CAV Emerging Technologies

North Carolina Department of Transportation

Strategic Transportation Corridor Master Plans Visions

Corridor P: Future I-42

Wake County to Port of Morehead City

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Table of Acronyms

ATSPM	Automated Traffic Signal Performance Measures
CCTV	Closed-Circuit Television (Cameras)
CV	Connected Vehicles
DMS	Dynamic Message Signs
EV	Emergency Vehicle
EVA	Emergency Vehicle Alert
HSR	Hard Shoulder Running
ICM	Integrated Corridor Management
ITS	Intelligent Transportation Systems
LAN	Local Area Network
NCDOT	North Carolina Department of Transportation
RWIS	Road Weather Information System
SCMS	Security Credential Management System
SPaT	Signal Phasing and Timing
STC	Strategic Transportation Corridors
STOC	Statewide Transportation Operations Center
TMC	Transportation Management Center
WEA	Wireless Emergency Alert
WWD	Wrong Way Driving

1 Overview and Project Background

This memorandum presents base and future year mobility analyses for Corridor P (I-40/Future I-42/U.S. 70) of the North Carolina Strategic Transportation Corridors (STC).

1.1 Overview of Strategic Transportation Corridors

In 2015, the North Carolina Department of Transportation (NCDOT) identified a network of key multimodal transportation corridors called Strategic Transportation Corridors (STC). Identifying these STCs support smart planning, help set long-term investment decisions, and ensure that North Carolina's economic prosperity goals are achieved. The STCs are intended to promote transportation system connectivity, provide high levels of mobility, and improve access to important state and regional activity centers. A key element in the advancement of the STCs is the development of corridor master plan visions. The purpose of the master plan visions is to:

- Identify high-level visions and associated improvement strategies for corridor mobility,
- Align corridor improvements and development with a long-term vision and expected corridor performance levels, and
- Help protect the corridor's key functions as defined in the corridor profiles.

1.2 Corridor Description

One such STC is I-40/Future I-42/U.S. 70, referred to in the STC network as Corridor P, Corridor P is 147 miles in length and spans eastern North Carolina from Raleigh to the Port of Morehead City. I-40/Future I-42/U.S. 70 is critical to eastern North Carolina prosperity, linking major economic activity centers of the Research Triangle region to major eastern North Carolina activity centers in Kinston, Goldsboro, New Bern, and Morehead City. Corridor P also connects the Triangle with both the Marine Corps Air Station (MCAS) Cherry Point in Havelock, NC and the Port of Morehead City. The corridor provides a direct route for tourists traveling to North Carolina beaches and this tourism traffic depends on reliable, uninterrupted highway service along the entire length of the corridor. The principal mobility expectation of the corridor is to provide safe, reliable freight service.

2 Technology Strategies

Emerging technologies are not just additional infrastructure deployed along the roadway, but also expansions of current programs to support safe mobility and operations during events, such as crashes and hurricane evacuations. Corridor P is a primary east-west evacuation route from the coast inward.

Technology strategies can either build upon existing infrastructure or deploy additional infrastructure – all to address safety concerns, provide additional tools so support mobility, and to enhance operations. Depending on the strategy, some strategies apply to an arterial setting while others are a better fit for freeway deployments.

2.1 Infrastructure

Corridor P currently includes intelligent transportation system (ITS) devices along both I-40 and US 70/Future I-42. Most of the devices are placed along the I-40 section, with a small percentage of devices along US 70, mostly near the Clayton/Smithfield area. These devices consist of closed-circuit television (CCTV) cameras, dynamic message signs (DMS), and vehicle detectors and speed probe data. The current ITS infrastructure is primarily used for situational awareness, providing traveler information messages to motorists reflecting travel time and incident information, and collecting data to be used for identifying congestion points. There are several ongoing projects along this corridor that will expand the number of ITS devices and provide the necessary fiber communications.

2.2 Future Strategies

Based on a qualitative review of the limitations of the existing geometrics of the corridor and potential stakeholder needs, the Department can determine the best strategy or combination of strategies that address the specific corridor needs. This assessment is typically done at the project level, although can be done as part of a longer corridor study. A few steps should be taken prior to deployment of future strategies. These steps include:

- Connection to signal central server
- Freeway Guideline (for installation and use)
- Seasonal considerations and preparation (i.e., hurricanes)

Table 1 shows possible strategies for the arterial segment of Corridor P. **Table 2** includes additional strategies to be considered to provide additional information to motorists.

Table 1. Arterial Strategies

Arterial Strategies	Description
Ethernet Communications	Standard communication protocol used to develop local area networks (LAN); Ethernet communications are used for signal controllers to communicate with a central server and allow for remote adjustments.

Arterial Strategies	Description
Automated Traffic Signal Performance Measures (ATSPM)	The collection and analysis of high-resolution traffic controller data and conversion of the data into actionable performance measures; for proactive signal system management.
Connected Vehicle (CV) Notifications	Using roadside and onboard (in-vehicle) units to collect data and alert motorists. These alerts can include notifications for Work Zone, School Zone, Signal Phasing and Timing (SPaT), and other critical traveler information.
Traffic Counting	Counting vehicular traffic to create a complete picture of traffic flows along the corridor; this can be used during an evacuation to provide more information to law enforcement and to the traffic management center (TMC).
Pedestrian Notification [for visually impaired]	Notification, typically an audible alert, provided to pedestrians with visual impairment, specifically at signalized intersections; notifications are provided through an application or other roadside unit to warn of an approaching vehicle.
Transit Applications	Interface between transit management centers and traffic management centers (TMCs) that can support the following functionalities: transit schedule information, personalized transit route requests, multi-modal coordination between transit agencies and other types of public transportation, typically through a mobile or desktop app.

Table 2. Additional Strategies

Additional Strategies	Description
Travel Time Analysis	Collecting, analyzing, and disseminating the time it will take to arrive at the next point on DMS to provide additional traveler information to motorists. These are typically based on distance between exits.
Traveler Information for Bypass Routing	Providing information to motorists on which route should be taken, specifically when used as a detour.
Hard Shoulder Running (HSR)	Utilizing the shoulder as a travel lane during specified hours of the day to relieve congestion, or during certain events such as a hurricane evacuation. HSR is sometimes accompanied and supported by dynamic lane-use control signs.
Incident Reporting and Notification	Collecting and disseminating information about an incident that occurred along the corridor in a timely manner for the motorist to make decisions.
Hard Braking Analysis	Pulling information from vehicle onboard units to analyze and identify areas that are prone to quick, sudden braking to determine if additional warnings are needed for motorists.

Additional Strategies	Description
Wireless Emergency Alert (WEA) and/or Emergency Vehicle Alert (EVA) systems	Providing advance warning to motorists of an emergency vehicle ahead and instructing the motorists to move over – providing a safer environment for first responders.
Predictive Traffic Analysis	Forecasting traffic patterns using real time traffic speeds, traffic congestion, and environmental data. This enables early identification of traffic jams so preventive measures could be taken to alleviate the congestion.
Freight Connections to the Port	Coordinating the process of freight movement from the port along the corridor to their final destination. This could be done through platooning and operational coordination between operation centers.
Integrated Corridor Management (ICM)	Coordinating multiple networks to create one interconnected system in order to route motorists from the freeway to an adjacent facility/alternate route to address congestion during an incident.
Signal Preemption	Providing a specific vehicle type the right of way through a signal – denoted with a green indication at the signal. This typically is used for transit, freight, emergency vehicles (EV).
Road Weather Information System (RWIS)	Devices placed in specific locations that collect a variety of weather data used to support maintenance decisions or provide additional situational awareness along the corridor. The devices including wind sensors, water depth sensors, CCTV cameras, etc.
Wrong Way Driving (WWD) Detection	Detecting vehicles traveling the wrong way – either along a ramp or on the roadway itself – and notifying the driver they are traveling in the wrong direction; an alert can also be sent to law enforcement and TMCs.
Incident Management Assistance Patrol (IMAP) Services	Providing on-scene assistance such as motorist services, traffic control for an incident in the roadway, and quick clearance of incident scenes. These services enhance the safety for motorists and first responders, as well as reduce the likelihood of a secondary crash.
Bridge Messages	Collected data (i.e., incident, ice, flood) on/around specific bridges used to automate messages to warn motorists of potential hazards.
Ramp Metering	Using signals to help regulate the flow of traffic entering freeways. Ramp meters are sometimes accompanied by variable speed limits.
Heavy Tow Program	Utilizing a performance-based contract with companies that have tow trucks capable of moving heavy equipment, such as tractor trailers, along designated corridors more quickly and efficiently than the typical tow rotation process.
Truck Parking	Designated locations, typically cooperative partnerships between public and private lots, for secure and safe truck parking. The parking locations are designated either through signs along the

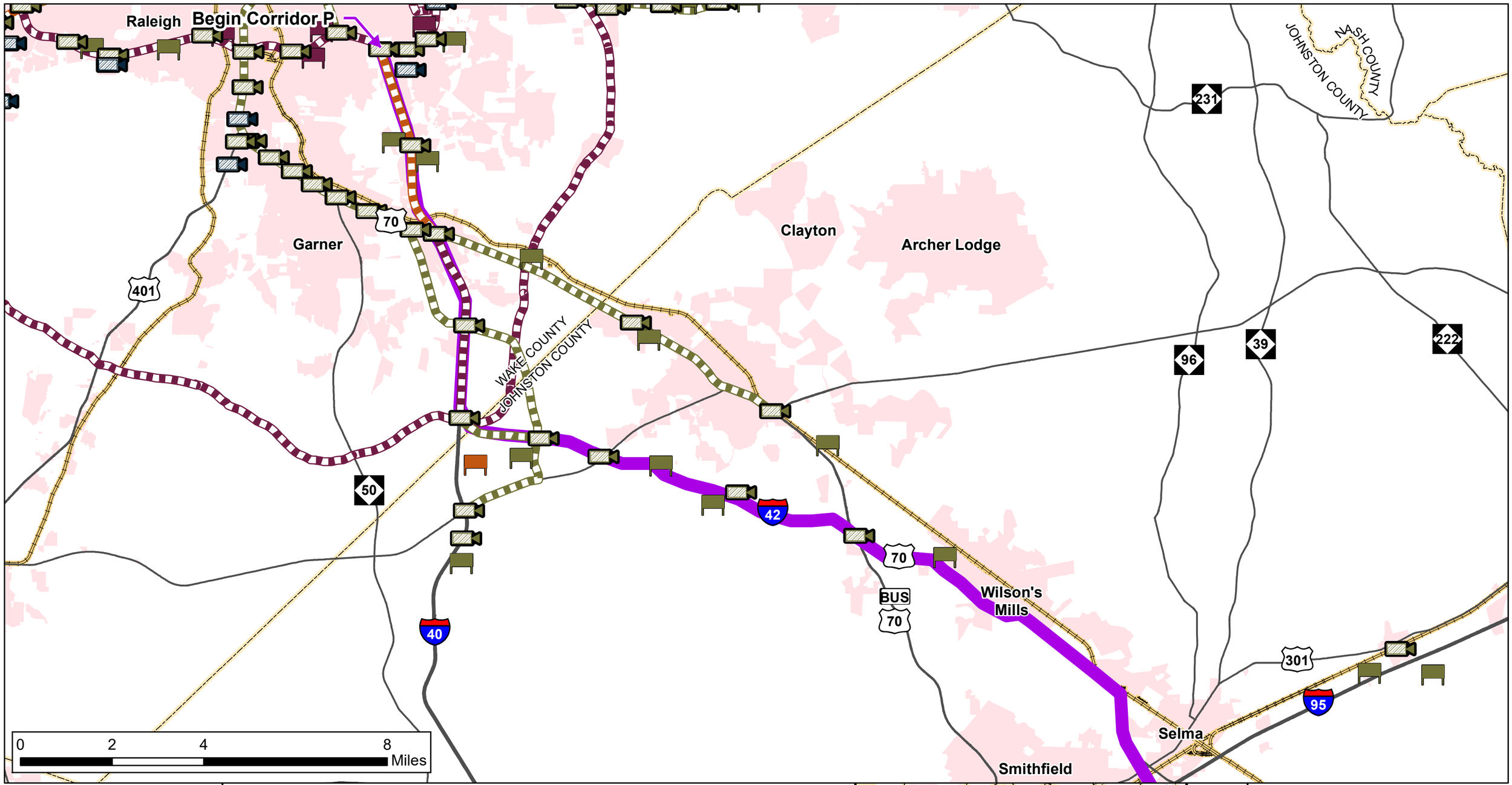
Additional Strategies	Description
	freeway and/or an app the truck drivers are able to access to note the number of open spots.
Automated Flood Warning Systems	Instruments (gages) installed at rivers or streams that include sensors for detecting changes to set parameters for measuring either precipitation volume or water levels. These systems can support proactive/predictive road warnings and/or closures.

2.3 Mitigations

There are always risks involved when deploying infrastructure or the need for additional technology. The following mitigations should be considered during deployment of the strategies noted above in **Table 1** and **Table 2**.

- Power to the devices – the Department may need to consider alternative or backup power sources such as solar, to power the devices
- Operational strategies in the event of an evacuation – closing interchanges, extended lane merge, signal coordination, etc.
- Security credential management system (SCMS) – to ensure integrity and authenticity of data
- Funding for maintenance of the infrastructure/devices – ensuring devices stay operational to provide the situational awareness to the statewide transportation operations center (STOC)
- Hard shoulder running and extended merge areas require design considerations, such as rumble-strip location, truck lane restrictions (e.g., not on the shoulder), width of paved shoulder, and depth of shoulder pavement.

Appendices



NC STRATEGIC TRANSPORTATION CORRIDOR P (STC)

MARCH 2022

Source: NCOneMap, NCDOT GIS, ESRI

Legend

- STC Highway Corridor P
- Interstate
- U.S./N.C. Route
- Rail
- Major Water Bodies
- Municipal Boundary
- Counties

CCTV Cameras

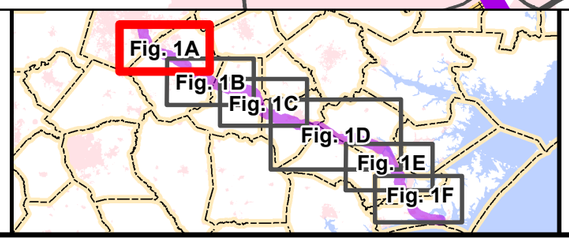
- Existing, Municipal
- Existing, NCDOT

DMS

- Existing
- Funded
- Proposed

Fiber

- Existing, NCDOT
- Funded, NCDOT
- Proposed, NCDOT



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CORRIDOR P: INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

FIGURE 1A: RALEIGH TO SMITHFIELD

*CCTV: Closed-Circuit Television (Cameras), DMS: Dynamic Message Signs

Wilson's Mills
Selma
Smithfield
Goldsboro
JOHNSTON COUNTY
WAYNE COUNTY
39
96
301
70
210
95
BUS
BYP
ALT
42
222
581
795
117
111
13
701
0 2 4 8 Miles

NC STRATEGIC TRANSPORTATION CORRIDOR P (STC)

MARCH 2022

Source: NCOneMap, NCDOT GIS, ESRI

Legend

- STC Highway Corridor P
- Interstate
- U.S./N.C. Route
- Rail
- Major Water Bodies
- Municipal Boundary
- Counties

CCTV Cameras

- Existing, NCDOT
- Proposed, NCDOT

DMS

- Existing
- Proposed

Fig. 1A
Fig. 1B
Fig. 1C
Fig. 1D
Fig. 1E
Fig. 1F

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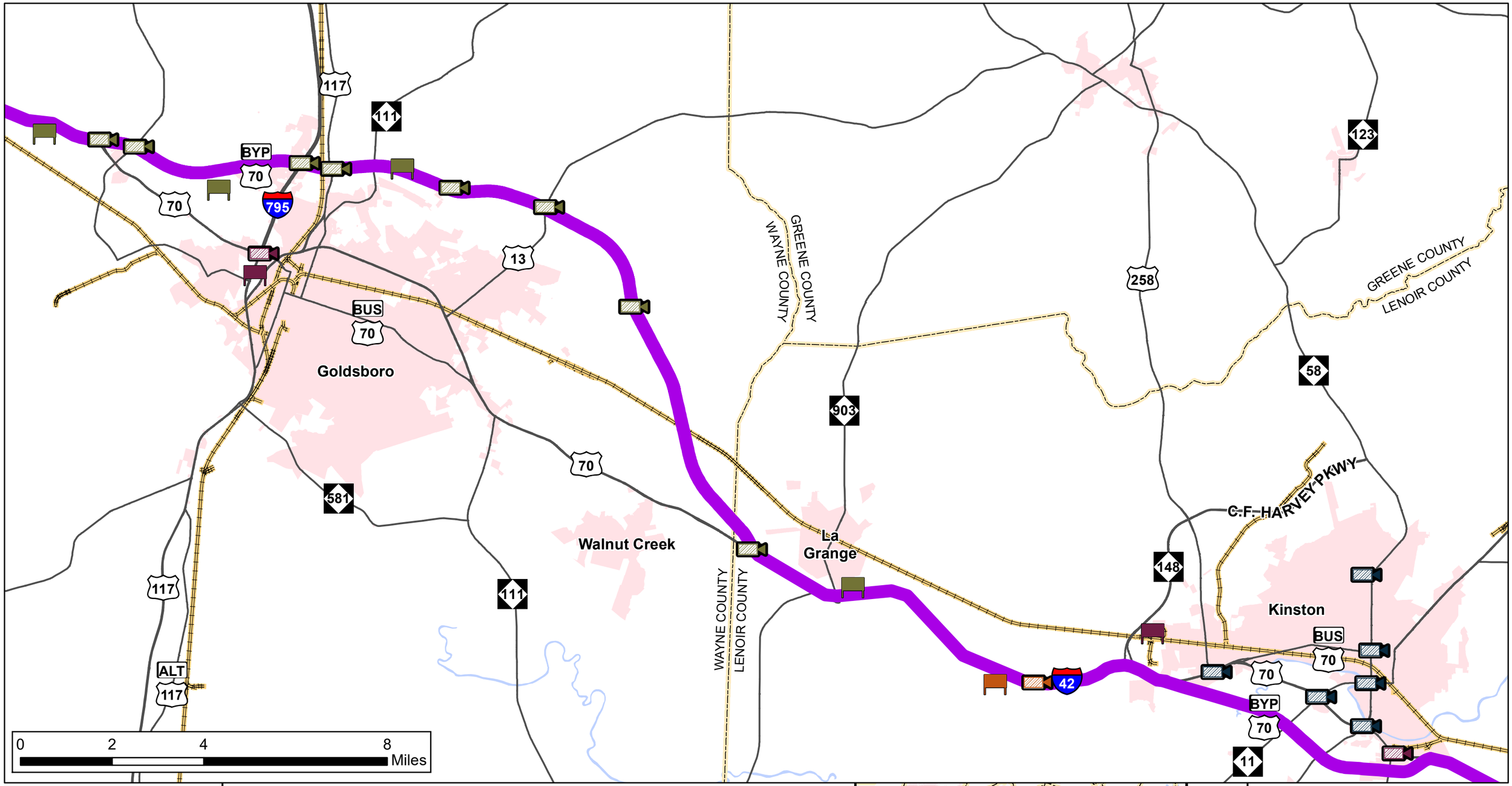
CORRIDOR P: INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

FIGURE 1B: SMITHFIELD TO GOLDSBORO

*CCTV: Closed-Circuit Television (Cameras), DMS: Dynamic Message Signs



NC STRATEGIC TRANSPORTATION CORRIDOR P (STC)

MARCH 2022

Source: NCOneMap, NCDOT GIS, ESRI

Legend

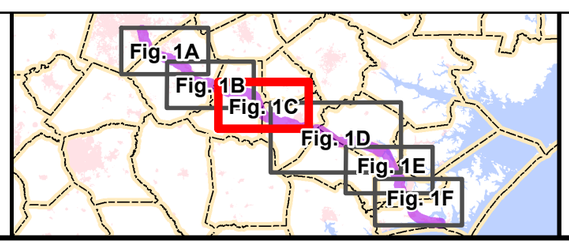
- STC Highway Corridor P
- Interstate
- U.S./N.C. Route
- Rail
- Major Water Bodies
- Municipal Boundary
- Counties

CCTV Cameras

- Existing, Municipal
- Existing, NCDOT
- Funded, NCDOT
- Proposed, NCDOT

DMS

- Existing
- Funded
- Proposed



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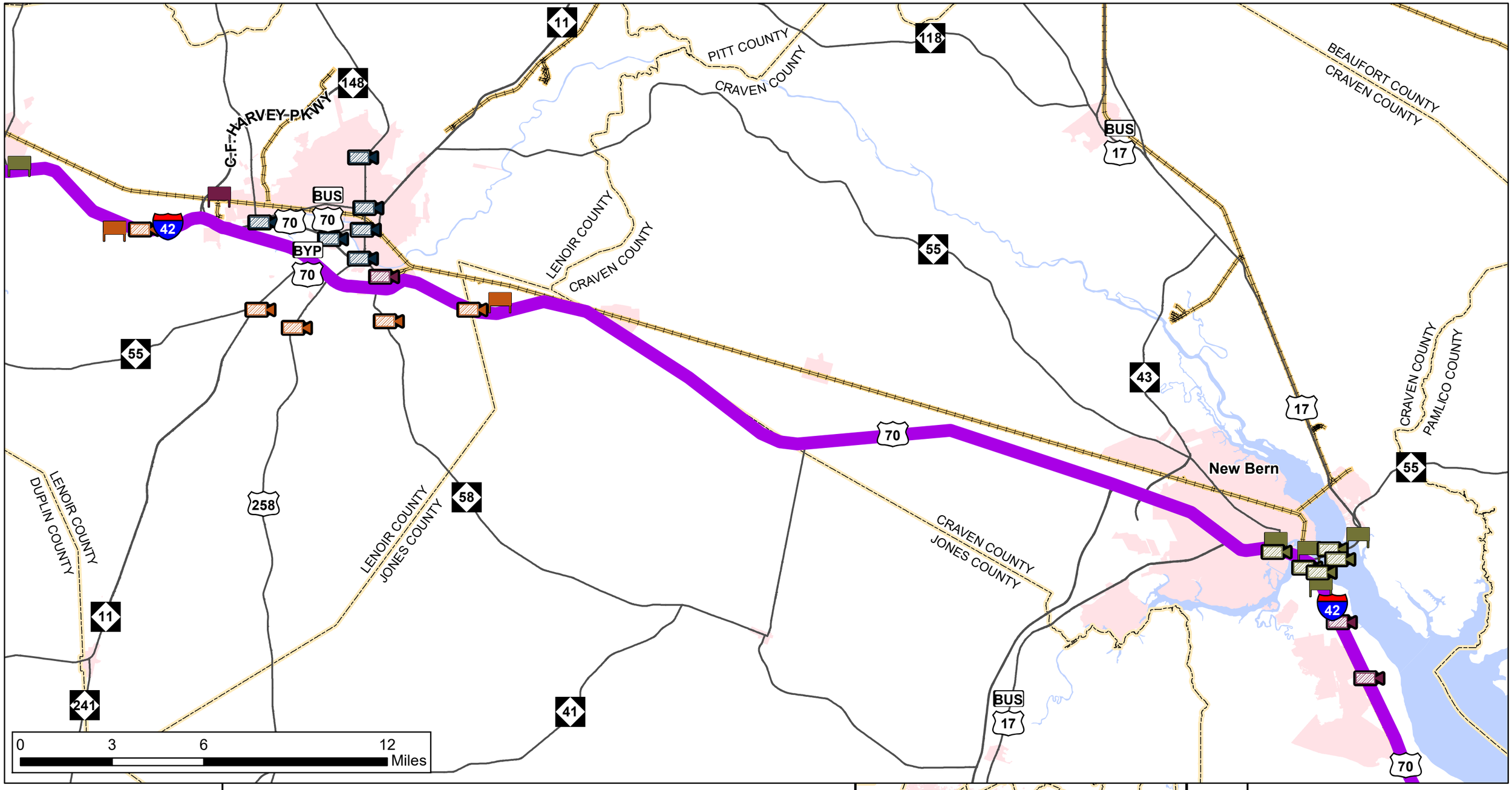
CORRIDOR P: INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

FIGURE 1C: GOLDSBORO TO KINSTON

*CCTV: Closed-Circuit Television (Cameras), DMS: Dynamic Message Signs



NC STRATEGIC TRANSPORTATION CORRIDOR P (STC)

MARCH 2022

Source: NCOneMap, NCDOT GIS, ESRI

Legend

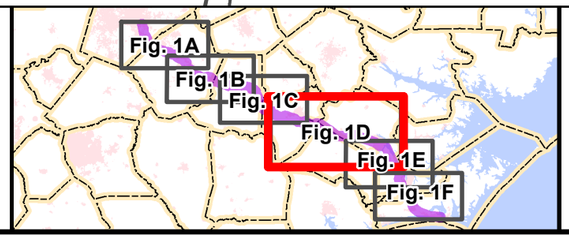
- STC Highway Corridor P
- Interstate
- U.S./N.C. Route
- Rail
- Major Water Bodies
- Municipal Boundary
- Counties

CCTV Cameras

- Existing, Municipal
- Existing, NCDOT
- Funded, NCDOT
- Proposed, NCDOT

DMS

- Existing
- Funded
- Proposed



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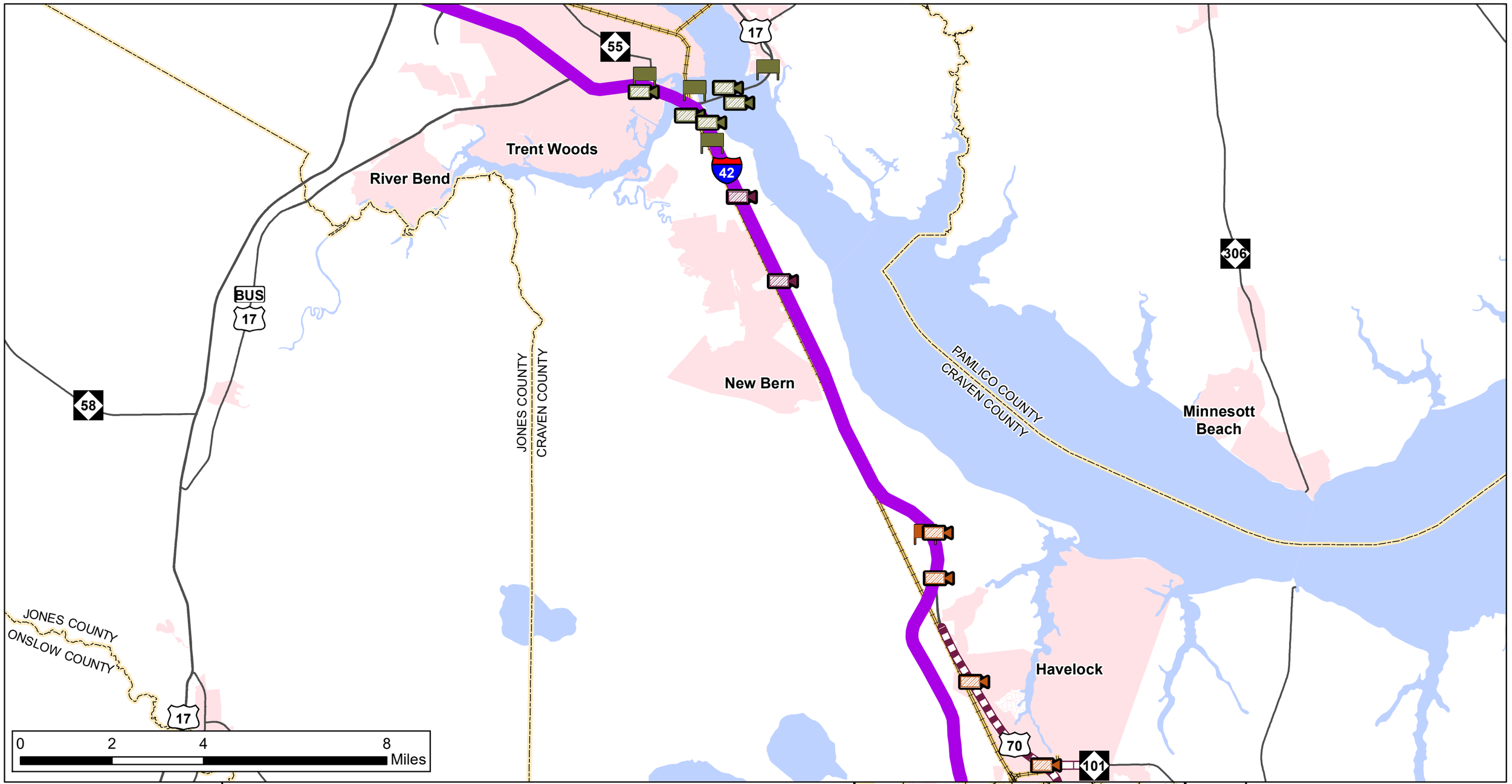
CORRIDOR P: INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

FIGURE 1D: KINSTON TO NEW BERN

*CCTV: Closed-Circuit Television (Cameras), DMS: Dynamic Message Signs



NC STRATEGIC TRANSPORTATION CORRIDOR P (STC)

MARCH 2022

Source: NCOneMap, NCDOT GIS, ESRI

Legend

- STC Highway Corridor P
- Interstate
- U.S./N.C. Route
- Rail
- Major Water Bodies
- Municipal Boundary
- Counties

CCTV Cameras

- Existing, NCDOT
- Funded, NCDOT
- Proposed, NCDOT

DMS

- Existing
- Funded

Fiber

- Proposed, NCDOT

CORRIDOR P: INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

FIGURE 1E: NEW BERN TO HAVELOCK

*CCTV: Closed-Circuit Television (Cameras), DMS: Dynamic Message Signs

Havelock
Newport
Morehead City
Beaufort
End Corridor P
JONES COUNTY
CRAVEN COUNTY
CARTERET COUNTY
70
BYP
306
42
101
58
24
0 2 4 8 Miles

NC STRATEGIC TRANSPORTATION CORRIDOR P (STC)

MARCH 2022

Source: NCOneMap, NCDOT GIS, ESRI

Legend

- STC Highway Corridor P
- Interstate
- U.S./N.C. Route
- Rail
- Major Water Bodies
- Municipal Boundary
- Counties

CCTV Cameras

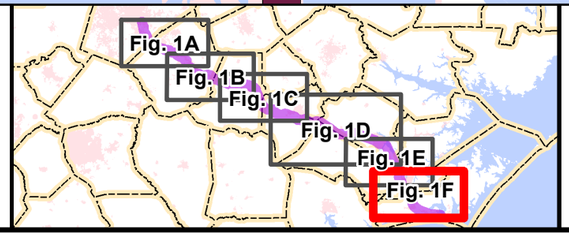
- Existing, NCDOT
- Funded, NCDOT

DMS

- Funded
- Proposed

Fiber

- Proposed, NCDOT



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CORRIDOR P: INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

FIGURE 1F: HAVELOCK TO MOREHEAD CITY

*CCTV: Closed-Circuit Television (Cameras), DMS: Dynamic Message Signs