I-26 Corridor

▶ Final Report

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I-26 Corridor

1. Introduction

The I-26 corridor serves as a backbone for economic development and growth in northeast Tennessee. As population and employment grow and redevelopment changes the face of the region, new travel demands place pressure on the Interstate as well as parallel and intersecting highways. This results in increased traffic congestion, travel times, and conflicts, which impact the corridor's ability to sustain future growth.

Interstate 26 is a nominally east-west (but physically northwest-southeast) route in the southeastern United States, connecting Charleston, South Carolina, at US-17, to Kingsport, Tennessee at US-11W. Originally constructed as US-23, this 54 mile stretch of I-26 within Tennessee begins at the North Carolina border and terminates at the junction of US-11W and US-23 in Kingsport.

The study area is shown in Figure 1-1; it includes Carter, Sullivan, Unicoi and Washington counties. The main purpose of this study is to identify existing and emerging deficiencies along the I-26 corridor and to evaluate and prioritize improvements to address those deficiencies. The study explores multimodal

Figure 1-1. I-26 Study Area

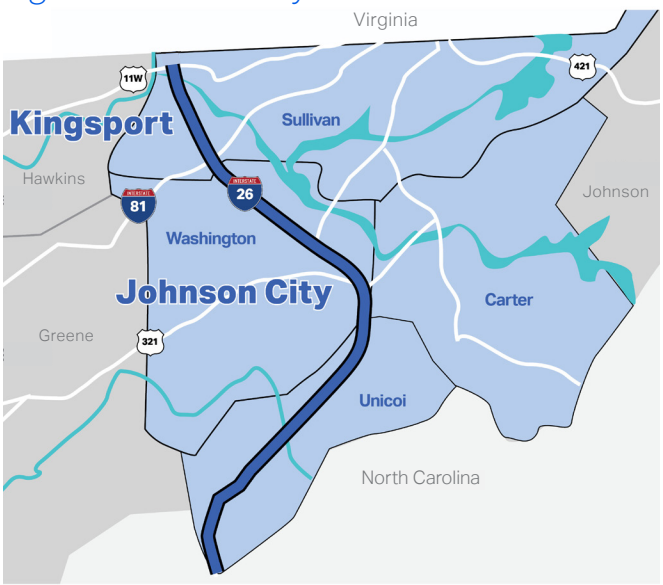
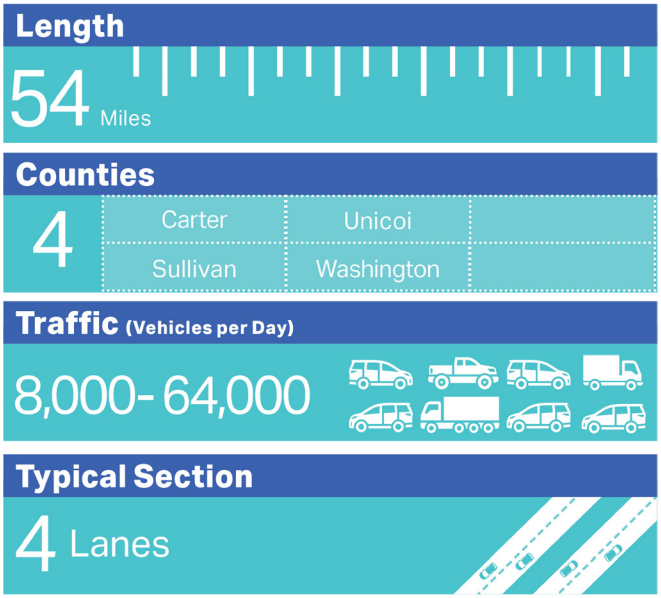


Figure 1-2. I-26 Fast Facts



issues and opportunities and considers innovative approaches available to the Tennessee Department of Transportation (TDOT) to address capacity and congestion, enhance operational efficiency, improve safety and security, expand transportation choices, and support economic growth and competitiveness.

Previous technical memoranda:

- Provided a data and information inventory for the corridor
- Assessed existing and future deficiencies and needs along the I-26 corridor
- Established goals and performance measures to assess the effectiveness of various solutions to the problems
- Filtered the I-26 universe of alternatives through a screening and prioritization process

The prioritization process evaluated solutions based on their impact on mobility and safety, potential environmental impacts, cost, and potential economic impacts. Ultimately, the prioritized solutions both resolve the identified deficiencies and have a high benefit-cost index.

2. Sources of Data

Roadway, demographic, economic and performance data were collected from numerous sources. These were supplemented by a robust program to gather input from key stakeholders -- such as metropolitan planning organizations, business groups, and large institutions -- and the traveling public. These data were used to identify trends in travel, employment, development, and land use that impact the future of the region. The data ultimately were evaluated to identify the key transportation deficiencies impacting travel in the I-26 corridor.

Previous Plans and Studies

Many agencies have conducted studies and developed a variety of plans for the I-26 study area; however, this study is the first comprehensive study to be conducted for the entire I-26 corridor. Previous studies have focused on all modes of transportation and various levels of infrastructure, from statewide and regional to community-specific. Key studies, plans, and programs (listed in Figure 2-1) were reviewed to develop an understanding of the corridor and the needs and opportunities that have been previously identified. TDOT's State Transportation Improvement Program (STIP), Kingsport and Johnson City Metropolitan Transportation Planning Organizations' (MTPO) Long Range Transportation Plans (LRTP) and Transportation Improvement Programs (TIP) were specifically reviewed to develop an understanding of the needs and opportunities that have previously been identified and to identify projects within the study area for which money has already been allocated. These programmed projects are shown in Table 2-1 and Figure 2-2.

Figure 2-1. Previous Plans and Studies — I-26

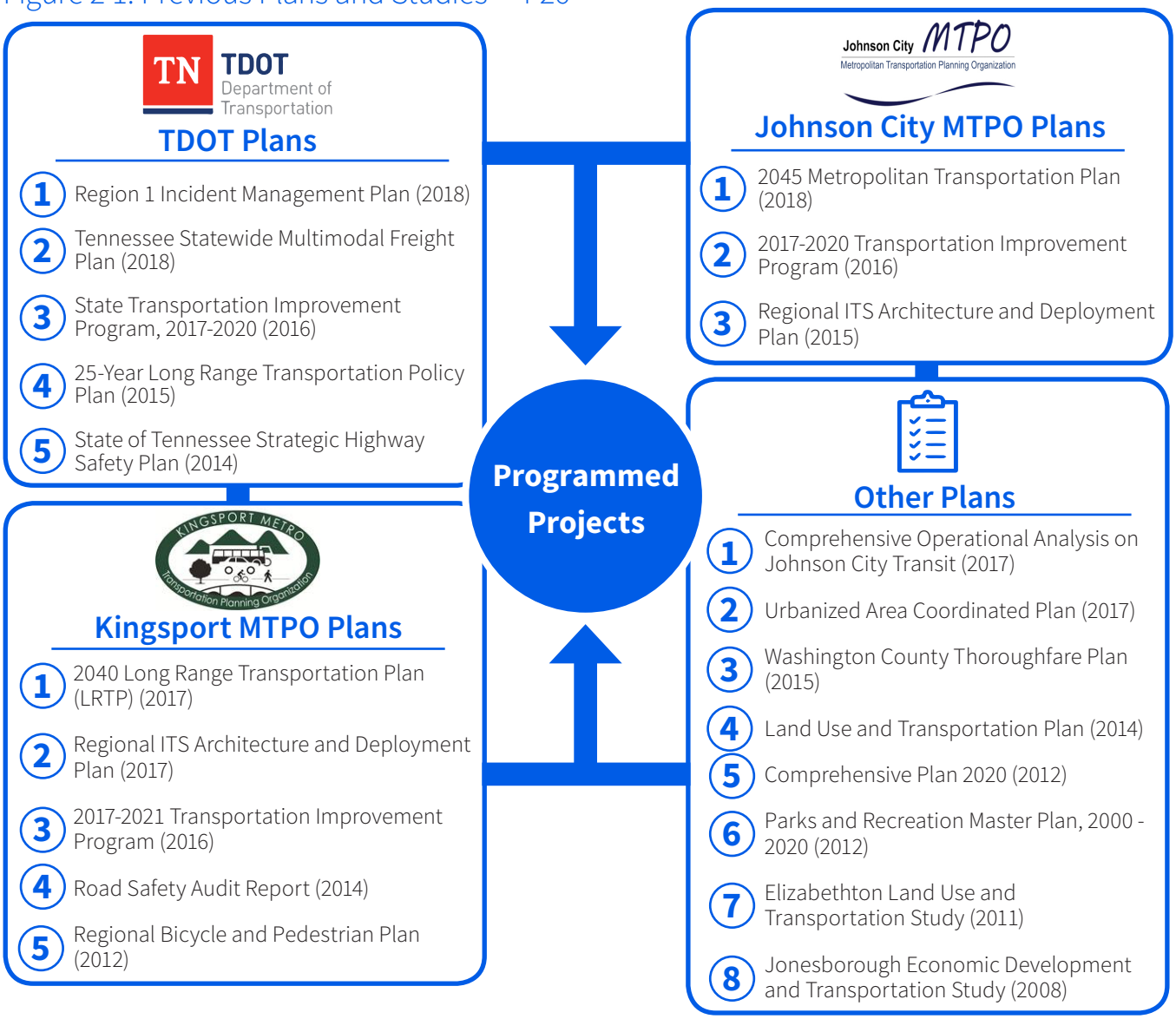


Table 2-1. Corridor Programmed Projects — I-26

	Figure 2-2 ID	Route and Project Limits	Improvement	Cost	Year	Lead Agency/ Funding Type	TIP #
Kingsport MTPO FY2017 - 2020 TIP	1	Kingsport Area Transit Service (KATS)	Operations	$9,000,000	2017-2021	Kingsport/FTA 5307	TIP # PT-1
			Capital	$2,867,000		Kingsport/FTA 5307	TIP # PT-2a
			Capital	$2,867,000		Kingsport/FTA 5339	TIP # PT-2b
			Planning	$175,000		Kingsport/FTA 5307	TIP # PT-3
Johnson City MTPO FY2017 - 2020 TIP	2	I-26: Interchange at SR-354 (Exit 17)	Diverging Diamond Interchange (DDI)	$14,900,000	2019	TDOT/NHPP/ IMPROVE Act	TIP # 90115
	3	SR-381 from Knob Creek Rd to Browns Mill Rd	Adaptive signal control	$290,000	2019	Johnson City/ STBG-Local	TIP # 2013-02
	4	Systemwide deployment throughout Johnson City	Adaptive signal control	$550,000	2020	STBG-Local	TIP # 2014-11
	5	Johnson City Transit (JCT)	Operations	$12,300,000	2017-2020	JCT/ FTA 5307	TIP # 2017-08
			Captial	$1,060,000	2017-2020	JCT/ FTA 5307	TIP # 2017-09
			Capital	$4,849,400	2017-2020	JCT/ FTA 5307/FTA 5339	TIP # 2017-10
			Operations	$2,677,470	2017-2020	JCT/ FTA 5310	TIP # 2017-11
			Capital	$731,780	2018-2019	JCT/ FTA 5317	TIP # 2017-15
			Operations	$220,000	2019-2020	JCT/ FTA 5316	TIP # 2017-17

Sources: Johnson City MTPO FY2017-2020 TIP and Kingsport MTPO FY2017-2020 TIP
FTA = Federal Transit Administration
L-STBG = Local Surface Transportation Block Grant Program
NHPP = National Highway Performance Program

Data Analysis

A large body of technical data were analyzed to develop a picture of corridor conditions. These included sources detailing roadway conditions, traffic and freight operations, safety, population and employment growth, environmental conditions, and other factors to create a "trend scenario." These data sources are shown in Figure 2-3.

Figure 2-3. Data Sources

TRIMS 2017 (Tennessee Roadway Information Management System)

NPMRDS (National Performance Management Research Data Set)

HPMS (Highway Performance Monitoring System)

MPO Regional Travel Demand Models

USFWS (United States Fish and Wildlife Service)

ATRI (American Transportation Research Institute)

NHRP (National Register of Historic Places)

TDOT Traffic History Website

TSM (Tennessee Statewide Travel Demand Model)

Woods & Poole Economics, Inc.

US Census Data (On the Map)

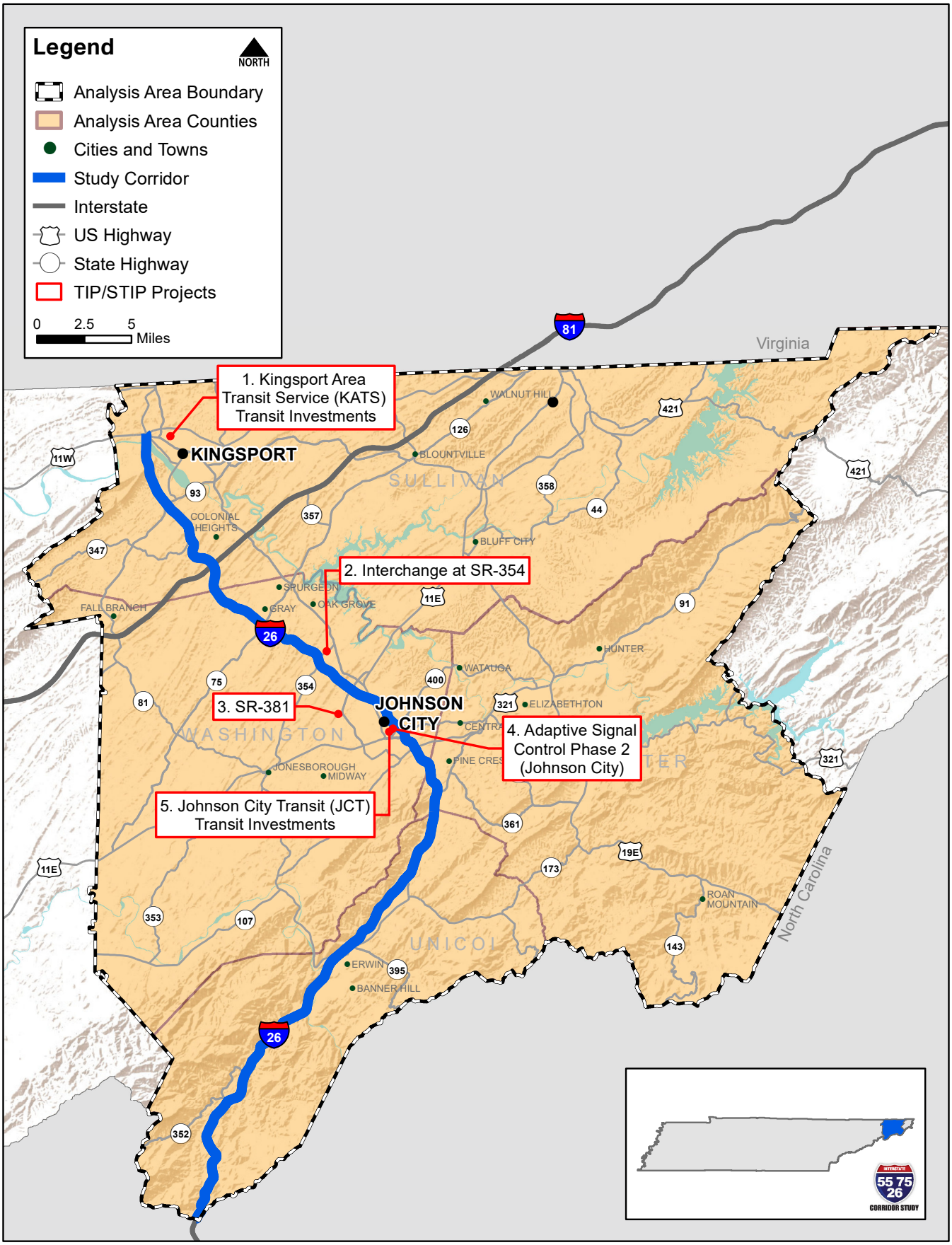
NWI (National Wetland Inventory)

Transearch

Google Earth

TN Comptroller

Figure 2-2. Corridor Programmed Projects* — I-26



* Only projects listed in the TIP or STIP are included in this figure.

Sources: Johnson City MTPO FY2017-2020 TIP and Kingsport MTPO FY2017-2020 TIP

The trend scenario predicts existing and future conditions if current practices, plans, and policies remain unchanged. The trend scenario establishes the existing and projected transportation conditions along the I-26 corridor and serves as the baseline for identifying needs and, ultimately, proposed improvements. The 2010 and 2040 Tennessee Statewide Travel Demand Model (TSM) trend scenarios were originally developed by TDOT in 2017 (Phase 3/ Version 3). As part of this study, the trend scenarios were updated and validated based on the following:

- Population and employment data and projections from Woods and Poole Economics, Inc.
- Projects currently programmed for construction in TDOT's STIP
- Projects currently programmed for construction in the Kingsport MTPO TIP and the Johnson City MTPO's TIP (both FY2017-2020)
- Recent MPO travel demand model projections of socioeconomic data, traffic volumes, and travel times
- Recent Transearch freight data and projections

The study team (including TDOT and MPO/MTPO staff) determined the updated Phase 3/Version 3 TSM (with 2010 base year) was producing results comparable to regional models with more recent base years- creating better model efficiency.

Public / Stakeholder Input

The study's technical analyses were complemented by a robust stakeholder and public involvement effort. The data generated by outreach activities – which included public meetings, key stakeholder interviews and a public survey – was used to focus technical analysis on items that stakeholders perceive as critical, and to prioritize transportation issues to be addressed. This was complemented and enhanced by an effort to provide information to and gather input from traditionally under-represented and underserved populations.

60% of survey comments related to the I-26 corridor

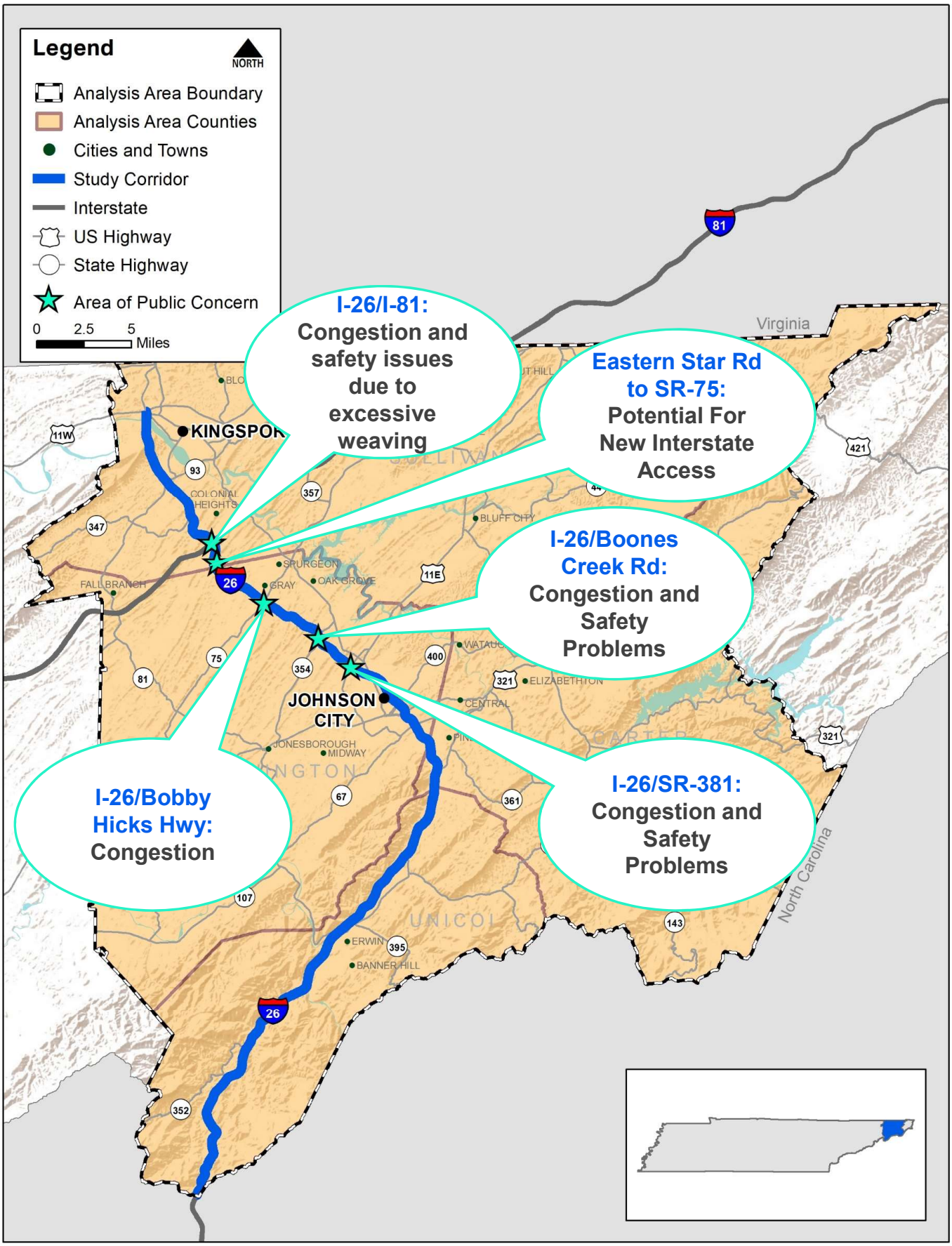
Members of the public and stakeholders identified many areas along the interstate corridor as exhibiting transportation problems. As shown in Figure 2-4, these areas are primarily distributed between Johnson City and Kingsport. The most frequently mentioned locations include:

- I-26/I-81 interchange
  - Congestion at this interchange is perceived to create delays and safety issues due to excessive weaving movements and lack of capacity. This interchange received more comments than any other location.
- I-26/SR-354 (Boones Creek Road) interchange
  - This location is perceived to have a lack of capacity. As indicated in Table 2-1, this interchange is programmed for reconstruction as a Diverging Diamond Interchange.
- I-26/SR-75 (Bobby Hicks Highway/Suncrest Drive Interchange)
  - This interchange, which serves a commercial and industrial area, is also reported to experience congestion.
- I-26/SR-381 interchange
  - This Single Point Urban Interchange is perceived to experience congestion problems.

3. Existing Conditions & Deficiencies

Existing and future deficiencies and needs along the I-26 corridor were identified by examining transportation issues including land use and economic development trends, highway capacity and congestion, travel demand, safety, presence of Intelligent Transportation Systems (ITS), freight, transit, and non-motorized travel.

Figure 2-4. I-26 Corridor Stakeholder Priority Locations

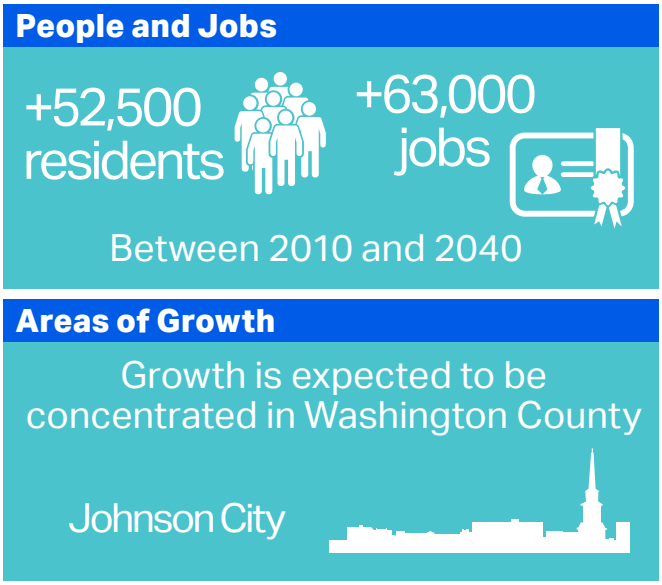


Source: TDOT Online Public Survey and I-26 Public Involvement Meeting (PIM)

Land Use & Economic Development

Land use, development patterns, and geographical and cultural features of the study area impact the demand for, design, and operations of transportation facilities. The locations of economic activity generators and the flows of goods and people between them are a key elements in identifying existing and future transportation needs.

Figure 3-1. Land Use and Economic Development



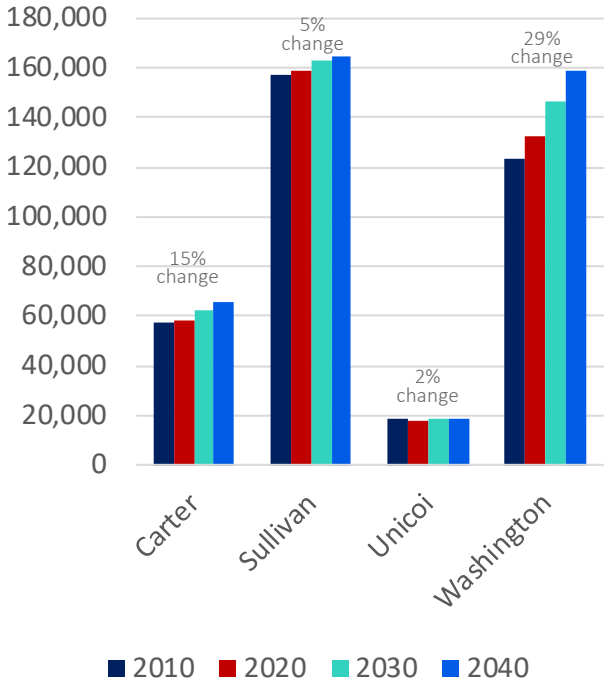
Population & Employment

Study area population and employment drives travel demand in the I-26 corridor. A high-level review of population and employment projections from Woods & Poole Economics, Inc. was undertaken for the four county study area. According to Woods & Poole Economics data, these counties are expected to see an additional 52,500 residents and 63,000 jobs by 2040. This represents a 15% increase in people and 33% increase in employment since 2010. Washington County is expected to see the most significant growth in employment and population accounting for approximately 68% of the region's population growth and 59% of the region's employment growth. Figures 3-2 and 3-3 show the population and employment growth trends per county. Figures 3-4 and 3-5 illustrate where the growth is expected to occur.

To focus on the needs of underserved populations, minority (persons identifying as other than "white alone") and low income populations – in this case persons living in poverty -- in the study area were mapped using data from the US Census Bureau's 2012-2016 American Community Survey (ACS). It should be noted that persons living in poverty represent the most extreme range of the region's low-income population.

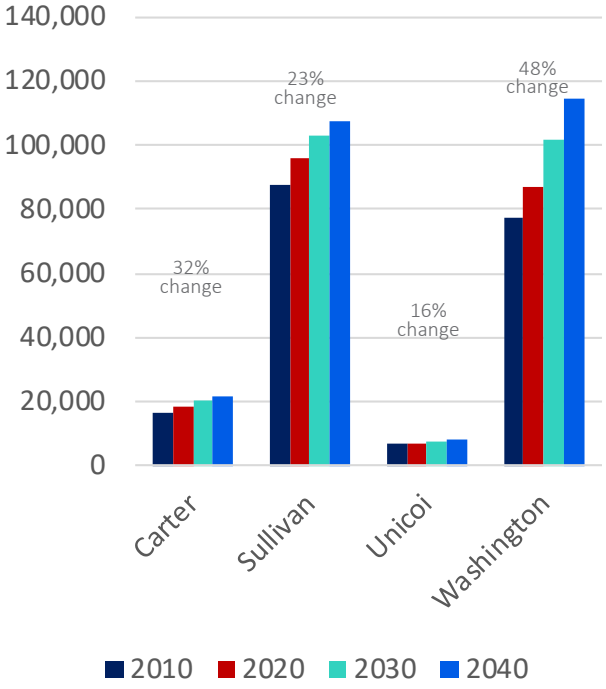
The ACS data showed the highest concentrations of minorities are found around Kingsport and Johnson City. The highest concentrations of people in poverty are found around Kingsport, Johnson City, and in Carter County.

Figure 3-2. County Growth Trends, Population — I-26



Source: Woods & Poole Economics, Inc., 2018

Figure 3-3. County Growth Trends, Employment – I-26



Source: Woods & Poole Economics, Inc., 2018

Figure 3-4. I-26 Change in Population (2010 to 2040)

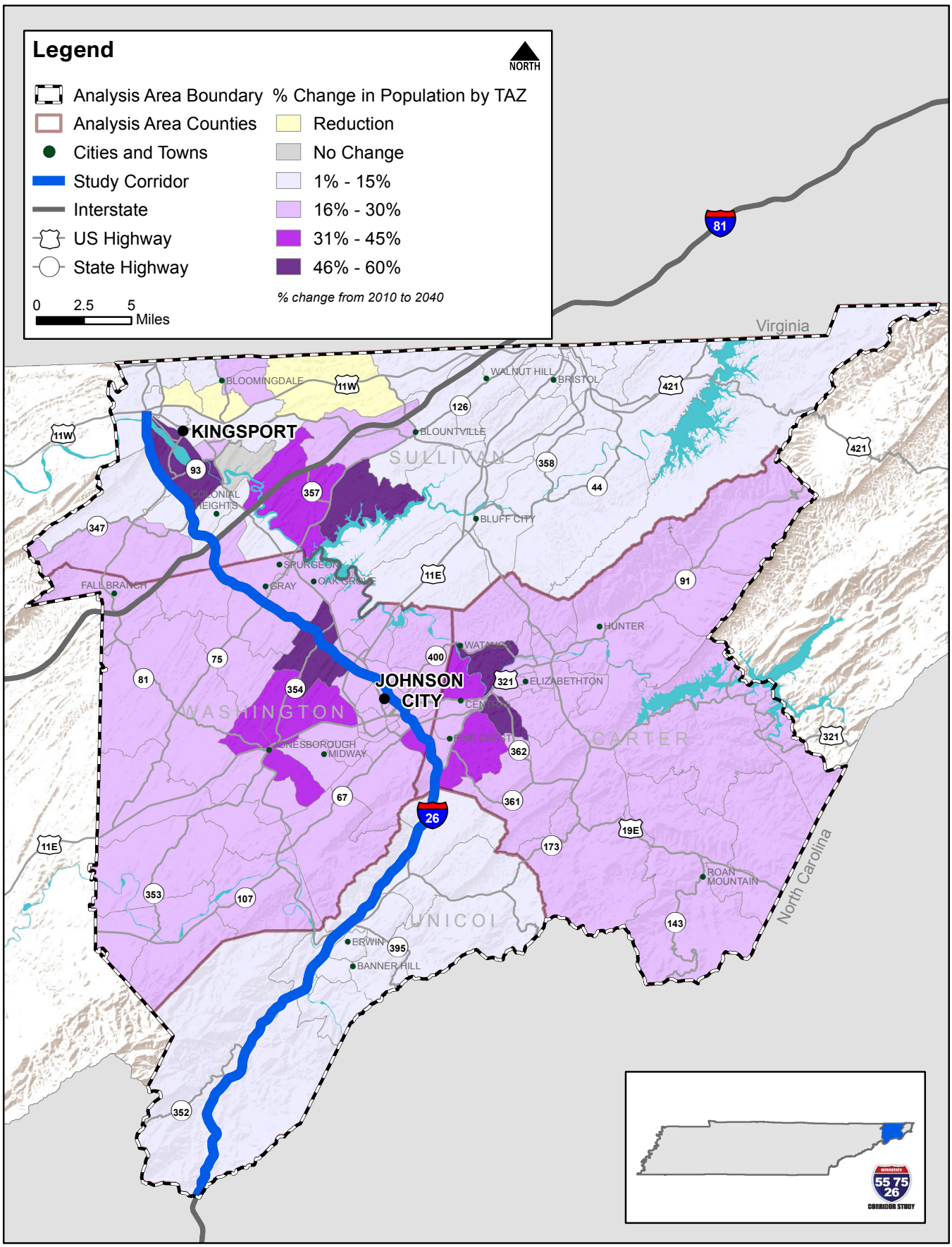
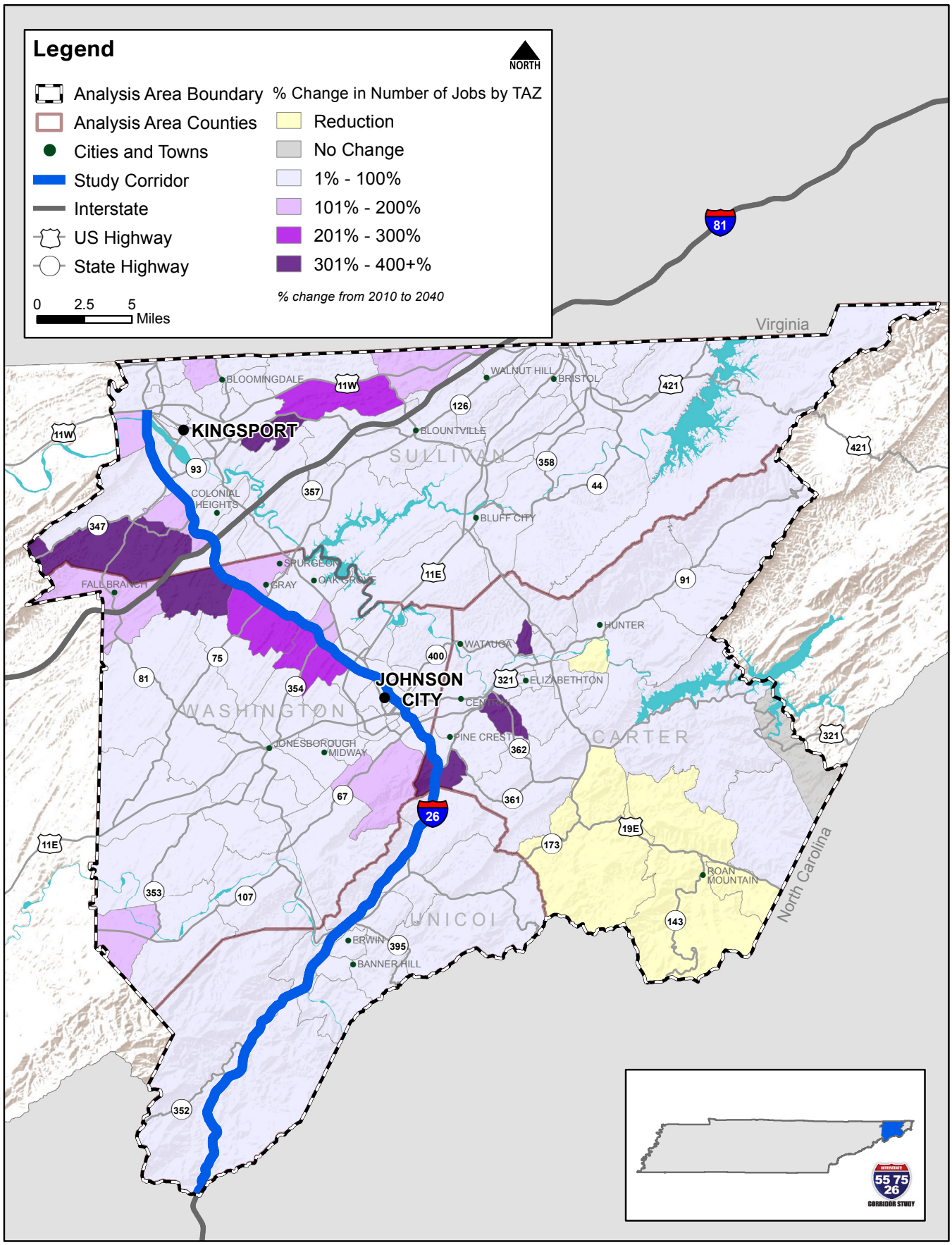


Figure 3-5. I-26 Change in Number of Jobs (2010 to 2040)



Land Use

Existing development patterns and in-progress plans will direct much of the forecasted population and employment growth over the next 20 years. As shown in Figures 3-4 and 3-5, much of the future growth anticipated along the I-26 corridor is expected to occur in and around the major urban areas of Kingsport and Johnson City in Sullivan and Washington Counties, respectively. Key development initiatives were identified and are shown on the existing land use map in Figure 3-6.

- Aerospace Park
  - This direct-airfield development at Tri- Cities Airport offers 40 acres certified for immediate development and has an additional 120 acres under construction. Aerospace Park has access to I-26 via SR-75 and I-81 via SR-357.
- The I-26/I-81 interchange area
  - Often referred to as the Tri-Cities Crossing, this area holds significant development potential, specifically for commercial and/or industrial developments, given its access to the Carolinas, Virginia, and the western portion of Tennessee.
- Exit 17 for SR-354 (Boones Creek Road)
  - Located in northern Washington County, Exit 17 is expected to see significant commercial growth around the interchange and additional residential growth is expected farther from the interchange around the new Boones Creek Elementary School, which opened in August 2019.
- Exit 19 for SR-381 (State of Franklin Road)
  - This area is home to a large number of commercial businesses and is expected to see increased development, including additional multifamily residential.
- Downtown Johnson City
  - Further south on I-26, the exits for downtown Johnson City are expected to see additional growth in the future as urban infill and redevelopment of historic buildings continue to occur for use as commercial and office space.
- Impact of out-of-state I-26 improvements
  - Future growth in industrial land uses could result along the corridor when improvements to I-26 are completed through Asheville, North Carolina.

Traffic Operations

TDOT collects and maintains Annual Average Daily Traffic (AADT) volume data on roadways across the state. Figure 3-7 shows the 2017 AADT volumes recorded in the Tennessee Roadway Information Management System (TRIMS) at 15 count stations along I-26. As shown, daily volumes range from 8,360 vehicles per day (VPD) (24% trucks) near the North Carolina border in Unicoi County, to 64,230 VPD (6% trucks) near Johnson City. Near the Virginia border in Sullivan County, volumes decrease to approximately 26,560 VPD (7% trucks). Throughout the corridor, eight to nine percent of the total daily volume occurs during the peak hours. The capacity of four-lane rural freeway facilities ranges from 52,000 VPD to 67,000 VPD. The capacity of four-lane urban freeway facilities ranges from 71,000 VPD to 92,000 VPD (Highway Capacity Manual 2010 Exhibit 10-8 and 10-9). I-26 is classified as an urban freeway facility between US-11W and the Carter/Unicoi County Line and within the Town of Erwin.

The highest traffic volume occurs just north of Johnson City

Table 3-1 is populated with data obtained from the TSM, which provides base year (2010) daily trip information and forecasts the daily trips that will be made in 2040 based on projected growth and land use changes.

As shown, total daily trips in the four-county area are expected to reach 2.3 million by 2040, representing a 23% increase over total trips in 2010.

Table 3-1. Area Daily Trip Breakdown 2010 and 2040 — I-26

	Daily Trips		
Trip Types	**2010**	**2040**	**% Change**
Personal Trips	1,784,300	2,196,300	23%
Truck Trips	51,200	68,500	34%
Total Trips	**1,835,500**	**2,264,800**	**23%**
Percent truck trips	2.8%	3.0%	

Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-6. I-26 Existing Land Use & Key Development Initiatives

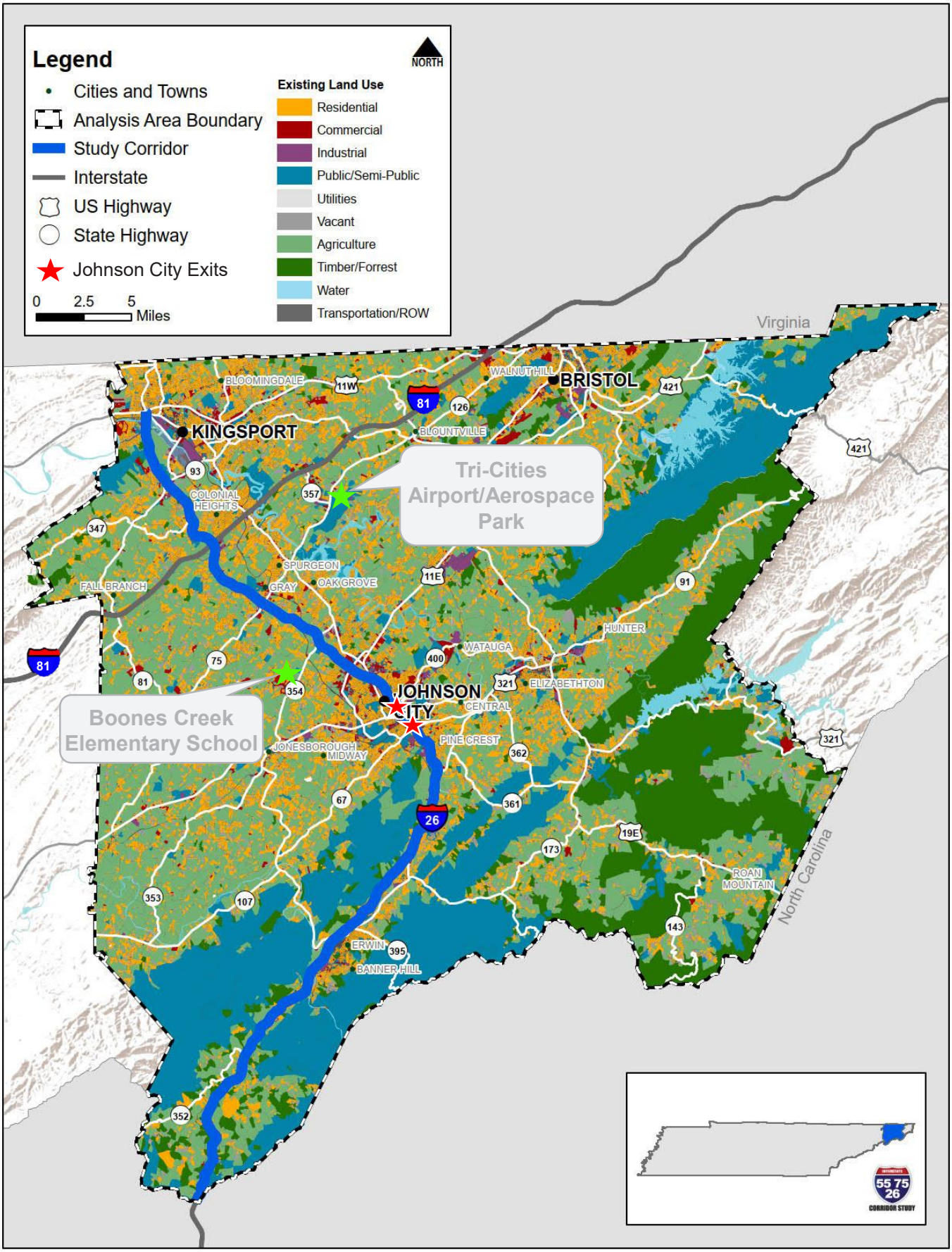
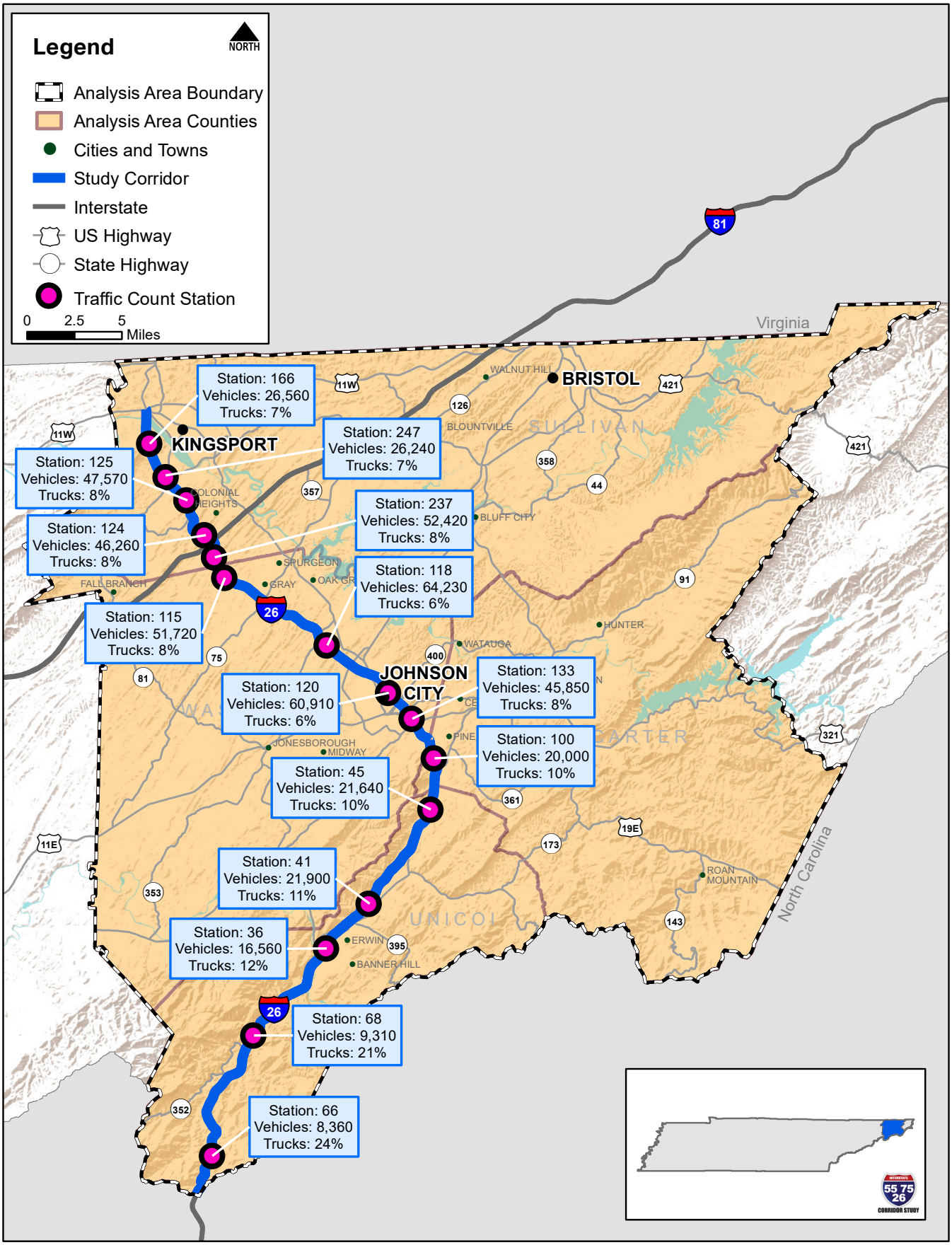


Figure 3-7. 2017 Average Annual Daily Traffic Volumes Along I-26



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Highway Capacity

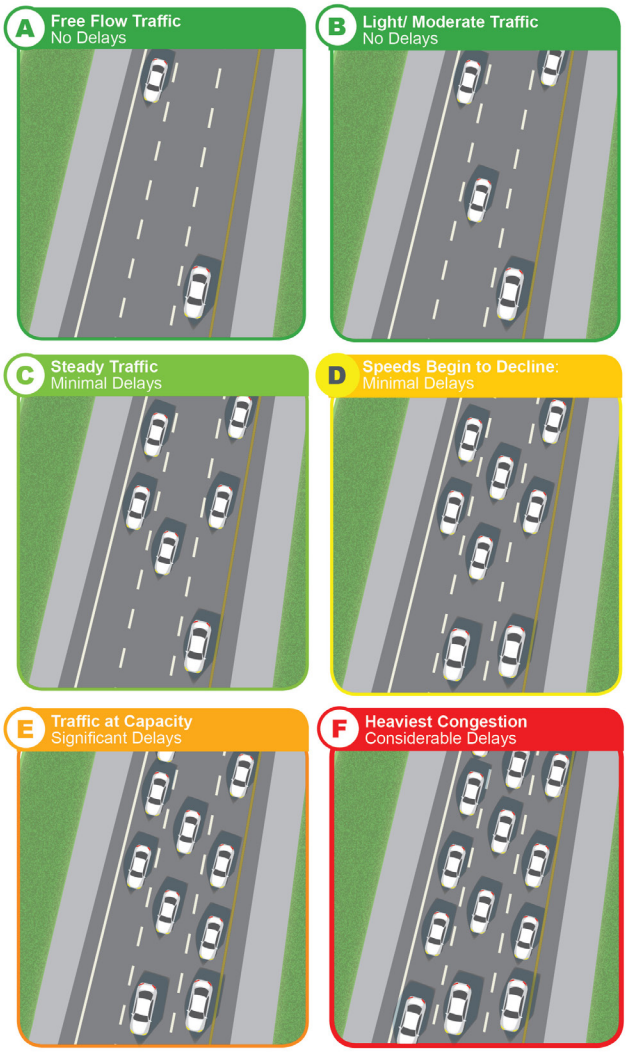
Vehicle capacity, as defined in the Highway Capacity Manual (HCM), is the maximum number of vehicles that can pass a given point during a specific period of time under prevailing roadway, traffic, and control conditions. Figure 3-8 illustrates the 2040 peak period volume-to-capacity (VC) ratios (obtained from the TSM) for each Interstate segment. Where the volume-to-capacity ratio is greater than 1.0, drivers experience poor operating conditions and high delay, represented as level-of-service (LOS) F (see Figure 3-9). According to the TSM output, I-26 currently operates very well – with all but one segment in Johnson City at LOS A and B. By 2040, segments of I-26, primarily between Johnson City and Kingsport, will begin to experience increased congestion, noted by LOS D. As indicated in red on Figure 3-8, one short segment of I-26 in the downtown Johnson City area is expected to reach capacity by 2040 and operate at LOS F.

Further investigation of this location revealed a short 1,400-foot distance between the eastbound on-ramp at SR-400 and eastbound off-ramp at SR-91. Close ramp spacing creates complicated weave areas, which tend to slow travel speeds during the AM and PM peak hours. It should be noted that the corresponding westbound lanes of I-26 have similar characteristics, and while they are not expected to reach capacity by 2040, traffic operations here should be monitored for similar operational issues.

It should be noted that the Kingsport MTPO 2040 and Johnson City MTPO 2045 LRTPs indicate that the following sections of I-26 will operate at LOS E or F in 2040/2045:

- I-26 at US-11W
- I-26 at SR-93
- I-26 between I-81 and Ford Creek Road, near the Sullivan/Washington county line
- I-26 between the Sullivan/Washington county line to near SR-381

Figure 3-9. LOS Characteristics



Transportation Systems Management & Operations (TSM&O)

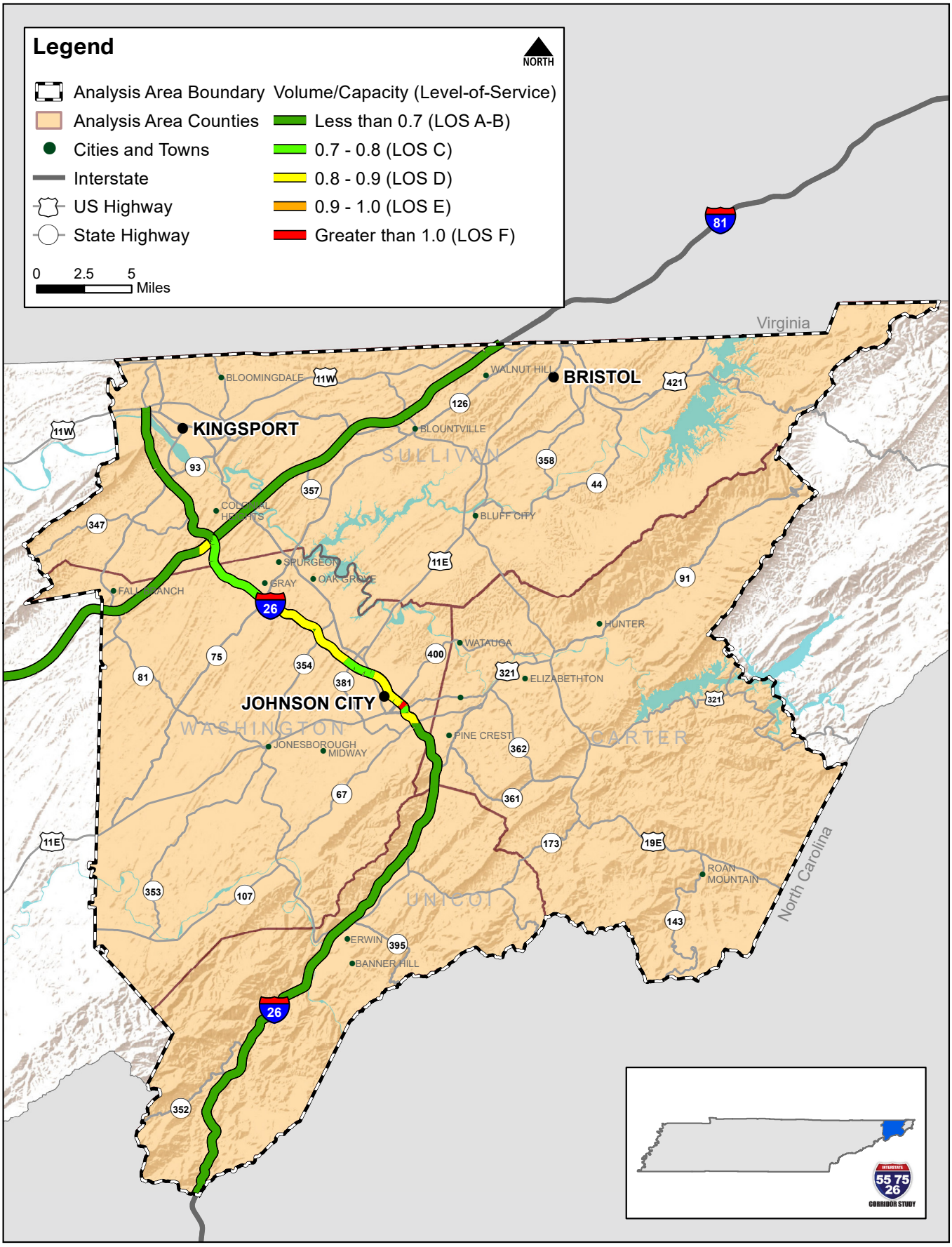
ITS

Intelligent Transportation Systems provide information which improves transportation safety, operations, and mobility. TDOT's ITS program, SmartWay, utilizes cameras and sensors to monitor interstate corridors throughout Tennessee. Approximately half of the I-26 corridor is rural in nature, and SmartWay technology is primarily concentrated in the urbanized areas.

Currently, SmartWay system elements are limited on the I-26 corridor. As shown in Figure 3-10, five Closed Circuit Television (CCTV) cameras monitor congestion on I-81 near the I-26 interchange, and two Digital Message Signs (DMS) visually communicate information to drivers. Highway Advisory Radio (HAR) transmitters broadcast messages to drivers on I-26 near the I-81 interchange. The Johnson City Traffic Division also operates and manages cameras along I-26. TN 511 provides traffic information and weather condition updates by phone throughout the corridor, and the SmartWay App provides real-time traffic information.

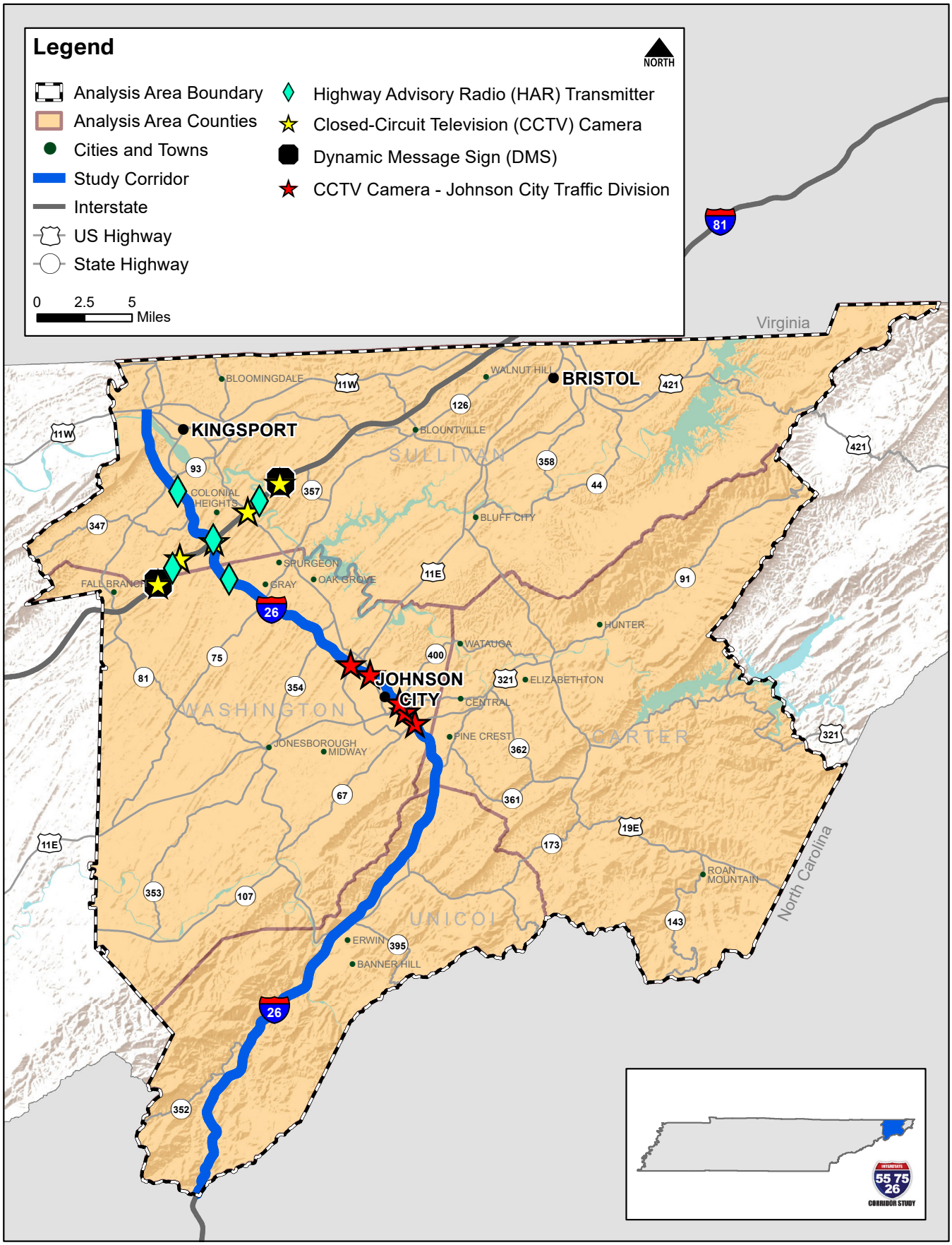
Johnson City and Kingsport have developed plans for and implemented intelligent transportation system (ITS) elements on the roadway network adjacent to I-26. The Johnson City ITS Architecture and Deployment Plan (updated in 2015), recommends projects ranging from speed monitoring deployment and flood detection/warning systems, to Traffic Operation Center (TOC) implementation, adaptive signal control, and SmartWay expansion. The Johnson City MTPO FY2017-2020 TIP includes Phase 1 of a project to add adaptive signal control on SR-381 in the vicinity of I-26.

Figure 3-8. Volume-to-Capacity Ratios/Level-of-Service (2040) — I-26



Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-10. Intelligent Transportation System Components — I-26



Source: Tennessee Department of Transportation

The Kingsport ITS Architecture and Deployment Plan, which involved the Virginia Department of Transportation, was adopted in 2008 and additionally recommended speed monitoring systems, freeway off-ramp queue detection, and TDOT SmartWay deployment at the I-26/I-81 interchange. As mentioned above, the latter has been installed.

Traffic Incident Management

Responding to traffic incidents in an effective and timely manner reduces congestion, wasted fuel, and the likelihood of secondary crashes. The time it takes to respond to an incident and clear the roads is directly related to the likelihood of a secondary crash. This response time can be greatly reduced using ITS technologies, including monitored CCTV cameras, radar detectors to determine travel speeds, and DMS to direct/notify drivers. The highly coordinated incident management process requires accurate and efficient communication among numerous agencies.

TDOT's HELP program has been incorporating the latest ITS technologies and strategies since its inception in 1999. However, with exceptions for assistance during special events, HELP trucks are currently not deployed on I-26. As a result, scene management and crash clearance rest solely on law enforcement and first responders.

According to the Johnson City MTPO, at the request of the Kingsport and Johnson City MTPOs, TDOT installed 0.2 mile marker signs on I-26 in both the Kingsport and Johnson City urbanized areas. While these signs support the local first responders, maintenance of the 0.2 mile marker signs has become an issue. Stakeholders report that routine maintenance is not always timely.

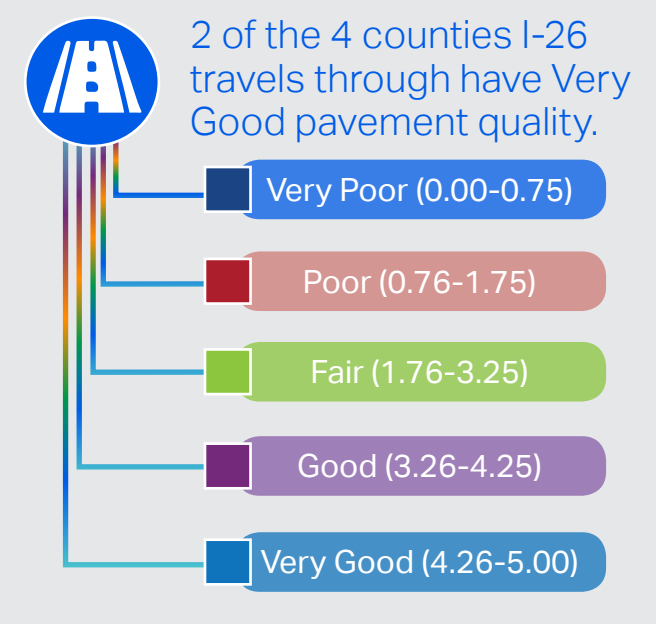
System Maintenance

Pavement

TDOT collects and maintains pavement management data for all roads included in the state's network. The Pavement Quality Index (PQI), expressed on a scale from 0-5, is the overall measure of a pavement's roughness and distress. The PQI is calculated based on both the Pavement Distress Index and the Pavement Smoothness Index, the latter of which is a function of the International Roughness Index (IRI). The IRI measures the number of vertical deviations over a section of road, and has been used as a performance measure toward goals set by the Federal Highway Administration (FHWA) since 1998. As of 2006, FHWA designated an IRI equal to 95 inches/ mile or less to be representative of a road with good ride quality.

Only 75% of I-26 roadway miles in Washington County meet FHWA's "Good" ride quality criteria. TRIMS maintenance history (as of 2017) illustrated in Figure 3-12, indicates that most of I-26 in Washington County was last resurfaced in 2002. Likewise, I-26 in Sullivan County and 11 miles in Unicoi County were last resurfaced in 2007. During a field review, pavement near Johnson City and Kingsport appeared to be recently resurfaced. The pavement along US-23, north of I-26, was observed to be in poor condition.

Figure 3-11. Pavement Quality Index

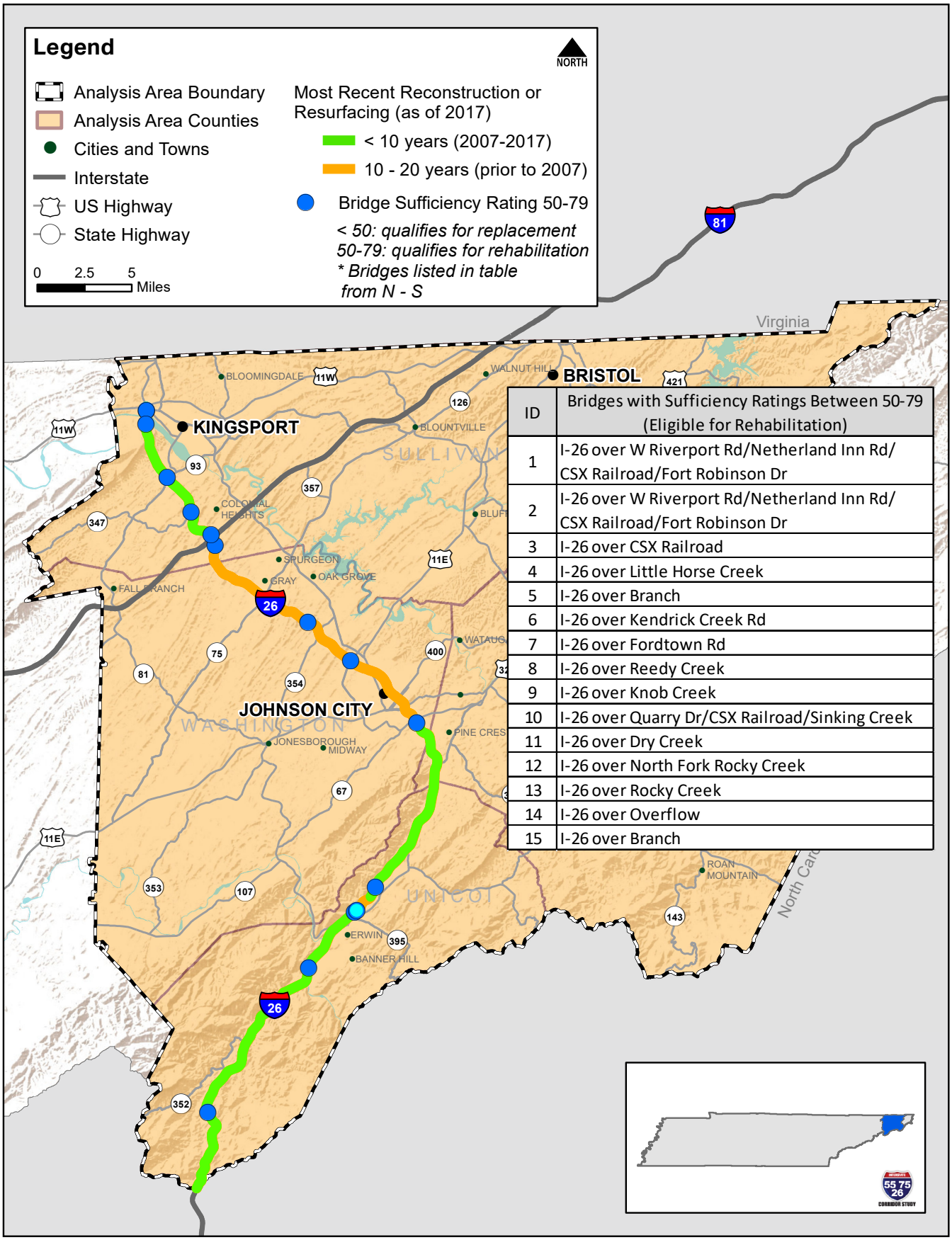


Bridge Conditions

TDOT routinely inspects and evaluates the 19,822 structures designated as public highway bridges in the state. These include bridges owned and maintained by TDOT, as well as those owned and maintained by local governments. TDOT designates a bridge as "structurally deficient" if one or more major structural components are rated in poor condition, or if its load carrying capacity is well below current design standards. Via the Better Bridge Program, the state addressed deficiencies on 193 of the 200 structurally deficient state-owned bridges in 2013. There are no structurally deficient bridges on the I-26 corridor.

The Federal Highway Administration's Highway Bridge Replacement and Rehabilitation Program provides funds to assist states in replacing or rehabilitating deficient highway bridges located on any public road. To be eligible, a bridge must carry highway traffic, be deficient, and have a sufficiency rating of 80 or less. The sufficiency rating of an individual bridge, on a scale of 0 to 100, is based on structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use. A rating of 0 is the worst possible bridge. A sufficiency rating that is less than 50 is eligible for replacement and a sufficiency rating of less than 80 but greater than 50 is eligible for rehabilitation.

Figure 3-12. Recent Reconstruction/Resurfacing, Bridge Sufficiency Ratings — I-26



ID	Bridges with Sufficiency Ratings Between 50-79 (Eligible for Rehabilitation)
1	I-26 over W Riverport Rd/Netherland Inn Rd/ CSX Railroad/Fort Robinson Dr
2	I-26 over W Riverport Rd/Netherland Inn Rd/ CSX Railroad/Fort Robinson Dr
3	I-26 over CSX Railroad
4	I-26 over Little Horse Creek
5	I-26 over Branch
6	I-26 over Kendrick Creek Rd
7	I-26 over Fordtown Rd
8	I-26 over Reedy Creek
9	I-26 over Knob Creek
10	I-26 over Quarry Dr/CSX Railroad/Sinking Creek
11	I-26 over Dry Creek
12	I-26 over North Fork Rocky Creek
13	I-26 over Rocky Creek
14	I-26 over Overflow
15	I-26 over Branch

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Of the 141 bridges on I-26 in the study area, only 15 have sufficiency ratings low enough to be eligible for rehabilitation under the Federal Highway Administration's program. The locations of these are shown on Figure 3-12. No bridges have sufficiency ratings low enough to be eligible for replacement.

Multimodal Facilities

Public Transportation

In the I-26 corridor, public transportation systems can be found in the form of on-demand paratransit services and fixed route bus services. Public transportation options are limited to the more densely populated areas of the study area including the cities of Kingsport and Johnson City (see Figure 3-13). Each of these cities offer a similar level of fixed route bus service and on-demand services to residents and visitors.

The Kingsport Area Transit Service (KATS) offers six fixed bus routes within the Kingsport area. While one of the four routes, Route 1, intersects I-26, none of the KATS routes run on the interstate itself. In addition to fixed route bus service, KATS also offers a dial-a-ride paratransit service, providing door-to-door next day service.

Johnson City Transit (JCT) offers seven fixed bus routes within the Johnson City area. While several of these JCT fixed bus routes intersect I-26, two routes run on the interstate itself:

- Orange North
- Silver

Each route has one bus running at a time and offers hourly service, with the exception of the Orange route which runs every 90 minutes. Most routes operate Monday through Friday from 6:15 a.m. to 6:15 p.m. and Saturdays from 8:15 a.m. to 5:15 p.m. Bus trips are $1.00 per ride, one way. In addition to the fixed route bus service, JCT offers an on-demand paratransit service called XTRA. This curb-to-curb service operates within the corporate limits of Johnson City, or within 3/4 mile of a JCT fixed route, whichever provides the farthest service to JCT patrons. Door-to-door service is provided on a case-by-case basis as needed. Fares for XTRA are $2.00 per one-way trip and $4.00 round trip.

Currently, there is one park and ride lot along the I-26 corridor located at the corner of North State of Franklin Road and West Oakland Avenue in Johnson City (see Figure 3-13). The Kingsport MTPO has recently undertaken a study to evaluate the feasibility of creating park and ride lots in the Kingsport metro area. The study will have recommendations including locations, destinations, shared costs and more.

Pedestrian/Bicycle

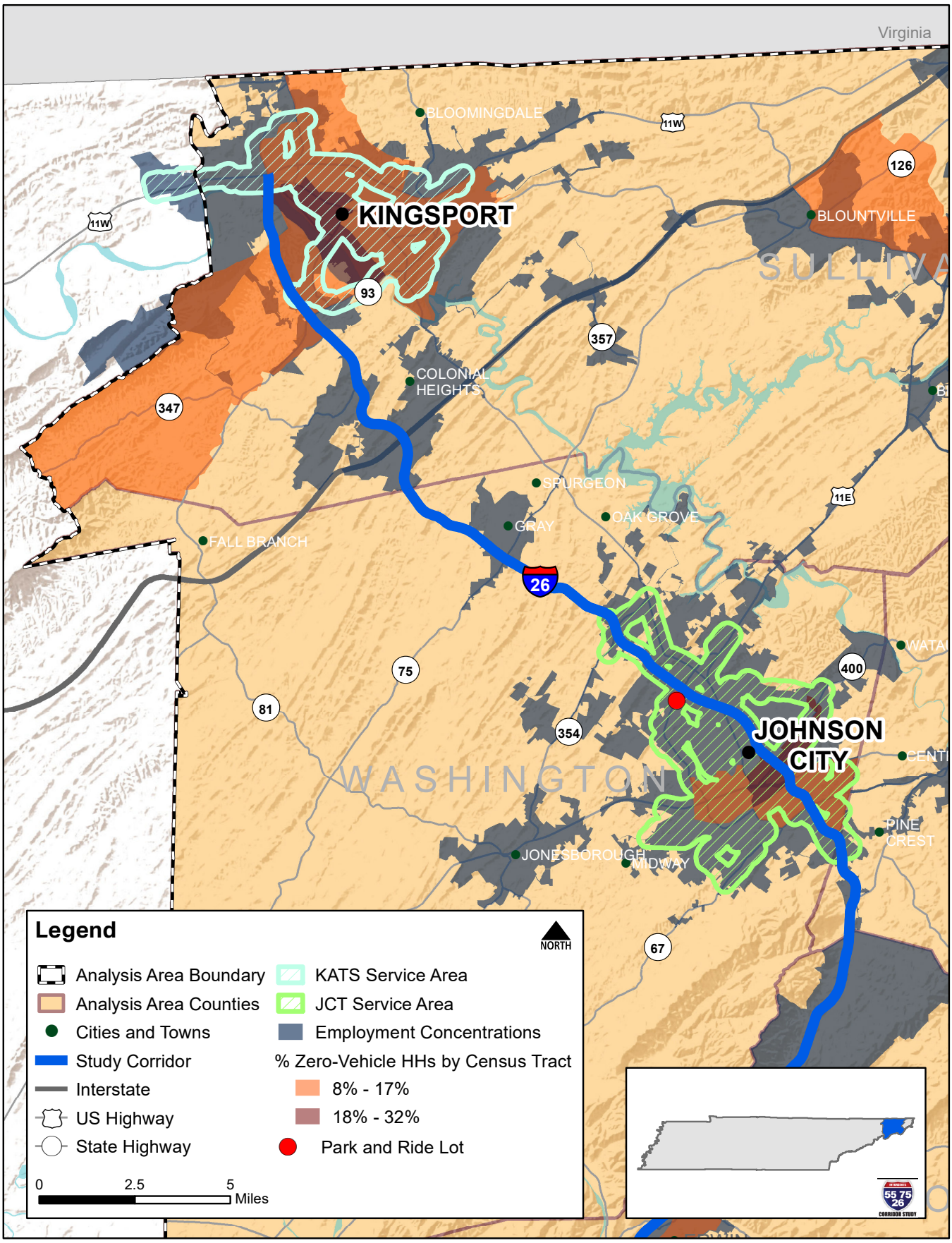
Unless planned for ahead of time, geometric limitations created by Interstate structures often result in discontinuous pedestrian and bicycle accommodations on cross-streets through an interchange. Where bicycle lanes and sidewalk may be present on either side of the Interstate, the cross-section through the interchange may be limited to only vehicular traffic, which discourages multi-modal connectivity. Furthermore, ramp intersections often create bicycle lanes and sidewalk paths that are difficult to navigate, and in some cases unsafe. As shown in Figure 3-14 and Table 3-2, I-26 interchanges with U.S. and state routes were evaluated to assess connectivity for pedestrians and bicyclists across the Interstate. Where pedestrian and bicycle accommodations existed on the cross-street, free-flow right turns at ramp interchanges were also noted. While free-flow right turns have operational benefits, the movement allows vehicles to maintain higher rates of speed off the ramp and through the intersection, putting pedestrians and bicyclists at a disadvantage. Motorists traveling at higher speeds are less likely to yield to pedestrians and higher intersecting speeds are more difficult for bicyclists to judge and manoeuvre. AADT on the cross-roads was also noted as higher traffic volumes limit mobility for pedestrians and bicyclists.

Noteworthy are the interchanges of I-26 with the two proposed state bicycle routes: SR-400 and US-11W/SR-1. SR-400 crosses I-26 as one-way pairs, through two interchange structures. No bicycle lane is designated; however, sidewalk and a wide outside lane are present. US-11W/SR-1 carries sidewalk through the interchange; however, no paved shoulder or bicycle lane is present. AADT volumes near this interchange approached 30,000 vpd in 2018.

Transportation Demand Management

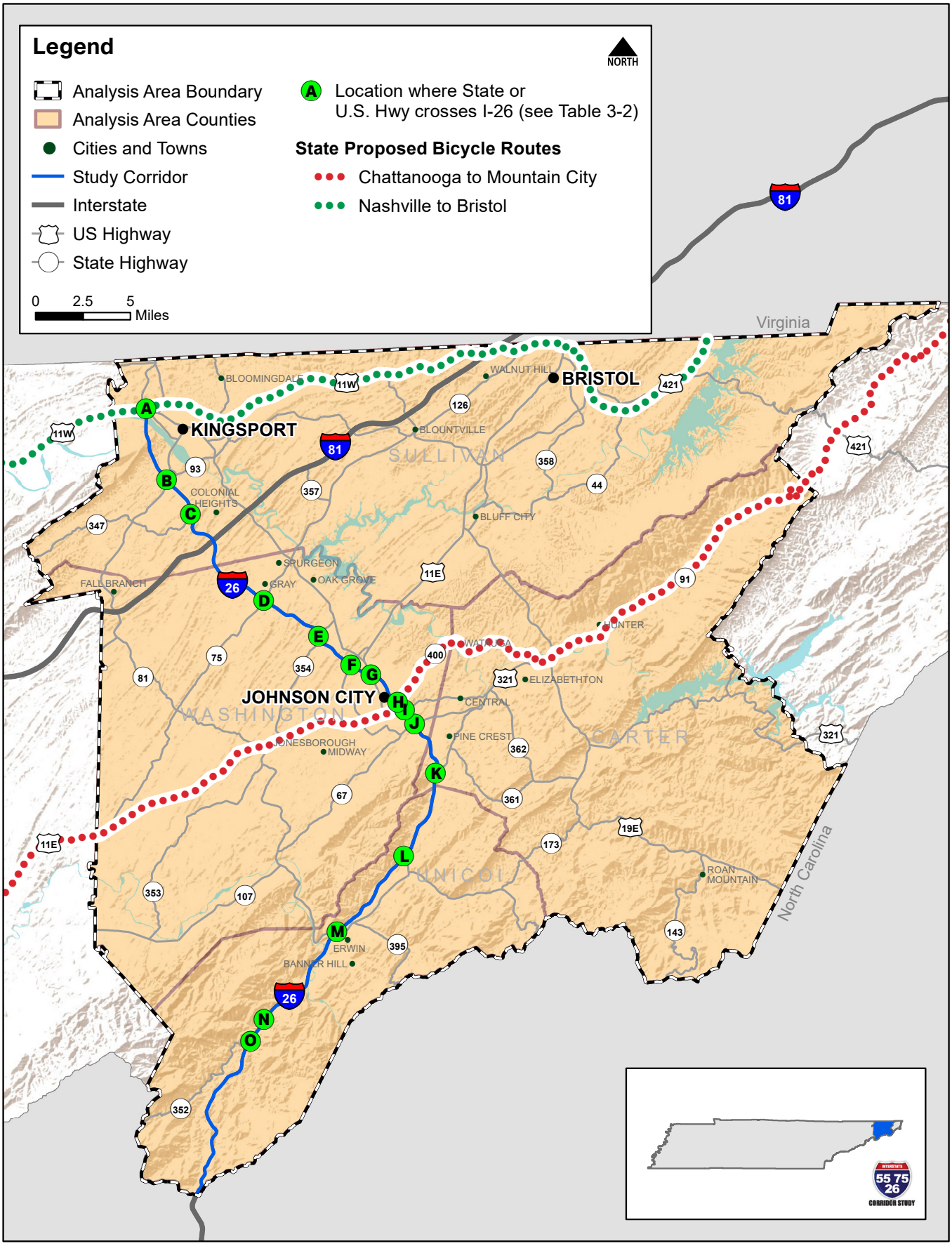
Transportation Demand Management (TDM) is a set of strategies that influence travel behavior to reduce single-occupancy vehicle travel. Ranging from ridesharing, bicycling, teleworking, taking transit, car sharing and on-demand or real-time applications, TDM strategies redistribute commuter travel across a variety of alternatives and away from daily peak periods. TDM programs represent a flexible, low-cost way to engage residents, travelers, businesses and local governments in the effort to reduce commuter travel and associated costs and impacts on the community including traffic congestion and emissions. The Statewide TDM Plan identified a number of ways regional TDM programs can support TDOT with managing mobility. They can also provide needed assistance on selected corridors when capacity is at a premium – especially during large construction projects. The I-26 corridor does

Figure 3-13. Transit Operations and Park-and-Ride Lots — I-26



Source: U.S. Census Bureau, Kingsport Area Transit Service, Johnson City Transit

Figure 3-14. Planned State Bicycle Routes and U.S./State Route Crossings — I-26



Source: Tennessee Department of Transportation

Table 3-2. Locations Where a U.S. or State Route Crosses I-26

Map Letter	State Route/U.S. Hwy Crossings	Crossroad AADT (2018)	Bicycle Lane/ Multi-Use Path?	Paved Shoulder >2'?	Sidewalk?	Free-Flow Right with Bicycle/Ped Facilities?
A	SR-1/US-11W (W. Stone Dr.)	29,500 (E)*	No	No	Yes	Yes
B	SR-93 (Wilcox Dr.)	25,500 (E) 13,400 (W)**	No	Yes	No	N/A
C	SR-347 (Rock Springs Rd.)	4,600 (E) 8,300 (W)	No	No	No	N/A
D	SR-75 (Bobby Hicks Hwy)	19,300 (E) 14,500 (W)	No	Yes	No	N/A
E	SR-354 (Boones Creek Rd.)	16,800 (E) 20,500 (W)	Yes	Yes	No	Yes
F	SR-381 (State of Franklin Rd.)	17,100 (E) 27,100 (W)	Yes	Yes	No	Yes
G	SR-34/US-11E (North Roan St.)	23,800 (E)	No	Yes	No	N/A
H	SR-400/ E. Watauga Ave./ E. Unaka Ave. (one-way pairs)	6,100 (W) 6,100 (W)	No	Wide Outside Lane	Yes	No
I	SR-91/ E. Market St./ E. Main St. (one-way pairs)	6,900 (E) 7,100 (W)	No	Wide Outside Lane	Yes	No
J	SR-67/US-321 (University Pkwy)	25,300 (W)	No	Yes	No	N/A
K	SR-359 (Okolona Rd.)	6,600 (E)	No	Yes	No	N/A
L	SR-173	5,700 (E)	No	Yes	No	N/A
M	SR-81/SR-107 (2nd Street - Erwin)	8,600 (E)	Yes (Ends at SB Ramps)	Yes	Under Structure Only	No
N	SR-36/US-19W (Dewey Frye Rd.)	No Counts	No	Yes	No	N/A
O	SR-352 (Old Asheville Hwy)	1,800 (E) 1,100 (W)	No	No	No	N/A

* East approach; ** West approach

Source: TDOT Traffic History website, Google Earth

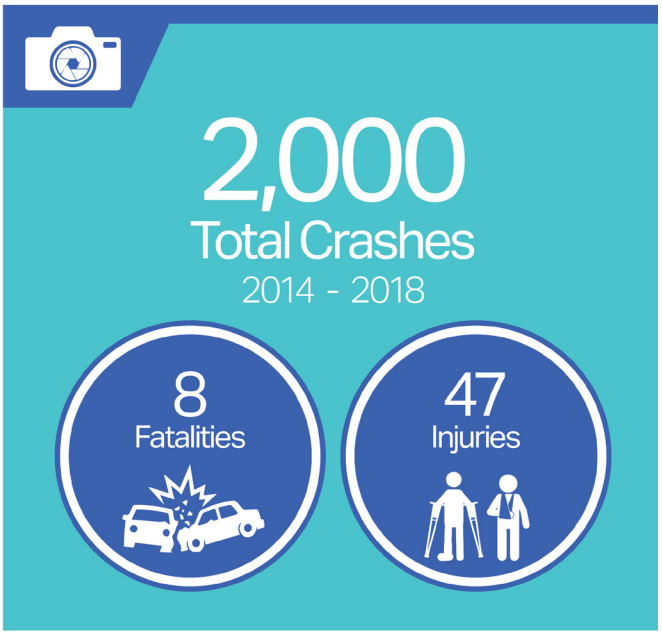
not currently contain an urban area TDM program. Additionally, the region could benefit from additional park-and-ride lots and vanpool programs, potentially between Johnson City and Kingsport.

Safety

Increased traffic volumes and vehicle miles traveled increase the likelihood of traffic incidents. To identify trends in potential safety issues along the I-26 corridor, five-year (2014-2018) crash data was collected from TRIMS and evaluated.

Tennessee is working to reduce traffic fatalities as part of the nation's vision Toward Zero Deaths®. This vision is a highway system free of fatalities.

Figure 3-15. I-26 Safety Snapshot



Using TDOT's traffic volumes collected in 2018, crash rates were also calculated. These rates are reported in terms of crashes per million vehicle miles traveled. Figure 3-16 shows the comparison of these rates to the statewide averages for facilities of a similar type. More specifically, the statewide average crash rate is 0.528 crashes per million vehicle miles traveled for rural freeways and 1.112 crashes per million vehicle miles for urban freeways. I-26 crash rates were compared to the Tennessee statewide averages based on the following metrics:

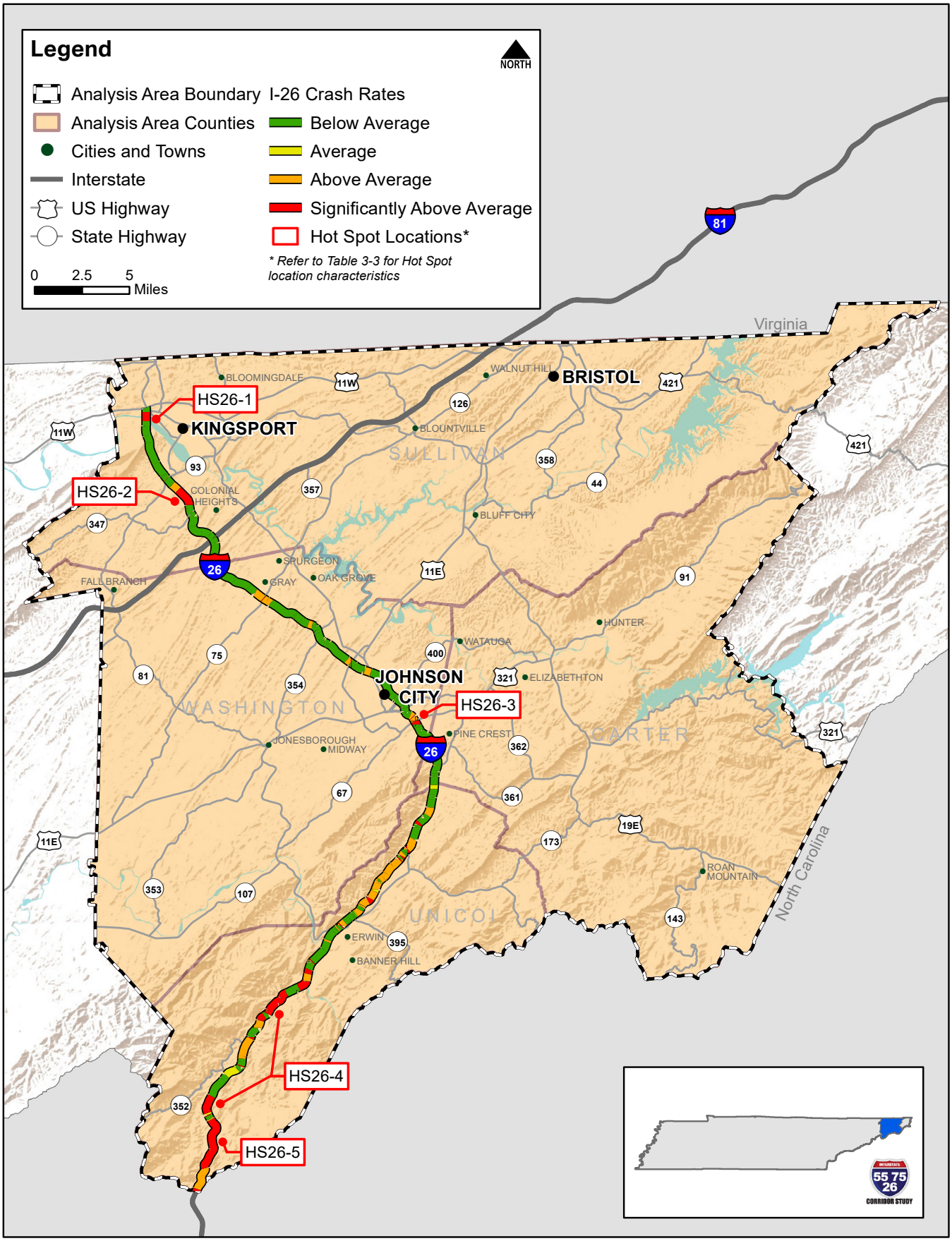
- **Below Average**: Locations with crash rates below the statewide average
- **Average**: Locations with crash rates at or within 15 percent above the statewide average
- **Above Average**: Locations with crash rates between 15 and 100 percent above the statewide average
- **Significantly Above Average**: Locations with crash rates greater than or equal to 100 percent higher than the statewide average

Areas where the crash rates were significantly above statewide averages were identified as hot spots and are shown in Figure 3-16 in red. Hot spots crash records were examined to discern if patterns indicated deficiencies that could be addressed. Table 3-3 shows the results of this analysis. In general, each of the hot spots were examined for trends in severity, prevalent collision types, non-vehicular accident events, lighting/weather conditions, relation to ramps and interchanges, as well as horizontal and vertical curvature. From these trends, potential crash factors were identified for each location, which ultimately informed the development of safety project solutions.

It should be noted that improvements to I-26 at the SR-67 interchange in Johnson City were completed in 2018 (PIN#112457.00). The project included an auxiliary lane on I-26 eastbound, an auxiliary lane on SR-67 northbound, improvements to the I-26 westbound off-ramp, signal modification at the ramp intersections, and lighting on I-26 eastbound. It is assumed that these improvements address deficiencies identified as safety hot spot H26-3.

Pedestrians and bicycle crashes within 500 feet of an interchange ramp were also analyzed for the 5-year period. In total, there were nine crashes involving a pedestrian or bicyclist, all of which occurred near downtown Johnson City. Of these three involved bicyclists and six involved pedestrians.

Figure 3-16. Crash Rates (2014-2018) — I-26



Source: Tennessee Statewide Travel Demand Model

Table 3-3. Hot-Spot Crash Location Characteristics – I-26

	Hot Spot ID				
	HS26-1	**HS26-2**	**HS26-3**	**HS26-4**	**HS26-5**
Termini	US-11W/ W. Stone Drive to Meadowview Parkway	SR-93/Wilcox Drive to SR-347/Rock Springs Road	SR-91/ E. Market Street to US-321/University Parkway	Various spot locations in Unicoi County (north of Flag Pond)	Various spot locations in Unicoi County (north of Flag Pond)
Number of Crashes	185	211	48	117	94
Severity (Fatal or Injuries)	22% (41)	25% (52)	10% (5)	21% (25)	32% (30)
Prevelant Collision Types	14% (25) Angle 67% (124) Non-Vehicle 12% (23) Rear-End	10% (22) Angle 68% (143) Non-Vehicle 13% (28) Rear-End	35% (17) Non-Vehicle 50% (24) Rear-End 13% (6) Sideswipe	85% (99) Non-Vehicle	96% (90) Non-Vehicle
Non-Vehicle Trends	56% (70) Roadway Barrier 22% (27) Animal	59% (84) Roadway Barrier 10% (21) Animal	35% (6) Roadway Barrier	61% (60) Roadway Barrier 21% (21) Animal	69% (62) Roadway Barrier
Lighting/ Weather	30% (55) in Dark-Unlit Conditions 25% (46) in Rain/Snow	28% (59) in Dark-Unlit Conditions 27% (56) in Rain/Snow	4% (2) in Dark-Unlit Conditions 25% (12) in Rain/Snow	34% (40) in Dark-Unlit Conditions 26% (30) in Rain/Snow	39% (37) in Dark-Unlit Conditions 46% (43) in Rain/Snow
Interchange Related	15% (28)	13% (28)	38% (18)	7% (8)	3% (3)
Curvature Issues	N/A	Horiz.: 2% (5) Grade: 4% average	Grade: 3% average	Horiz.: 69% (81)	Horiz.: 74% (70) Grade: 5% average
Potential Crash Factors	• Animal crossings from nearby nature preserve • Inadequate lighting at interchange • Small inside shoulder width near roadway barriers • Inadequate signage at interchange	• Inadequate lighting at welcome center ramps/exits • Small inside shoulder width near roadway barriers	• Uphill acceleration required on EB I-26 from SR-91/E. Market Street • Weaving on EB I-26 due to minimal sight distance between the end of acceleration lanes and US-321 (University Parkway)	• Curvature/speeding at night and/or in bad weather conditions	• Curvature/speeding at night and/or in bad weather conditions

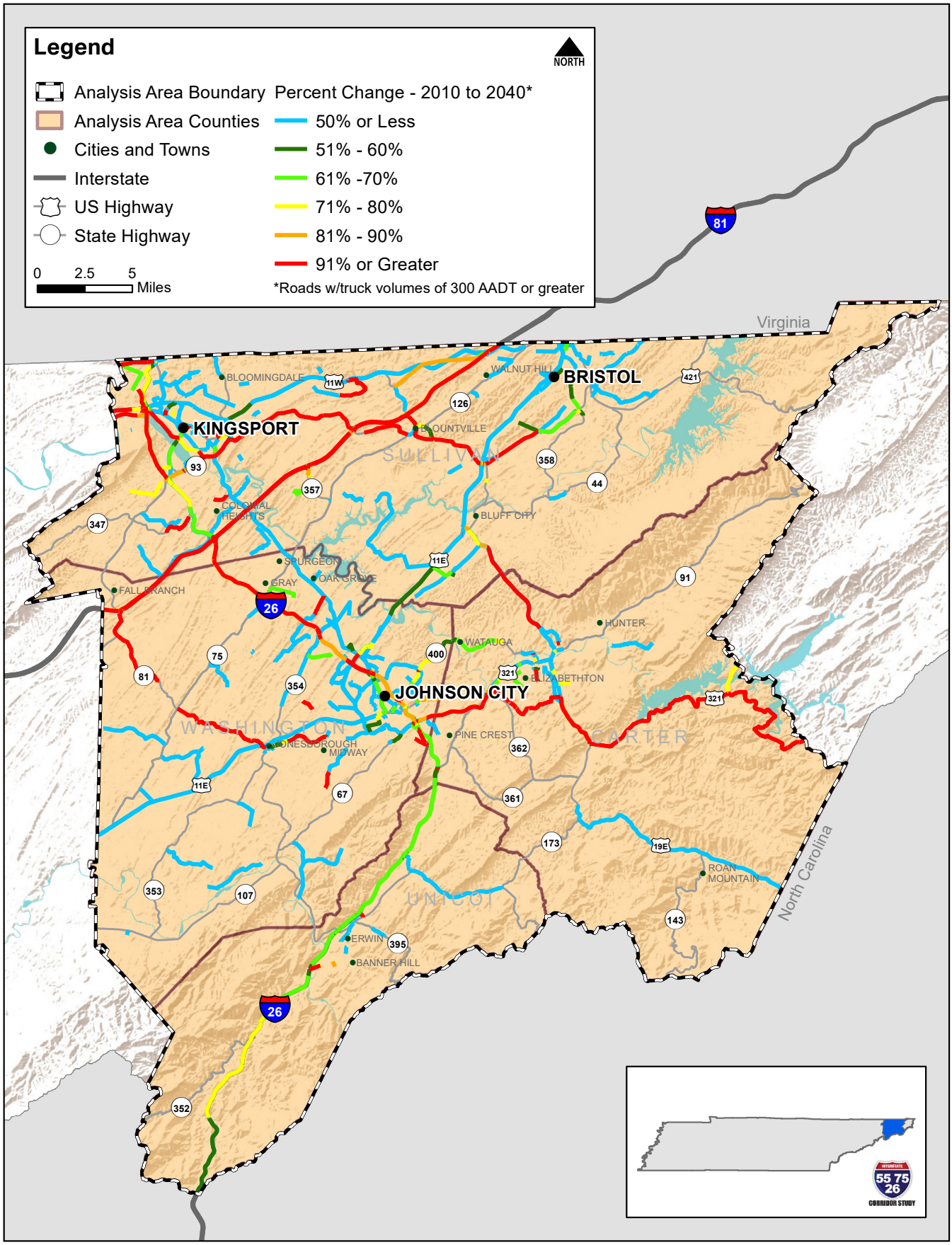
Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Freight

Freight movement is an important element of a regional and national economy, as more efficient modes and routes enable improved logistics and result in reduced transportation costs. These cost savings can then be reallocated to growth, providing better jobs and higher wages in the area. Truck is the primary mode of transporting freight in the I-26 corridor, accounting for nearly 100 percent of inbound and outbound freight in the study area in 2016. Truck volumes are expected to grow by at least 61 percent from 2010 to 2040, with the portion north of Johnson City to south of the Virginia state border growing at a faster rate of 91 percent as shown in Figure 3-17. Parallel corridors are also showing high growth, indicating that traffic is and will continue diverting to other routes as a result of the lower level-of-service on I-26 between Johnson City and Kingsport (shown in Figure 3-18). The corridor sees high volumes of through traffic with between one and five million tons annually, with heavier volumes near Johnson City. The corridor has limited public and private truck parking with just two welcome centers and one private parking location.

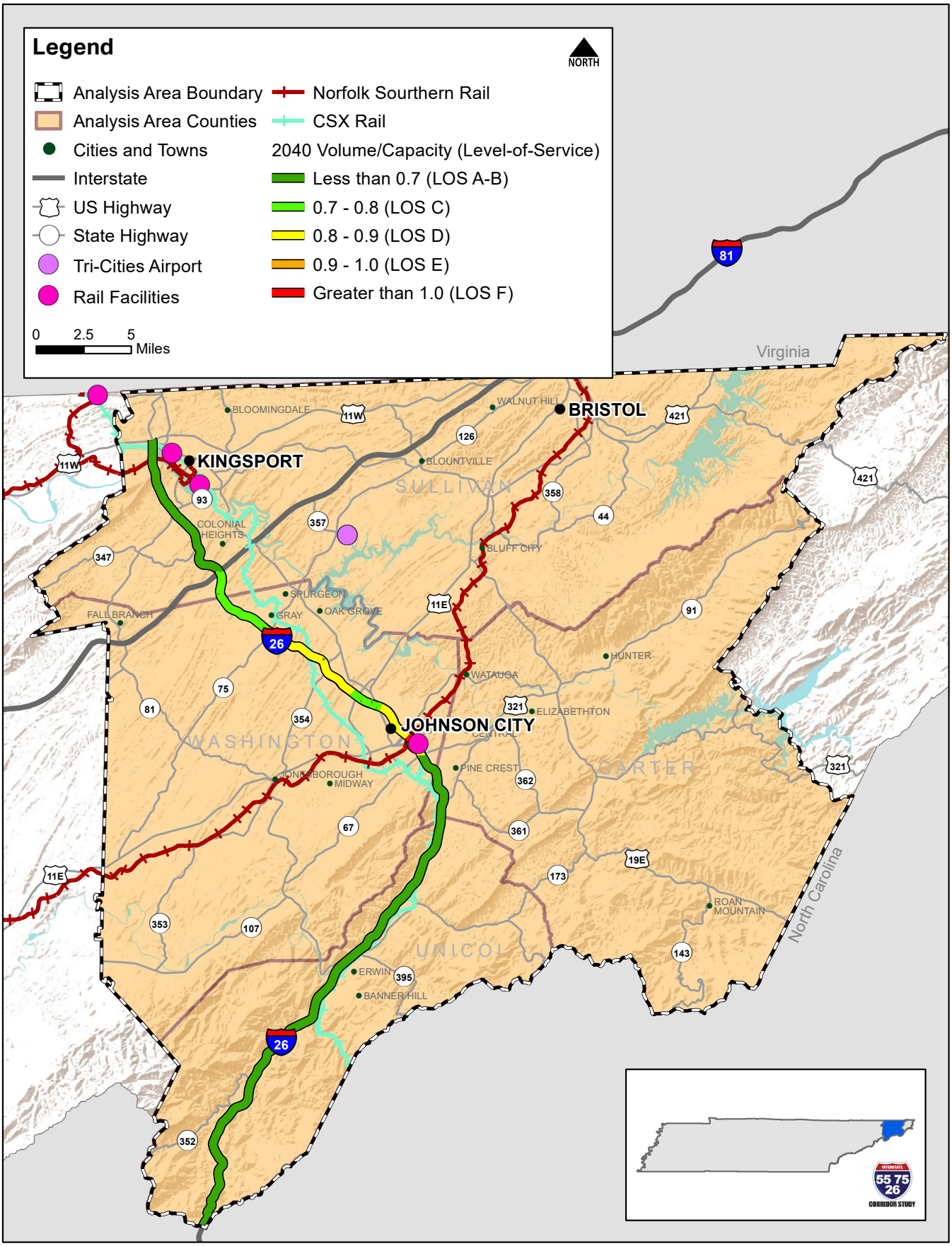
As noted in the Tennessee Statewide Multimodal Freight Plan (2018), changes to the I-26 corridor study area are recommended in the form of elimination of bottleneck locations, interchange improvements, and implementation of intelligent transportation systems (ITS). Additionally, truck parking is a critical need for the I-26 corridor.

Figure 3-17. Growth in Truck Volume from 2010 to 2040 — I-26



Source: Tennessee Statewide Travel Demand Model

Figure 3-18. Freight Facilities — I-26



Source: InfoUSA and Tennessee Statewide Travel Demand Model

A. Bottleneck Locations: The Tennessee Freight Plan lists three potential bottleneck locations on the I-26 corridor. All involve steep grades through mountainous terrain:

- Between US-11W and Meadowview Parkway in Sullivan County
- Between Flag Pond Road and the North Carolina State Line in Unicoi County
- At Clear Branch Access in Unicoi County

B. Interchange Upgrades: Four interchange upgrades are listed in the Tennessee Freight Plan. These projects are in various stages of planning, construction and completion:

- An interchange modification is needed in Washington County at I-26 and SR-354. The project location is on a Critical Freight Corridor (CFC) of the National Highway Freight Network (NHFN). The CFCs are delineated into rural and urban corridors that provide important connections to Interstates, ports, public transportation facilities, and intermodal freight facilities. The project has begun and has an estimated completion date of fall 2020.
- Completed in 2018, the interchange upgrade at I-26 and SR-67 in Washington County added an auxiliary lane and widened eastbound I-26. The interchange is also on the CFC.
- Reconstruction of the I-81/I-26 interchange is needed to improve safety. TDOT is also assessing short-term solutions, but reconstruction may be necessary. This project scored as a low priority state project in the 2018 Freight Plan.
- Reconstruction of intersections and interchanges between I-26 and West Stone Drive on John B. Dennis Highway (SR-93). The project would improve traffic flow, upgrade signals, and improve geometry thereby increasing economic efficiency, productivity and competitiveness, reducing congestion, and improving safety, security, and resilience. The project is estimated to cost $1.7 million and scored as a low priority state project.

C. ITS Projects: Proposed ITS projects as found in the Tennessee Freight Plan are listed below.

- Expansion of ITS options along I-81 between I-26 and the Virginia State Line. The project would improve economic efficiency, productivity, and competitiveness, reduce congestion, improve safety, security, and resiliency, improve state of good repair, use advanced technology, and reduce adverse and burdensome impacts. It is estimated to cost $1.8 million and is scored as a medium priority state project.

D. Truck Parking: Truck parking is a critical component of supply chain operations. Hours of service rules state that drivers must stop after 14 hours; therefore, it is important that drivers are offered a selection of locations throughout their journey where they can rest and possibly eat, shower, or sleep overnight. Without proper rest, drivers risk fines and crashes, jeopardizing the safety of all road users, especially in mountainous corridors like I-26. Drivers often spend the last hour of their driving time looking for a place to park. In the absence of available truck parking, trucks often stop on highway on- and off-ramps, which is both unsafe and illegal. As of 2015, Tennessee had one of the lowest rates of commercial vehicle truck parking spaces per 100,000 miles of combination truck vehicles miles of travel (VMT) in the nation, at less than 60.[1]

The website www.truckstopguide.com does not list any truck stops along I-26 in TN. The closest truck stop along the I-26 corridor is in Hendersonville, North Carolina, which is approximately 90 minutes from Johnson City. Some public truck parking exists at the Welcome Centers in Unicoi (27 spots) and Kingsport (13 spots) and at Sam's Gap Hill (13 spots), but these are not sufficient and may not provide adequate amenities. Parking at the welcome centers, for example, is limited to 2 hours maximum. According to the FHWA Model Development for National Assessment of Commercial Vehicle Parking[2], this segment of I-26 should have 25 rest area parking spots and 81 truck stop parking spots. In addition, with the exception of the Kingsport Welcome Center, existing truck parking is not located near the population centers that are the origins and destinations of most truck traffic. While more parking overall is necessary, parking within the urban core has the additional benefit of reducing the number of inbound trucks during the morning peak hours.

Deficiencies Summary

As detailed in the previous subsections, this study identified and evaluated existing and forecast transportation deficiencies in the I-26 corridor based on extensive plans review, data analysis, and stakeholder outreach. The identified deficiencies are summarized, by mode or strategy, in Table 3-4. In addition to the location and description of each deficiency, Table 3-4 shows the source by which each deficiency was identified.

1- https://ops.fhwa.dot.gov/freight/infrastructure/truck_parking/jasons_law/truckparkingsurvey/ch2.htm
2- https://www.fhwa.dot.gov/publications/research/safety/01159/3.cfm

Table 3-4. Deficiencies Summary — I-26

Mode/ Strategy	Location	Issues/Deficiency	Source
Highway Capacity	I-81 Interchange	Congestion & safety issues due to ramp geometry / weaving	Public/Stakeholder
	SR-75 Interchange	Congestion	Public/Stakeholder
	SR-354 Interchange*	Congestion & safety problems	Public/Stakeholder
	SR-381 Interchange	Congestion & safety problems	Public/Stakeholder
	Eastbound I-26, from SR-400 to SR-91	TSM predicts segment to be overcapacity by 2040. Short weave distance between ramps.	Data Analysis
Safety	US-11W to Meadowview Pkwy	Animal crossings from adjacent nature preserve; inadequate lighting and signage at interchange; small inside shoulders	Data Analysis; Public/ Stakeholder
	SR-93 to SR-347	Inadequate lighting at welcome center ramps; small inside shoulder width near roadway barriers	Data Analysis; Public/ Stakeholder
	Various spot locations in Unicoi County	Curvature; speeding at night and/or in bad weather conditions	Data Analysis; Public/ Stakeholder
	SR-91 Interchange	Pedestrian/bicycle crashes near the ramp intersections	Data Analysis
TSM&O	Kingsport & Johnson City Urbanized Areas	Need for additional CCTV & DMS	Public/Stakeholder
	Throughout Corridor	Need for systems to improve incident management response time	Public/Stakeholder
	Throughout Corridor	HELP Truck Deployment	Public/Stakeholder
	Throughout Corridor	Maintenance of signs & median cable barrier	Public/Stakeholder
Freight	US-11W to Meadowview Pkwy	Grade-related potential bottleneck	Tennessee Freight Plan
	Between Flag Pond Rd and the NC State Line	Grade-related potential bottleneck	Tennessee Freight Plan
	Near Clear Branch Access	Grade-related potential bottleneck	Tennessee Freight Plan
	SR-93 to SR-347	Grade-related potential bottleneck	Kingsport MTPO 2040 LRTP
	Between SR-354 and SR-381	Potential bottleneck	Tennessee Freight Plan
	I-81 Interchange	Reconstruction needed to improve freight safety	Tennessee Freight Plan
	Throughout Corridor	Need for additional truck stop parking spaces	Data Analysis
Multimodal	Kingsport to Johnson City	Need for commuter service between these locations.	Data Analysis / JCT Comprehensive Operations Analysis
	Throughout Corridor	Only one park-and-ride lot available	Data Analysis
	SR-400 Interchange	Proposed State Bicycle Route; No designated bicycle lane.	Data Analysis
	US-11W Interchange	Proposed State Bicycle Route; No paved shoulder or bicycle lane	Data Analysis
	US-11W Interchange, SR-381 Interchange	Free-flow right turns from exit ramps with sidewalk on cross-street	Data Analysis
Economic Development	Eastern Star Rd to SR-75	Potential for new interstate access	Public/Stakeholder
	I-81 Interchange	Improvements to accommodate nearby future development	Public/Stakeholder
	Downtown Johnson City Interchanges	Improvements to accommodate urban infill and redevelopment	Public/Stakeholder

*Programmed interchange modification to a Diverging Diamond Interchange is under construction.

4. Multimodal Solutions/ Universe of Alternatives

Introduction

Following the identification and analysis of corridor transportation deficiencies, the study developed goals for the corridor and performance measures used to assess the effectiveness of various solutions to those problems. A universe of alternatives, or potential solutions, was developed. The universe of alternatives was organized based on the issues each potential solution addresses, including safety, traffic congestion, freight movement, and multimodal travel. Many of the solutions may benefit more than one aspect of travel in the corridor. Ultimately, selected solutions were assembled into a Build (2040) scenario that accounted for their impacts on regional travel.

30 potential solutions for the I-26 corridor are discussed in this report

Performance Measures

Goals for potential improvements along the I-26 corridor were selected to reinforce the three strategic emphasis areas in TDOT's 25-Year Long-Range Transportation Plan: efficiency, effectiveness, and economic competitiveness. As shown in Table 4-1, the five identified goals were further developed into 12 specific objectives, intended to guide development and evaluation of possible solutions. In order to evaluate how well a potential solution satisfies an objective - and ultimately a goal - measures must be established that are data driven and comparable across the Base (2010), Trend (2040) and Build (2040) scenarios. Table 4-2 outlines the performance measures established for the I-26 corridor. As indicated, the measures fall into four categories (Traffic Operations, Safety, Operations & Maintenance, and Multimodal), which directly support the objectives identified in Table 4-1.

Traffic Operations Alternatives

As indicated in Section 3 of this report, TSM analysis of the 2040 Trend scenario identified one location for more detailed traffic operations analyses and evaluation of possible solutions: eastbound I-26 between SR-400 and SR-91.

Table 4-1. Performance Goals and Objectives — I-26

Goals	Objectives		
Provide efficient and reliable travel	Improve travel times and reduce delay	Provide transportation options for people and freight	Optimize freight movement
Improve safety conditions	Reduce crash rates along the corridor – especially at identified crash "hot spots"	Implement or upgrade technologies that promote safety and effective incident management	Improve bicycle and pedestrian accommodations
Coordinate transportation investments with economic development plans	Improve interchange on/ off ramps	Coordinate with MPOs/ RPOs to determine areas where new/improved Interstate access is needed	
Invest equitably throughout the corridor	Expand transportation options for traditionally underserved populations within the corridor	Consider regional transit options	Identify areas with the greatest data-driven needs
Protect the natural environment and sensitive resources within the corridor	Identify transportation improvements that are not likely to result in major impacts to environmental, social, and cultural resources		

Table 4-2. Performance Measures — I-26

Goal	Performance Measure		Unit
Traffic Operations	Traffic on interstate operates at LOS D or better		% of interstate operating at LOS D or better
	Total Daily Vehicle Miles Traveled (VMT)		Miles (1,000s)
	Total Daily Vehicle Hours of Travel (VHT)		Hours (1,000s)
	Total Peak Hour Vehicle Hours of Delay (VHD)		Hours
	Total VMT / Trip		Miles
	Total Vehicle Minutes Traveled / Trip		Minutes
	Average Peak Hour Travel Speed	Urban Interstate	MPH
		Rural Interstate	MPH
	Congested Travel Time between key O&D Pairs along Corridor (Total)		Minutes
	Peak Hour Density at Improved Interchanges		Vehicles/Mile/Lane
	Average and Max Queues at Improved Interchanges		Feet
Safety	Crash reduction in safety "hot spots"		Above or Below Average Crash Reduction Potential
Operations & Maintenance	Bridge Condition (Sufficiency Rating)		% of bridges < 50
			50 < % of bridges < 80
	Pavement Condition (Resurfacing)		% of corridor resurfaced within the last 10 years
Multimodal	Pedestrian and Bicycle Accommodations at U.S. and State Route Interchanges		% interchanges with bike facilities
			% interchanges with ped. facilities
	Freight (Truck Parking)		# of Rest Area Spots
			# of Truck Stop Spots

The projected 2040 PM peak period volumes for this segment exceed the capacity of the existing facility. Additionally, the short 1,400-foot distance between the eastbound on-ramp at SR-400 and eastbound off-ramp at SR-91 creates a complicated weave area, which is expected to slow travel speeds during the AM and PM peak hours. It should be noted that the corresponding westbound lanes of I-26 have similar characteristics, and while they are not expected to reach capacity by 2040, traffic operations here should be monitored for similar operational issues. Possible solutions address the weave area by implementing one of the following four options:

1. Providing more distance between the on- and off-ramps
2. Constructing a collector-distributor road
3. Separating movements via braided ramps
4. Providing an option lane at the SR-91 off-ramp

In a February 2020 letter to TDOT, the Kingsport MTPO noted concerns about growth-related future capacity issues near the I-26/I-81 interchange and the Meadowview Basin area (SR-126 & SR-93 interchanges). The MTPO suggested that long-range plans should include six lanes on I-26 from Exit 3 in the Meadowview (Kingsport) area to Exit 27 near Unicoi. As shown in Figure 3-8, the 2040 TSM Trend Scenario results indicate that with exception to the segment between SR-400 and SR-91 that was just discussed, the entire length of I-26 will operate at LOS D or better in 2040. While other solutions identified as part of this study will help to mitigate future congestion, widening is not specifically recommended. To address the MTPO's concerns about the Meadowview Basin area, which

include weaving movements between the closely spaced Meadowview Parkway and SR-93/SR-126 interchanges, possible solutions also include a study to evaluate the need for collector-distributor lanes or other improvements between these interchanges.

Note that the conceptual planning and preliminary design phases of all interchange and surface road improvements recommended in this report should incorporate pedestrian and bicycle planning.

Eastbound weave area between SR-400 and SR-91

Safety Alternatives

As a first step in identifying safety solutions to address these factors along the I-26 corridor, TDOT's April 2017 IMPROVE Act was reviewed to determine if any safety-related solutions were recommended in these areas. There were no explicit safety solutions proposed as part of the IMPROVE Act on I-26, though there is one recommendation for a Diverging Diamond Interchange (DDI) improvement at SR-354/Boones Creek Road near Johnson City, which is currently under construction.

The potential crash factors at each hot spot were then reviewed, in tandem with public comments as well as aerial and street-level photography to identify potential solutions. It is important to note that some recommendations are unrelated to a crash hot spot, but instead may have originated from public or stakeholder input obtained throughout the planning process, or were noted during a field review.

In addition to identifying potential safety improvements for locations along the corridor, the crash reduction potential for each recommendation was explored through the research of Crash Modification Factors (CMFs). A CMF estimates a safety countermeasure's ability to reduce crashes and crash severity. Based on data provided by the CMF Clearinghouse, each recommendation is categorized as having above or below average crash reduction potential, specific to the I-26 corridor, where data was available. It is important to note that the reduction potential for each recommendation is only applicable to crash types that would be prevented by implementing the improvements.

Figures 4-1a and 4-1b depict each safety solution and its crash reduction potential. Priority should also be given to maintenance of new and existing signage, guardrail, and median cabling. If damaged, these treatments are not effective for safety.

TSM&O Alternatives

According to FHWA, TSM&O is "a set of strategies that focus on operational improvements that can maintain and even restore the performance of the existing transportation system before extra capacity is needed." Based on the definition of TSM&O, the I-26 corridor is a prime candidate for such strategies, as levels of service are currently such that motorists experience congestion, but not yet significant delays.

Several of the possible solutions outlined in other sections of this report would also be considered TSM&O solutions:

- Freight Solution, F4: Install CCTV to monitor for congestion and accidents and advise trucks via HAR in Washington County between SR-381 and SR-321
- Safety Solution, S4: Install Road Weather Information System in Unicoi County
- Multimodal Solution, BP1: Add bicycle lane/multi use path on SR-400 through the I-26 interchange
- Multimodal Solution, BP2: Add bicycle lane/ multi-use path on SR-1 / US-11W through the I-26 interchange
- Multimodal Solution, BP3: Conduct a study to propose bicycle and pedestrian connectivity and safety improvements at existing U.S. and State Route interchanges.

Additional solutions were developed via review of existing plans, public / stakeholder feedback, and field observations. These solutions are shown in Figure 4-2. It should be noted that stakeholders in the Kingsport area acknowledge the importance of providing multiple resources to "refill" a vehicle-including electric charging stations and propane or natural gas refueling stations. In a February 6th letter to TDOT, Kingsport MTPO staff noted the desire to partner with NCDOT to identify I-26 as an official "Alternative Fuels Corridor".

Figure 4-1a. Potential Safety Improvements — I-26

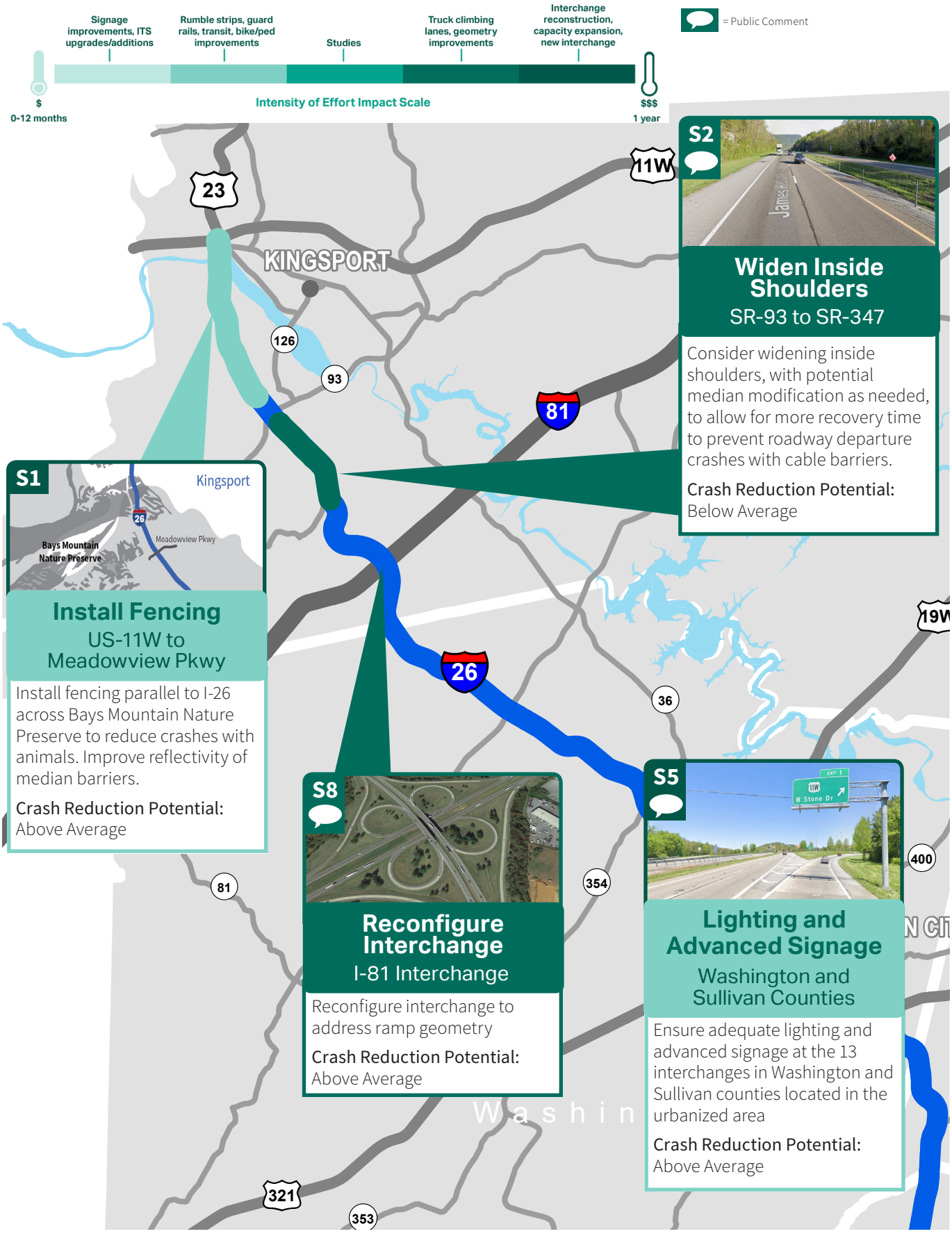
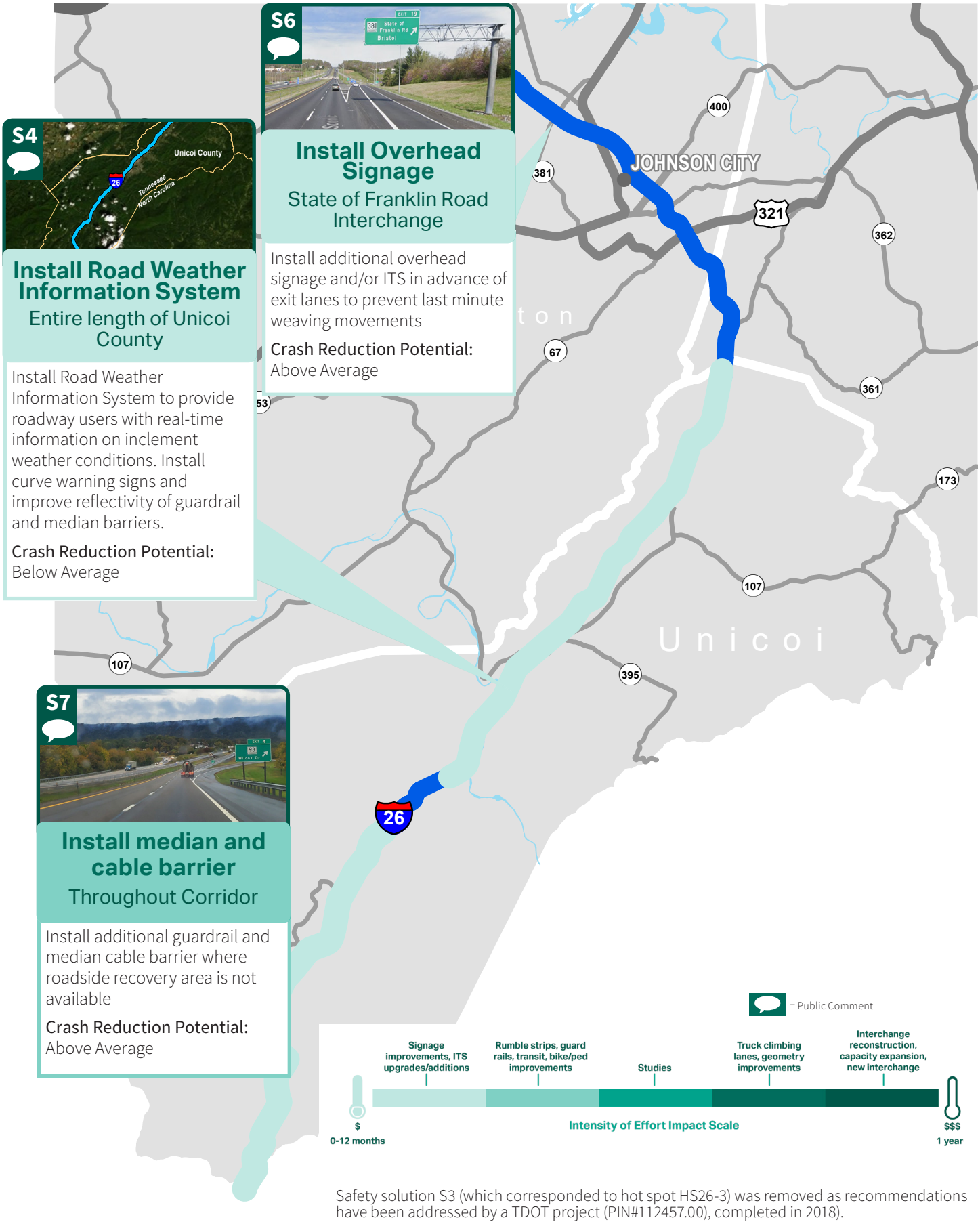


Figure 4-1b. Potential Safety Improvements — I-26



Safety solution S3 (which corresponded to hot spot HS26-3) was removed as recommendations have been addressed by a TDOT project (PIN#112457.00), completed in 2018).

Freight Alternatives

Potential options for improving freight mobility include infrastructure improvements, such as truck climbing lanes and interchange redesigns, as well as management and operation strategies, such as truck parking and communication strategies. Suggested freight improvements for the I-26 corridor are shown in Figure 4-3 and discussed as needed below.

Truck Parking

To address truck stop parking needs supportive of the hours of service rules, an additional 50 truck parking spots with overnight availability should be constructed along the corridor.

Interchange Redesigns

The TN Freight Plan indicated a potential truck bottleneck near US-11W in Kingsport. Likewise the Kingsport MTPO 2040 LRTP indicated need for study of the I-81 interchange for capacity and freight vehicle accommodations.

Truck Climbing Lanes

Large commercial vehicles are extremely sensitive to changes in grade. Research has shown that the frequency of collisions increases dramatically when vehicles traveling more than 10 mph below the average traffic speed are present in the traffic stream. When the length of the ascending grade is not long enough for trucks to maintain speeds within 10 mph of the average traffic speed, climbing lanes can relieve some conflict by allowing slower vehicles to move out of the primary traffic lanes thereby increasing the level of service for the highway. Longer acceleration and deceleration lanes at interstate on- and off-ramps can provide analogous benefits.

To address potential bottlenecks due to grade, identified in Section 3 of the report, truck climbing lanes are recommended as potential solutions at the following locations:

- EB SR-93 to SR-347
- EB near Clear Branch Access
- EB from Flag Pond Road to North Carolina state line

ITS

To monitor congestion and accidents in the Johnson City area, the study recommends installation of CCTV and HAR to advise trucks.

Parallel Corridors

The identification and use of alternative, parallel routes can be an approach to accommodate increasing traffic. One alternative route exists along the corridor that allows travelers to bypass Johnson City via SR-354 and SR-81; however, this route adds 1.2 miles to the trip distance and 10-15 minutes to the travel time on roads that are not well-suited for large truck travel.

The most recent Kingsport MTPO TIP (2020-2023) includes the 5-lane widening of SR-36 from SR-75 to I-81, which is the last 2-lane segment of this parallel route between Johnson City and Kingsport. In general, diverting truck traffic from interstate highways to lower order roads will increase potential safety problems, pavement wear, and traffic disruption. Therefore, these alternative routes would not be recommended in the absence of a traffic incident on I-26.

Driver Education and Stakeholder Engagement

In addition to the infrastructure and management strategies previously discussed, a key freight stakeholder noted several other items that can improve truck freight traffic in the State. These include driver education and stakeholder engagement regarding roadway construction. Driver education can include both truck and non-truck driving populations. Driver training programs can change truck driver behaviors to improve delivery efficiency, energy consumption, environmental impacts, and the safety of all road users.

The Tennessee Trucking Association has partnered with the Tennessee Highway Safety Office to educate students and senior citizens about sharing the road with trucks and has expressed interest in connecting with other agencies to teach the public about freight safety.

Economic Development

The Tennessee transportation system supports the economy of the state by providing access to employment for workers and facilitating the movement of goods into, out of, and within the state. Among the goals for transportation system planning in this study is the following: Coordinate transportation system investments with economic development plans. This goal is informed by two objectives:

- Improve interchange on/off ramps.
- Coordinate with MPOs/RPOs to determine areas where new or improved Interstate access is needed.

Based on this analysis and stakeholder input, development and employment growth in the I-26 corridor is expected to be centered on the segment of interstate between Kingsport and Johnson City. The area southwest of the interchange of I-26 and I-81 was identified in both analyses to be particularly attractive to new development. This area is already relatively job-dense, and future development may drive traffic growth beyond the capacity of current interchange design.

Figure 4-2. Potential TSM&O Solutions — I-26

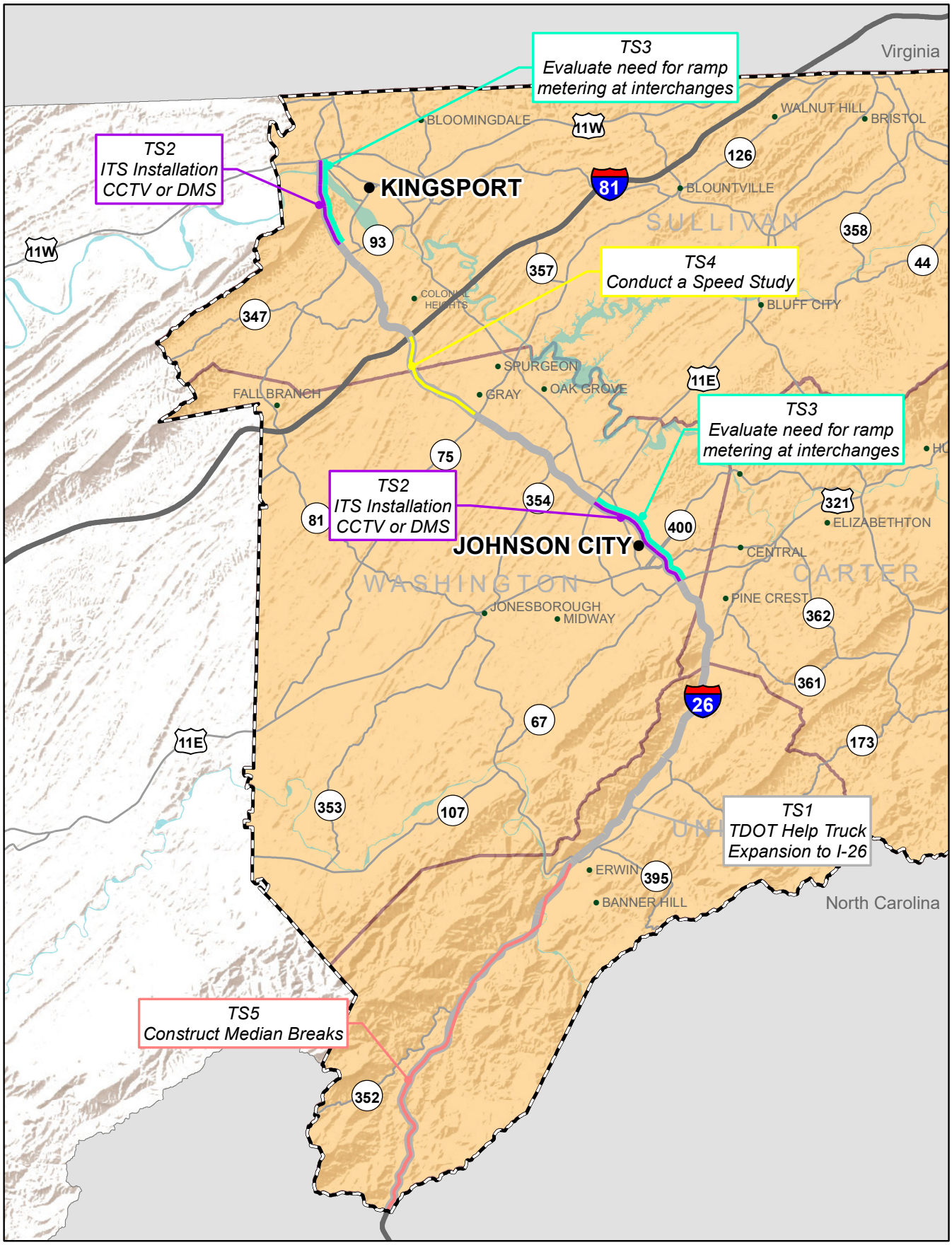
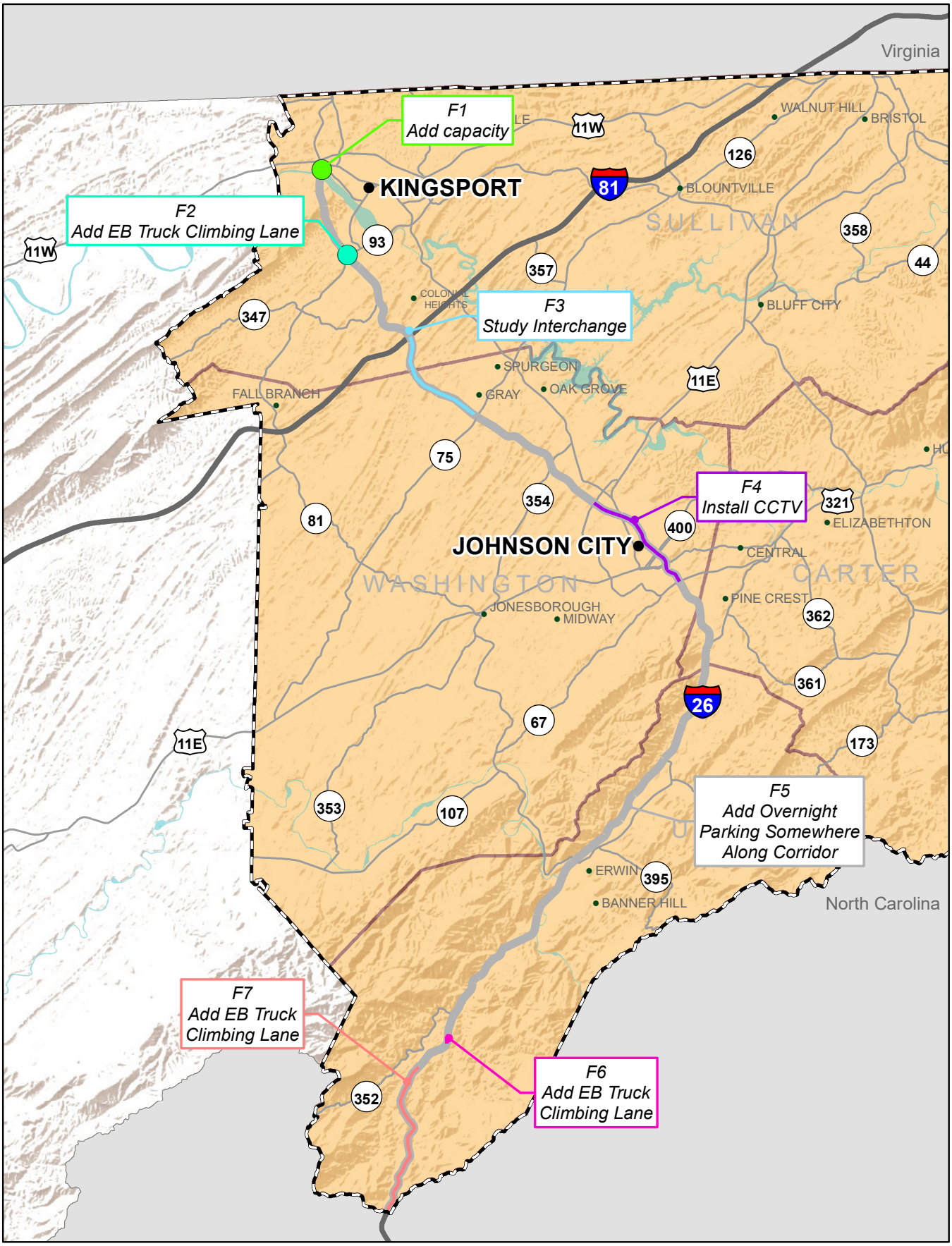


Figure 4-3. Potential Freight Improvements — I-26



The other area expected to see additional employment is located south of Johnson City, near Pine Crest. Currently, development in this area is relatively sparse, but its proximity to the urbanized area and Interstate access may make it attractive to developers.

One segment of the freeway corridor was called out by stakeholders for potential consideration of an additional access point. The segment of I-26 between Eastern Star Road and SR-75 was considered for an interchange approximately 20 years ago according to regional transportation planners. As this area is expected to see economic development activity in the future, it may be reasonable to reconsider adding an interchange to facilitate orderly development.

Figure 4-4. Potential Economic Development Improvements — I-26

Multimodal

While driving is the mode most supported in the I-26 corridor, it is important to ensure that multimodal transportation options exist. Several multimodal deficiencies were identified in Section 3, including a lack of regional connection between Johnson City and Kingsport and the need for more park-and-ride facilities. Meaningful transportation choices provide mobility opportunities for all users and can help alleviate congestion along I-26. A complete multimodal network includes transit, bicycle and pedestrian infrastructure, and additional resources including park-and-ride facilities that promote carpooling and transit use.

Potential transit and bicycle/pedestrian solutions recommended for the I-26 corridor include:

- T3: Commuter-Focused Rideshare – Several large employers located in Gray, outside of Johnson City, are currently not served by transit. By creating a rideshare program, more commuter traffic could be directed off of I-26, alleviating perceived congestion issues around Johnson City.
- T9: Regional Transit Access: Consider conducting a study as to whether a commuter route between Johnson City and Kingsport would be feasible. If created, a commuter route could reduce vehicles on I-26 during peak hours.
- T10: A January 2020 letter from the Kingsport MTPO and to TDOT Long Range Planning noted that an MTPO study of potential ridesharing/ van-pool service between Johnson City and Kingsport revealed the need for park-and-ride lots at the SR-93, SR-347, and SR-75 interchanges.
- BP1: Add bicycle lane/multi-use path on SR-400 through the I-26 interchange to accommodate bicycles on the proposed Chattanooga to Mountain City state bicycle route
- BP2: Add bicycle lane/multi-use path on SR-1/US-11W through the I-26 interchange to accommodate bicycles on the proposed Nashville to Bristol state bicycle route
- BP3: Consider conducting a study to identify bicycle and pedestrian connectivity and safety improvements at existing U.S. and state route interchanges.

Further bicycle and pedestrian study should consider the following measures:

- In-field, geometric analysis:
  - Average pedestrian crossing distance
  - Whether motor vehicles cross through crosswalks using free flow or slip lanes
  - Average buffer distance from traffic flow
  - Sidewalk width
  - Bicycle facility width
  - Existence of vertical buffers for pedestrians or cyclists
- Land Use Analysis (rural, rural town, suburban, urban core)
- Evaluation of Adjacent Infrastructure
- Detailed review of pedestrian and bicycle-related crashes within 0.5 miles of an interchange

Bicycle and pedestrian studies could further be expanded to include all interchanges and identify locations where new pedestrian/bicycle crossings may be appropriate.

Universe of Alternatives

Table 4-3 gathers these potential solutions into the total universe of alternatives for the I-26 corridor. The universe of alternatives presents a wide range of potential solutions to identified deficiencies. No solution is excluded from the universe of alternatives – it is essentially a brainstorming effort comprised of public and stakeholder ideas as well as best practices identified by planners and engineers. The list is supplemented by projects proposed in existing plans and studies.

Figure 4-5. Potential Solutions By Category — I-26

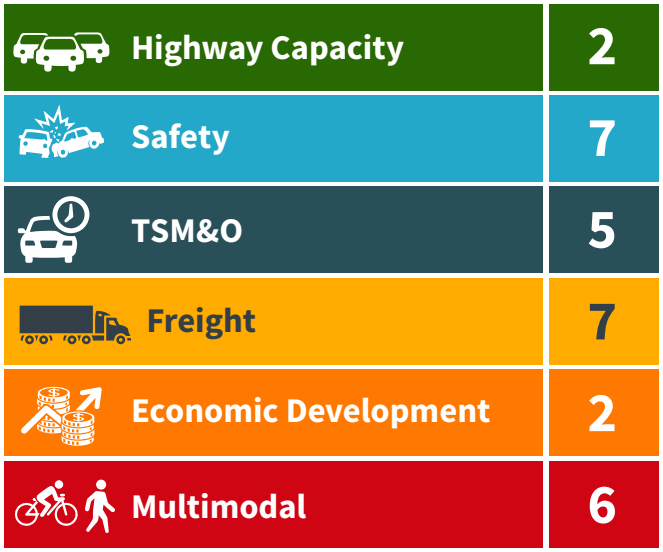


Table 4-3. Universe of Alternatives — I-26

	ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
Highway Capacity	C1	Washington	SR-91	SR-400	Increase spacing between ramps OR create C-D system OR construct braided ramps OR widen off-ramps to provide option lanes	Data Analysis
	C2	Sullivan	Meadowview Parkway	SR-93/SR-126	Conduct a study to evaluate the need for collector-distributor lanes and/or other improvements between these interchanges	Public/Stakeholder
Safety	S1	Sullivan	US-11W/W. Stone Drive	Meadowview Parkway	Install Fencing by Bays Mountain Nature Preserve	Data Analysis
	S2	Sullivan	SR-93/Wilcox Drive	SR-347/Rock Springs Road	Widen Inside Shoulders	Public/Stakeholder
	S4	Unicoi	TN/NC State Line	Unicoi/Carter County Line	Install Road Weather Information System	Public/Stakeholder
	S5	Washington, Sullivan	Kingsport and Johnson City Urbanized Areas		Install Additional Lighting and Signage	Public/Stakeholder
	S6	Washington	State of Franklin Road		Install Additional Overhead Signage	Public/Stakeholder
	S7	All	Throughout Corridor		Install additional guardrail and median cable barrier where roadside recovery area is not available	Public/Stakeholder
	S8	Sullivan	I-81 Interchange		Reconfigure interchange to address ramp geometry	Public/ Stakeholder and Tennessee Freight Plan (2018)

Table 4-3. Universe of Alternatives cont. — I-26

	ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
TSM&O	TS1	All	Throughout Corridor		HELP Truck Expansion to I-26	Public/Stakeholder
	TS2	Washington/ Sullivan	Kingsport and Johnson City Urbanized Areas		ITS Installation (CCTV & DMS)	Public/Stakeholder
	TS3	Washington/ Sullivan	Kingsport and Johnson City Urbanized Areas		Evaluate Need for Ramp Metering	Public/Stakeholder
	TS4	Washington	Eastern Star Road	Boones Creek Road	Conduct a speed study on I-26	Public/Stakeholder
	TS5	Unicoi	Erwin	NC State Line	Construct median breaks to allow for EMS vehicle turnaround	Public/Stakeholder
Freight	F1	Sullivan	US-11W	Meadowview Parkway	Add capacity to relieve bottleneck south of US-11W	Tennessee Freight Plan (2018)
	F2	Sullivan	SR-93	SR-347	Add eastbound truck climbing lane	Kingsport MPTO 2040 LRTP
	F3	Sullivan	I-81 Interchange		Study I-81/I-26 interchange for capacity, design for ease of truck use	Kingsport MPTO 2040 LRTP
	F4	Washington	SR-381	US-321	Install CCTV to monitor for congestion and accidents, advise trucks via HAR	Data Analysis
	F5	All	Kingsport	NC State Line	Add at least one overnight parking location along the corridor (~50 truck parking spots)	Data Analysis
	F6	Unicoi	West of Clear Branch Access	East of Clear Branch Access	Add eastbound truck climbing lane	Tennessee Freight Plan (2018)
	F7	Unicoi	Flag Pond Road	NC State Line	Add eastbound truck climbing lane	Tennessee Freight Plan (2018)
Economic Development	ED1	Washington	Eastern Star Road	SR-75	Evaluate need for additional interstate access point to accommodate economic growth	Public/Stakeholder
	ED2	Sullivan	I-81 Interchange		Improve interchange capacity and geometry to accommodate expected economic growth	Public/Stakeholder
Multimodal	T3	Washington	JCT Transit Center	Citi Commerce Solutions/ Frontier Health (Gray)	Study a commuter route between Johnson City and Gray	JCT Comprehensive Operations Analysis
	T9	Washington, Sullivan	Johnson City	Kingsport	Study a commuter route between Johnson City and Kingsport	Data Analysis
	BP1	Washington	E. Watauga / E. Unaka from Oak Street	E. Watauga / E. Unaka to Elm Street	Add bicycle lane/multi-use path on SR-400 through I-26 interchange	Data Analysis
	BP2	Sullivan	W. Stone Drive from Stonegate Road	W. Stone Drive to Union Street	Add bicycle lane/multi-use path on SR-1/ US-11W (W. Stone Drive) through I-26 interchange	Data Analysis
	BP3	All	Throughout Corridor		Conduct a study to propose bicycle and pedestrian connectivity and safety improvements at existing U.S. and SR interchanges	Data Analysis
	T10	Washington/ Sullivan	Various Locations		Designate park-and-ride lots near SR-93, SR-347, and SR-75	Public/Stakeholder

5. Solutions Screening & Project Priorities

The I-26 universe of alternatives were filtered through a solutions screening and prioritization process (see Figure 5-1). This process evaluates solutions based on their impact on mobility and safety, potential environmental impacts, cost, and potential economic impacts. Ultimately, the prioritized solutions both resolve the identified deficiencies and have a high benefit/cost ratio.

Solutions Screening, Phase 1

The Phase 1 solutions screening process was intended to eliminate solutions with evident fatal flaws. To do so, each possible solution was evaluated against the following questions:

1. Does the proposed solution make sense given the identified deficiency?
2. Does the proposed solution align with other planned or programmed projects in the area?
3. Is the proposed solution supported by stakeholders and the public?
4. Does the proposed solution negatively impact environmental features such as wetlands, rare or protected species, or superfund sites?
5. Does the proposed solution negatively impact cultural features such as sensitive community populations, historic sites, public lands, or community institutions?

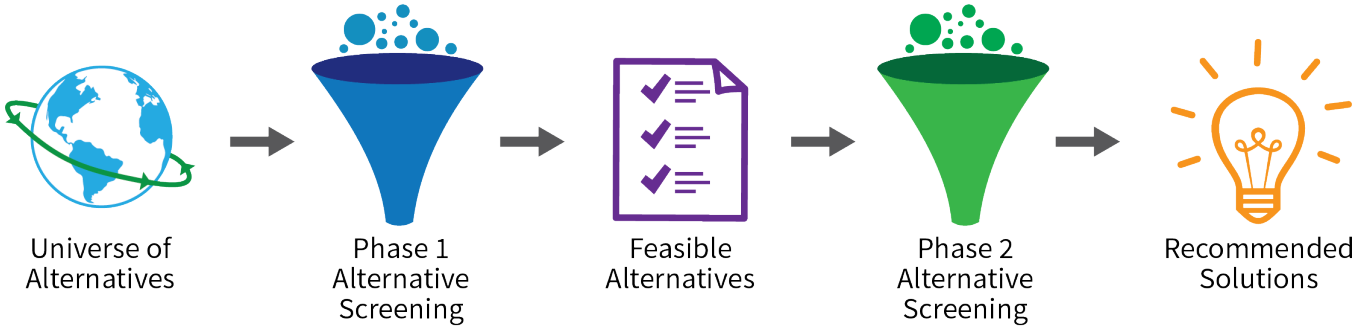
Projects which received a "NO" response for questions 1, 2, or 3, or a "YES" response for questions 4 or 5 were eliminated and did not move forward to the Phase 2 solutions screening. Exceptions include projects where the potential is high for environmental/cultural impact mitigation. Two I-26 solutions were eliminated in the Phase I solutions screening process – both because the recommended infrastructure is already in place:

- F1: Add capacity to relieve bottleneck south of US-11W. (Stakeholders agreed that traffic volumes here are very low and truck climbing lanes are already provided in both directions over Bays Mountain).
- BP1: Add bicycle lane/multiuse path on SR-400 through the interchange. Upon closer evaluation, SR-400 provides a wide outside lane, shoulder and carries only one-way traffic through the I-26 interchange.

Figure 5-2. Solutions Passing Phase 1 Screening — I-26

Highway Capacity	2
Safety	7
TSM&O	5
Freight	6
Economic Development	2
Multimodal	5

Figure 5-1. Solutions Screening and Prioritization Process



Solutions Screening, Phase 2

The Phase 2 alternatives screening process utilized performance measures to further refine the list of feasible alternatives. Potential solutions that passed the Phase 1 Screening were evaluated against the following questions:

1. Does the proposed solution improve level of service on the interstate corridor?
2. Does the proposed solution improve peak hour travel speeds on the interstate corridor?
3. Does the proposed solution improve travel times between key origin and destination (O&D) pairs along the corridor?
4. Does the proposed solution improve peak hour densities at the improved interchange?
5. Does the proposed solution reduce average and max queues at the improved interchange?
6. Does the proposed solution have the potential to reduce crashes in safety hot spots?
7. Does the proposed solution address deficiencies in bridges with a low sufficiency rating?
8. Does the proposed solution increase pavement quality?
9. Does the proposed solution provide for pedestrian / bicycle connectivity and safety at interchanges?
10. Does the proposed solution provide additional truck parking opportunities, particularly in urban areas?
11. Does the proposed solution have the potential to reduce vehicle miles traveled (VMT)?
12. Does the proposed solution improve incident management?
13. Does the proposed solution provide potential economic development opportunities?

Projects which received only "NO" responses were eliminated and did not move forward as feasible multimodal solutions. As indicated by Figure 5-3, all projects passed the Phase 2 screening and were moved forward to project prioritization.

Prioritization Methodology

Aligning with previous TDOT multimodal corridor studies, the prioritization methodology for this study addresses coordinated construction efforts (priority given to projects that could be accomplished simultaneously at a given location) and culminates in a benefit-cost index for each project, which recognizes the relative multimodal benefit of each project compared to the estimated financial investment. Consistency with TDOT and MPO programmed projects has been maintained throughout the alternative development process, having identified such projects as part of the Trend Scenario.

The most recent TDOT multimodal corridor study introduced flexible decision-making support tool wherein weights can be applied to priority settings based on policy, programming, and political decisions. The prioritization criteria and measures for the I-26 corridor are structured in a similar fashion, such that weights can be applied by decision-makers. As indicated in Table 5-1, solutions developed for the I-26 corridor were evaluated over six categories: mobility, safety, economic development, system maintenance, implementation and cost efficiency, as detailed here.

Figure 5-3. Solutions Passing Phase 2 Screening — I-26

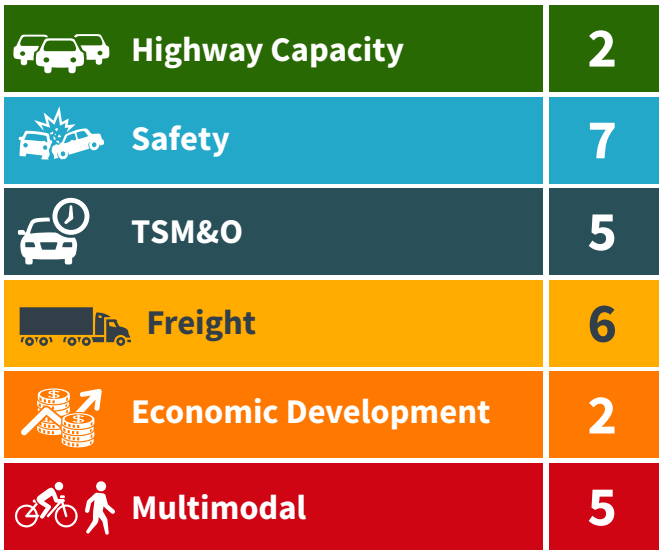


Table 5-1. Prioritization Criteria and Measures by Mode and Strategy — I-26

Mode/ Strategy	Mobility	Safety	Economic Development	System Maintenance	Implementation	Cost Efficiency
Highway Capacity	2040 Trend VC	Crash Rate (Relative to Statewide Avg)	2020 Employment	Project addresses bridge deficiency (Y/N)	# of related projects	Benefit-Cost Index
	2040 Build VC	Project improves incident management (Y/N)	2040 Employment	Project addresses pavement deficiency (Y/N)		Dollar per Benefit
Safety	2040 Trend	Crash Rate (Relative to Statewide Avg)	2020 Employment	Project addresses bridge deficiency (Y/N)	Cost Estimate	Benefit-Cost Index
	2040 Build VC	Project improves incident management (Y/N)	2040 Employment	Project addresses pavement deficiency (Y/N)	# of related projects	Dollar per Benefit
		Crash Reduction Potential				
TSM&O	2040 Trend	Crash Rate (Relative to Statewide Avg)	2020 Employment	Project addresses bridge deficiency (Y/N)	# of related projects	Benefit-Cost Index
	2040 Build VC	Project improves incident management (Y/N)	2040 Employment	Project addresses pavement deficiency (Y/N)	Cost Estimate	Dollar per Benefit
Freight	2040 Trend VC	Project improves incident management (Y/N)	2020 Employment	Project addresses bridge deficiency (Y/N)	# of related projects	Benefit-Cost Index
	2040 Build VC		2040 Employment	Project addresses pavement deficiency (Y/N)	Cost Estimate	Dollar per Benefit
	% Trucks			Provides truck parking (Y/N)		
Multimodal	2020 Population	Project improves incident management (Y/N)	2020 Employment	Project addresses bridge deficiency (Y/N)	# of related projects	Benefit-Cost Index
	2040 Population		2040 Employment	Project addresses pavement deficiency (Y/N)	Cost Estimate	Dollar per Benefit
Economic Development	2020 Population	Project improves incident management (Y/N)	2020 Employment	Project addresses bridge deficiency (Y/N)	# of related projects	Benefit-Cost Index
	2040 Population		2040 Employment	Project addresses pavement deficiency (Y/N)	Cost Estimate	Dollar per Benefit

Prioritization Criteria and Measures

Mobility

Appropriate measures for mobility differ across modes/strategies. While the volume-to-capacity (VC) ratio is appropriate for measuring highway capacity, it does not capture mobility for bicycles and pedestrians, for example. As shown in Table 5-1, comparison of the 2040 Trend VC ratio versus the 2040 Build VC ratio was used as a measure of mobility for highway capacity, safety, TSM&O, and Freight projects. Numeric scores 1, 2, and 3, were recorded based on the following thresholds, which consider the resulting change in VC and, for freight projects, the percent trucks on the adjacent section of interstate:

Capacity, Safety, TSM&O

1 = No improvement to mobility

2 = Likely improvement to mobility

3 = Definite improvement to mobility

Freight

1 = No improvement to mobility

2 = Improvement to mobility, % trucks < 20%

3 = Improvement to mobility, % trucks > 20%

Comparison of 2020 population versus 2040 population within three miles of each project was used for multimodal and economic development projects. Population numbers were obtained via the Tennessee Statewide Travel Demand Model (TSM) and by traffic analysis zone. Resulting numeric scores were based on the following thresholds:

Multimodal, Economic Development

1 = 0-10% Increase

2 = 10-15% Increase

3 = 15% + Increase

Where criterion could not be measured and "N/A" was noted, engineering judgement was used to score the project's potential for mobility improvement within the applicable thresholds.

Safety

Criterion used to measure the potential safety improvement for each project also vary across mode/strategy. One measure common to all was a "yes" or "no" response to the question "Does the project improve incident management?" For freight, multimodal and economic development projects, this was the only measure used for safety. Thresholds were applied as follows:

Freight, Multimodal, Economic Development

1 = N/A

2 = No

3 = Yes

Building upon hot spot calculations from Technical Memorandum 2, capacity, safety, and TSM&O projects are measured by the relative crash rate as well. The impact of safety projects is further refined by the crash reduction potential, which was determined in Technical Memorandum 3. The following thresholds were applied:

Capacity, TSM&O

1 = Crash rate < statewide average crash rate[1]

2 = Crash rate > statewide average crash rate; Does not improve incident management

3 = Crash rate > statewide average crash rate; Improves incident management

Safety

1 = Crash rate < statewide average crash rate

2 = Crash rate > statewide average crash rate; Below average crash reduction potential

3 = Crash rate > statewide average crash rate; Above average crash reduction potential OR Improves incident management

Where criterion could not be measured and "N/A" was noted, engineering judgement was used to score the project's potential for safety improvement within the applicable thresholds.

Economic Development

The economic development potential of each project was measured by the projected change in employment from 2020 to 2040 within three miles of each project. Employment projections were obtained via the TSM and by traffic analysis zones. The following thresholds were used to score each project.

Capacity, Safety, TSM&O, Freight, Multimodal, Economic Development

1 = 10-20% increase

2 = 20-25% increase

3 = 25%+ increase

System Maintenance

System maintenance was added as a measure for the I-26 corridor prioritization to recognize opportunities where projects will also address existing bridge and/or pavement deficiencies. The following thresholds were used to score each project, given "yes" or "no" responses to the questions "Project addresses bridge deficiency?" and "Project addresses pavement

1- The statewide average crash rate for rural interstate facilities is 0.528 and 1.112 for urban interstates.

deficiency?'. For freight projects, an additional "yes" / "no" question was added: "Project provides truck parking?"

Capacity, Safety, TSM&O, Multimodal, Economic Development

1 = No to both

2 = Yes to one

3 = Yes to both

Freight

1 = No to all

2 = Yes to one

3 = Yes to all

Implementation

The implementation measure was included to give priority to projects that could be constructed or initiated in conjunction with other projects, thus conserving the time and money associated with multiple, individual contracts. Figure 5-4 illustrates the relative proximity of the multimodal solutions prioritized for the I-26 corridor. The following thresholds were utilized to score the implementation of each project:

Capacity, Safety, TSM&O, Freight, Multimodal, Economic Development

1 = 0 overlapping projects

2 = 1 or 2 overlapping projects

3 = 3+ overlapping projects

Cost Efficiency

For the I-26 corridor project prioritization, a benefit-cost index and a dollar-per-benefit was calculated for each solution. These measures capture the benefit of each prioritization criteria and compare the total relative benefit to the estimated project cost. Specifically, the score assigned to each of the five prioritization criteria were summed to represent the total relative benefit of each project. To calculate the benefit-cost index, this total relative benefit was divided by the cost (in millions) estimated for each project. The dollar-per-benefit is simply the cost estimate divided by the total benefit score. Note that cost estimates were prepared for solutions that were recommended for further study. However, because the total benefit represents the potential of the associated capital improvement, no direct benefit-cost index or dollar-per-benefit was calculated for these solutions.

Project Rankings

When evaluated side-by-side, the total benefit score, benefit-cost index, and dollar-per-benefit indicate projects with high benefit that can be implemented with smaller financial investment. The project rankings are discussed per mode/strategy below. Tables 5-1 through 5-6 of Technical Memorandum 4 detail the prioritization effort and rank the projects by the total benefit score, which ranges from 5 (lowest) to 15 (highest).

Project Rankings by Mode and Strategy

Highway Capacity

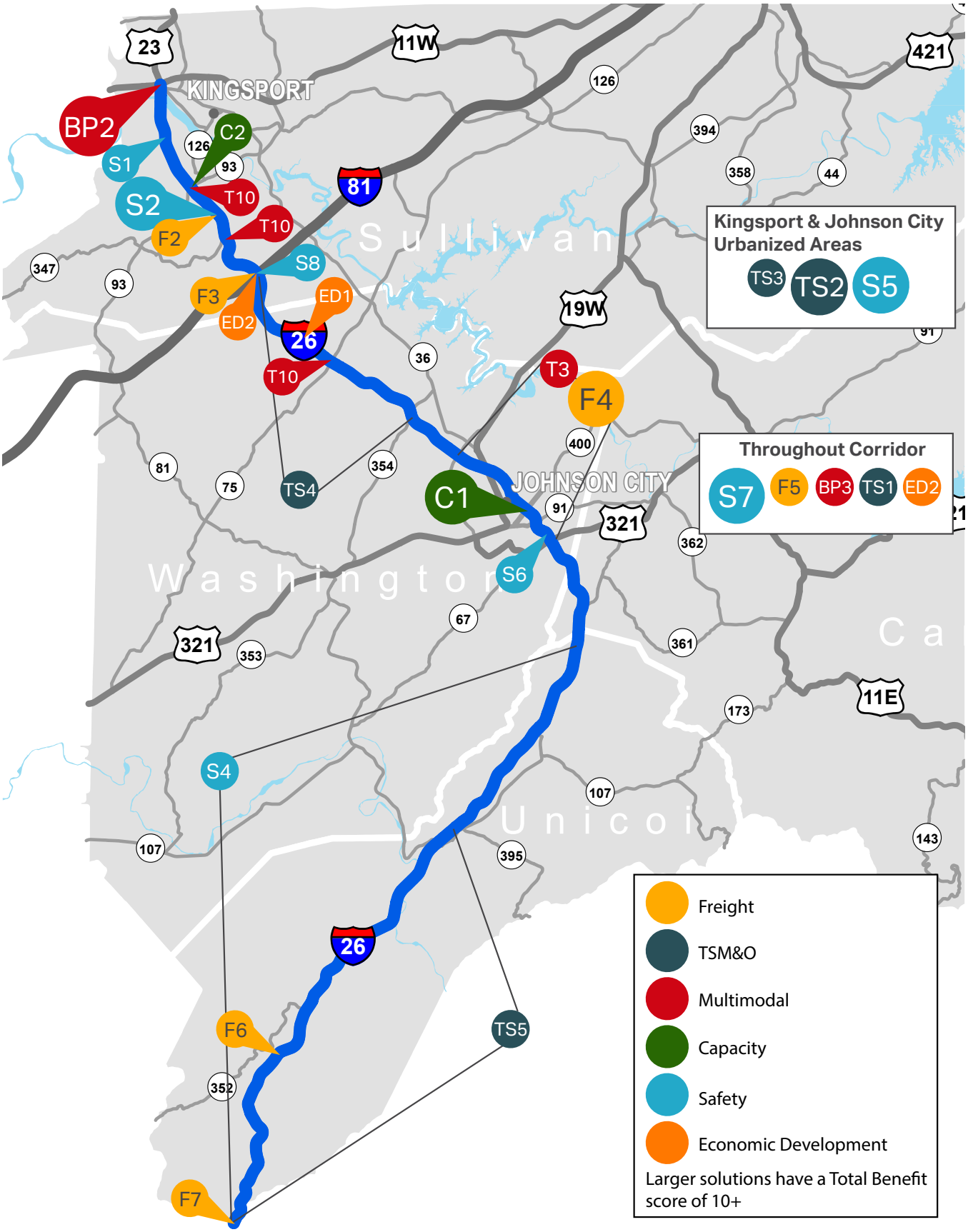
Capacity solution C1 received a high total benefit score reflective primarily of its improvement to mobility through the Johnson City urban area. Detailed traffic analyses of the braided ramps versus option lane indicated that an option lane at the eastbound off-ramp to SR-91 would best accommodate future volumes with the least impact to adjacent structures and land uses. Details of the traffic analysis can be found in the Traffic Operations Technical Memorandum.

Capacity solution C2 received a lower total benefit score. This section of I-26 is expected to operate at acceptable levels of service into 2040, and it does not have a crash rate indicative of a safety hot spot. The location should continue to be monitored by the Kingsport MTPO over time as the ramp proximity could create issues if unexpected new development were to occur in the area.

Safety

Safety solutions S2 and S5 received both high total benefit scores and high benefit-cost indexes. Widening inside shoulders through the Bays Mountain area (S2) and installing additional interchange lighting in the urban areas (S5) address safety hot spots and improve incident management. Safety solution S5 additionally offers an above average crash reduction potential and could be designed in cooperation with ITS and communication components of TSM&O solutions TS2 and TS3. At a higher dollar per benefit, but with the potential to impact the whole corridor, safety solution S7 also scored a high total benefit.

Figure 5-4. Relative Proximity of Multimodal Solutions — I-26



TSM&O

TSM&O solution TS2 scored a high total benefit and a benefit-cost index of 3.1. This reflects potential for improving incident management in a safety hot spot location, potential for implementation in conjunction with other projects, and a relatively low cost.

Freight

Of the six freight solutions that passed the Phase 2 screening, F4 (CCTV to monitor congestion and accidents/ advise trucks via HAR) scored the highest total benefit. This solution, initiated by stakeholders, corresponds closely to TSM&O solution TS2 and is attributed the same benefits. Study of the I-81/I-26 interchange (F3) scored the second highest total benefit. Study of this interchange is also identified in Safety and Economic Development strategies, as S8 and ED2, respectively.

Multimodal

Study of a commuter route between the Johnson City Transit Center and Gray (T3) scored the highest total benefit among multimodal solutions. The route would benefit an expected nearby 10-15% increase in population and 25-30% increase in employment. Addition of a bicycle lane/multi-use path on US-11W through the I-26 interchange (BP2) would also benefit a growing population and would provide connectivity on TDOT's proposed Nashville to Bristol State Bicycle Route.

Economic Development

Neither of the Economic Development solutions received high total benefit scores. However, it should be noted that study of improvements to the I-26/I-81 interchange was also recommended in Freight and Safety strategies.

6. Key Findings

The prioritized solutions address the key corridor transportation deficiencies identified by stakeholders and through data analysis.

As a result of the structure of the project prioritization system, all projects have a potential total benefit range of 5-15 and can therefore be compared across modes/ strategies. Table 6-1 tabulates all solutions for the I-26 corridor, sorted by total benefit score. Solutions which recommend studies are shown in Table 6-2. Projects scoring a total benefit of 10 or higher have generally demonstrated benefit to mobility, safety, economic development, system maintenance, and implementation.

Use of Table 6-1 in conjunction with Figure 5-4 can be used to inform decisions on fund allocation and construction packages. As mentioned previously, weights can easily be applied to the prioritization criteria in Tables 5-1 through 5-6 of Technical Memorandum 4 to adjust for policy, programming, and political decisions.

Finally, Table 6-3 summarizes the performance benefits of the collective solutions recommended for the I-26 corridor. As shown, proposed solutions improve network VHD during the peak period by only one percent (compared to the 2040 Trend scenario). As reflected by the 4% improvement in urban interstate peak travel speeds however, the corresponding peak VHD for urban interstates is improved by 11%, and the peak VHD for rural interstates is improved by 4%. These improvements in delay are largely attributed to capacity improvements at the SR-91 interchange and the addition of truck climbing lanes at various locations.

Additionally, multimodal solution performance measures indicate improvement to bridge and pavement conditions as well as truck parking. Bike/ ped solution BP2 accounts for the improvement to pedestrian and bicycle accommodations at U.S. and state route interchanges.

Further improvements to the I-26 corridor are expected to result from the "deep dive" studies shown in Table 6-2. The speed study, for example may reveal the need for additional enforcement in northern Washington County. Likewise, the bike/ped connectivity study has the potential to propose numerous small-scale safety and connectivity improvements for non-vehicle users across the corridor.

Table 6-1. Project Ranking Across all Modes/Strategies — I-26

ID	Project Description	Termini	Source of Solution	Cost Efficiency			
				Total Benefit	Cost Estimate	Benefit Cost Index	Dollar per Benefit
C1	Widen EB Off-Ramp to Provide Option Lane	SR-400 to SR-91	Data Analysis	12	$1,290,000	9.3	$107,500
F4	Install CCTV to Monitor Congestion & Accidents, Advise Trucks Via HAR	SR-381 to US-321	Data Analysis	11	$1,950,000	5.6	$177,300
S2	Widen Inside Shoulders	SR-93 to SR-347	Public/ Stakeholder	10	$3,180,000	3.1	$318,000
S5	Install Additional Lighting & Signage	Kingsport and Johnson City Urbanized Areas	Public/ Stakeholder	10	$6,490,000	1.5	$649,000
S7	Install Additional Guardrail & Median Cable Barrier	Throughout Corridor	Public/ Stakeholder	10	$14,400,000	0.7	$1,440,000
TS2	ITS Installation (CCTV & DMS)	Kingsport and Johnson City Urbanized Areas	Public/ Stakeholder	10	$3,270,000	3.1	$327,000
BP2	Add Bicycle Lane/ Multi-Use Path on US-11W Through I-26 Interchange	I-26 / US-11W Interchange	Data Analysis	10	$2,050,000	4.9	$205,000
S8	Reconfigure Interchange to Address Ramp Geometry	I-26/I-81 Interchange	Public/ Stakeholder, TN Freight Plan	9	$18,000,000	0.5	$2,000,000
ED2	Improve Interchange Capacity & Geometry to Accommodate Expected Economic Growth	I-26/I-81 Interchange	Public/ Stakeholder	9	$18,000,000	0.5	$2,000,000
S4	Install Road Weather Information System	TN/NC State Line to Unicoi/Carter Co Line	Public/ Stakeholder	8	$12,200,000	0.7	$1,525,000
S6	Install Additional Overhead Signage	State of Franklin Rd Interchange (SR-381)	Public/ Stakeholder	8	$248,000	32.3	$31,000
F5	Add Overnight Parking Location (~50 spaces)	Along Corridor	Data Analysis	8	$1,270,000	6.3	$158,800
F2	Add Eastbound Truck Climbing Lane	SR-93 to SR-347	Kingsport MTPO 2040 LRTP	8	$6,720,000	1.2	$840,000
F7	Add Eastbound Truck Climbing Lane	Flag Pond Rd to NC State Line	TN Freight Plan	8	$40,800,000	0.2	$5,100,000
S1	Install Fencing by Bays Mountain Nature Preserve	US-11W to Meadowview Pkwy	Data Analysis	7	$441,000	15.9	$63,000

Table 6-1. Project Ranking Across all Modes/Strategies (cont.) — I-26

ID	Project Description	Termini	Source of Solution	Cost Efficiency			
				Total Benefit	Cost Estimate	Benefit Cost Index	Dollar per Benefit
F6	Add Eastbound Truck Climbing Lane	Near Clear Branch Access	TN Freight Plan	7	$32,700,000	0.2	$4,671,400
TS5	Construct Median Breaks to allow for EMS Vehicle Turnaround	Erwin to NC State Line	Public/ Stakeholder	7	$77,000	90.9	$11,000
T10	Designate Park-and-Ride Lots Near SR-93, SR-347, SR-75	Various Locations	Public/ Stakeholder	7	$906,000	7.7	$129,400
TS1	HELP Truck Expansion to I-26	Throughout Corridor	Public/ Stakeholder	6	$675,000	8.9	$112,500

Table 6-2. Project Ranking Across all Modes/Strategies (Studies) — I-26

ID	Project Description	Termini	Source of Solution	Cost Efficiency			
				Total Benefit	Cost Estimate	Benefit Cost Index	Dollar per Benefit
TS3	Evaluate Need for Ramp Metering	Kingsport and Johnson City Urbanized Areas	Public/ Stakeholder	10	$75,000	N/A	N/A
T3	Study Commuter Route Between JCT Transit Center & Citi Commerce Solutions/Frontier Health (Gray)	Johnson City to Gray	JCT Comprehensive Operations Analysis	10	$50,000	N/A	N/A
F3	Study I-81/I-26 Interchange for Capacity, Truck Use	I-26/I-81 Interchange	Kingsport MTPO 2040 LRTP	9	$220,000	N/A	N/A
TS4	Conduct Speed Study	Eastern Star Rd to Boones Creek Rd (SR-354)	Public/ Stakeholder	9	$25,000	N/A	N/A
ED1	Evaluate Need for Additional Interstate Access Point	Eastern Star Rd to SR-75	Public/ Stakeholder	9	$100,000	N/A	N/A
T9	Study Commuter Route Between Johnson City & Kingsport	Johnson City to Kingsport	Data Analysis	9	$75,000	N/A	N/A
BP3	Study to propose Bike/ Ped Connectivity & Safety Improvements at U.S. & State Route Interchanges	Throughout Corridor	Data Analysis	9	$50,000	N/A	N/A
C2	Evaluate Need for C-D Lanes and/or Other Improvements Between Interchanges	Meadowview Pkwy to SR-93/ SR-126	Public/ Stakeholder	8	$160,000	N/A	N/A

Table 6-3. Performance Measure Summary — I-26

Goal	Performance Measure		Unit	Base (2010)	Trend (2040)	Build 2040	% Change (Base vs Trend)	% Change (Trend vs Build)
Traffic Operations	Traffic on interstate operates at LOS D or better		% of interstate operating at LOS D or better	100	99.6	99.6	<1	0
	Total Daily Vehicle Miles Traveled (VMT)		Miles (1,000s)	7,815	9,784	9,688	25	-1
	Total Daily Vehicle Hours of Travel (VHT)		Hours (1,000s)	211	259	258	23	-1
	Total Peak Hour Vehicle Hours of Delay (VHD)		Hours	7.3	9.4	9.35	28	-1
	Total VMT / Trip		Miles	4.26	4.32	4.28	1	-1
	Total Vehicle Minutes Traveled / Trip		Minutes	6.89	6.87	6.83	0	-1
	Average Peak Hour Travel Speed	Urban Interstate	MPH	68	63	66	-7	4
		Rural Interstate	MPH	72	70	70	-3	0
	Congested Travel Time between key O&D Pairs along Corridor (Total)		Minutes	172	185	185	8	0
	Peak Hour Density at Improved Interchanges		Vehicles/Mile/Lane	See “Traffic Operations Memo”				
	Average and Max Queues at Improved Interchanges		Feet	See “Traffic Operations Memo”				
Safety	Crash reduction in safety “hot spots”		Above or Below Average Crash Reduction Potential	See “Safety Recommendations”				
Operations & Maintenance	Bridge Condition (Sufficiency Rating)		% of bridges < 50	0	0	0	N/A	N/A
			50 < % of bridges < 80	11	9[1]	8	N/A	N/A
	Pavement Condition (Resurfacing)		% of corridor resurfaced within the last 10 years	71[2]	87[3]	87	N/A	N/A
Multimodal	Pedestrian and Bicycle Accommodations at U.S. and State Route Interchanges		% interchanges with bike facilities	33	33	40	N/A	N/A
			% interchanges with ped. facilities	27	27	27	N/A	N/A
	Freight (Truck Parking)		# of Rest Area Spots	53	53	53	0	0
			# of Truck Stop Spots	0	0	50	0	100

1- Per TDOT Structures Division, two bridges on I-26 are scheduled for repair.
2- Based on 2017 TRIMS data
3- Per TDOT Pavement Office’s 2020 and 2021 Resurfacing Program. Also includes 2019 resurface from Boones Creek Road to University Parkway in Washington County.