



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

JOSH STEIN
GOVERNOR

DANIEL H. JOHNSON
SECRETARY

February 17, 2026

NOTICE TO PROSPECTIVE BIDDERS

Subject: Addendum #1
Division Eleven

Contract No.: MK00189
WBS: TBD
County: Alleghany, Ashe, Avery, Caldwell, Surry, Watauga, Wilkes, and Yadkin Counties
Location: Various Secondary and Primary Routes within Division 11
Type of Work: ID/IQ Work Zone Traffic Control Services
Bid Opening: February 19, 2026

To Whom It May Concern:

Reference is made to the proposal furnished to you on this project.

The following revisions have been made to the proposal:

Page Number	Revision
Proposal Cover	Note added that reads "Includes Addendum Number 1 Dated 02-17-2026".
TC-3 though TC-21	Clarifies and corrects the traffic control by specifying that the number of flaggers incidental to each lane closure line item is three (3), four (4) with a pilot car.

The contract will be prepared accordingly.

Sincerely,

Bethany Elmore, PE
Division Contract Engineer

- CC: Michael Poe, PE, Division Engineer
 Brandon Whitaker, PE, Deputy Division Engineer
 Ivan Dishman, PE, Division Construction Engineer
 Matthew Evans, PE, Division Maintenance Engineer
 Ramie Shaw, PE, Division Program Development Engineer
 Chris Brown, Division Traffic Engineer
 Sam Henson, Deputy Division Traffic Engineer

Mailing Address:
NC DEPT. OF TRANSPORTATION
DIVISION ELEVEN
P. O. BOX 250
NORTH WILKESBORO, NC 28659

Telephone: (336) 903-9101
Website: www.ncdot.org

Location:
NC DEPT. OF TRANSPORTATION
DIVISION ELEVEN
801 STATESVILLE RD
NORTH WILKESBORO, NC 28659

When lane closures are not in effect, space channelizing devices in work areas no greater in feet than twice the posted speed limit (MPH), except 10 ft. on-center in radii, and 3 ft. off the edge of an open travelway. Refer to *2024 Standard Specifications* Sections 1130 (Drums), 1135 (Cones), and 1180 (Skinny Drums) for additional requirements.

Refer to attached details and Standard Drawing No. 1101.02, 1101.03, 1101.04, 1101.05, 1101.11, 1110.01, 1110.02, 1115.01, 1130.01, 1135.01, 1145.01, 1150.01, 1165.01, and 1180.01 of the 2024 Roadway Standard Drawings when closing a lane of travel in a stationary work zone such as pavement patching, resurfacing, curb ramp work, or pavement marking removal. Properly ballasted cones and skinny drums may be used instead of drums. However, drums are required for the upstream taper portion of lane closures in all applications. The stationary work zone shall be a maximum of 1 mile in length at any given time on 2 Lane, 2 Way facilities unless otherwise approved by the Engineer. A pilot vehicle operation may be used in conjunction with flaggers and the appropriate pilot vehicle warning signing as directed by the Engineer. During periods of construction inactivity, return the traffic pattern to the existing alignment and remove or cover any work zone signs. When covering work zone signs, use an opaque material that prevents reading of the sign at night by a driver using high beam headlights. Use material, which does not damage the sign sheeting.

Measurement and Payment

Compensation for Lane Closure shall be for work listed above and shall include but not be limited to, installing, maintaining, and removing Traffic Control Devices.

All payment is based upon the traffic control being set up for ten (10) hours or less and a length of 1 mile or less. The length of traffic control will be measured from the first Drum at the beginning of the installation to the last Drum at the end of the installation.

Compensation for Lane Closure, each additional mile shall be on a per mile (or portion thereof) basis and shall be in addition to compensation provided for the specific "Traffic Control Item" installed, if the traffic control area exceeds 1 mile.

Compensation for Lane Closure, each additional hour shall be on a per hour (or portion thereof) basis and shall be in addition to the compensation provided for the specific traffic control item installed, if the length of time exceeds the original ten (10) hour period. However, this item will only be paid if the contractor is on the job and ready to work at the scheduled time for Scheduled Traffic Control.

Compensation for Reset Traffic Control shall be paid for each time the contractor has to remove and reset traffic control devices in same location during the life of the "project". The initial

closure will be paid by the line items specified elsewhere in the contract. Any additional installations by the same crew in the same 10 hour operation will be paid as a Reset of Traffic Control. This payment will not include the closure and opening of ramps inside of the initial closure as it is incidental to the closure.

Each Lane Closure will include the work of 3 flaggers (including AFAD or PTS units). If a pilot vehicle is used for Lane Closure, Line Item Price for Lane Closure will include the work of 4 flaggers. The operator of a pilot vehicle will be considered one of the 4 flaggers. Any additional flagging beyond the included amount covered in the Lane Closure Pay Items will be considered additional flagging and compensated at the contract line item Flagger as approved by the Engineer.

Truck Mounted Attenuators (TMA) will be measured and paid for each day TMA's are acceptably placed and in use at any one time for all operations other than Moving and Mobile Operations. TMAs will be incidental to all moving and mobile operations.

Pay Item	Pay Unit
2 Lane, 2 Way Roadway, 1 Lane Closure, 10 Hours or Less, 1 Mile or Less	Each
Multi-Lane Roadway, Lane Closure, 10 Hours or Less, 1 Mile or Less	Each
Lane Closure, Each Additional Mile	Each
Lane Closure, Each Additional Hour	Each
Reset Traffic Control	Each
Truck Mounted Attenuator	Day

Signs (portable, stationary, and/or barricade mounted), Portable Changeable Message Signs (PCMS), Flashing Arrow Boards (FAB), Pilot Vehicle, Flaggers, Cones, Skinny Drums and Drums will be measured and paid in accordance with the item's specific Section in the 2024 Standard Specifications, Section 1105 of the 2024 Standard Specifications, or the item's Special Provision, as determined by the Engineer.

CONNECTED LANE CLOSURE SYSTEM
(10/29/2018) (Rev. 2/17/2026)

Description

Furnish, install, operate, maintain, relocate, and remove Connected Lane Closure Systems (CLCS) for lane closures on multi-lane roadways with posted speed limits of 55 mph and greater. The purpose of CLCS is to transmit real-time information of active lane closures for use by the State Transportation Operations Center (STOC), Regional Transportation Management Centers (TMCs), and traveler information systems; and for third party vendors (Mapping, Navigation, Connected Vehicles, etc.) to identify and provide advanced notification of active lane closures to approaching motorists.

Materials

The CLCS shall be designed and built to transmit the real-time location and direction of the lane closure. The information transmitted shall conform to the current version of the USDOT's Work Zone Data Exchange (WZDx) specification and be made available to NCDOT approved consumers of this data. More information about the WZDx specification can be found at <https://www.transportation.gov/av/data/wzdx>

The connected lane closure devices shall be capable of wireless communication.

The initial connected device representing the START location shall be designed and attached to the flashing arrow board in such a manner that it is only activated when either the left or right arrows are displayed, not when the flashing arrow board is operated in caution mode. The connected device shall no longer transmit location information when the flashing arrow board is turned off or changed to caution mode. The device shall have a visual indicator (e.g. an illuminated light, either steady burn or flash) to allow clear, visual proof the device is powered on, has established communication and is transmitting. The visual indicator shall not be located such that it potentially creates confusion for the motorists.

A second connected device representing the END location shall be installed on a crashworthy traffic control device. It shall have an easily accessible power switch and a small status indicator light mounted such that it is visible when passing by in a vehicle at operating speed. When switched to the ON position, the light shall indicate the device has established communication and is transmitting. The light may be either steady burn or flashing and shall not exceed one (1) inch in diameter. This second connected device representing the END location may be created virtually by a connected flashing arrow board.

The devices shall have sufficient battery life to maintain operation for the duration of the lane closure or can be recharged without deactivating the device or impacting the lane closure information transmitted to the external parties. All costs associated with charging are incidental and shall be included in the cost of the system.

Construction Methods

CLCS shall be used on all lane closures on multi-lane roadways with posted speed limits of 55 mph and greater throughout the duration of the project.

A START and END location shall be established by the installed system per grouping of lane closures (single, double, or triple); one attached and wired into the flashing arrow board at the beginning of the first taper. The other at the last traffic control device at the end of the lane closure(s) if the END location cannot be created virtually. Supplemental flashing arrow boards in advance of the first lane closure taper or flashing arrow boards in subsequent lane closures (for double and triple lane closures) shall not transmit location information if equipped with connected devices. Subsequent lane closures occurring downstream of where all lanes have been reopened or lane closures in the opposite direction of travel will require additional connected devices.

The second connected lane closure device shall be manually turned ON and OFF by crews installing and removing the lane closure unless the device can be controlled or virtually created by the initial connected device. The unit shall be turned ON immediately upon installation of the lane closure and turned OFF immediately upon removal of the lane closure.

When the lane closure is removed, the flashing arrow board shall be turned off or changed to caution mode, and the connected device shall automatically turn off simultaneously and shall no longer transmit location information. Turning the device away from traffic or moving the device to a staging area with the arrow board in arrow mode is not acceptable.

The CLCS shall run continuously during any active lane closure for the duration of the contract. Once installed, the Contractor shall verify that the connected lane closure devices are transmitting information prior to leaving the device unattended and re-verify transmission every 72 hours for long-term installations.

Technical Requirements

The GPS within the connected devices shall have a horizontal accuracy of 10 feet, 95% of the time.

The system shall send real-time alerts to designated NCDOT personnel when the flashing arrow mode or direction is changed. The alert shall be within 5 minutes of the actual change.

The connected device shall transmit a Connected Work Zone (CWZ) Device Feed in compliance with the Work Zone Data Exchange (WZDx) specification (WZDx Specification (Field Device) / Connected Work Zone Specification (CWZ)). The feed shall be transmitted within five (5) minutes of initiation and updated every fifteen (15) minutes to the central server.

All required properties shall be transmitted. In addition, the following properties are also require:

- Road Direction
- Road Name
- Status Messages
- Is in Transport Position

More information about the WZDx specification can be found at <https://www.transportation.gov/av/data/wzdx>.

The Contractor shall provide multiple logins to a secured server (e.g. vendor dashboard) that provides real-time and historic status. The status must be exportable, within 24 hours, in .csv or .xls/.xlsx format and include data for date, device name, flashing arrow mode, communication status, road name, road direction, battery voltage, time on, time off, and GPS coordinates. The historic logged information shall be available to CLCS users 24/7/365 during the length of the entire construction phase. All logged information from the project shall be retained by the Contractor and be available to the NCDOT for at least three (3) years after the contract ends.

The battery voltage shall be collected at least once an hour. The information shall be stored and available for troubleshooting. To prevent communication loss, the system shall transmit an alert via E-mail or SMS to designated personnel if the battery voltage of a device is under a specified threshold.

The CLCS shall provide an immediate electronic alert (e.g. via E-mail or SMS) to the Traffic Control Supervisor or other designated individual if a device is not transmitting its position for a period of 30 minutes or more.

The outputs from the connected device on the arrow board and the downstream connected (or virtual) device at the end of the lane closure shall be easily identifiable as a single system, either by sequential device IDs, identical project names, or other method as approved by the Engineer. Additional pairs on the project shall have unique identifiable information such that it is not confused with another project system.

Measurement and Payment

Connected Lane Closure System will be measured and paid as the maximum number of connected systems acceptably placed and in use at any one time during the life of the project. Each lane closure system may be satisfied by one of the following:

- Two (2) connected lane closure devices; one connected to the flashing arrow board and the other on a crashworthy device at the downstream end of the lane closure.
- One (1) connected lane closure device connected to the flashing arrow board that can generate a virtual END location with 10' accuracy.

All devices for each system must be functioning properly to receive payment for the system. No payment will be made for a system until all devices are satisfactorily installed and operational at the device and on the vendors dashboard. A copy of the device status reporting should be provided by the Contractor every 2 weeks.

The price for each connected lane closure system will cover all material, labor, maintenance, relocation, removal, and communication costs required for the duration of the project.

Flashing arrow boards and crashworthy devices (such as drums) used to mount the downstream connected lane closure device are paid separately elsewhere in this Contract.

Pay Item**Pay Unit**

Connected Lane Closure System

Each

DYNAMIC ZIPPER MERGE SYSTEM:

(12/10/2019) (8/3/2021) (Rev. 10/13/2023)

Description

Provide, install, program, relocate, operate, maintain, and remove an automated, stand-alone, real-time Dynamic Zipper Merge System meeting the requirements noted herein, until project completion for the duration specified by the Engineer.

A Dynamic Zipper Merge System is a group of devices that work together using software to automatically detect traffic conditions and respond using preprogrammed response algorithms. The purpose of this system is to provide advance notification to motorists of traffic queues in advance of long-term lane closures in order to reduce the likelihood of high-speed crashes and to encourage either early or late lane merges depending on live traffic conditions.

The Dynamic Zipper Merge System shall detect the presence of a lane closure and slow/stopped traffic queues that develop in advance of the lane closure and display lane closure or slowed/stopped and driver merge instruction messages on the integrated message boards.

Materials and System Operational Requirements**A. General**

These specifications cover the general operational requirements for the Dynamic Zipper Merge System. The Dynamic Zipper Merge System shall be positioned at locations indicated in the contract or designated by the Engineer.

Provide physical and electronic/software protections for all components of the system and processes pertaining thereto prevent access by unauthorized parties.

Provide the following for this project:

- Customized website integrated with each Dynamic Zipper Merge System for NCDOT and project partners.
- Traffic Management Software capable of analyzing data and accurately supplying the indicated information.

Provide the following equipment for each Dynamic Zipper Merge System:

- 7 Traffic Speed Sensors
- 6 Portable Changeable Message Signs
- 2 Full Matrix Display Portable Changeable Message Signs, capable of displaying a flashing arrow indication

- Communication equipment for all above devices to include all components and communication methods necessary to allow each device to send and receive data to and from the website and Traffic Management Software.
- Integration equipment to receive lane closure status from Connected Lane Closure Devices (see separate Special Provision).

B. Documentation

Provide a set of complete specifications and literature on the selected Dynamic Zipper Merge System. Address all the requirements of the Contract Documents in the submittal. Provide documents for each device containing all information necessary to determine product specification compliance. Provide the detailed security plan and protocol used to protect data and communications of the Dynamic Zipper Merge System to the Engineer for approval at least 10 days prior to the delivery of the Dynamic Zipper Merge System. This plan includes physical locking mechanisms where the locks are unique for this Dynamic Zipper Merge System (a key to be provided to NCDOT), password handling techniques, and limited static IPs for remote access to equipment.

C. Power Source

Provide power for devices for continuous operation, as defined in the section Malfunctions, Maintenance, and Inspection below. All utility hookups, solar panels, batteries and other power sources are incidental.

D. Installation

Locate and aim the devices to ensure data accuracy. Coordinate installation locations and details with the Engineer prior to installation.

E. Traffic Sensors

Provide sensors to withstand and operate in, without deterioration, inclement weather and visibility conditions including sunlight, light precipitation, temperature, light, fog, darkness, excessive dust and road debris.

Provide sensors which:

- Collect and report individual vehicle data;
- Collect and report data on a per lane basis;
- Collect speed, volume, and lane occupancy data, for the required direction(s) of traffic; and
- Communicate data to the Traffic Management Software at least once per minute.

Install and maintain sensors to continuously detect all public traffic on **Any Road, as per Work Order Assignment or as Directed by the Engineer**. Configure sensors to allow active and inactive collection zones, so that construction traffic is differentiated from public traffic. At a minimum, detect speed, volume, and occupancy levels in each lane, each minute. Summarize data in 5 minute bins for data storage and transfer. Do not block or shield critical locations from the sensor. Test each sensor and re-test as needed to confirm the accuracy of the data reported.

Collect and report data to the Traffic Management Software which meets the following requirements at any given time during testing and operation:

- Per direction volume accuracy: greater than 90%;
- Per lane volume accuracy: greater than 90%; and
- Per direction average speed accuracy: greater than 90%.

F. Portable Changeable Message Signs (PCMS)

Provide and maintain Portable Changeable Message Signs (PCMS) capable of displaying the traffic queue length and travel time advisories to motorists. Provide PCMS that meet or exceed the material and functional requirements as described in the Contract Documents. The PCMS shall be capable of communicating wirelessly with and being controlled by the Traffic Management Software. Provide signs which display messages and log the date, time and text of the messages when being controlled by the Traffic Management Software.

No more than 1 pixel illumination failure on the board shall be allowed at any given time during testing and operation. Continuously monitor PCMS status. Include in the monitoring procedure an evaluation of power levels, communication connections, and the number of unlit pixels. Also, use a human observer periodically to document that the correct message is displayed with the correct date and time.

G. Traffic Management Software

The software has three main functions: Queue Warning, Driver Merge Instructions, and Lane Closure Notification. Use software that meets or exceeds the following requirements for each function:

Queue Warning

The intent of the Queue Warning function is to detect traffic congestion and queue formation and notify approaching drivers of the conditions. Queue Warning is the most critical function of the system. Continuously monitor traffic and report the required operational characteristics to the software each minute. Use a combination of real-time speed and percent lane occupancy information reported by traffic sensors, compared with configurable thresholds, to initiate a slow, stopped, or driver merge instruction message. Display configurable messages on the PCMS located upstream of sensors that detect changes in speed and lane occupancy in such a way that approaching drivers see a slow message before a stopped message, and a stopped message before a late merge message. Include accurate distance until the condition in the slow and stopped messages, and round distances to the nearest ½ mile. Message examples include “SLOW TRAFFIC 2 MILES/WATCH FOR SLOW TRAFFIC,” “STOPPED TRAFFIC 1 MILE/PREPARE TO STOP,” and “USE BOTH LANES/TO MERGE POINT.”

Configure Queue Warning messages to override all other messages on a PCMS. Send communication to project personnel when traffic conditions violate predetermined thresholds. Data collected by the Dynamic Zipper Merge System will be owned by NCDOT and must be in a file format compatible with the STOC’s operating platform.

Include human observation in the monitoring procedure to document posted messages and times during an actual event. Compare those messages with the information available from the software. Complete software monitoring as needed and when requested by the Engineer.

Driver Merge Instructions

The intent of the Driver Merge Instructions function is to detect traffic congestion and queue formation and convert the lane closure from a traditional early merge scenario to a late lane merge condition. Driver Merge Instructions is another critical function of the system. Continuously monitor traffic and report the required operational characteristics to the software each minute. Use a combination of real-time speed and percent lane occupancy information reported by traffic sensors, compared with configurable thresholds, to initiate the appropriate driver merge instruction message. Display configurable messages on the PCMS located upstream of sensors that detect changes in speed and lane occupancy in such a way that approaching drivers see an early merge message when queueing is less than one mile in advance of the taper, and a late lane merge message when queueing extends beyond one mile in advance of the merge taper. Message examples include “RIGHT LANE CLOSED/1 MILE AHEAD,” “USE BOTH LANES/TO MERGE POINT.” and “MERGE HERE/TAKE TURNS.”

Configure Queue Warning messages to override all other messages on a PCMS. Send communication to project personnel when traffic conditions violate predetermined thresholds. Data collected by the Dynamic Zipper Merge system will be owned by NCDOT and must be in a file format compatible with the STOC’s operating platform.

Include human observation in the monitoring procedure to document posted messages and times during an actual event. Compare those messages with the information available from the software. Complete software monitoring as needed and when requested by the Engineer.

Lane Closure Notification

The intent of the lane closure notification function is to detect active lane closures when no queues are present and notify approaching drivers of the conditions. Lane closure notification is a secondary function and serves as the default function when Queue Warning is inactive. An example message for this function is “RIGHT LANE CLOSED/3 MILES AHEAD.”

When no lane closures are in place and no queues are present, each PCMS shall display flashing dots in all four corners to indicate the system is operating correctly.

Include human observation in the monitoring procedure to document posted messages when a Queue Warning event is not occurring.

Reporting and Operational Requirements

Communicate with and/or control all of the devices belonging to the Dynamic Zipper Merge System. Poll the sensors and PCMS a minimum of once per minute. Collect from each device, as applicable, and store in configurable bins the following data: device name and location, 50th percentile and 85th percentile speeds, volume, lane occupancy, message sign history, as well as battery status and communication status. Make historical data available to NCDOT staff at all times for the duration of work zone activity. Provide an electronic copy of all data, including date and duration of system malfunctions, to NCDOT staff after all work zone activity is completed and the Dynamic Zipper Merge System has been removed.

H. Website

The purpose of the website is to be a real time traffic operations dashboard showing current traffic conditions, real time speeds, and posted messages to the nearest minute. Display a full color map of the project area, using Google Maps or equivalent, which shows roadways impacted by project activities and for which data is being collected. Display current average speed at each traffic sensor for which data is available. Display a representation of each device in its approximate location, relative to the roadway and other nearby features, and indicate the operational status of each device. Display the messages posted on the message signs. Refresh information at least once per minute. In the event devices are moved to a new location in the field, automatically reflect these changes to the system layout on the website.

I. Traffic Control Devices

Provide traffic control devices as needed to set up, operate, maintain and tear down the Dynamic Zipper Merge System as shown in the Contract Documents. Coordinate device placement with other Contractors as needed to meet or exceed placement requirements in the Contract Documents.

If applicable, all PCMS used for advance notice of a variable speed zone within the Dynamic Zipper Merge System shall be removed and replaced with double indicated “VARIABLE SPEED ZONE AHEAD” static sign as shown on the detail.

J. Malfunctions, Maintenance, and Inspection

Operate the Dynamic Zipper Merge System, including all components listed above, continuously (24 hours per day, 7 days per week) when deployed on the project, for the duration specified by the Engineer.

In addition, the Contractor shall have portable mounted lane closure signs as detailed in Roadway Standard Drawing 1101.02, Sheet 4, available on site to be used in the case of a system malfunction. These static lane closure signs shall not be visible to traffic except in the case of a system malfunction and will remain in place until the system is fully functional again.

Continuously operate the Dynamic Zipper Merge System with no major malfunctions throughout its operation. System malfunctions include, but are not limited to, the inability of the equipment to provide accurate, real-time traffic data, inability of the equipment to determine lane closure status from connected lane closure devices; inability to withstand a construction roadside environment or normal weather conditions; or interference from construction equipment. Monitor and inspect equipment and data, and on a regular basis to avoid malfunctions. Upon discovery or notification of a system malfunction, the Contractor shall immediately make the pre-staged static lane closure signs visible to traffic and make all necessary corrections to the components of the system such that system malfunctions are corrected within a 24-hour period through repair or replacement of the equipment.

Components include sensors, message signs, communications equipment and all hardware and software required to place the real time information on the devices to operate according to Contract Documents.

It is the responsibility of the Contractor to detect data malfunctions. Monitor, inspect, and maintain sensors so that malfunctions in data collection can be detected as soon as possible. Causes of malfunction may include high winds, shifting earth beneath or around the device, or interference by construction equipment. Monitoring, at a minimum, includes evaluation and documentation of power levels, communication connections, and accuracy of data provided to the Traffic Management Software. Monitoring data accuracy may include re-calibration and aiming of the device or retesting accuracy using human observers. Monitor as needed and when requested by the Engineer.

K. Complete and Operational System

Direct and indirect costs associated with operating the Dynamic Zipper Merge System are incidental to this bid item and may include FCC licensing, cellular communication, wireless data networks, satellite and internet subscription charges, solar power system support and battery charging and maintenance.

Construction Methods

A. System Manager

Provide one person, available 24 hours per day, as the System Manager for the Dynamic Zipper Merge System. Provide this person's 24-hour contact information to the Engineer. Provide a system manager who is locally available to supervise, monitor, and maintain the system components including the website, relocate devices as necessary, and respond to emergencies.

B. Dynamic Zipper Merge System Deployment

Deliver all of the required devices to the place and time designated by the Engineer and confirm they are in good condition and in working order. Each PCMS shall be in new condition when delivered to the project site. Coordinate with the Engineer to determine final sensor locations, then deploy and install sensors. Complete stand-alone tests, system operational tests, final deployment, and system initiation prior to impacting traffic.

System Logic and Programming

The Contractor shall use the logic provided by NCDOT to program the Dynamic Zipper Merge System. This logic indicates what each PCMS will display in response to changing traffic conditions according to each speed sensor. Coordinate with the Engineer, Work Zone Traffic Control, and the State Traffic Operations Center staff prior to system installation to verify the system programming is accurate. Coordinate with the Engineer in the event system programming adjustments are necessary due to field conditions.

Stand-alone Testing

Conduct stand-alone tests of each device. Test sensors from their installed locations. PCMS may be tested in other locations. Turn all PCMS away from traffic during testing.

Complete a stand-alone test for each PCMS prior to installation, and to verify that the unit operates as specified. Include in the stand-alone test procedure tests for the following functions:

- Turning the sign on and off;
- Displaying and removing a test message;

- Counting pixels not illuminated (no more than 1 malfunctioning pixel);
- Checking message logs for accuracy; and
- Measuring sign legibility and visibility.

If a unit fails to pass the stand-alone test, repair or replace the unit, and repeat the test until successful.

System Operational Testing

Provide a System Operational Testing Plan to the Engineer for approval, at least 7 days prior to beginning testing. The Plan shall detail a five-day operational test procedure of the System Operational Requirements. Include in the plan procedures operation of the software using real time information from sensors already tested and installed and tested signs located in an off-project location. Begin testing 14 days prior to implementation to verify the system operates in a fully functional manner and as described.

Provide complete operations support from the Software supplier during the operational test, if applicable. Provide verification that the reported drive times, speeds, and volumes through the work zone accurately reflect actual field conditions. Use a human observer to monitor and document the posted messages. Post test messages two times per day during the test period to verify functionality and communications and verification that proper messages are being posted to the PCMS. If any equipment malfunctions occur for a combined period of two hours or more during the operational test on any day, restart the five-day test and no credit will be given for that day of the operational test period.

The Contractor shall be responsible for replacing all defective equipment at no additional cost to the Department.

Indicate the date and time of any activity necessary to maintain operation of the Dynamic Zipper Merge System during the operational test period. Include in each entry, at a minimum, the following information:

- A description of the malfunction;
- Identity of the malfunctioning equipment;
- Cause of equipment malfunction (if known);
- A description of the type of work performed; and
- Time and date of repair completion.

Once the operational test report is received and approved by the Engineer, the Dynamic Zipper Merge System will be considered operational, and the system will be accepted for use.

Measurement and Payment

Dynamic Zipper Merge System Deployment will be measured and paid on a Lump Sum basis upon completion of the first Dynamic Zipper Merge System delivered to the project site, installed, tested, and found to be fully operational.

Dynamic Zipper Merge System Relocation will be measured and paid on a per each basis upon completion of each system removal from one location on the project and installation to a different location on the project. Payment will be paid once the system is fully operational.

Dynamic Zipper Merge System will be measured and paid on a daily basis for each satisfactorily installed Dynamic Zipper Merge System, including all necessary labor, equipment, materials, communications, licensing, and software to maintain operation of the system. Each Dynamic Zipper Merge System is expected to operate continuously (24 hours per day, 7 days per week) with no major malfunctions. Monitor and maintain the system according to the Malfunctions, Maintenance, and Inspection section above.

All work zone signs will be paid for at the contract unit price according to Article 1110-4 in the Standard Specifications for Roads and Structures.

In the event of a system or data malfunction, payment will be made for the first day of the malfunction. If the malfunctioning Dynamic Zipper Merge System is not completely operational at the end of 24 hours, additional payment will not be made until the system's operation is fully restored.

Pay Item	Pay Unit
Dynamic Zipper Merge System Deployment	Lump Sum
Dynamic Zipper Merge System Relocation	Each
Dynamic Zipper Merge System	Day

HIGH VISIBILITY DEVICES

(10/25/2019) (Rev. 5/19/2026)

Description

Furnish and install high visibility devices on all roadways within the project limits with speed limits of 55 mph or higher.

Materials

(A) General

Use the following high visibility devices for work zone performance applications that are listed on the NCDOT APL.

- (a) Drums
- (b) Skinny Drums
- (c) Work Zone Stationary Signs
- (d) Work Zone Rigid Portable Signs (nighttime use)

All drums and skinny drums shall meet the requirements of Article 1089-5 of the *Standard Specifications* and shall have Grade B flexible, fluorescent orange sheeting that meets the retroreflective requirements of Article 1092-2 of the *Standard Specifications*.

All stationary work zone signs shall meet the requirements of Articles 1089-1 and 1089-2 of the *Standard Specifications*. Legend overlays are prohibited. Vertical sign post reflector strips shall be added to all stationary sign supports. Use Grade B fluorescent orange for work zone sign supports and Grade B fluorescent yellow for exit sign supports. Install sign post reflector strips a minimum of 2" wide, a minimum of 6' long on sign supports with one sign mounted and a minimum of 4.5' long for sign supports with two or more signs mounted vertically.

All portable work zone signs shall meet the requirements of Article 1089-1 and 1089-2 of the *Standard Specifications*. However, roll-up signs are prohibited for night work.

(B) Material Qualifications/Certifications

Provide a Type 3 Material Certification for all materials in accordance with Articles 106-3 and 1087-4 of the *Standard Specifications*.

Construction Methods

Install high visibility devices in accordance with this special provision and the applicable requirements of Section 1110, 1130 and 1180 of the *Standard Specifications*.

Maintenance

Replace any sign or drum that prematurely fails due to any damage or defect that causes it to perform unsatisfactorily with a device of similar quality and age according to the guidelines set forth in the American Traffic Safety Service Association's (ATSSA) Quality Guidelines for Work Zone Traffic Control Devices.

Measurement and Payment

High Visibility Drums will be measured and paid as the maximum number of drums placed and in use at any one time during the life of the project.

High Visibility Skinny Drums will be measured and paid as the maximum number of skinny drums placed and in use at any one time during the life of the project.

High Visibility Stationary Signs will be measured as the actual number of square feet satisfactorily installed at each location and accepted by the Engineer. Where a particular sign is used at more than one location, measurement will be made at each location.

High Visibility Portable Signs will be measured and paid as the actual number of square feet satisfactorily installed and accepted by the Engineer. Payment will be made for the initial

installation only. Relocation of signs will be incidental to the measurement of the quantity of High Visibility Portable Signs.

No direct payment will be made for work zone high visibility stationary sign supports or portable sign stands. All work zone high visibility stationary sign supports or portable sign stands will be incidental to the work of providing *High Visibility Stationary Signs* or *High Visibility Portable Signs* respectively. Relocation, replacement, repair, disposal and maintenance of high visibility devices will be incidental to the work of this special provision. Relocation, replacement, repair, disposal or maintenance of ballasts or reflective sheeting will be incidental to the work of this special provision.

Payment will be made under:

Pay Item:	Pay Unit
High Visibility Drums	Each
High Visibility Skinny Drums	Each
High Visibility Stationary Signs	Square Foot
High Visibility Portable Signs	Square Foot

TEMPORARY PORTABLE TRAFFIC SIGNAL SYSTEM:

(07/14/2015) (Rev. 4/21/2026)

Description

Furnish, install, place in operation, repair, maintain, relocate, and remove the temporary portable traffic signal system for traffic maintenance. The temporary portable traffic signals will require a system that is coordinated to maintain safe and efficient traffic operations along **Any Road, as per Work Order Assignment or as Directed by the Engineer** during construction. The system will contain (2) trailer mounted traffic signal units along **Any Road, as per Work Order Assignment or as Directed by the Engineer.**

Materials

Provide:

(2) Temporary Portable Traffic Signals (PTS). Each shall be a trailer mounted unit with two 12” signal heads per trailer. One signal head shall be mounted on an overhead mast arm capable of extending over the travel lane. The other signal head shall be mounted on a vertical upright. Each PTS unit shall be equipped with traffic detection equipment.

All PTS must be on the NCDOT Qualified Products List.

Communication Requirements

All PTS shall maintain communication at all times. Acceptable communication shall be either hardwire cable or wireless radio link communication. If the hardwire cable communication is

utilized the communication cable shall be deployed in a manner that will not intrude in the direct work area of the project or obstruct vehicular and pedestrian traffic. If the wireless radio link communication option is utilized clear line of sight between signals within the signal setup shall be maintained. Radio communication shall utilize the 900MHz frequency band and have frequency hopping capability. The radio link communication system shall have a minimum range of (1 mile).

Fault Mode Requirements

The PTS system shall revert to a solid red mode upon system default. The default setting shall be solid red unless otherwise specified by the project engineer. The temporary portable traffic signal system repairs shall be the responsibility of the contactor and shall be rendered in a manner that will return the system to full operation in the most expeditious manner. The PTS shall be equipped with a remote monitoring system. Where cell communication availability exists, the remote monitoring system shall have capabilities as described in the Remote Monitoring System section of this specification.

Remote Monitoring System

The remote monitoring system (RMS) shall be capable of reporting signal location, battery voltage / battery history and system default. The RMS shall include a password protected web site viewable from any computer with internet capability. In the event of a system default, the RMS shall provide specific information concerning the cause of the system default (i.e. red lamp on signal number 1). The RMS shall be equipped with a mechanism capable of immediately contacting a minimum of three previously designated individuals via text messaging and/or email upon a default.

The running program operating the PTS system shall be available and viewable through the RMS website at all times. The RMS shall maintain a history of the operating system in each signal including operating hours and events and the location of the PTS trailer. The RMS is not required as part of this bid proposal.

Implementation

The signal system shall operate in a rest in red, first-come, first-served mode, unless specifically directed otherwise by the Engineer.

Deployment and installation of the PTS System shall only be facilitated by personnel that have been factory trained and fully authorized by the manufacturers.

Measurement and Payment

The Temporary Portable Traffic Signal System will be measured as the (2) trailer mounted units (PTS) furnished, installed, field verified, accepted, operated and removed.

No measurement will be made for operation, relocation, maintenance, removal, or use of flaggers during repair periods as these will be considered incidental to furnishing, installing, and operating the temporary portable traffic signal system.

No measurement will be made for signal controllers, communication, vehicle detection system, and traffic signal software as these will be considered incidental to furnishing, installing, and operating the temporary portable traffic signal system.

No payment will be made until signal timing and operation has been field verified and accepted by the Engineer.

Pay Item	Pay Unit
Temporary Portable Traffic Signal System	Day

WORK ZONE DIGITAL SPEED LIMIT SIGNS

(5/10/2021) (Rev. 12/16/2025)

Description

Furnish and install Work Zone Digital Speed Limit Signs as indicated in the plans or as directed by the Engineer. Work Zone Digital Speed Limit Signs are regulatory speed limit signs with LED displays for the speed limit numbers.

Materials

Digital Speed Limit Signs shall be a minimum 36 inches wide x 48 inches high. The speed limit sign (R2-1) shall be black on white with high intensity white prismatic sheeting.

The Digital Speed Limit Sign shall be mounted such that the bottom of the sign is 7 feet above roadway.

The LED panel shall be a minimum of 28 inches wide x 18 inches high. The display on the LED panel shall be amber or white.

The LED numbers shall have a minimum 5 wide by 7 high pixel array with a minimum height of 18”.

The LED panel shall have auto brightness/dimming capability.

The black on orange G20-5aP WORK ZONE sign shall be mounted above the speed limit sign. It shall be 36 inches wide x 24 inches high with high intensity prismatic orange sheeting.

The black on white R2-6bP \$250 FINE sign shall be mounted below the speed limit sign. It shall be 36 inches wide x 24 inches high with high intensity prismatic white sheeting.

All digital speed limit systems shall have operational software and wireless communications that allows for remote operation and data monitoring. It shall be configured to allow access by the Engineer or their designee to change each sign independently or change the speed limit on all signs at once from a PC, tablet or cellular phone application.

The Work Zone Digital Speed Limit systems shall have flashing beacons. The beacons are to be a minimum of 8 inch diameter LED circular yellow. They shall be mounted above and below the sign assemblies and are to be centered. The beacons shall alternately flash at rates not less than 50 or more than 60 times per minute.

The flashing beacons shall be mounted in such a manner that the \$250 FINE sign is not obscured when in operation.

Digital Speed Limit Signs may be trailer mounted or stationary mounted. The unit shall be solar powered and operate continuously. It shall be supplemented with a battery backup system which includes a 110/120 VAC powered on-board charging system.

The batteries, when fully charged, shall be capable of powering the display for 20 continuous days with no solar power. The unit shall be capable of being powered by standard 110/120 VAC power source.

Store the battery bank and charging system in a locked, weather and vandal resistant box.

All Work Zone Digital Speed Limit Sign equipment shall be on the NCDOT Approved Products List.

Digital Speed Limit Displays

The speed limit shall be continuously displayed on the signs. All stationary speed limit signs shall be covered when Digital Speed Limit systems are in operation.

Displaying Reduced Speed Limits

The Digital Speed Limit systems shall have beacons activated when the work zone speed limit is reduced. Otherwise, the beacons are to remain off.

Displaying Existing Speed Limits

When the existing speed limit is displayed on the Digital Speed Limit Signs, the beacons are to remain off.

Other Construction Methods

The speed limits are the sole authority of the NCDOT. An ordinance signed by the State Traffic Engineer is required for all speed limits in order to have a lawfully enforceable speed limit.

The Regional Traffic Engineering Office and the Division Construction Engineer in coordination with the Work Zone Traffic Control Section will provide all work zone speed limit recommendations based on activities and conditions.

The Contractor will be responsible for coordinating with the Engineer when the work zone speed limits are to be changed and will have to seek approval by the Engineer or their designee before the speed limit is changed.

Whenever possible, each trailer mounted unit shall be placed on the paved shoulder and shall have the capability of being leveled.

Install stationary mounted advance warning signs WORK ZONE, VARIABLE SPEED ZONE AHEAD, and \$250 FINE according to the attached detail.

Measurement and Payment

Work Zone Digital Speed Limit Signs will be measured and paid as the maximum number of Work Zone Digital Speed Limit Signs satisfactorily installed according to the attached detail and properly functioning at any one time during the life of the project.

This includes all materials and labor to install, maintain and remove all the Work Zone Digital Speed Limit Signs.

Stationary mounted advance warning signs installed according to the attached detail are measured and paid separately in accordance with Article 1110-4 of the Standard Specifications.

Pay Item

Work Zone Digital Speed Limit Signs

Pay Unit

Each