may be from Streetlight data, which also uses cell phones to provide speeds, link demands, turning movements, weaving demands, and similar data at quite granular levels. The Mobility and Safety Division recently contracted with Streetlight for a year-long test of the capabilities of this service, and WZTC is active and involved in that test.

Process Review. NCDOT is still committed to conduct a bi-annual Process Review to assess performance of existing processes and procedures and make changes that bring about improvements. NCDOT will be using data from the FHWA Work Zone Self-Assessment Program and Safety Audits during the process review. Recent organizational changes and budget constraints have had an impact on the needed resources to conduct these reviews. However, NCDOT is working on a recommendation to develop a procedure for conducting process reviews and make it an integral part of the business process.

Continued Education Efforts. One of the biggest challenges facing work zone traffic control at NCDOT is the need for continued and improved education of all the parties across such a vast system. NCDOT necessarily runs a very decentralized system, with hundreds or even thousands of division staff members and contractor employees making large and small decisions all of the time that have consequences for the safety and efficiency of motorists and other road users in our work zones. Webinar technology and websites are great tools to reach these actors, and contract provisions help greatly in ensuring some level of compliance, but one does not have to drive far in NC to find some work zone practices that fall far short of ideal. We need to continue and strengthen our efforts to educate and encourage our partners across the state at all levels to do the right things for our stakeholders.

CONCLUSION

It has been a challenging couple of years in NCDOT work zones. A crisis in Department finances hampered our ability to do many things, including fill vacant positions. Covid changed much, of course, including our work places and habits. Labor and material shortages in the construction industry caused prices to soar and experience levels to decrease. While demands and congestion were down, speeds and fatalities were up. Nonetheless, work zone traffic control at NCDOT continued to try to manage and innovate and do what we could to mitigate the negatives. We improved our practices in several ways, including several brand new innovations and several improvements to previous procedures. We also put more resources into things that were previously shown to be working. We have a long way to go before we will be satisfied, but with stable (or even increased) funding prospects in the next few years, Covid seeming to be receding, and no shortage of promising ideas to try, we feel optimistic about our chances to mitigate the negatives in the next couple years.

REFERENCE MATERIAL

- FHWA Work Zone Safety & Mobility Final Rule Effective October 12, 2007, available at http://ops.fhwa.dot.gov/wz/resources/final_rule.htm.
- FHWA Temporary Traffic Control Devices Final Rule Effective October 4, 2008, available at <http://ops.fhwa.dot.gov/wz/resources/policy.htm>.
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