I-55/75/26
Multimodal Corridor Study
▶Technical Memorandum 3: Development of Feasible Multimodal Solutions

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TN TDOT Department of Transportation

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I-55/75/26 Multimodal Corridor Study

Technical Memorandum 3: Development of Feasible Multimodal Solutions

Introduction

Safe, efficient, and equitable multimodal surface transportation infrastructure is critical to promoting the wellbeing and economic vitality of the people of Tennessee. The state's interstate facilities form the backbone of that transportation system, complemented by state highways, local roads, airports, railroads, transit systems, bicycle and pedestrian facilities, and waterborne navigation facilities. Tennessee's interstates carry about 30% of all vehicle miles traveled in the state, and 80% of all truck miles, making them the key component of the roadway system, facilitating the movement of people and goods across the state and across the country. Developing a multimodal transportation system that meets the changing needs of Tennessee's residents, businesses, and visitors will support the state's growth and provide a range of safe transportation options.

The purpose of the I-55/75/26 Multimodal Corridor Study is to evaluate potential transportation improvements to address existing and emerging issues in the system. The analysis is centered on study areas surrounding four Interstate corridors: I-55 in southwestern Tennessee, I-155 in northwestern Tennessee, I-75 in the east-central part of the state, and I-26 in eastern Tennessee. Together, these corridors represent more than 200 miles of freeway traveling through urban and rural counties, supported by a robust network of state and local roadways, rail, air, transit, and non-motorized transportation facilities.

The study considers innovative, long-range solutions to multimodal issues and opportunities in these corridors. Solutions address traffic and congestion, operations and safety, expanded transportation choices, and the ways in which the transportation system supports economic growth, freight movement, and access to employment.

The study involves four core activities:

- Gathering and evaluating transportation, demographic, economic, and other data.
- Assessing existing and expected future system deficiencies to develop goals and performance measures for each corridor.
- Developing and evaluating feasible multimodal solutions to meet those goals.
- Prioritizing actions to implement those solutions.

This report documents the development of the universe of alternatives to the transportation issues investigated and documented in Technical Memorandum 2: Assessment of Existing and Future Deficiencies. For each corridor, the report includes a synopsis of those deficiencies, a detailed explanation of the goals and performance measures developed to evaluate the effectiveness and feasibility of solutions recommended for each corridor, and a discussion of potential solutions across the following categories:

1. Traffic operations
2. Safety
3. Transportation System Management
4. Freight Movement
5. Economic Development
6. Transit/Bicycle and Pedestrian/Transportation Demand Management Systems

These potential transportation solutions will be evaluated for effectiveness and then prioritized for potential implementation in Technical Memorandum 4: Project Priorities.

Figure 1. Study Corridors

Four interstate corridors - I-55, I-155, I-75 and I-26 - are included in the study.

I-55 Corridor

▶Development of Feasible Multimodal Solutions

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I-55 Corridor

1. Introduction

The I-55 corridor serves as a backbone for economic development and growth in the Memphis region. As population and employment continue to 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 threaten the corridor's ability to sustain future growth.

A previous technical memorandum (Technical Memorandum 1) provided a data and information inventory for the corridor. Technical Memorandum 2 assessed existing and future deficiencies and needs along the I-55 corridor, focusing on traffic operations, safety, and multimodal conditions. These identified deficiencies are re-visited briefly in Section 2 of this corridor report. However, the primary focus of Technical Memorandum 3 is the development of 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, is ultimately established.

To supplement the technical analysis performed during this process, public workshops and surveys were used to generate feedback from citizens and stakeholders located throughout the corridor. A series of detailed interviews were also conducted with transportation and development officials. The resulting universe of alternatives is organized based 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. The forthcoming Technical Memorandum 4: Project Priorities will report on the evaluation and strategic prioritization of the potential solutions described here.

28 potential solutions for the I-55 corridor are discussed in this memorandum.

2. Overview of Existing Deficiencies and Future Needs

Technical Memorandum 2: Assessment of Existing and Future Deficiencies, defined the trend scenario for the I-55 corridor – an effort that predicts existing and future conditions if current practices and plans remain unchanged. The trend scenario includes population and employment projections, capital projects currently programmed for construction in either Tennessee Department of Transportation's (TDOT) Statewide Transportation Improvement Program (STIP) or one of the Metropolitan Transportation Planning Organizations (MTPO) Transportation Improvement Program (TIP), recent MPO travel demand model projections, and Transearch freight projections.

Evaluation of the trend scenario, coupled with feedback from citizens and stakeholders, brought to light existing deficiencies and future needs for which solutions have not yet been programmed. These deficiencies align with economic development projections and fall into the following six categories, which are summarized in Figure 2-1.

- Traffic Operations
- Safety
- Transportation System Management
- Freight
- Transit / Bike & Ped / TDM
- Pavement & Structures

The content of Figure 2-1 was reviewed with TDOT Region 4 representatives on January 22, 2020. Responses recognized one additional deficiency: the need for advanced warning and/or pull-off area for over-dimensional vehicles in advance of the Mississippi River Bridge approach.

The remaining chapters of this technical memorandum document the development of feasible multimodal solutions to address the complete list of existing and future deficiencies.

Figure 2-1. Existing Deficiencies and Future Needs — I-55

I-55 Existing Deficiencies and Future Needs

Additional information about the existing deficiencies and future needs for the I-55 corridor can be found in Technical Memorandum 2.

Legend:
- 🛠 Deficiencies and needs supported by data analysis
- 💬 Deficiencies and needs identified by stakeholders

Traffic Operations

- 🛠 Existing and forecasted areas of traffic congestion:
  - 🛠 💬 "I-240"
  - 🛠 💬 "I-55 bridge over the Mississippi River"
  - 🛠 💬 "Crump Blvd."
  - 🛠 McLemore Ave.
  - 🛠 US-61 (S. 3rd St.)
  - 💬 "Holmes Rd."

Safety

- 🛠 Higher crash rates likely related to inadequate signage from the Mississippi River Bridge to the Crump Blvd. interchange and at the I-240 interchange.
- 🛠 Higher crash rates likely due to small radii of ramps at the US-61 (S. 3rd St.) and I-240 interchanges.
- 🛠 Higher crash rates at Brooks Rd. potentially due to inadequate drainage in rain events.
- 🛠 💬 "Higher crash rates related to short merge/diverge areas at the Crump Blvd. interchange and at US-61 (S. 3rd St.)."
- 💬 "Inadequate signage at various locations throughout the corridor."

Freight

- 🛠 Insufficient overnight truck parking.
- 🛠 Freight bottleneck located at the Mississippi River crossing due to geometry of the interchange and capacity of the bridge.
- 🛠 Freight bottleneck located on Lamar Ave., a parallel route to I-55.
- 💬 "Need new interchange to serve Port of Memphis and relieve truck congestion."

Economic Development

- 🛠 Employment growth projected at all I-55 interchanges.
- 🛠 Future growth along the I-55 corridor will likely be in the freight, logistics and warehousing sectors.
- 💬 "New interchange desired at I-55 and Holmes Rd."

Transit / Bike & Ped / TDM

- 🛠 Minimal park-and-ride facilities.
- 🛠 Lack of regional transit.
- 🛠 Lack of bicycle and pedestrian accommodations at interchanges.
- 💬 "The airport is not served by frequent transit service."

Transportation System Management

- 🛠 Need for improved signal coordination on streets adjacent to I-55.
- 🛠 Need for dynamic speed limit signs and end of queue advance warning systems for incident management.

Pavement & Structures

- 🛠 One structurally deficient bridge.
- 🛠 Two bridges eligible for replacement.
- 🛠 12 bridges eligible for rehabilitation.
- 🛠 The I-55 bridge over the Mississippi River was not built to withstand earthquakes

TN TDOT Department of Transportation **I-55/75/26 Corridor Study**

3. Performance Measures

Goals for potential improvements along the I-55 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 3-1, the 5 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)[1], Trend (2040) and Build (2040) scenarios. Table 3-2 outlines the performance measures established for the I-55 corridor and includes results for the Base and Trend Scenarios. As indicated, the measures fall into four categories (Traffic Operations, Safety, Operations & Maintenance, and Multimodal), which directly support the objectives identified in Table 3-1. Results for the Build Scenario will be included in Technical Memorandum 4.

It is important to note that many of these performance measures represent the corridor as a whole – aggregating the benefit of the potential solutions in the Build year. Exceptions include the "Crash reduction in safety 'hot spots'", "Peak hour Density at Improved Interchanges", and "Average & Max Queues at Improved Interchanges." These performance measures were applied at isolated locations where the universe of alternatives for addressing deficiencies may be larger. For example, in Technical Memorandum 2, the section of I-55 between I-240 and US-61 was identified both as a safety hot spot and a traffic bottleneck. Several potential solutions were developed to address the deficiencies, including widening, improving entrance/exit ramps, and constructing option lanes. Additional traffic operational analyses were necessary to evaluate the benefit of each potential solution, and these specific performance measures were used to guide that evaluation.

The following section is a glossary of the specific performance measures, providing the definitions, and details regarding how the measure was calculated or assessed.

Table 3-1. Performance Goals and Objectives — I-55

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		

1- The Statewide Travel Demand Model (TSM) uses a 2010 base year for this study. The study team determined the TSM was producing results comparable to regional models with more recent base years- creating better model efficiency.

Table 3-2. Performance Measure Summary — I-55

Goal	Performance Measure		Unit	Base (2010)	Trend (2040)	% Change (Base vs Trend)
Traffic Operations	Traffic on interstate operates at LOS D or better		% of interstate operating at LOS D or better	87.5	80.8	8
	Total Daily Vehicle Miles Traveled (VMT)		Miles (1,000s)	20,726	25,572	23
	Total Daily Vehicle Hours of Travel (VHT)		Hours (1,000s)	725	958	32
	Total Peak Hour Vehicle Hours of Delay (VHD)		Hours	22.5	26.6	18
	Total VMT / Trip		Miles	3.91	4.05	4
	Total Vehicle Minutes Traveled / Trip		Minutes	8.20	9.10	11
	Average Peak Hour Travel Speed	Urban Interstate	MPH	46	41	-10
		Rural Interstate	MPH	72	74	~0
	Congested Travel Time between key O&D Pairs along Corridor (Total)		Minutes	100	111	11
	Peak Hour Density at Improved Interchanges		Vehicles/Mile/Lane	See "Traffic Operations"		
	Average and Max Queues at Improved Interchanges		Feet	See "Traffic Operations"		
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	9[2]	0[1]	N/A
			50 < % of bridges < 80	38[2]	47[1]	N/A
	Pavement Condition (Resurfacing)		% of corridor resurfaced within the last 10 years	66[2]	66[3]	N/A
Multimodal	Pedestrian and Bicycle Accommodations at U.S. and State Route Interchanges		% interchanges with bike facilities	0	0	N/A
			% interchanges with ped. facilities	100	100	N/A
	Freight (Truck Parking)		# of Rest Area Spots	13	13	0
			# of Truck Stop Spots	88	88	0

1- Per TDOT Structures Division, repair projects ongoing or scheduled for Mississippi River Bridge, ICGRR Bridges, and US-61 Bridge. Assumed these moved to 50-80 range.
2- Based on 2017 TRIMS data
3- Per TDOT Pavement Office's 2020 and 2021 Resurfacing Program. Also review of 2018-Feb 2020 TDOT Bid Lettings. (included resurfacing of L.M. 0.00-3.56)

Description of Performance Measures

Traffic Operations

- **Traffic on Interstate Operates at LOS D or Better:** Defined by percent of the interstate corridor where operations are level of service (LOS) A, B or C. This measure provides insight into the amount of congestion experienced on the interstate corridor, reflecting the following relationship between volume-to-capacity and level of service, as defined in Technical Memorandum 2 for the previously completed I-65 corridor study (February 2017):
  - V/C < 0.7 (LOS A-B)
  - V/C 0.7 – 0.8 (LOS C)
  - V/C 0.8 – 0.9 (LOS D)
  - V/C 0.9 – 1.0 (LOS E)
  - V/C > 1.0 (LOS F)

  Segments of interstate where Base and/or Trend TSM output indicated LOS E or F were identified for further analyses/evaluation of potential solutions. Additionally, rural segments with LOS D in 2040 were also identified, recognizing that delay associated with LOS D on a four-lane facility through rolling/mountainous terrain is perceived differently than LOS E or F on a six or eight lane urban cross-section. No rural segments with LOS D were identified in the I-55 Corridor.
- **Total Daily Vehicle Miles Traveled (VMT):** Detailed by urban and rural functional classifications within the Technical Memorandums, this performance measure indicates the total vehicle miles traveled each day within the study area. It is used to measure growth and ultimately sheds light on the efficiency of the system post-improvements, as a comparison of Build vs. Trend scenarios can indicate shifts in miles traveled on various functional types.
- **Total Daily Vehicle Hours of Travel (VHT):** Vehicle hours of travel is a measure of total time motorists are spending on the road each day. This performance measure is broken down by urban and rural functional classification. When compared to daily VMT, daily VHT can indicate increased or decreased delay on a system.
- **Total Peak Hour Vehicle Hours of Delay (VHD):** Also detailed by urban and rural functional classifications, peak hour VHD measures congestion of a facility during the peak hour. Typically, it is inversely proportional to travel speeds – as peak hour VHD increases, peak hour travel speeds decrease.
- **Total VMT/Trip:** Representing the system as a whole, total daily VMT divided by total daily vehicle trips, measures motorists average trip length (in miles/trip). Within a study area, changes in this performance measure can reflect changes in land use (which may promote shorter trip lengths, for example) or new / improved access to common destinations. Therefore, this performance measure must be evaluated in conjunction with an understanding of programmed roadway projects and planned developments in the study area.
- **Total Vehicle Minutes Traveled / Trip:** This performance measure represents the average time a motorist spends in their vehicle per trip. When the Vehicle Minutes Traveled/Trip remains consistent between the Base and Future year scenarios, changes in the Vehicle Minutes Traveled/ Trip performance measure can indicate increased or decreased congestion on the system.
- **Average Peak Hour Travel Speed:** This performance measure indicates the average travel speed a motorist experiences on a facility during the peak hour. When aggregated over a study area, change in average peak hour travel speed is indicative of system-wide increases or decreases in congestion and is usually inversely proportional to total peak hour vehicle hours of delay.
- **Congested Travel Time between Key O&D Pairs along Corridor:** Changes in travel time between origin and destination (O&D) pairs is a direct indicator of delay – and excluding incidents, also indicates congestion. Known origins and destinations along the corridor were selected, focusing on those that would primarily utilize the interstate corridor. Using the traffic analysis zones (TAZs) most representative of each origin and destination, Base and Trend congested travel times were pulled from the TSM and reported in minutes. These will be compared to travel times with the Build scenario.
- **Peak Hour Density at Improved Interchanges (Specified locations):** Based on deficiencies identified in Technical Memorandum 2, spot locations were identified for further traffic analysis using HCS, Synchro, and/or Transmodeler. Peak hour density for improved freeway segments, weave areas, merge areas, and diverge areas is directly indicative of level of service for the facility. Peak hour density will be measured for Trend and Build scenarios.
- **Average and Max Queues at Improved Ramp Intersections (Specified Locations):** Based on deficiencies identified in Technical Memorandum 2, spot locations were identified for further traffic analysis using HCS, Synchro, and/or Transmodeler. Exit ramp queue length will be measured for each interchange within the spot locations and compared to the existing storage provided. Queues that extend past the available storage significantly

impact mainline traffic operations and safety. Average and Max exit ramp queue lengths will be measured for Trend and Build scenarios.

Safety

- **Crash Reduction in Safety "Hot Spots":** This performance measure is used to represent the relative safety benefit associated with each proposed improvement. Hot spots, as defined in Technical Memorandum 2, are areas along the interstate corridor where calculated crash rates are significantly above the statewide average. The crash reduction potential for each recommended improvement was explored through the research of crash modification factors (CMFs), which estimates a safety countermeasure's ability to reduce crashes and crash severity. Based on data provided by the CMF clearinghouse, each recommendation was categorized as having above or below average crash reduction potential, specific to the I-55 corridor. Note that the reduction potential is only applicable for crash types that would be prevented by implementation of improvements.

Operations and Maintenance

- **Bridge Condition (sufficiency rating):** This performance measure is used to represent the structural benefit of proposed solutions, including those with the primary goal of addressing safety, capacity, or other needs. Highway bridges eligible for FHWA Bridge Replacement and Rehabilitation Program must have a sufficiency rating of 80 or less. A sufficiency rating that is less than 50 is eligible for replacement, and one that is less than 80 but greater than 50 is eligible for rehabilitation. The sufficiency rating is based on structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use. This measure is reported as a percentage of the total number of bridges (per corridor) within each sufficiency rating range.
- **Pavement Condition (resurfacing):** Pavement condition is directly tied to resurfacing. This performance measure is used to capture the ride quality benefit associated with solutions proposed primarily for safety and capacity deficiencies, for which resurfacing will be necessary.

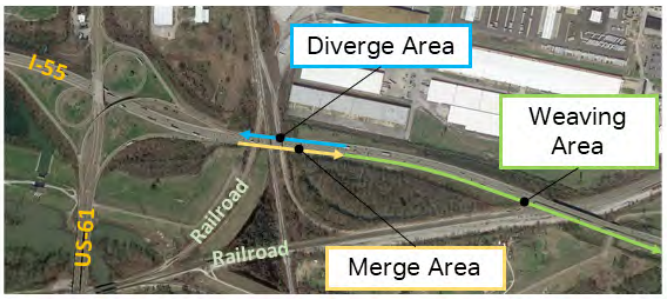
Multimodal

- **Pedestrian and Bicycle Accommodations:** Geometric limitations created by interstate structures often result in discontinuous or unsafe pedestrian and bicycle accommodations on cross-streets through an interchange. In turn, this discourages multimodal connectivity. The Pedestrian and Bicycle Accommodations performance measure indicates the benefit that proposed safety and operational solutions may have on multimodal accessibility and connectivity at interchanges. Data collected for this performance measure is limited to interchanges with federal highways and state routes.
- **Freight (Truck Parking):** Truck parking is a critical component of supply chain operations, particularly with new service rules requiring drivers to stop after 14 hours. Without available parking, trucks often stop on highway on- and off-ramps, which is unsafe and illegal. This performance measure is indicative of compliance and safety improvements associated with truck parking solutions.

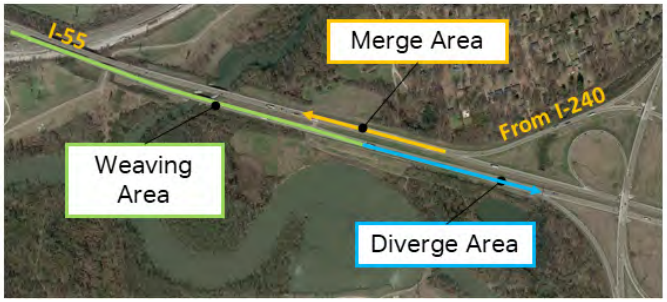
4. Traffic Operations

Section 3 of Technical Memorandum 2 documented future highway capacity needs based on a high-level, TSM analyses of the 2040 Trend Scenario. Within the I-55 corridor, three specific locations were identified for more detailed analyses and evaluation of possible solutions:

1. I-55 between US-61 and the I-240 / I-69 interchange
   - As indicated in Section 3.4 of Technical Memorandum 2, projected 2040 peak hour volumes exceed the existing capacity in both directions. In the northbound direction, this occurs primarily near the US-61 off-ramp; however, in the southbound direction the capacity is exceeded throughout the entire segment. Congestion on this segment is likely amplified by weaving, merging and diverging movements as large volumes of vehicles exit in the northbound direction and enter I-55 in the southbound direction (approximately 45% of I-55 traffic enters/exits from US-61.)



I-55 at US-61



I-55 at I-240

2. I-55 through the McLemore Avenue interchange
   - TSM analysis conducted as part of Technical Memorandum 2 indicated existing congestion at this location and corresponding volume-to-capacity (V/C) ratios greater than 1.0 by 2040. Southbound I-55 drops from three lanes to two lanes at the off-ramp to McLemore Avenue. The third lane is reintroduced approximately 1,400 feet south as the on-ramp from McLemore Avenue. A lane drop also occurs in the northbound direction between the off- and on-ramps.

I-55 at McLemore Ave

3. I-55 Bridge over the Mississippi River
   - As noted in Section 3.3 of Technical Memorandum 2, improvements to the Crump Boulevard interchange will improve safety and add capacity to I-55 south of the Mississippi River bridge. However, future flows will remain constrained by the four travel lanes available on the bridge. TSM 2040 output indicates that volumes on the bridge will exceed capacity.

I-55 at Bridge over the Mississippi River

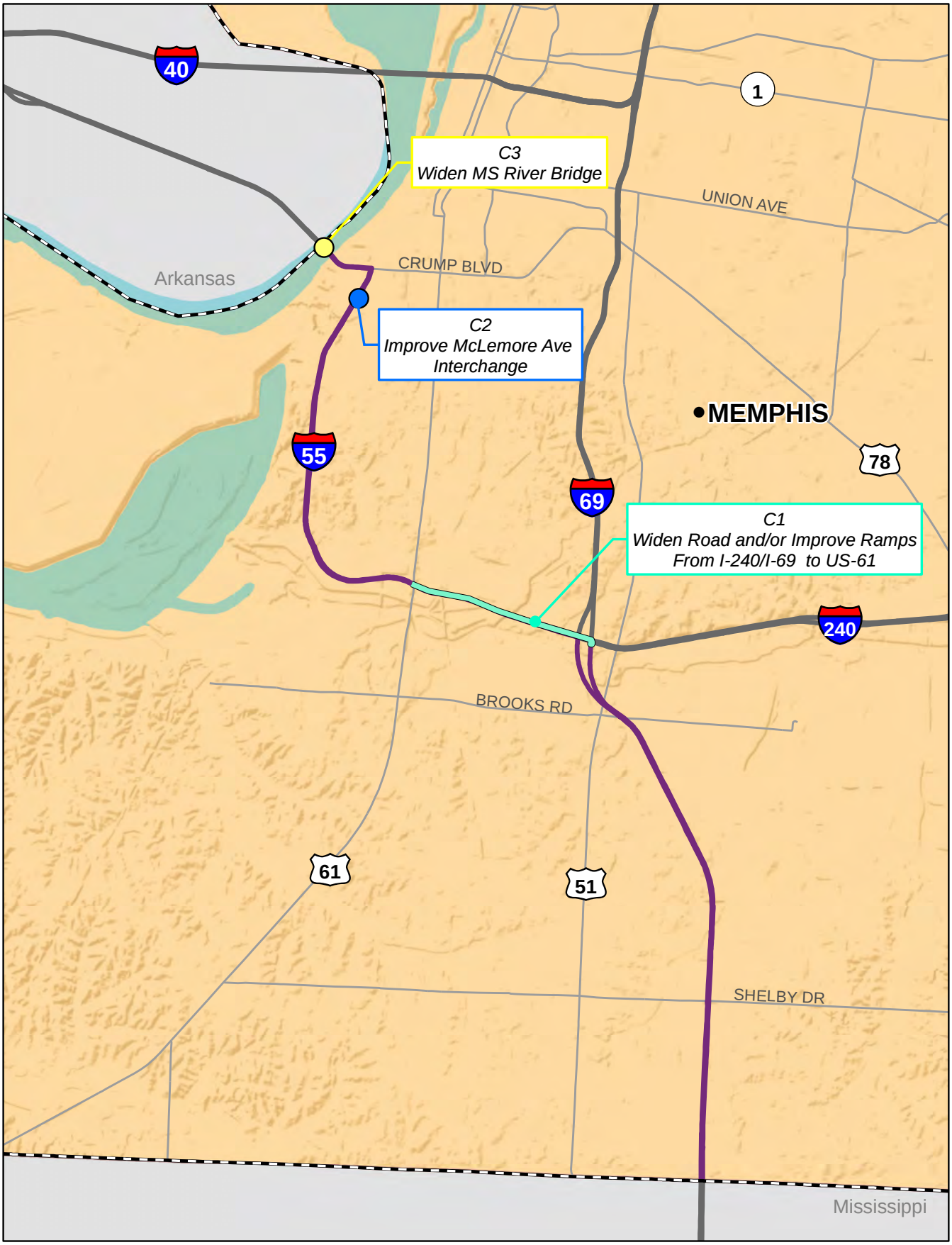
Possible solutions to be considered at the three identified locations are outlined in Table 4-1 and Figure 4-1. The reasonableness of these solutions will be evaluated through the screening and prioritization process included in Technical Memorandum 4. As part of that evaluation, Transmodeler software will be used to measure traffic operations under 2040 Trend and Build conditions at the McLemore Avenue interchange. Since the Mississippi River Bridge is an independent segment and the need is clearly additional capacity, further analysis of this location will be conducted using the TSM. Due to insufficient availability of traffic data, further operational analysis of the US-61 to I-240 segment was deferred to a future study. The recommendation (C1) will continue to move forward in the Universe of Alternatives as "Evaluate options for increasing capacity and improving merge/diverge and weave areas between the US-61 and I-240 interchanges."

Table 4-1. Potential Traffic Operations Improvements — I-55

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
C1	Shelby	I-240/I-69	US-61	Widen existing four lane section and/or improve entrance and exit ramps, including addition of option lanes at exit ramps[1]	Data Analysis, Regional Freight Plan, Livability 2040 RTP
C2	Shelby	McLemore Ave. Interchange		Improve interchange to maintain 6 lanes between ramps	Data Analysis
C3	Shelby	Mississippi River Bridge		Widen existing 4-lane bridge	Data Analysis and Public/Stakeholder

1- per 2009 MUTCD: "Some freeway and expressway splits or multi-lane exit interchanges contain an interior option lane serving both movements in which traffic can either leave the route or remain on the route, or choose either destination at a split, from the same lane." See 2009 MUTCD Figure 2-E4.

Figure 4-1. Potential Traffic Operations Improvements — I-55



5. Safety

As documented in Technical Memorandum 2, an analysis was undertaken to identify areas along the I-55 corridor where safety issues may be present. These locations were identified as 'hot spots' and included segments along the corridor where the calculated crash rate was more than double the statewide average for similar facility types. Included in this analysis was the identification of potential factors that may contribute to the higher frequency of crashes in these areas. For the I-55 corridor, potential factors commonly identified included density of interchanges that create conflicting weaving and merging movements, urban congestion, signage for exits, speeding, and short acceleration ramps.

As a first step in identifying safety solutions to address these factors along the I-55 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-55.

However, there are a number of hot spot locations where previous TDOT studies have identified improvements through TDOT's Interchange Access Request (IAR) process. More specifically, there are previously identified solutions for the Crump Boulevard/Metal Museum Drive and I-240 interchanges. Improvements recommended for those areas in this technical memorandum, therefore, should be considered interim solutions or should be implemented in concert with those larger interchange modifications.

The potential crash factors were reviewed for each hot spot in tandem with public comments as well as aerial and street-level photography to identify potential solutions. Where crash data supported an observed safety issue and where no improvements are currently planned, additional recommendations to address deficiencies are presented in Table 5-1.

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-55 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.

Information on the following pages depicts each safety recommendation and the crash factors identified previously.

Table 5-1. Potential Safety Improvements — I-55

ID	County	Location	Description	Crash Reduction Potential
S1	Shelby	Metal Museum Drive	Close Exit 12C; Convert Enter/Exit Lanes to Merge/Exit Lanes for I-55	Above Average
S2	Shelby	Metal Museum Drive	Install Additional Jersey Barrier on south side of I-55	Below Average
S3	Shelby	Metal Museum Drive	Add Pavement Markings; Add Additional Overhead Signage	Above Average
S4	Shelby	Metal Museum Drive	Add Pavement Markings	Above Average
S5	Shelby	Crump Boulevard	Interchange Improvement	Below Average
S6	Shelby	Entire I-55 Corridor	Resurface Pavement	Below Average
S7	Shelby	South 3rd Street (US-61)	Maintain SB 3rd Street On-Ramp; Realign NB 3rd Street On-Ramp	Above Average
S8	Shelby	I-240	Add Advance Signage and Pavement Markings; Extend SB Deceleration Lane	Above Average
S9	Shelby	I-240	Extend WB Deceleration Lane	Below Average
S10	Shelby	Brooks Road	Evaluate the Need for Additional Drainage	Above Average

Figure 5-1a. Potential Safety Improvements — I-55

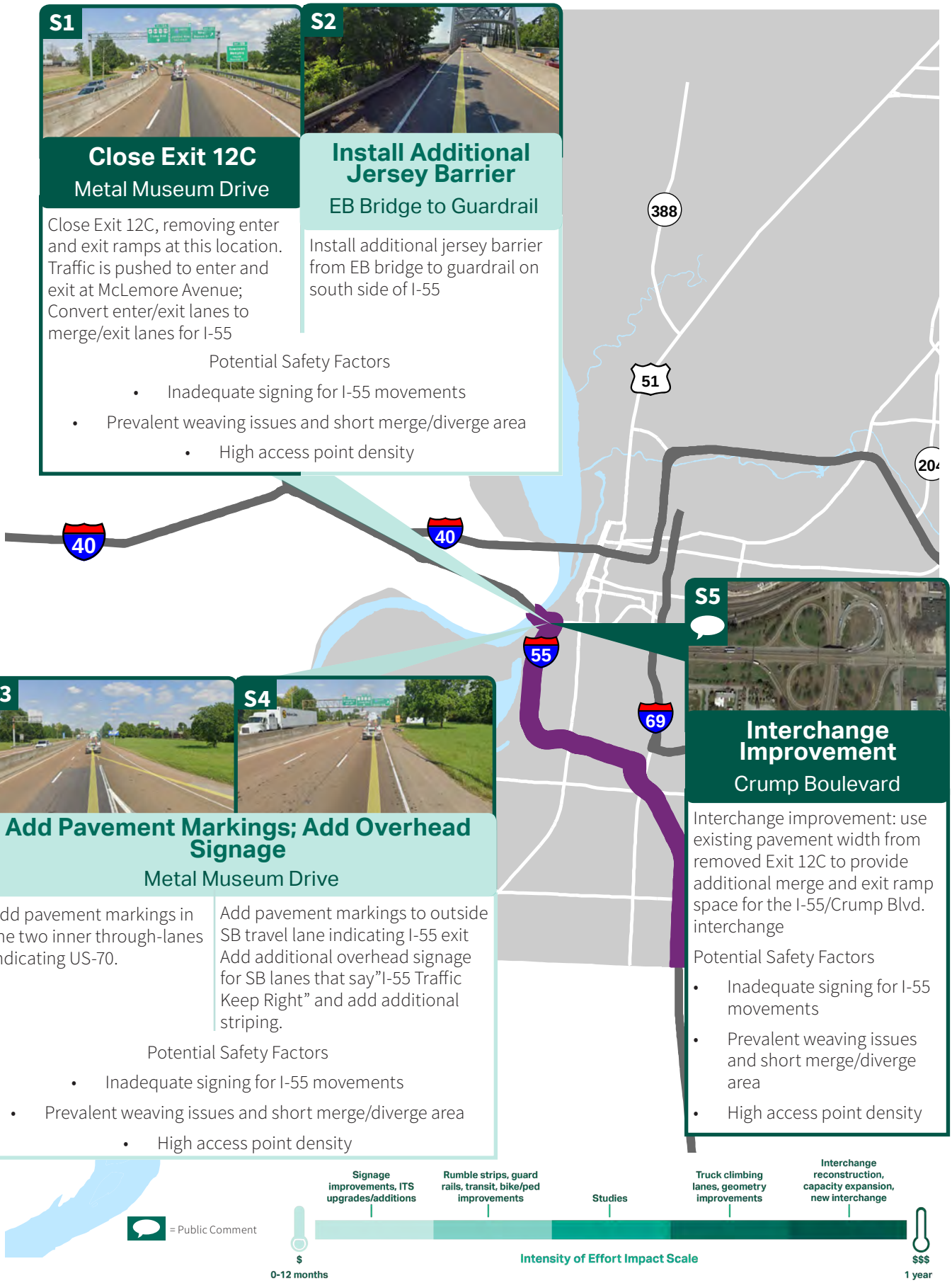
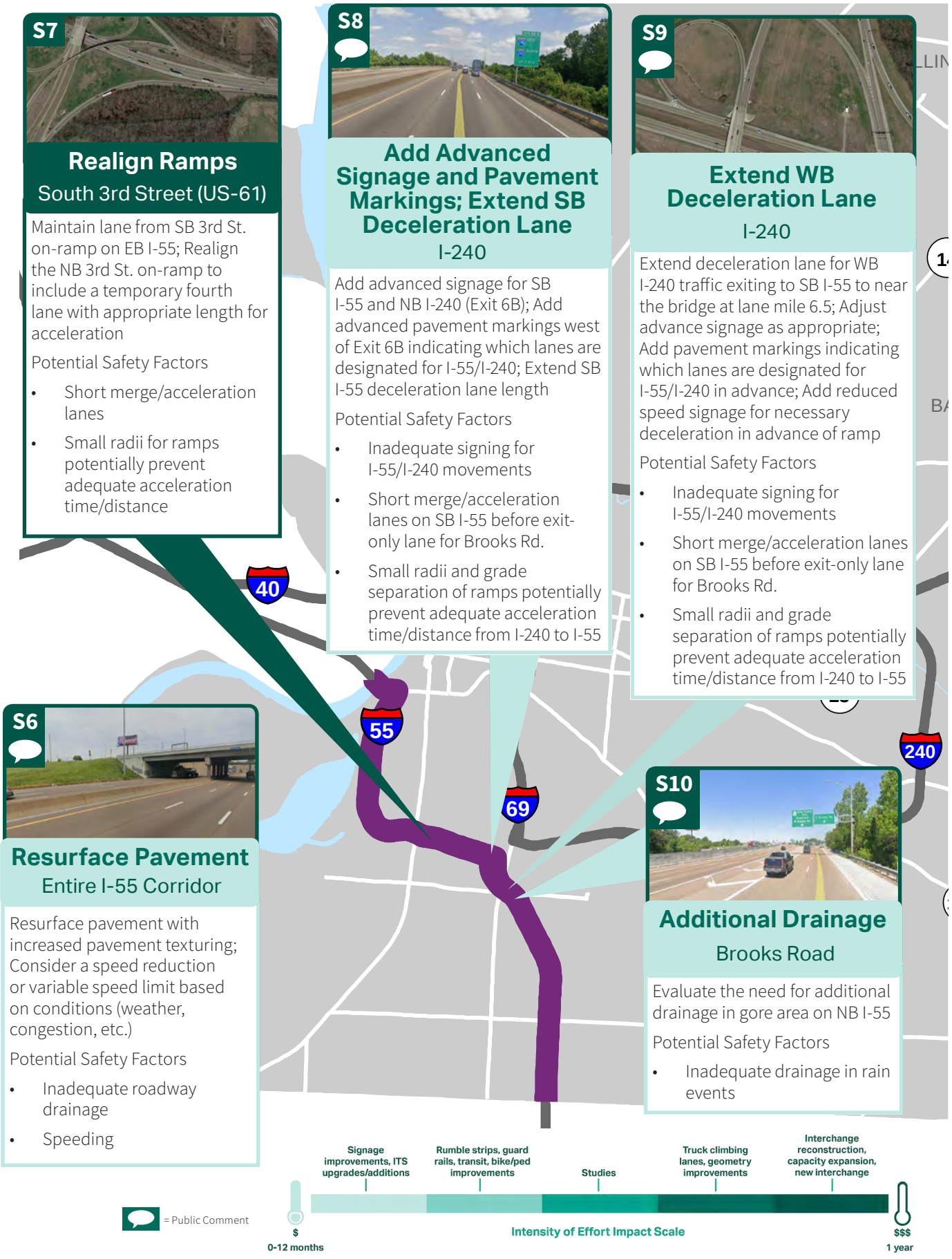


Figure 5-1b. Potential Safety Improvements — I-55 (continued)



6. Transportation System Management & Operations

Transportation Systems Management and Operations (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-55 corridor is a prime candidate for such strategies; for most of the corridor, levels of service are currently such that motorists experience congestion, but not yet significant delays. Two of the possible solutions outlined in other sections of this technical memorandum would also be considered a TSM&O solution:

- Freight Solution, F5: Apply signal coordination on adjacent arterial streets with heavy truck traffic to manage on- and off-ramp congestion (Crump, McLemore, US-61, Brooks)
- Multimodal Solution, BP1: Consider a study to identify 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 outlined in Table 6-1. Specifically, TDOT's Region 4 office noted continued issues with low overhead clearance on the I-55 Mississippi River Bridge. "When over height loads approach these bridges, they pull over to shoulders and we have to close the interstate down to back the trucks up and turn around." The Region 4 office suggested advanced warning and construction of a pull over area or a collapsible barrier in the median to address this issue. The Region also recommended installation of corridor management assets (ITS/DMS).

I-55 WB approaching Mississippi River Bridge

Photo Credit: Google Earth

Table 6-1. Potential Transportation System Management & Operations Improvements — I-55

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
TS-1	Shelby	In advance of Mississippi Bridge WB approach		Advanced warning and pull-off OR collapsible barrier in the median for over-dimensional vehicles	Public/ Stakeholder
TS-2	Shelby	Throughout Corridor		Install corridor management assets (ITS/DMS)	Public/ Stakeholder

7. Freight

Freight movement is an important element of a regional and national economy, especially for the I-55 corridor. Given its proximity to the Memphis International Airport as well as its connectivity across the Mississippi River, future growth along the I-55 corridor will likely be in the freight, logistics, and warehousing sectors. Nationally recognized logistics hubs such as the International Port of Memphis and the Memphis International Airport, as well as five Class I railroads and the associated intermodal/ distribution facilities, are responsible for both short- and long-haul trips that directly impact the corridor. The Memphis International Airport is the hub for FedEx Global and is the busiest cargo airport in the United States. Its operations generate considerable freight traffic in the area, including on I-55. Heavy vehicles currently comprise greater than 40% of traffic on I-55 north of US-61, and truck trips in the study area are expected to grow over 50 percent between 2010 and 2040.

Technical Memorandum 2 identified existing and future deficiencies. This memorandum presents potential measures to improve freight mobility and support

efficient and safe freight movement, now and into the future. Potential options include infrastructure improvements, such as truck parking and intersection redesigns, as well as management and operation strategies, such as lane restrictions and communication strategies.

Traditional infrastructure improvements, such as interstate capacity expansions, benefit all traffic and are addressed in Section 4 of this memo. Other infrastructure improvements can be made specifically to benefit freight movement. These include truck parking and interchange improvements.

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. 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 lists four truck stops along I-55 in Tennessee; only two provide overnight parking and all four have a combined 88 parking spots. The Shelby County I-55 Northbound Welcome Center has 13 truck parking spots. Other nearby welcome centers include the Tennessee Welcome Center on I-40 (6 spots), the Arkansas Welcome Center on I-55 directly across the Mississippi River (8 spots), and the Mississippi Welcome Center on I-55 southbound approximately 13 miles south of the Tennessee/Mississippi state line (12 spots), but none of these are directly on the I-55 corridor within Tennessee.

Is is also noteworthy that all parking spaces at Tennessee Welcome Centers and rest areas have a maximum 2 hour parking limit. No overnight parking is allowed. Although the I-55 corridor is only 13 miles long, the existing truck parking locations are not sufficient given the high volume of truck traffic. According to the FHWA *Model Development for National Assessment of Commercial Vehicle Parking*[2], this segment of I-55 should have 50 rest area parking spots and 168 truck stop parking spots. Overall, the area should have over 100 more parking spaces than what is currently available. Truck parking within the city center is more expensive than similar parking outside the city due to land costs; however, that cost can be justified if parking near truck origins/destinations can reduce truck traffic entering the city during peak morning rush hour.

Interchange Improvements

I-55 in Tennessee has a number of interchanges that see heavy truck traffic; the Port of Memphis and the Memphis International Airport generate high volumes of freight traffic that enter and exit I-55 within the corridor. From 2014 to 2018, the highest number of crashes along the corridor occurred near freeway interchanges, including I-55/I-69/I-240 and I-55/US-61.

Potential safety and capacity solutions at these interchanges are discussed in Sections 4 and 5 of this technical memorandum and give consideration to the following tools that have a measurable impact on congestion, specifically improving truck safety and operations.

On-ramp signals: Also called ramp meters, on-ramp signals are stop-and-go signals used during peak congestion times to control, or meter, the number of vehicles merging onto an already congested freeway. The signals allow one or two cars every few seconds to merge onto the freeway, avoiding the congestion that occurs when large numbers of vehicles attempt to merge with traffic already on a highway.

Dynamic zipper merge: As its name suggests, a dynamic zipper merge is intended to work like a zipper. When traffic is heavy and slowed at a lane reduction point, signs direct drivers to use both lanes until reaching the merge point, where they merge into a single lane. By taking turns at the merge point, drivers experience smoother merging conditions, which reduces traffic backups.

Turbine interchange: A turbine interchange design circles all left-turning traffic around a central bridge in a counterclockwise direction, like a whirlpool, allowing a high volume of traffic to travel between two interstates at highway speed. Since it features smaller bridges with smaller supports and lower roadway profiles than a traditional interchange, a turbine interchange has less impact to traffic during construction, and costs less to build and maintain than other types of interchanges.

Automation & Truck Platooning

Many technologies are being developed that help drivers by providing their vehicles with information about their environment. The first widespread implementation of automation technology is likely to be semi-autonomous truck platooning. Platooning became permitted on Tennessee roads in April 2017. This allows freight trucks to use a system that automatically controls speed and braking by communicating between participating vehicles. This not only improves efficiency by increasing aerodynamics as the trucks can drive closer together,

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

but also safety because the system will automatically apply brakes if it senses a hazard. However, widespread use of truck platooning may require some infrastructure upgrades, specifically regarding bridges.

The load dynamics created by a truck platoon are different than for a conventional truck. Bridge spans must be able to handle more weight as more trucks are able to fit on a smaller space. They may also experience more wear on pavement and bridge elements due to new and different load dynamics, and existing railings may be too weak to withstand a crash by several trucks. The design of protective barriers might not be strong enough for a two or more-truck platoon with nearly no headway. Although accidents are expected to be rare, they might happen and in that case the barriers must be able to withstand the extra forces.[3]

It should also be noted that truck platooning may not be efficient or advisable in urban areas with higher traffic volumes. Under congested conditions, vehicles are more likely to try to cut between trucks in a platoon, reducing the platoon's efficiency and increasing the potential for crashes.

Managed Lanes and Lane Restrictions

Some common management techniques for congestion relief include managed lanes, speed modification, and lane restrictions. However, these techniques may not always be appropriate and may be counter-productive from a freight standpoint. For example, lane restrictions that force trucks to remain in the right lane can cause safety issues with drivers merging and weaving at on-and off-ramps. Additionally, studies have not produced consistent results on the safety of differential speed limits.

Similarly, studies of toll lanes have also not produced consistent results. Many truck operators are reluctant to use toll lanes because the toll costs, unlike gas taxes, cannot be recouped in the current pricing structure. An additional consideration is that different commodities may be more or less sensitive to tolls based on the differing pricing structures for transportation of bulk versus containerized or breakbulk goods and may be more likely to switch to alternate routes or remain in the general purpose (non-tolled) lanes. A shift of some auto travelers to a HOV lane or toll lane could generate additional capacity for freight operators in the remaining lanes; however, the estimated violation rate for the existing high-occupancy vehicle (HOV) lanes on I-55 in the study area approaches 90 percent.[4] Given the high violation rate, TDOT may want to consider alternative uses for this existing pavement width. With the high truck percentage on this section of I-55, a truck-only lane may be a viable option, especially as semi-autonomous truck platooning increases in frequency. The benefits of truck-only lanes go beyond operational gains for trucking firms and include general traffic safety improvements from reduced conflicts and lower maintenance costs on general-traffic lanes. Because the acceleration and braking performance of trucks is much lower than that of most passenger vehicles, removing trucks could substantially improve the flow of segments with heavy traffic. Motorists would be able to travel with faster and more consistent speeds, without the safety risks of heavy trucks operating in the same traffic stream, and with the more relaxed environment made possible by the elimination of large trucks from passenger vehicle lanes.

There are many different ways to implement managed lanes, and any implementation should be preceded by a comprehensive investigation of the desired objectives for a particular stretch of roadway and various options to achieve those objectives.

Parallel Corridors

The identification and use of alternative, parallel routes can be an approach to accommodate increasing traffic. Only one other Mississippi River crossing exists in the area via I-40, approximately one mile north of the I-55 crossing. Although I-69 and I-40 can provide an alternative route across the River for incident management purposes, this route is likely to be just as congested as I-55. For longer north-south routes, alternatives include I-269 or I-240 to avoid the downtown area. I-240 between US-78 (Lamar Ave) and I-55 is currently programmed for widening to six to eight lanes, which could make this alternative route more attractive. For local traffic, a planned extension of Shelby Drive west to Paul Lowry Road will provide alternative access to the Port of Memphis and may alleviate some truck traffic on I-55 between US-61 and Shelby Drive.

In general, diverting truck traffic from interstate highways to lower order roads will increase potential multimodal safety problems, pavement wear, and traffic disruption. Existing structures on lower order roads must also be able to accommodate the loads and dimensions of freight vehicles.

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. Truck drivers can be trained to drive in ways that save fuel, reduce emissions, and reduce noise so that night deliveries do not disturb neighbors.

3- TSU/Vanderbilt 2018 Study
4- Physical Infrastructure Needs for Autonomous & Connected Trucks, Johan Tobias Paulsen, June 2018

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.

Potential Freight Mobility Solutions

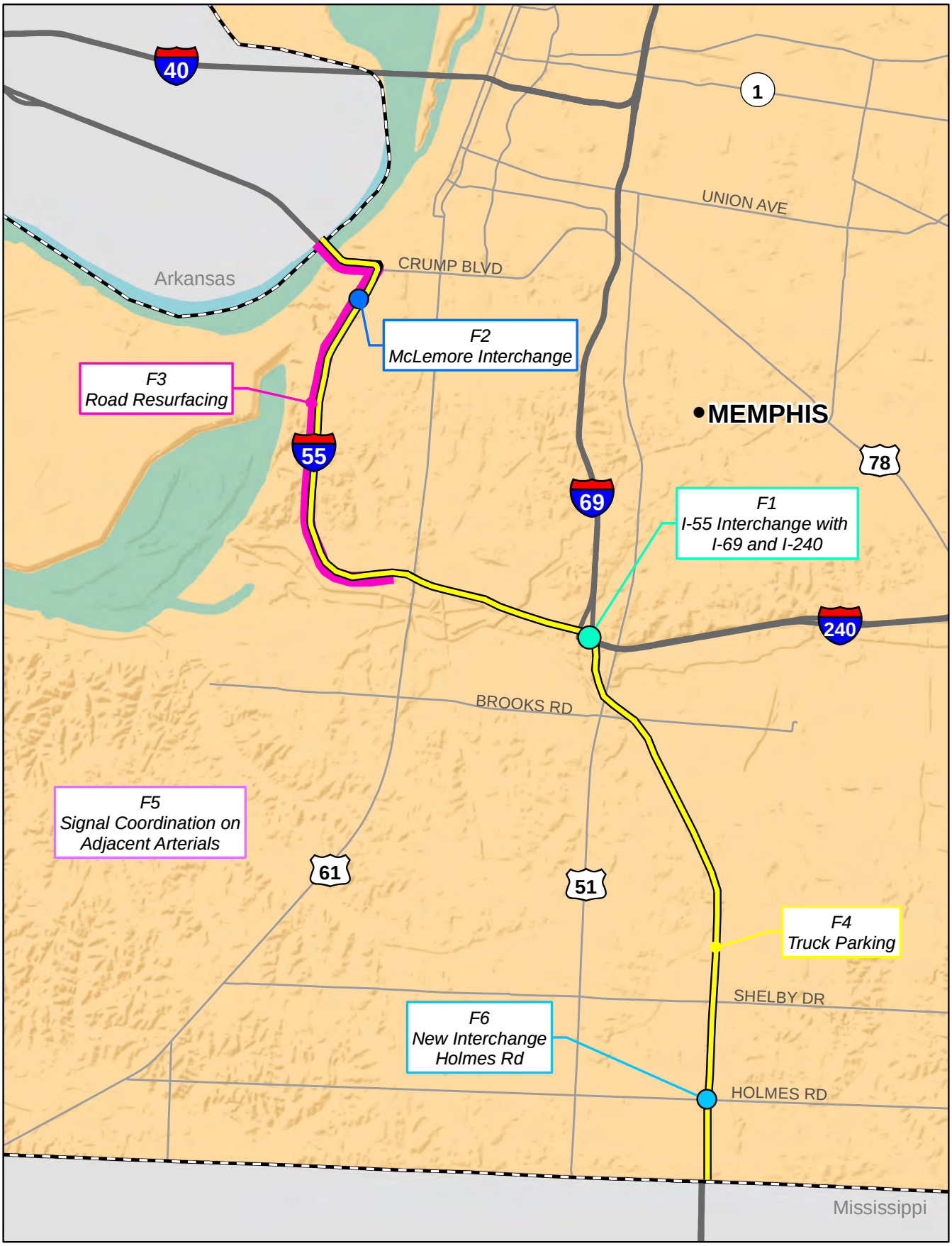
Suggested freight improvements for the I-55 corridor are shown in Table 7-1 and Figure 7-1. As part of a project to widen I-240 from US-78 to I-55, the I-240 interchange at I-55 is planned for improvements. Potential solution F1 is recommended to ensure that the planned improvements also address safety and capacity issues with I-55 to I-55 movements. Note that the segment of I-55 between I-240 and US-61 was evaluated as part of this corridor study and is included in Section 4 of this memo. Auxiliary lanes at McLemore Avenue were evaluated in Section 4 as well.

The Memphis MPO has programmed a signal coordination project on US-61 from Vance Avenue to Winchester Road (See Table 4-1 of Technical Memorandum 2). Additionally, the MPO's 2050 Regional Transportation Plan (RTP) identifies a new interchange on I-55 at Holmes Road as a future vision project. While the need for this interchange is not apparent in 2040 projections it is also identified in the 2018 Tennessee Freight Plan as a high-priority need. It's inclusion in the 2050 RTP indicates that the existing two interchanges on I-55 between I-240 and the Mississippi state line may not be sufficient for future long-term growth.

Table 7-1. Potential Freight Improvements — I-55

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
F1	Shelby	West of I-69	South of I-240	Study interchange design to ensure safe, efficient truck movement	Data Analysis
F2	Shelby	McLemore off-ramp	McLemore on-ramp	Add auxiliary lane between off-ramps and on-ramps at McLemore Avenue	Tennessee Freight Plan (2018) Regional Freight Plan
F3	Shelby	Horn Lake Road	Mississippi River	Resurface so that at least 90% of the corridor has good ride quality	Data Analysis
F4	Shelby	Arkansas State Line	Mississippi State Line	Add overnight truck parking capacity (~100 spots)	Data Analysis
F5	Shelby	Arkansas State Line	Mississippi State Line	Apply signal coordination on adjacent arterial streets with heavy truck traffic (Crump, McLemore, US-61, Brooks) to manage on- and off-ramp congestion	Data Analysis
F6	Shelby	Holmes Road		New Interchange	Tennessee Freight Plan (2018), Memphis MPO 2050 RTP, Regional Freight Plan, Livability 2040 RTP

Figure 7-1. Potential Freight Improvements — I-55



8. 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.

To assess needs and develop a universe of potential actions that support economic development, the study team interviewed key stakeholders and analyzed future employment projections to determine economic development focus areas in each corridor. Areas forecasted to see significant employment growth were noted in Technical Memorandum 1. Stakeholder input was collected specific to economic development potential along the corridor, including areas that may benefit from additional Interstate access points in the future. Studies of these areas that may be subject to development pressure were included in the universe of potential solutions. Other potential solutions that impact regional economic development are included in the capacity, safety, operations, and freight sections of this report.

Employment growth in the I-55 study corridor is expected to be centered on the area west of the interstate surrounding and including the Port of Memphis. Access to and from the Interstate is currently gained at the McLemore and W. Mallory Avenue interchanges. Job growth in this area is anticipated to reach up to 250% between 2010 and 2040, with numerous new logistics and industrial jobs attracted to the area. Additional employment growth is expected around the Memphis airport, near Graceland, and along the Mississippi state line. Adding employee traffic to these areas may lead to increased congestion or interchange-related safety issues.

Interviewees and transportation experts in the corridor suggest that an additional interchange serving the Port of Memphis area may be desirable to support future growth. Note that the extension of Paul Lowry Road to Shelby Drive is included in the Memphis 2020-2023 TIP. This project will provide the Port with a second access to I-55 via Shelby Drive.

A potential interchange at Holmes Road, near the state line, was also suggested as a potential longer term improvement to support economic development in this growing area. That project is identified in the MPO's 2050 Regional Transportation Plan as a future vision project (ID 53), but at this time is not included in the fiscally constrained project list of the RTP. See Table 8-1 and Figure 8-1 for a summary of potential alternatives to support economic development.

Figure 8-1. Potential Economic Development Improvements — I-55

Table 8-1. Potential Economic Development Improvements — I-55

ID	County	Termini (From)	Termini (To)	Description	Sourced of Recommended Solution
ED1	Shelby	I-240	Mississippi State Line	Evaluate need for additional interstate access point to accommodate economic growth	Public/Stakeholder and MPO 2050 RTP

9. Transit/Bicycle and Pedestrian/TDM

While driving is the mode of choice throughout the I-55 corridor, it is important to ensure that multimodal transportation options exist. As noted in Technical Memorandum 2, MATA provides great service coverage but has long headways and limited night and weekend service. There is also a missed transit connection between Memphis commuters to the west, (Arkansas) and south (Mississippi). Meaningful transportation choices provide mobility opportunities for all users and can help alleviate congestion along I-55. A complete multimodal network includes transit, bicycle and pedestrian infrastructure, and additional resources that promote carpooling and transit use.

Tables 9-1 and 9-2, lists identified transit, transportation demand management (TDM), and bike/ped projects that would help support mobility in the I-55 corridor. The list of recommendations was compiled from existing transit plans, bike/ped plans, public/stakeholder input, and best practice recommendations resulting from this corridor study's analysis.

Several of the identified projects have been starred. The starred projects are those that most strongly relate to the I-55 corridor and include T2, T9, T10, T12, T13, and BP1. These recommendations include extending transit into northern Mississippi (DeSoto County), directly addressing a deficiency identified in Technical Memorandum 2. Additional recommendations include improved transit access to the Memphis International Airport, bicycle and pedestrian infrastructure, and employment transit circulator routes in high density employment areas along I-55.

- T2: Airport Shuttle – Recommendation to improve frequency of airport shuttle service to the Memphis International Airport and, indirectly, major employment centers in the vicinity of the airport. Reliable and efficient transit connections to the Memphis International Airport could help alleviate congestion on I-55 and create better access to employment for residents.
- T9 & T10: Employment Access Express Route/ Circulator Shuttle – The Memphis Intermodal Facility along I-55 is a large trip generator, as it employs a large number of workers. This destination could be better serviced by an express route from the SR-64/Stage Rd and by a circulator shuttle within the Memphis Intermodal Facility area. These transit improvements could keep vehicles off the I-55 corridor, decreasing congestion.
- T12 & T13: New Transit service to DeSoto County (Northern Mississippi). Many residents from northern Mississippi (mainly DeSoto County) commute north, along I-55 into Memphis daily. By providing transit access traffic along I-55 could be reduced.
- BP1: Consider conducting a study to identify bicycle and pedestrian connectivity and safety improvements at existing U.S. and state route interchanges. A significant number of bicycle and pedestrian related crashes have occurred at I-55 interchanges. As indicated in Technical Memorandum 2, no bicycle accommodations are provided at these interchanges, and at each free flow right turns from off-ramps jeopardize pedestrian safety.

  Further bicycle and pedestrian study should consider the following measures:

  - In-field, Geometric Analysis, including:
    - 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

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

Table 9-1. Potential Transit Improvements — I-55

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
T1	Shelby	Throughout Network		Hubs and Centers - Restructure routes around network "backbone" with a route hierarchy. Seven additional routes created, service time and frequency improved.	Memphis MPO TIP FY 2020-2023
*T2	Shelby	All Transit Centers	Memphis International Airport	Improve shuttle service frequency to the Memphis International Airport and major employment centers in the vicinity of the airport. The shuttle would operate daily from 5:00 AM to 11:00 PM and be scheduled with departures every 20 minutes.	Data Analysis and Memphis 3.0 Transit Vision

Table 9-1. Potential Transit Improvements — I-55 (continued)

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
T3	Shelby	Throughout Network		Transit Super Stops: Add shelters with lighting, signage, information board, trash can and bicycle parking. Allow for signalized pedestrian crosswalk, roadway and accessibility improvements.	Memphis MPO TIP 2020-2023
T5	Shelby	Throughout Network		MATA plans to construct a system of transit centers in various locations throughout MATA's service area. Bus routes in each area will be adjusted to serve the centers, and schedules will be adjusted to minimize wait times for transfers.	Livability 2040 Regional Transportation Plan
T6	Shelby	Throughout Network		New transit service for four proposed routes that will expand bus service to employment centers in the Memphis area. The four routes include: 1. 400 Wolfchase Connector 2. 280 Airways 3. 44 Getwell Connector 4. 64 Airport Shuttle	Livability 2040 Regional Transportation Plan & Memphis MPO TIP 2020-2023
T7	Shelby	Throughout Network		MATA plans to provide transit service on three new routes and to two new park-and-ride locations under the CMAQ program. The three routes include: 5. I-40 Corridor Circulator 6. Route 34 Express 7. Shelby Farms Circulator The two park-and-ride lots will service: 1. Route 52 Express - Greenline 2. Route 34 Express - Agricenter	Livability 2040 Regional Transportation Plan & Memphis MPO TIP 2020-2023
T8	Shelby	Throughout Network		Commute Options Travel Demand Management Initiative: Develop employer program to reduce drive-alone commuting and increase use of transit, bicycling, ridesharing and walking among employees and students. Develop marketing and outreach tools ,pilot strategies with six employers during grant period.	Livability 2040 Regional Transportation Plan
*T9	Shelby	SR-64/Stage Rd	BNSF Railway/ Memphis Intermodal Facility	Employment Access Express Route: Many transit origins from SR-64/Stage Rd ending in high industrial employment area near Memphis Intermodal facility. For better transit access between these two locations, an express route traveling along I-240 with select stops around the intermodal facility could fulfill this need.	Livability 2040 Regional Transportation Plan
*T10	Shelby	Memphis Intermodal Facility	Memphis Intermodal Facility	Employment Access Circulator Shuttle: A circulator shuttle could satisfy this mobility and accessibility need, allowing a more direct connection to these places of employment.	Livability 2040 Regional Transportation Plan
T11	Shelby	Throughout Network		Additional north-south connections would strengthen transit access between environmental justice (minority, low income, etc.) communities and major employment centers, improving travel time as well as expanding employment opportunities.	Livability 2040 Regional Transportation Plan
*T12	Shelby, DeSoto	US-61	Goodman Rd/MS-305	Route 39 Extension to DeSoto County: New transit service to DeSoto County (Mississippi)	Livability 2040 Regional Transportation Plan
*T13	Shelby, DeSoto	TN/MS State Line	Goodman Rd/MS-305	Route 32 Extension to DeSoto County: New transit service to DeSoto County (Mississippi)	Livability 2040 Regional Transportation Plan

Table 9-1. Potential Transit Improvements — I-55 (continued)

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solutions
T14	Shelby	Throughout Network		Advanced Public Transportation Systems: Apply advanced technologies to address public transportation needs. These systems may include: communication systems, fare collection systems, security systems, transit signal priority, automatic vehicle location (AVL) systems, mobility management software, project administration, and other management systems.	Memphis MPO TIP 2020-2023
T15	Shelby	Airways Transit Center	American Way Transit Center	Fixed-Route Bus Electrification and Aerotropolis Shuttle Service: New transit service for an Aerotropolis Shuttle, which will serve the Memphis Aerotropolis/Memphis International Airport.	Memphis MPO TIP 2020-2023
T16	Shelby	Throughout Network		Create a transit network that focuses on key corridors to connect anchors and job centers designated for growth by frequent transit and shared mobility. Short-Term and Long-Term (2040) network identified.	Memphis 3.0 Transit Vision
T17	DeSoto	Throughout Network		Set up a Mobility Management Program: Create marketing and educational materials and to look for funding to expand existing resources and services.	DeSoto County Transit Feasibility Study- Memphis MPO
T18	DeSoto	Throughout Network		The Voucher Program would quickly expand services and provide more flexible travel options for DeSoto County's most vulnerable residents.	DeSoto County Transit Feasibility Study- Memphis MPO
T19	DeSoto	Throughout Network		Develop commuter service to the Tunica casinos or Shelby County (or both) to start developing fixed-route services.	DeSoto County Transit Feasibility Study- Memphis MPO
T20	DeSoto	Throughout Network		Develop more traditional bus service along DeSoto County's primary corridor. Service will need to be developed cautiously, given the challenging land uses and pedestrian environment.	DeSoto County Transit Feasibility Study- Memphis MPO

*Improvements with the highest potential to impact travel on I-55. These alternatives will be included in the universe of alternatives for I-55.

Table 9-2. Potential Bicycle and Pedestrian Improvements — I-55

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solutions
*BP1	Shelby	Throughout Network	Throughout Network	Consider conducting a study to identify bicycle and pedestrian connectivity and safety improvements at existing U.S. and State Route interchanges.	Data Analysis

10. Universe of Alternatives

Sections 4-9 of this technical memorandum detail development of possible solutions to identified deficiencies in the areas of capacity, safety, transportation system management, freight, economic development, and multi-modal options. Table 10-1 and Figure 10-1 gather these potential solutions into the total universe of alternatives for the I-55 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 10-1. Potential Solutions By Category — I-55

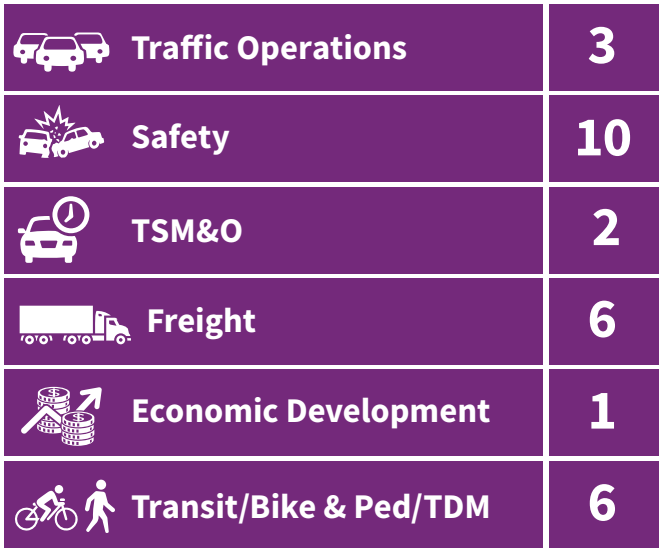


Table 10-1. Universe of Alternatives — I-55

	ID	Termini (From)	Termini (To)	Description	Source of Recommended Solution
Traffic Operations	C1	I-240/I-69	US-61	Evaluate options for increasing capacity and improving merge/diverge and weave areas between the US-61 and I-240 interchanges	Data Analysis and Regional Freight Plan, Livability 2040 RTP
	C2	McLemore Ave. Interchange		Improve interchange to maintain six lanes between ramps	Data Analysis
	C3	Mississippi River Bridge		Widen existing 4-lane bridge	Data Analysis
Safety	S1*	Metal Museum Drive		Close Exit 12C; Convert enter/exit lanes to merge/exit lanes for I-55	Data Analysis
	S2*	Metal Museum Drive		Install additional jersey barrier	Data Analysis
	S3*	Metal Museum Drive		Add pavement markings; add additional overhead signage	Data Analysis
	S4*	Metal Museum Drive		Add pavement markings	Data Analysis
	S5*	Crump Boulevard		Interchange improvement	Public/Stakeholder/ TN Freight Plan (2018) Regional Freight Plan
	S6	MS River Bridge	MS State Line	Resurface pavement	Public/Stakeholder
	S7	South 3rd Street (US-61)		Realign ramps	Data Analysis
	S8*	I-240		Add advanced signage and pavement markings; Extend SB deceleration lane	Public/Stakeholder
	S9*	I-240		Extend WB deceleration lane	Public/Stakeholder
	S10	Brooks Road		Evaluate the need for additional drainage	Public/Stakeholder

*Should be considered interim solution or should be implemented in concert with planned interchange modification projects at Crump Avenue and I-240.

Table 10-1. Universe of Alternatives — I-55 (continued)

	ID	Termini (From)	Termini (To)	Description	Source of Recommended Solution
TSM&O	TS1	Advance of Mississippi River Bridge WB Approach		Advance warning and pull-off OR collapsible barrier in the median for over-dimensional vehicles	Public/Stakeholder
	TS2	Throughout Corridor		Install corridor management assets (ITS/DMS)	Public/Stakeholder
Freight	F1	West of I-69	South of I-240	Study interchange design to ensure safe efficient truck movement	Data Analysis
	F2	McLemore Ave. off-ramp	McLemore Ave. on-ramp	Add auxiliary lane between off-ramps and on-ramps at McLemore Avenue	Tennessee Freight Plan (2018) Regional Freight Plan
	F3	Horn Lake Road	Mississippi River	Resurface so that at least 90% of the corridor has good ride quality	Data Analysis
	F4	Arkansas State Line	Mississippi State Line	Add overnight truck parking capacity (~100 spots)	Data Analysis
	F5	Arkansas State Line	Mississippi State Line	Apply signal coordination on adjacent arterial streets with heavy truck traffic to manage on- and off- ramp congestion (Crump, McLemore, US-61, Brooks)	Data Analysis
	F6	Holmes Road		New interchange at Holmes Road	Tennessee Freight Plan (2018) Regional Freight Plan, Livability 2040 RTP
Economic Development	ED1	I-240	Mississippi State Line	Evaluate need for additional interstate access point to accommodate economic growth	Public/Stakeholder
Multimodal	T2	All Transit Centers	Memphis International Airport	Improve shuttle service frequency to the Memphis International Airport and major employment centers in the vicinity of the airport.	Data Analysis and Memphis 3.0 Transit Vision
	T9	SR-64/Stage Road	BNSF Railway/ Memphis International Airport	Express route along I-240 with select stops around the international facility could fulfill this need	Livability 2040 Regional Transportation Plan
	T10	Memphis Intermodal Facility		Circulator shuttle allowing a more direct connection to places of employment	Livability 2040 Regional Transportation Plan
	T12	US-61	Goodman Road/MS-305	Route 39 Extension to DeSoto County (Mississippi)	Livability 2040 Regional Transportation Plan
	T13	TN/MS State Line	Goodman Road/MS-305	Route 32 Extension to DeSoto County (Mississippi)	Livability 2040 Regional Transportation Plan
	BP1	Throughout Network		Conduct a study to identify bike/ped accommodations at U.S. and State Route interchanges	Data Analysis

11. Solutions Screening Process Methodology

Technical Memorandum 4 for the Study will filter the I-55 universe of alternatives through a solutions screening and prioritization process (see Figure 11-1). This process will evaluate solutions based on their impact on mobility and safety, potential environmental impacts, cost, and potential economic impacts. Ultimately, the prioritized solutions will both resolve the identified deficiencies and have a high benefit/cost ratio.

Phase 1 Alternative Screening

The Phase 1 alternatives screening process is intended to eliminate solutions with evident fatal flaws. This two-phase process will evaluate each possible solution 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 receive a "NO" response for questions 1, 2, or 3, or a "YES" response for questions 4 or 5 will be eliminated and will not move forward to the Phase 2 alternative screening. Exceptions include projects where the potential is high for environmental/cultural impact mitigation.

Phase 2 Alternative Screening

The Phase 2 alternatives screening process will utilize performance measures identified in Section 3 to further refine the list of feasible alternatives. Additionally, a benefit/cost analysis will be conducted. Potential solutions that pass the Phase 1 Screening will be evaluated against the following questions:

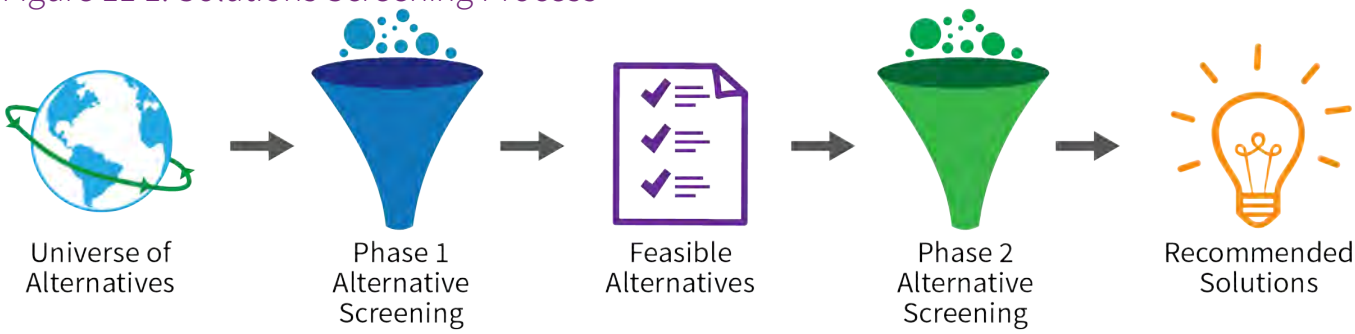
1. Does the proposed solution improve level of service on the interstate corridor?
2. Does the proposed solution improve peak hour travel speeds on the interstate corridor?
3. Does the proposed solution improve travel times between key O&D pairs along the corridor?
4. Does the proposed solution improve 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 improve incident management?
12. Does the proposed solution provide potential economic development opportunities?
13. Does the proposed solution have the potential to reduce VMT?
14. Does the benefit/cost ratio of the proposed solution exceed 1.0?

Projects which receive only "NO" responses will be eliminated and will not move forward as feasible multimodal solutions.

Identification of Recommended Solutions

Potential solutions which receive a "Yes" in the Phase 2 screening will be carried forward to the list of recommended solutions. The recommended solutions will move into the project prioritization phase, wherein recommended solutions will be ordered based on their effectiveness, potential for solving identified deficiencies, and benefit/cost ratio.

Figure 11-1. Solutions Screening Process



I-155 Corridor

▶ Development of Feasible Multimodal Solutions

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I-155 Corridor

1. Introduction

The I-155 corridor serves as a backbone for economic development and growth in northwest Tennessee. As population and employment continue to grow and development 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 threaten the corridor's ability to sustain future growth.

A previous technical memorandum (Technical Memorandum 1) provided a data and information inventory for the corridor. Technical Memorandum 2 assessed existing and future deficiencies and needs along the I-155 corridor, focusing on traffic operations, safety, and multimodal conditions. These deficiencies are re-visited briefly in Section 2 of this corridor report. However, the primary focus of Technical Memorandum 3 is the development of 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, is ultimately established.

To supplement the technical analysis performed during this process, public workshops and surveys were used to generate feedback from citizens and stakeholders located throughout the corridor. A series of detailed interviews were also conducted with transportation and development officials. The resulting universe of alternatives is organized based on the issues each potential solution address, including safety, traffic congestion, freight movement, and multimodal travel. Many of the solutions may benefit more than one aspect of travel in the corridor. The forthcoming Technical Memorandum 4: Project Priorities will report on the evaluation and strategic prioritization of the potential solutions described here.

8 potential solutions for the I-155 corridor are discussed in this memorandum.

2. Overview of Existing Deficiencies and Future Needs

Technical Memorandum 2: Assessment of Existing and Future Deficiencies, defined the trend scenario for the I-155 corridor – an effort that predicts existing and future conditions if current practices and plans remain unchanged. The trend scenario includes population and employment projections, capital projects currently programmed for construction in either the Tennessee Department of Transportation's (TDOT) Statewide Transportation Improvement Program (STIP) or one of the Metropolitan Transportation Planning Organizations (MTPO) Transportation Improvement Program (TIP), recent MPO travel demand model projections, and Transearch freight projections.

Evaluation of the trend scenario, coupled with feedback from citizens and stakeholders, brought to light existing deficiencies and future needs for which solutions have not yet been programmed. These deficiencies align with economic development projections and fall into the following six categories, which are summarized in Figure 2-1.

- Traffic Operations
- Safety
- Transportation System Management
- Freight
- Transit / Bike & Ped / TDM
- Pavement & Structures

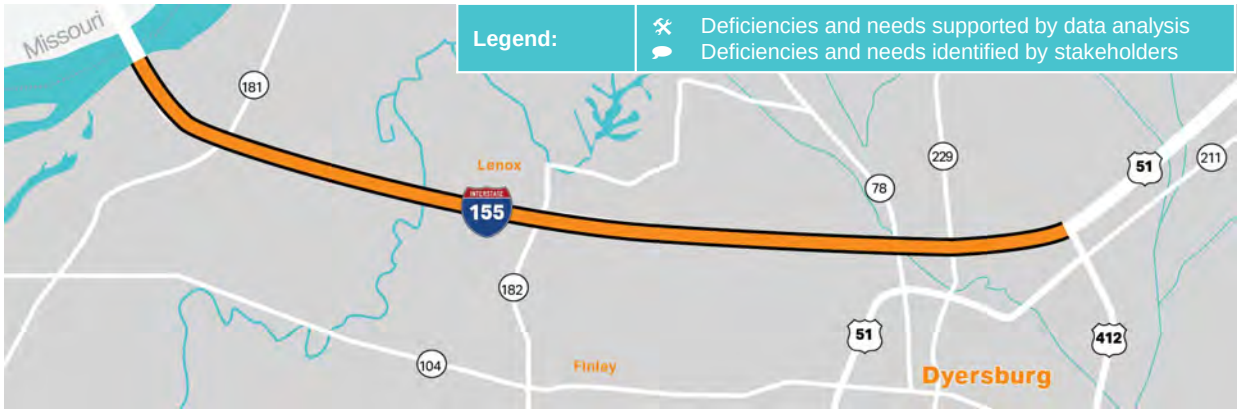
The content of Figure 2-1 was reviewed with TDOT Region 4 representatives on January 22, 2020. Responses recognized no additional deficiencies.

The remaining chapters of this technical memorandum document the development of feasible multimodal solutions to address the complete list of existing and future deficiencies.

Figure 2-1. Existing Deficiencies and Future Needs — I-155

I-155 Existing Deficiencies and Future Needs

Additional information about the existing deficiencies and future needs for the I-155 corridor can be found in Technical Memorandum 2.



Traffic Operations

- "Congestion identified at the I-155 interchange with Lake Rd. due to slow moving farm equipment."

Safety

- Higher crash rates at the Mississippi River Bridge and on I-155 between SR-182 and SR-78 likely due to inadequate lighting, small inside shoulder width near roadway barriers, and animal crossings from the nearby forested areas.
- Bicycle/pedestrian crashes are present near the I-155/SR-78 interchange – an area with commercial land uses that drive non-motorized travel.
- "Safety issues on the segment of I-155 west of Dyersburg due to the presence of snow and ice in hilly areas with no adequate warning system."
- "Safety issues at US-412 interchange due to sharp curves that lead to truck rollovers."
- "Safety issue due to the presence of cable barriers with inadequate shoulder width."

Freight

- Insufficient truck parking facilities.
- Truck volumes are expected to increase by 91% between 2010 and 2040.

Transit / Bike & Ped / TDM

- The I-155 study area is not served by any fixed-route transit services.
- Lack of bicycle and pedestrian accommodations at interchanges.

Transportation System Management

- Consider work zone management, traffic incident management, traffic signal coordination on adjacent arterials, and improved bicycle and pedestrian crossings.

Pavement & Structures

- Two bridges eligible for rehabilitation:
  - I-155 over the Mississippi River
  - I-155 over Lewis Creek (east of SR-78)

Economic Development

- Employment growth projected at all four I-155 interchanges (SR-181, SR-182, SR-78 and US-412)
- Employment growth is likely to occur in anticipation of the proposed I-69 corridor east of the study limits.
- "Additional development in the Dyersburg North Industrial Park is anticipated to increase truck volumes on US-412 and I-155."

TN TDOT Department of Transportation **I-55/75/26 Corridor Study**

3. Performance Measures

Goals for potential improvements along the I-155 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 3-1, the 5 identified goals were further developed into 12 specific objectives, intended to guide development and evaluation of alternative 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)[1], Trend (2040) and Build (2040) scenarios. Table 3-2 outlines the performance measures established for the I-155 Corridor and includes results for the Base and Trend Scenarios. As indicated, the measures fall into four categories (Traffic Operations, Safety, Operations & Maintenance, and Multimodal), which directly support the objectives identified in Table 3-1. Results for the Build Scenario will be included in Technical Memorandum 4.

It is important to note that many of these performance measures represent the corridor as a whole – aggregating the benefit of the potential solutions in the Build year. The exception is "Crash reduction in safety 'hot spots'". This performance measure was applied at isolated locations where the universe of alternatives for addressing deficiencies may be larger.

The following section is a glossary of the specific performance measures, providing the definitions, and details regarding how the measure was calculated or assessed.

Description of Performance Measures

Traffic Operations

- **Traffic on Interstate Operates at LOS D or Better:** Defined by percent of the interstate corridor where operations are level of service (LOS) A, B or C. This measure provides insight into the amount of congestion experienced on the interstate corridor, reflecting the following relationship between volume-to-capacity and level

Table 3-1. Performance Goals and Objectives — I-155

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		

1- The Statewide Travel Demand Model (TSM) uses a 2010 base year for this study. The study team determined the TSM was producing results comparable to regional models with more recent base years- creating better model efficiency.

Table 3-2. Performance Measure Summary — I-155

Goal	Performance Measure		Unit	Base (2010)	Trend (2040)	% Change (Base vs Trend)
Traffic Operations	Traffic on interstate operates at LOS D or better		% of interstate operating at LOS D or better	100	100	0
	Total Daily Vehicle Miles Traveled (VMT)		Miles (1,000s)	2,430	3,058	26
	Total Daily Vehicle Hours of Travel (VHT)		Hours (1,000s)	55	67	20
	Total Peak Hour Vehicle Hours of Delay (VHD)		Hours	1.7	2.0	2
	Total VMT / Trip		Miles	5.65	5.98	6
	Total Vehicle Minutes Traveled / Trip		Minutes	7.70	7.380	1
	Average Peak Hour Travel Speed	Urban Interstate	MPH	76	76	0
		Rural Interstate	MPH	76	76	0
	Congested Travel Time between key O&D Pairs along Corridor (Total)		Minutes	48	49	0
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[2]	0[1]	N/A
			50 < % of bridges < 80	20[2]	10[1]	N/A
	Pavement Condition (Resurfacing)		% of corridor resurfaced within the last 10 years	95[2]	95[3]	N/A
Multimodal	Pedestrian and Bicycle Accommodations at U.S. and State Route Interchanges		% interchanges with bike facilities	0	0	N/A
			% interchanges with ped. facilities	0	0	N/A
	Freight (Truck Parking)		# of Rest Area Spots	10	10	0
			# of Truck Stop Spots	40	40	0

1- Per TDOT Structures Division, no repair projects are ongoing or scheduled for I-155. Review of 2018-Feb 2020 TDOT Bid lettings included repair of I-155 Bridge over Mississippi River ($13.5 million). Assumed this improved sufficiency rating to 80+.
2- Based on 2017 TRIMS data
3- Per TDOT Pavement Office's 2020 and 2021 Resurfacing Program. Also review of 2018-Feb 2020 TDOT Bid Lettings.

of service, as defined in Technical Memorandum 2 for the previously completed I-65 corridor study (February 2017):

- V/C < 0.7 (LOS A-B)
- V/C 0.7 – 0.8 (LOS C)
- V/C 0.8 – 0.9 (LOS D)
- V/C 0.9 – 1.0 (LOS E)
- V/C > 1.0 (LOS F)

Segments of interstate where Base and/or Trend TSM output indicated LOS E or F were identified for further analyses/evaluation of potential solutions. Additionally, rural segments with LOS D in 2040 were also identified, recognizing that delay associated with LOS D on a four-lane facility through rolling/mountainous terrain is perceived differently than LOS E or F on a six or eight lane urban cross-section. No rural segments with LOS D were identified in the I-155 Corridor.

- **Total Daily Vehicle Miles Traveled (VMT):** Detailed by urban and rural functional classifications within the Technical Memorandums, this performance measure indicates the total vehicle miles traveled each day within the study area. It is used to measure growth and ultimately sheds light on the efficiency of the system post-improvements, as a comparison of Build vs. Trend scenarios can indicate shifts in miles traveled on various functional types.
- **Total Daily Vehicle Hours of Travel (VHT):** Vehicle hours of travel is a measure of total time motorists are spending on the road each day. This performance measure is broken down by urban and rural functional classification. When compared to daily VMT, daily VHT can indicate increased or decreased delay on a system.
- **Total Peak Hour Vehicle Hours of Delay (VHD):** Also detailed by urban and rural functional classifications, peak hour VHD measures congestion of a facility during the peak hour. Typically, it is inversely proportional to travel speeds – as peak hour VHD increases, peak hour travel speeds decrease.
- **Total VMT/Trip:** Representing the system as a whole, total daily VMT divided by total daily vehicle trips, measures motorists average trip length (in miles/trip). Within a study area, changes in this performance measure can reflect changes in land use (which may promote shorter trip lengths, for example) or new / improved access to common destinations. Therefore, this performance measure must be evaluated in conjunction with an understanding of programmed roadway projects and planned developments in the study area.
- **Total Vehicle Minutes Traveled / Trip:** This performance measure represents the average time a motorist spends in their vehicle per trip. When the Vehicle Minutes Traveled/Trip remains consistent between the Base and Future year scenarios, changes in the Vehicle Minutes Traveled/ Trip performance measure can indicate increased or decreased congestion on the system.
- **Average Peak Hour Travel Speed:** This performance measure indicates the average travel speed a motorist experiences on a facility during the peak hour. When aggregated over a study area, change in average peak hour travel speed is indicative of system-wide increases or decreases in congestion and is usually inversely proportional to total peak hour vehicle hours of delay.
- **Congested Travel Time between Key O&D Pairs along Corridor:** Changes in travel time between origin and destination (O&D) pairs is a direct indicator of delay – and excluding incidents, also indicates congestion. Known origins and destinations along the corridor were selected, focusing on those that would primarily utilize the interstate corridor. Using the traffic analysis zones (TAZs) most representative of each origin and destination, Base and Trend congested travel times were pulled from the TSM and reported in minutes. These will be compared to travel times with the Build scenario.
- **Peak Hour Density at Improved Interchanges (Specified locations):** Based on deficiencies identified in Technical Memorandum 2, spot locations were identified for further traffic analysis using HCS, Synchro, and/or Transmodeler. Peak hour density for improved freeway segments, weave areas, merge areas, and diverge areas is directly indicative of level of service for the facility. Peak hour density will be measured for Trend and Build scenarios.
- **Average and Max Queues at Improved Ramp Intersections (Specified Locations):** Based on deficiencies identified in Technical Memorandum 2, spot locations were identified for further traffic analysis using HCS, Synchro, and/or Transmodeler. Exit ramp queue length will be measured for each interchange within the spot locations and compared to the existing storage provided. Queues that extend past the available storage significantly impact mainline traffic operations and safety. Average and Max exit ramp queue lengths will be measured for Trend and Build scenarios.

Safety

- **Crash Reduction in Safety "Hot Spots":** This performance measure is used to represent the relative safety benefit associated with each proposed improvement. Hot spots, as defined in Technical Memorandum 2, are areas along the interstate corridor where calculated crash rates are significantly above the statewide average. The crash reduction potential for each recommended

improvement was explored through the research of crash modification factors (CMFs), which estimates a safety countermeasure's ability to reduce crashes and crash severity. Based on data provided by the CMF clearinghouse, each recommendation was categorized as having above or below average crash reduction potential, specific to the I-26 corridor. Note that the reduction potential is only applicable for crash types that would be prevented by implementation of improvements.

Operations and Maintenance

- **Bridge Condition (sufficiency rating):** This performance measure is used to represent the structural benefit of proposed solutions, including those with the primary goal of addressing safety, capacity, or other needs. Highway bridges eligible for FHWA Bridge Replacement and Rehabilitation Program must have a sufficiency rating of 80 or less. A sufficiency rating that is less than 50 is eligible for replacement, and one that is less than 80 but greater than 50 is eligible for rehabilitation. The sufficiency rating is based on structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use. This measure is reported as a percentage of the total number of bridges (per corridor) within each sufficiency rating range.
- **Pavement Condition (resurfacing):** Pavement condition is directly tied to resurfacing. This performance measure is used to capture the ride quality benefit associated with solutions proposed primarily for safety and capacity deficiencies, for which resurfacing will be necessary.

Multimodal

- **Pedestrian and Bicycle Accommodations:** Geometric limitations created by interstate structures often result in discontinuous or unsafe pedestrian and bicycle accommodations on cross-streets through an interchange. In turn, this discourages multimodal connectivity. The Pedestrian and Bicycle Accommodations performance measure indicates the benefit that proposed safety and operational solutions may have on multimodal accessibility and connectivity at interchanges. Data collected for this performance measure is limited to interchanges with federal highways and state routes.
- **Freight (Truck Parking):** Truck parking is a critical component of supply chain operations, particularly with new service rules requiring drivers to stop after 14 hours. Without available parking, trucks often stop on highway on- and off-ramps, which is unsafe and illegal. This performance measure is indicative of compliance and safety improvements associated with truck parking solutions.

4. Traffic Operations

Technical Memorandum 2 documented future capacity needs based on a high-level, TSM analysis of the Trend Scenario. Within the I-155 corridor, all segments of interstate were expected to operate at LOS C or better through 2040. Stakeholders did, however, note congestion problems near the SR-78 (Lake Road) interchange due to slow moving farm equipment. A possible solution to this issue is identified in Section 7 (Freight) of this memo: "Install appropriate signage and increase enforcement to remove farm equipment from the interstate." No other traffic operations solutions were identified for inclusion in the universe of alternatives.

5. Safety

As documented in Technical Memorandum 2, an analysis was undertaken to identify areas along the I-155 corridor where safety issues may be present. These locations were identified as 'hot spots' and included segments along the corridor where the calculated crash rate was more than double the statewide average for similar facility types. Included in this analysis was the identification of potential factors that may contribute to the higher frequency of crashes in these areas. For the I-155 corridor, potential factors commonly identified included limited lighting along the corridor, limited visibility and reflectivity of median barriers, and frequent animal crossings.

As a first step in identifying safety solutions to address these factors along the I-155 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-155. As such, the potential crash factors were reviewed for each hot spot in tandem with public comments as well as aerial and street-level photography to identify potential solutions. These are shown in Table 5-1.

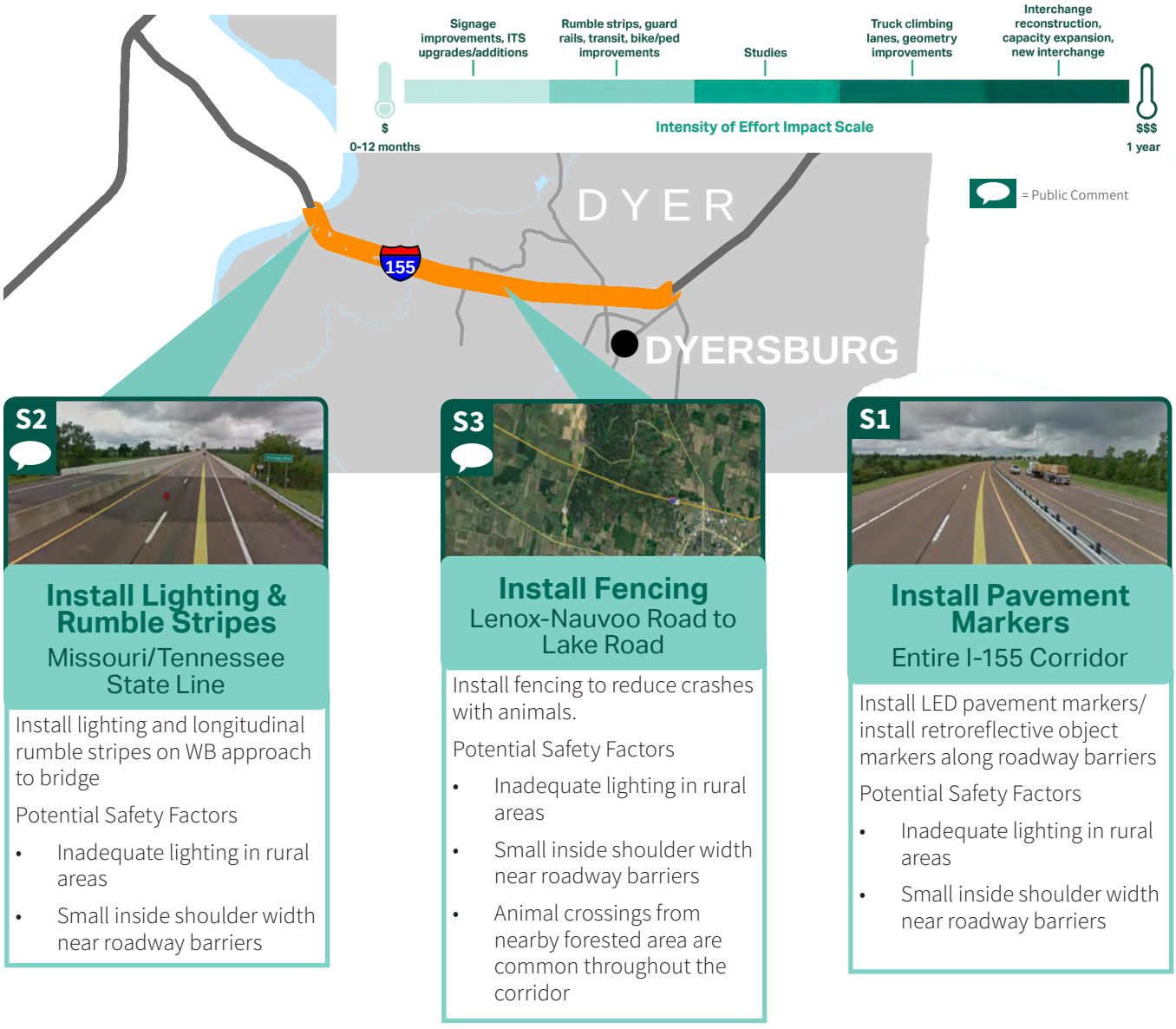
In addition to identifying potential safety improvements for locations along the corridor, the crash reduction potential for each recommendation was explored through the research of Crash Modification Factors (CMFs). A CMF estimates a safety countermeasure's ability to reduce crashes and crash severity. 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-155 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.

Information on the following page depicts each safety recommendation and the crash factors identified previously.

Table 5-1. Potential Safety Improvements — I-155

ID	County	Location	Description	Crash Reduction Potential
S1	Dyer	Entire I-155 Corridor	Install LED Pavement Markers	Below Average
S2	Dyer	Mississippi River Bridge	Install Lighting and Longitudinal Rumble Stripes on WB Approach to Bridge	Above Average
S3	Dyer	Lenox-Nauvoo Road to Lake Road	Install Fencing	Above Average

Figure 5-1. Potential Safety Improvements — I-155



6. Transportation System Management & Operations

Transportation Systems Management and Operations (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." Currently, traffic volumes on I-155 are well under the available capacity and motorists experience minimal delays. However, as development occurs, planners should be mindful of proactive options to mitigate congestion. One of the possible solutions outlined in other sections of this technical memorandum would also be considered a TSM&O solution:

- Freight Solution, F1: Install ITS warning system for snow, ice and inclement weather from Great River Road to Jenkinsville-Jamestown Rd.

Additional solutions were developed on a review of existing plans, public / stakeholder feedback, and field observations. These solutions are outlined in Table 6-1.

Table 6-1. Potential TSM&O Improvements — I-155

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
TS-1	Dyer	Mississippi River Bridge		Installation of structural impact monitoring system to identify severity of barge collisions	Public/Stakeholder
TS-2	Dyer	Mississippi River Bridge		Installation of barge sensor monitoring system	Public/Stakeholder

7. Freight

Freight movement is an important element of a regional and national economy. More efficient modes and routes for freight transportation enable improved logistics and result in reduced transportation costs; these cost savings can then be reallocated to growth, providing better jobs and higher wages. Technical Memorandum 2 identified existing and future deficiencies. This memorandum presents potential measures to improve freight mobility and support efficient and safe freight movement, now and into the future. Potential options include infrastructure improvements, such as truck parking and interchange redesigns, as well as management and operation strategies, such as lane restrictions and improving communication.

Truck Parking

Truck parking is a critical component of supply chain operations. Hours of service rules state that drivers must stop after 14 hours; 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, impacting the safety of all roadway users. Drivers often spend the last hour of their driving time looking for a place to park. In the absence of available truck parking, trucks 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 vehicle miles traveled (VMT) in the nation, at less than 60.[1]

The website www.truckstopguide.com lists one truck stop along I-155 in Tennessee with parking for 40 trucks, in addition to the 10 truck spots at the Tennessee Welcome Center. According to the FHWA *Model Development for National Assessment of Commercial Vehicle Parking*[2], this segment of I-155 should have 12 rest area parking spots and 38 truck stop parking spots; therefore, truck parking along this corridor should be sufficient and no truck parking solutions were identified for inclusion in the universe of alternatives.

Interchange Improvements

There are a variety of interchange configurations and variations available for access-controlled systems depending on the conditions encountered. Each interchange must be designed to fit individual site needs, conditions, and constraints. I-155 in Tennessee does not have high traffic volumes but does have a high percentage of truck traffic. Truck dimensions and operating characteristics affect the physical roadway infrastructure and their impacts should be appropriately considered in the geometric design of that infrastructure.

Traditional interstate service interchanges are variations of either a diamond or cloverleaf design. However, one drawback to cloverleaf interchanges is

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

that large trucks are more likely to roll over. This was indicated as an issue at the I-155 & US-412 interchange during the stakeholder outreach.

Automation & Truck Platooning

Many technologies are being developed that help drivers by providing their vehicles with information about their environment. The first widespread implementation of automation technology is likely to be semi-autonomous truck platooning. Platooning became permitted on Tennessee roads in April 2017. This allows freight trucks to use a system that automatically controls speed and braking by communicating between participating vehicles. This not only improves efficiency by increasing aerodynamics as the trucks can drive closer together, but also safety because the system will automatically apply brakes if it senses a hazard. However, widespread use of truck platooning may require some infrastructure upgrades, specifically regarding bridges.

The load dynamics created by a truck platoon are different than for a conventional truck. Bridge spans must be able to handle more weight as more trucks are able to fit on a smaller space. They may also experience more wear on pavement and bridge elements due to new and different load dynamics, and existing railings may be too weak to withstand a crash by several trucks. The design of protective barriers might not be strong enough for a two or more-truck platoon with nearly no headway. Although accidents are expected to be rare, they might happen and in that case the barriers must be able to withstand the extra forces.[3]

Parallel Corridors

The identification and use of alternative, parallel routes can be an approach to accommodate increasing traffic. The I-155 crossing of the Mississippi River is an important freight connection for this area, as demonstrated by the high percentage of truck traffic along the I-155 corridor. There are no other bridge crossings of the Mississippi River between Memphis, TN to the south and Cairo, IL to the north. The distance between Dyersburg, TN, to Cairo, IL, via I-155, I-55, and I-57 is approximately 98 miles and takes approximately 1 hour and 30 minutes; the distance via US-51 is 84 miles and takes approximately 1 hour and 40 minutes. Proper maintenance of the I-155 bridge over the Mississippi River is critical to maintaining efficient freight movement in the study area.

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. Truck drivers can be trained to drive in ways that save fuel, reduce emissions, and reduce noise so that night deliveries do not disturb neighbors.

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.

Potential Freight Mobility Solutions

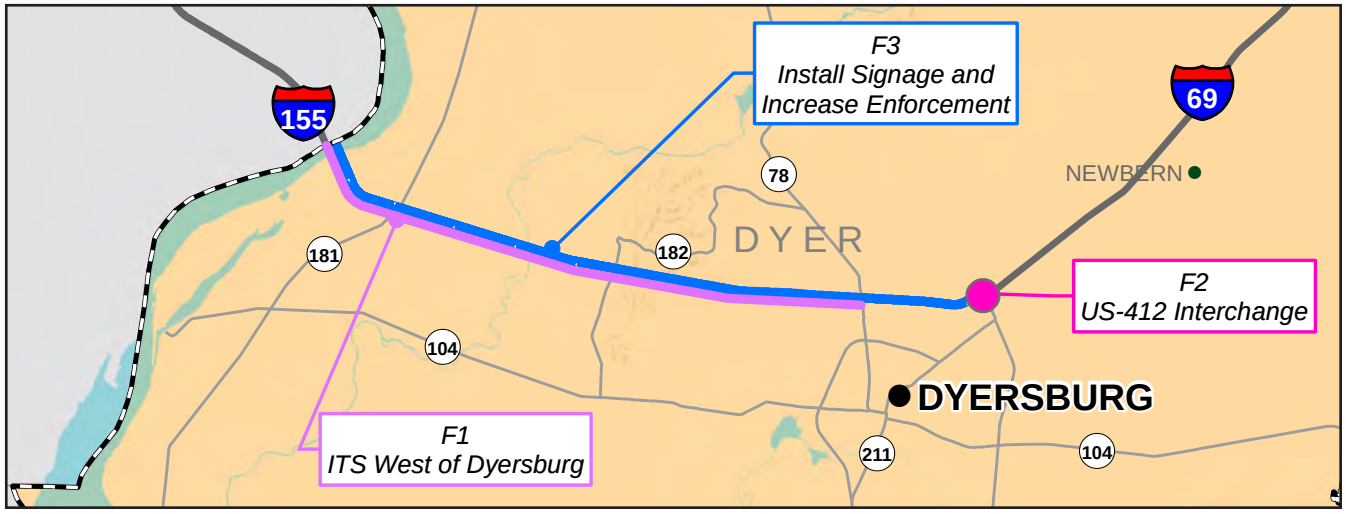
Specific suggested freight improvements for the I-155 corridor are shown in Table 7-1 and Figure 7-1. Solutions F1 and F2 were identified by stakeholders through the public outreach process. F3 is recommended based on Tennessee law (TCA55-7-205(a)) regarding farm equipment on controlled access facilities.

Table 7-1. Potential Freight Improvements — I-155

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
F1	Dyer	Great River Road	Jenkinsville-Jamestown Road	ITS west of Dyersburg: Warning system for snow, ice, and inclement weather	Public/Stakeholder
F2	Dyer	West of US-412	US-51, East of US-412	US-412 Interchange: Evaluate the need to redesign interchange to reduce truck rollovers	Data Analysis and Public/Stakeholder
F3	Dyer	Mississippi River	US-412	Install appropriate signage and increase enforcement to remove farm equipment from the interstate[4]	Data Analysis

3- Physical Infrastructure Needs for Autonomous & Connected Trucks, Johan Tobias Paulsen, June 2018
4- per TCA55-7-205(a)(3) law prohibiting farm equipment on controlled access facilities

Figure 7-1. Potential Freight Improvements — I-155



8. 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.

To assess needs and develop a universe of potential actions that support economic development, the study team interviewed key stakeholders and analyzed future employment projections to determine economic development focus areas in each corridor. Areas forecasted to see significant employment growth were noted in Technical Memorandum 1. Stakeholder input was collected specific to economic development potential along the corridor, including areas that may benefit from additional Interstate access points in the future to support planned development areas.

Employment growth in the mostly rural I-155 corridor is expected to be modest over the next 20 years, with most jobs added at the corridor's eastern terminus in and around Dyersburg. Development of the Dyersburg North Industrial Park could add job-related travel and truck traffic on the Interstate. No additional freeway access points were identified by transportation experts at the regional planning organization.

9. Transit/Bicycle and Pedestrian/TDM

Transit

The I-155 study area is not served by any fixed-route transit service and the existing rural transit service provided through the Northwest Tennessee Human resource Agency (NWTHRA) public transportation program is adequate to serve the I-155 corridor. No transit solutions were identified for inclusion in the universe of alternatives.

Bicycle and Pedestrian

Given the largely rural nature of the I-155 corridor, no specific bicycle and pedestrian solutions were identified for inclusion in the universe of alternatives. As interchange reconstruction projects are needed, consideration should be given to including sidewalks, bicycle lanes and/or shared use paths at all interchanges in urban areas to facilitate safer interstate crossings for bicycles and pedestrians. In addition, if the SR-78 interchange is reconstructed, consideration should be given to removing the free-flow right turn lane as this configuration can be especially problematic for pedestrians.

TDM

The I-155 corridor does not currently contain an urban area TDM program. Given the low levels of congestion on I-155, no TDM solutions were identified for inclusion in the universe of alternatives.

10. Universe of Alternatives

Sections 4-9 of this technical memorandum detail development of possible solutions to identified deficiencies in the areas of capacity, safety, transportation system management, freight, economic development, and multi-modal options. Table 10-1 gathers these potential solutions into the total universe of alternatives for the I-155 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 10-1. Potential Solutions By Category — I-155

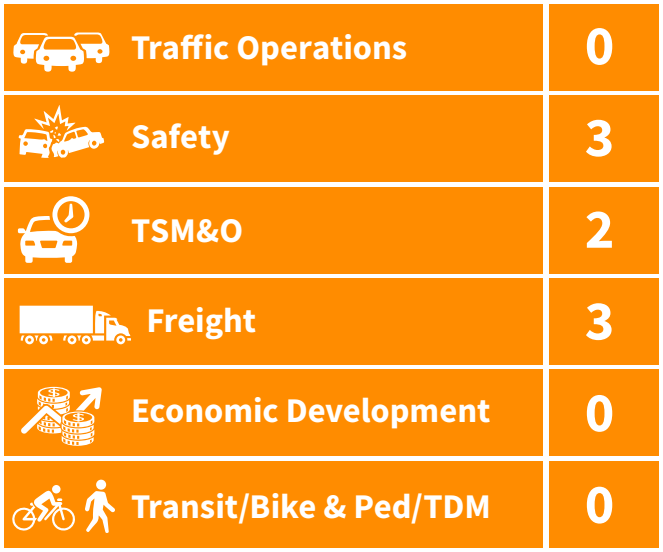


Table 10-1. Universe of Alternatives — I-155

ID		County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
Traffic Operations			None Recommended			
Safety	S1	Dyer	Entire I-155 Corridor		Install LED Pavement Markers	Data Analysis
	S2	Dyer	Mississippi River Bridge		Install Lighting and Longitudinal Rumble Stripes on WB approach to Bridge	Data Analysis
	S3	Dyer	Lenox-Nauvoo Rd.	Lake Road	Install Fencing	Data Analysis
TSM&O	TS1	Dyer	Mississippi River Bridge		Installation of structural impact monitoring system to identify severity of barge collisions	Public/Stakeholder
	TS2	Dyer	Mississippi River Bridge		Installation of barge sensor monitoring system	Public/Stakeholder
Freight	F1	Dyer	Great River Rd.	Jenkinsville-Jamestown Rd.	Warning system for snow ice, and inclement weather	Public/Stakeholder
	F2	Dyer	US-412 Interchange		US-412 Interchange: Evaluate the need to redesign interchange to reduce truck rollovers	Data Analysis & Public/Stakeholder
	F3	Dyer	Mississippi River Bridge	US-412	Install appropriate signage and increase enforcement to remove farm equipment from the interstate	Data Analysis
Economic Development			None Recommended			
Multimodal			None Recommended			

11. Solutions Screening Process Methodology

Technical Memorandum 4 for the Study will filter the I-155 universe of alternatives through a solutions screening and prioritization process (see Figure 11-1). This process will evaluate solutions based on their impact on mobility and safety, potential environmental impacts, cost, and potential economic impacts. Ultimately, the prioritized solutions will both resolve the identified deficiencies and have a high benefit/cost ratio.

Phase 1 Alternative Screening

The Phase 1 alternatives screening process is intended to eliminate solutions with evident fatal flaws. This two-phase process will evaluate each possible solution 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 receive a “NO” response for questions 1, 2, or 3, or a “YES” response for questions 4 or 5 will be eliminated and will not move forward to the Phase 2 alternative screening. Exceptions include projects where the potential is high for environmental/cultural impact mitigation.

Phase 2 Alternative Screening

The Phase 2 alternatives screening process will utilize performance measures identified in Section 3 to further refine the list of feasible alternatives. Additionally, a benefit/cost analysis will be conducted. Potential solutions that pass the Phase 1 Screening will be 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 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 improve incident management?
12. Does the proposed solution provide potential economic development opportunities?
13. Does the proposed solution have the potential to reduce VMT?
14. Does the benefit/cost ratio of the proposed solution exceed 1.0?

Projects which receive only “NO” responses will be eliminated and will not move forward as feasible multimodal solutions.

Identification of Recommended Solutions

Potential solutions which receive a “Yes” in the Phase 2 screening will be carried forward to the list of recommended solutions. The recommended solutions will move into the project prioritization phase, wherein recommended solutions will be ordered based on their effectiveness, potential for solving identified deficiencies, and benefit/cost ratio.

Figure 11-1. Solutions Screening Process

I-75 Corridor

▶ Development of Feasible Multimodal Solutions

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I-75 Corridor

1. Introduction

The I-75 corridor serves as a backbone for economic development and growth in east central Tennessee. As population and employment continue to grow and development 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 threaten the corridor's ability to sustain future growth.

A previous technical memorandum (Technical Memorandum 1) provided a data and information inventory for the corridor. Technical Memorandum 2 assessed existing and future deficiencies and needs along the I-75 corridor, focusing on traffic operations, safety, and multimodal conditions. These identified deficiencies are re-visited briefly in Section 2 of this corridor report. However, the primary focus of Technical Memorandum 3 is the development of 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, is ultimately established.

To supplement the technical analysis performed during this process, public workshops and surveys were used to generate feedback from citizens and stakeholders located throughout the corridor. A series of detailed interviews were also conducted with transportation and development officials. The resulting universe of alternatives is 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. The forthcoming Technical Memorandum 4: Project Priorities will report on the evaluation and strategic prioritization of the potential solutions described here.

43 potential solutions for the I-75 corridor are discussed in this memorandum.

2. Overview of Existing Deficiencies and Future Needs

Technical Memorandum 2: Assessment of Existing and Future Deficiencies, defined the trend scenario for the I-75 corridor – an effort that predicts existing and future conditions if current practices and plans remain unchanged. The trend scenario includes population and employment projections, capital projects currently programmed for construction in either Tennessee Department of Transportation's (TDOT) Statewide Transportation Improvement Program (STIP) or one of the Metropolitan Transportation Planning Organizations (MTPO) Transportation Improvement Program (TIP), recent MPO travel demand model projections, and Transearch freight projections.

Evaluation of the trend scenario, coupled with feedback from citizens and stakeholders, brought to light existing deficiencies and future needs for which solutions have not yet been programmed. These deficiencies align with economic development projections and fall into the following six categories, which are summarized in Figure 2-1 and detailed in Figures 2-2a, b, c and d.

- Traffic Operations
- Safety
- Transportation System Management
- Freight
- Transit / Bike & Ped / TDM
- Pavement & Structures

The content of Figure 2-1 and Figure 2-2 was presented to the public on January 15, 2020 at a public meeting in Chattanooga. Public and stakeholder responses recognized two additional deficiencies: 1) the need for a new interchange between Ooltewah and Cleveland, and 2) the need for improvements to the Shallowford Road interchange, specifically the southbound exit ramp, and signal coordination.

The remaining chapters of this technical memorandum document the development of feasible multimodal solutions to address the complete list of existing and future deficiencies.

Figure 2-1. Existing Deficiencies and Future Needs — I-75

INTERSTATE 55 75 26 CORRIDOR STUDY

I-75 Existing Deficiencies and Future Needs

Additional information about the existing deficiencies and future needs for the I-75 corridor can be found in Technical Memorandum 2.

Legend:
- Deficiencies and needs supported by data analysis
- Deficiencies and needs identified by stakeholders

Traffic Operations

Existing and forecasted areas of traffic congestion:

- I-24 to the Georgia State Line
- "US-64 bypass to SR-60"
- SR-72 to I-40
- "Shared I-40/I-75"
- Western Ave. to I-275/I-640
- Congestion due to weave / merge areas near SR-320 and SR-153 interchanges
- Merchants Dr. to SR-131
- SR-170 to SR-63
- "Hamilton County Line to Exit 20"
- "I-75 at I-24 and at I-640/275"

Safety

- Higher crash rates likely related to limited visibility, narrow inside shoulders, and steep grades in Jellico Mountain area.
- Higher crash rates likely related to peak hour congestion near SR-61, Merchants Dr., Western Ave., US-64, Brainerd Rd., and the I-75/I-24 interchange
- Higher crash rates likely related to horizontal curves / exit ramps at the McMinn County Rest Area and SR-60 interchanges
- Highest density of bicycle/pedestrian crashes are near the interchanges along shared I-40/I-75 segment. Parallel facilities & crossovers lack pedestrian / bicyclist infrastructure
- "Fog near SR-308 and SR-163 (near Hiwassee River)"

Transportation System Management

- Only one park-and-ride lot in the Knoxville area.
- "No opportunity to access alternate route when I-75 is closed due to fog near Hiwassee River or due to crashes between US-74 and US-11 in Ooltewah. Need advance alerts for drivers north of US-74."

Pavement & Structures

- As of 2017, Hamilton County had the lowest pavement quality in the study area. Portions of pavement in several counties were last resurfaced in early 2000s.
- Four structurally deficient bridges; 54 eligible for rehabilitation.

Freight

- Insufficient truck parking between Chattanooga and Knoxville.
- Truck traffic north of Knoxville is projected to double.
- Potential bottlenecks by 2040 located in Campbell County, just north of SR-25W, and in Knox County from Watt Rd. to I-275.
- "Need truck climbing lane over White Oak Mountain, southbound, south of US-74"

Transit / Bike & Ped / TDM

- Lack of regional transit connection between Chattanooga and Cleveland, as well as Knoxville and Oak Ridge and Knoxville and Alcoa.
- More commuter and express routes on and along I-75 are needed, as well as connection to Knoxville airport.
- No paved shoulder, wide-outside-lane, or bicycle lane available through the interchanges at SR-2 and SR-317. Sidewalk provided through interchange at only 3 of the 35 US or State Route crossings.

Economic Development

- Employment growth projected near interchanges in Knoxville, Cleveland and Chattanooga, as well as US-64 and SR-308 interchanges in Bradley County .
- "New interchange needed in Cleveland at SR-312"

TN TDOT Department of Transportation **I-55/75/26 Corridor Study**

Figure 2-2a. Traffic Operations & Structural Deficiencies — I-75

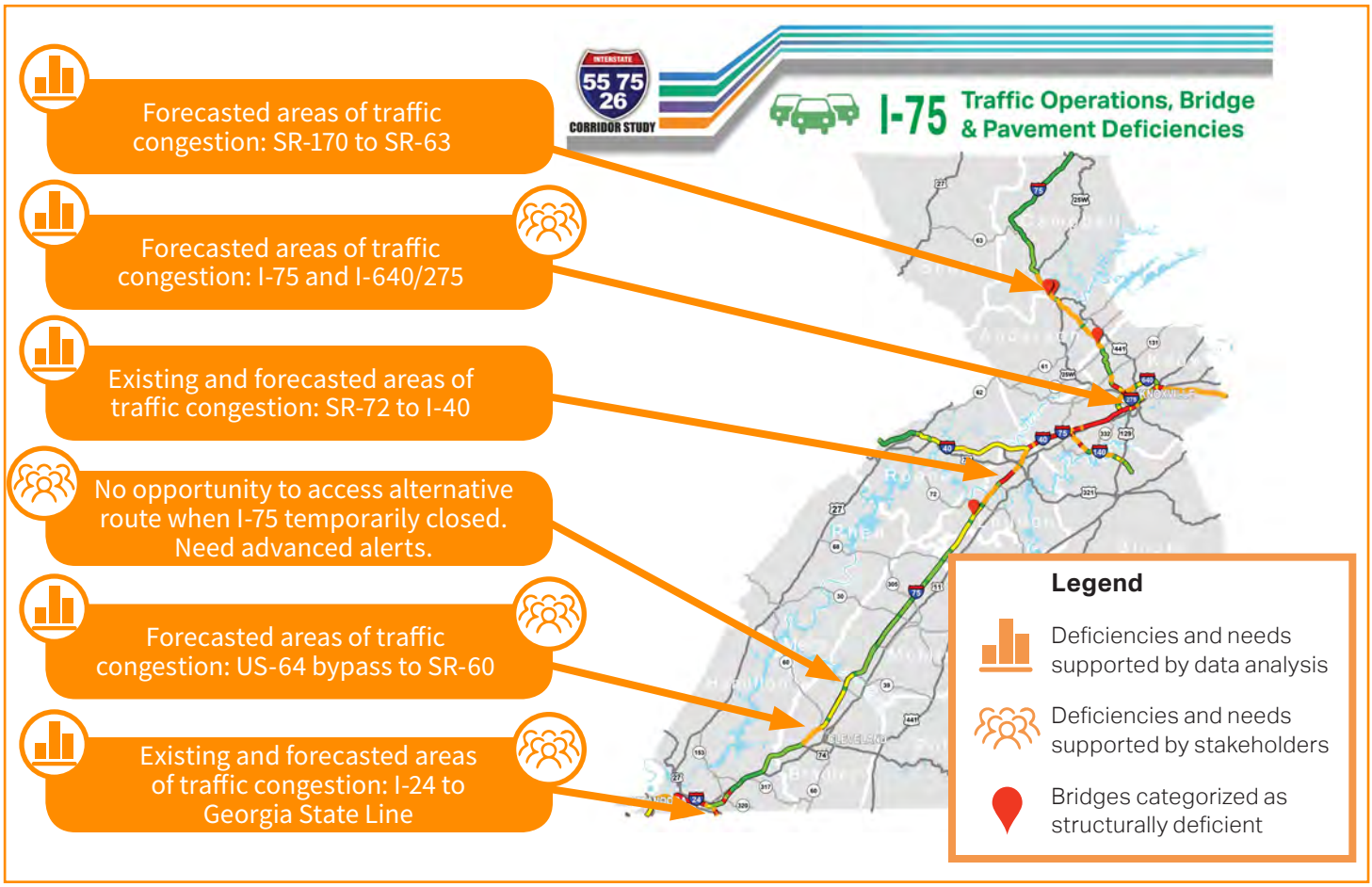


Figure 2-2b. Safety Issues — I-75

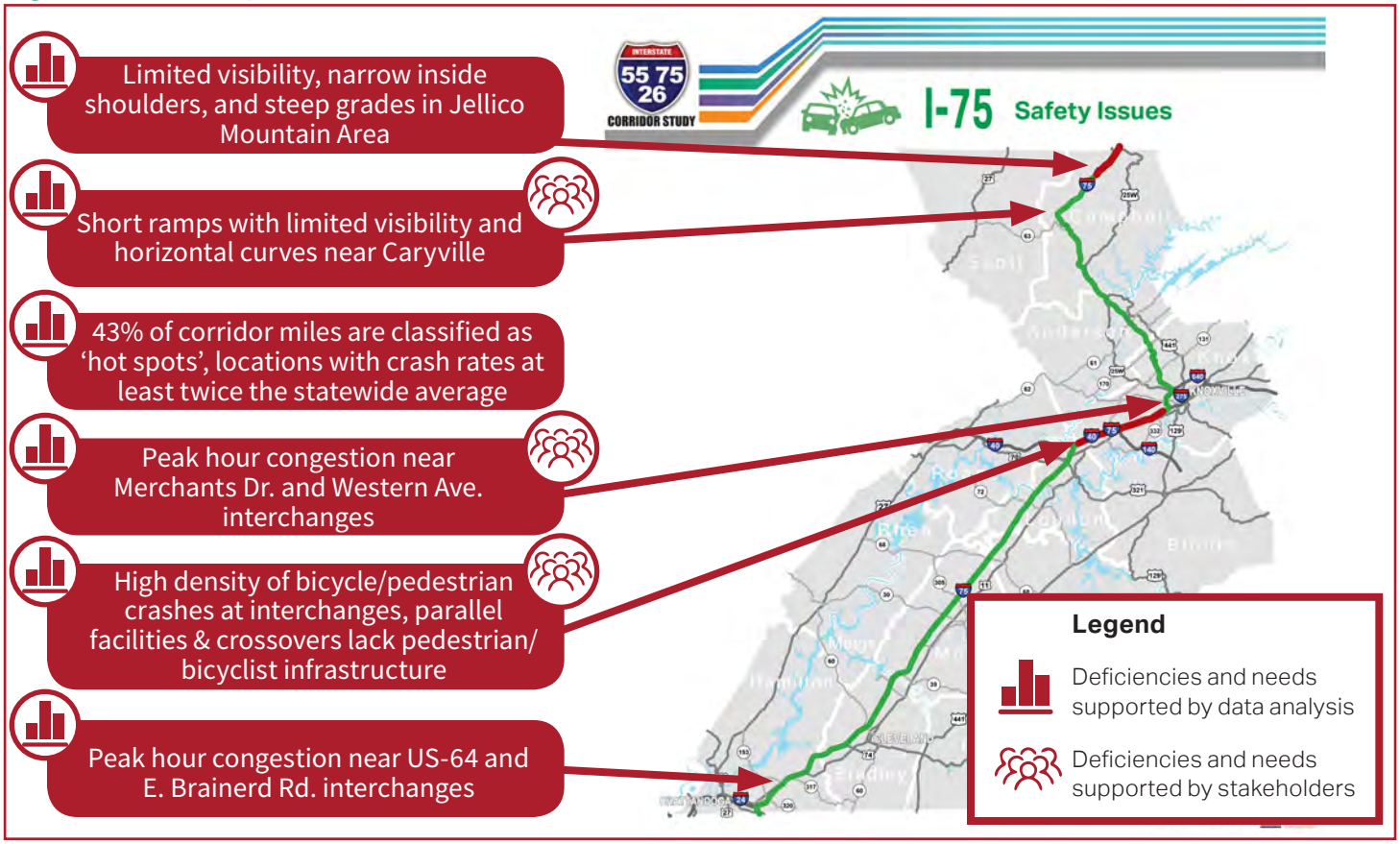


Figure 2-2c. Multimodal Issues — I-75

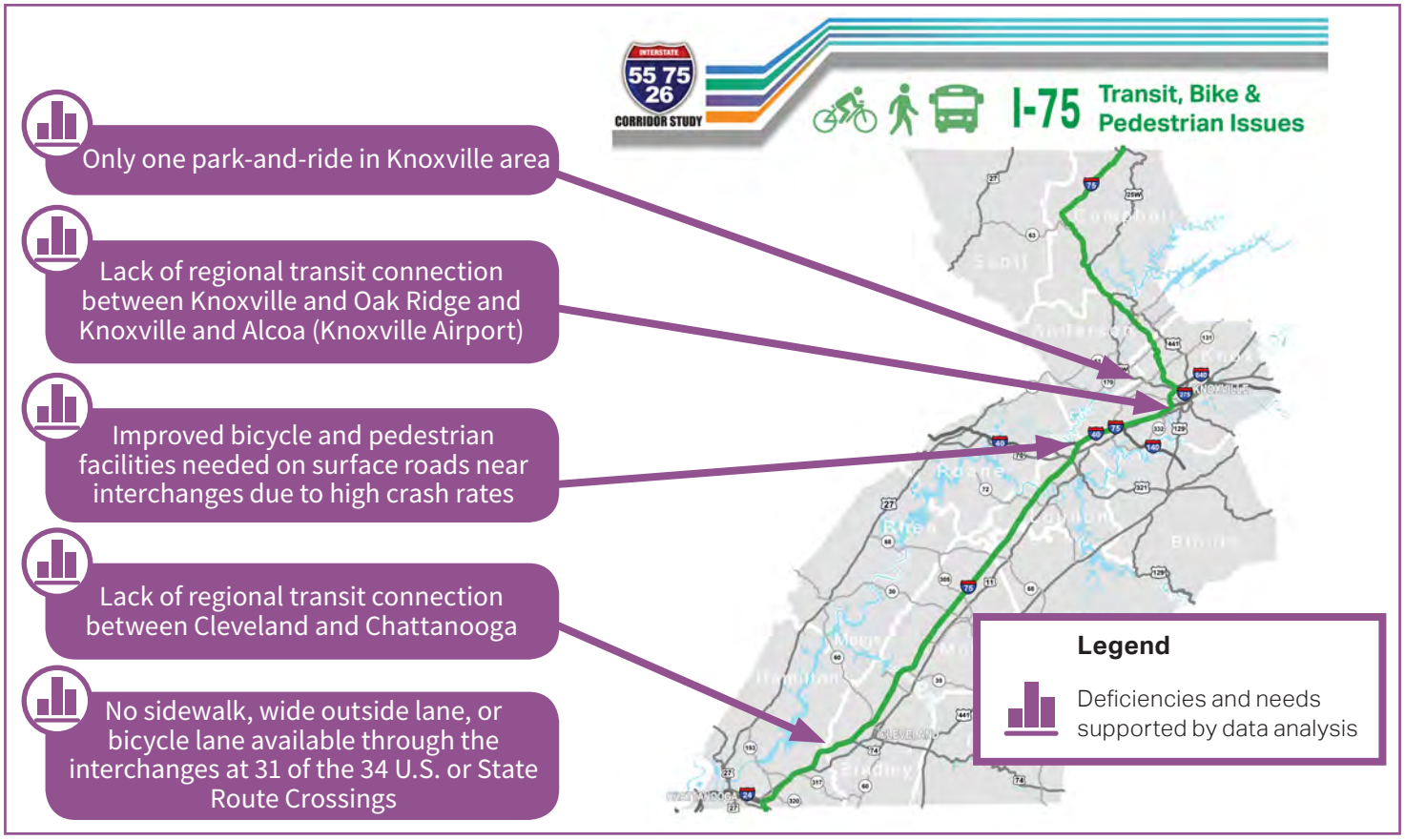
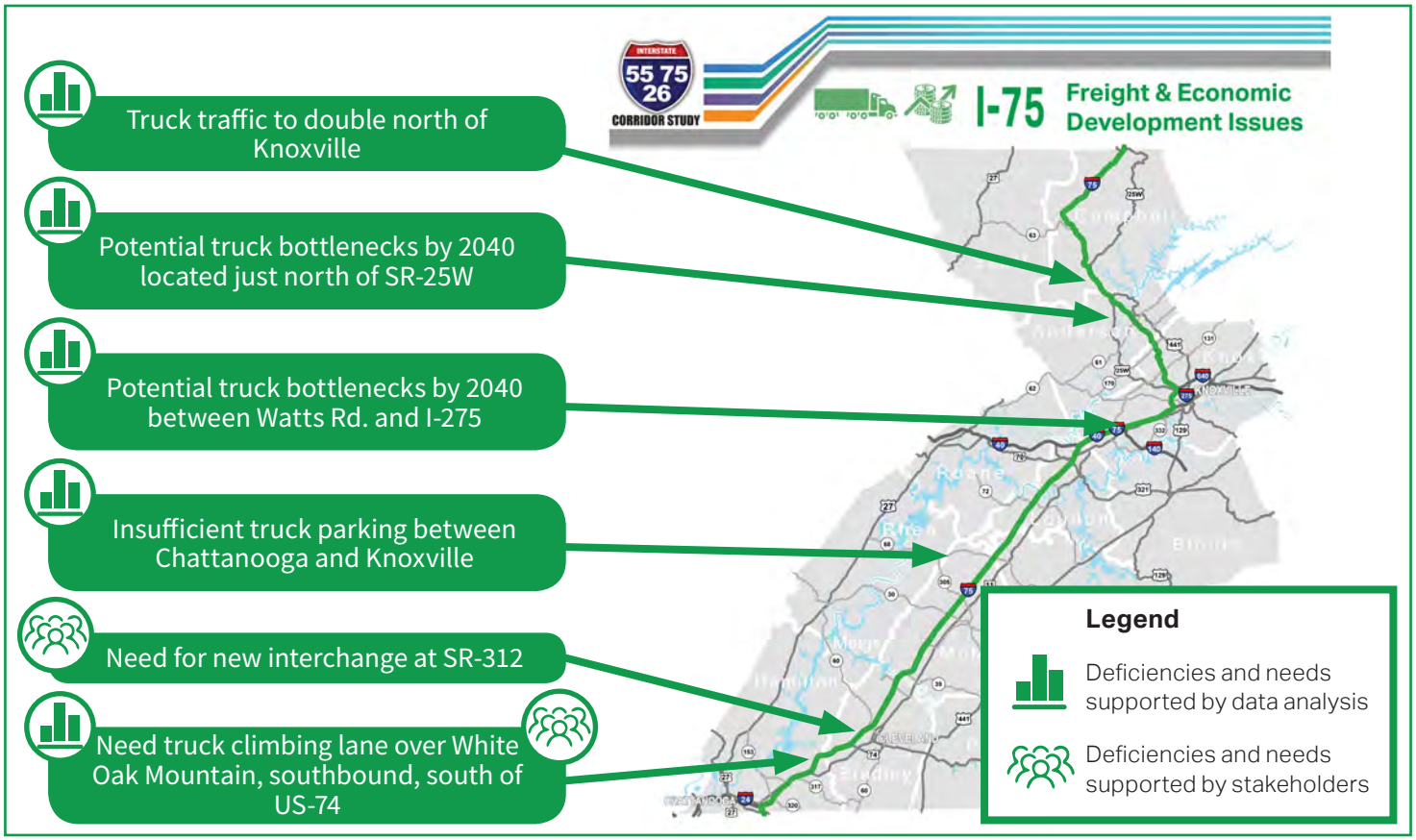


Figure 2-2d. Freight & Economic Development Issues — I-75



3. Performance Measures

Goals for potential improvements along the I-75 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 3-1, the 5 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)[1], Trend (2040) and Build (2040) scenarios. Table 3-2 outlines the performance measures established for the I-75 corridor and includes results for the Base and Trend Scenario. As indicated, the measures fall into four categories (Traffic Operations, Safety, Operations & Maintenance, and Multimodal), which directly support the objectives identified in Table 3-1. Results for the Build Scenario will be included in Technical Memorandum 4.

It is important to note that many of these performance measures represent the corridor as a whole – aggregating the benefit of the potential solutions in the Build year. Exceptions include the "Crash reduction in safety hot spots", "Peak hour density at improved interchanges", and "Average & max queues at improved interchanges." These performance measures were applied at isolated locations where the universe of alternatives for addressing deficiencies may be larger. For example, in Technical Memorandum 2, the section of I-75 near SR-320 and SR-153 was identified both as a safety hot spot and a traffic bottleneck. Several potential solutions were developed to address the deficiencies, including ramp extensions, ramp reconfiguration, and collector-distributor roads. Additional traffic operational analyses were necessary to evaluate the benefit of each potential solution, and these specific performance measures were used to guide that evaluation.

The following section is a glossary of the specific performance measures, providing the definitions, and details regarding how the measure was calculated or assessed.

Table 3-1. Performance Goals and Objectives — I-75

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		

1- The Statewide Travel Demand Model (TSM) uses a 2010 base year for this study. The study team determined the TSM was producing results comparable to regional models with more recent base years- creating better model efficiency.

Table 3-2. Performance Measure Summary — I-75

Goal	Performance Measure		Unit	Base (2010)	Trend (2040)	% Change (Base vs Trend)
Traffic Operations	Traffic on interstate operates at LOS D or better		% of interstate operating at LOS D or better	94.5	65.1	31
	Total Daily Vehicle Miles Traveled (VMT)		Miles (1,000s)	38,071	51,409	35
	Total Daily Vehicle Hours of Travel (VHT)		Hours (1,000s)	1,069	1,762	64
	Total Peak Hour Vehicle Hours of Delay (VHD)		Hours	35.5	54.6	54
	Total VMT / Trip		Miles	4.93	4.88	-1
	Total Vehicle Minutes Traveled / Trip		Minutes	1.68	2.06	22
	Average Peak Hour Travel Speed	Urban Interstate	MPH	49	40	-19
		Rural Interstate	MPH	67	54	-20
	Congested Travel Time between key O&D Pairs along Corridor (Total)		Minutes	328	412	26
	Peak Hour Density at Improved Interchanges		Vehicles/Mile/Lane	See "Traffic Operations"		
	Average and Max Queues at Improved Interchanges		Feet	See "Traffic Operations"		
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[2]	0	N/A
			50 < % of bridges < 80	30[2]	30[1]	N/A
	Pavement Condition (Resurfacing)		% of corridor resurfaced within the last 10 years	74[2]	76[3]	N/A
Multimodal	Pedestrian and Bicycle Accommodations at U.S. and State Route Interchanges		% interchanges with bike facilities	0	0	N/A
			% interchanges with ped. facilities	9	9	N/A
	Freight (Truck Parking)		# of Rest Area Spots	145	145	0
			# of Truck Stop Spots	1,161	1,161	0

1- Per TDOT Structures Division, one bridge on I-75 is scheduled for repair. Improve Act projects also include 3 bridge repair projects on I-75, two in Loudon County and 1 in Knox County.
2- Based on 2017 TRIMS data
3- Per TDOT Pavement Office's 2020 and 2021 Resurfacing Program. Also review of 2018-Feb 2020 TDOT Bid Lettings. (included resurfacing L.M.3.60-8.70, Knox County)

Description of Performance Measures

Traffic Operations

- **Traffic on Interstate Operates at LOS D or Better:** Defined by percent of the interstate corridor where operations are level of service (LOS) A, B or C. This measure provides insight into the amount of congestion experienced on the interstate corridor, reflecting the following relationship between volume-to-capacity and level of service, as defined in Technical Memorandum 2 for the previously completed I-65 corridor study (February 2017):
  - V/C < 0.7 (LOS A-B)
  - V/C 0.7 – 0.8 (LOS C)
  - V/C 0.8 – 0.9 (LOS D)
  - V/C 0.9 – 1.0 (LOS E)
  - V/C > 1.0 (LOS F)

  Segments of interstate where Base and/or Trend TSM output indicated LOS E or F were identified for further analyses/evaluation of potential solutions. Additionally, rural segments with LOS D in 2040 were also identified, recognizing that delay associated with LOS D on a four-lane facility through rolling/mountainous terrain is perceived differently than LOS E or F on a six or eight lane urban cross-section. Two of these locations were identified along the I-75 Corridor: 1) Northbound between SR-308 and SR-163 and 2) both directions between SR-322 and SR-72. While no specific recommendations are made for these rural segments at this time, delay and level-of-service should be monitored at these locations into the future.
- **Total Daily Vehicle Miles Traveled (VMT):** Detailed by urban and rural functional classifications within the Technical Memorandums, this performance measure indicates the total vehicle miles traveled each day within the study area. It is used to measure growth and ultimately sheds light on the efficiency of the system post-improvements, as a comparison of Build vs. Trend scenarios can indicate shifts in miles traveled on various functional types.
- **Total Daily Vehicle Hours of Travel (VHT):** Vehicle hours of travel is a measure of total time motorists are spending on the road each day. This performance measure is broken down by urban and rural functional classification. When compared to daily VMT, daily VHT can indicate increased or decreased delay on a system.
- **Total Peak Hour Vehicle Hours of Delay (VHD):** Also detailed by urban and rural functional classifications, peak hour VHD measures congestion of a facility during the peak hour. Typically, it is inversely proportional to travel speeds – as peak hour VHD increases, peak hour travel speeds decrease.
- **Total VMT/Trip:** Representing the system as a whole, total daily VMT divided by total daily vehicle trips, measures motorists average trip length (in miles/trip). Within a study area, changes in this performance measure can reflect changes in land use (which may promote shorter trip lengths, for example) or new / improved access to common destinations. Therefore, this performance measure must be evaluated in conjunction with an understanding of programmed roadway projects and planned developments in the study area.
- **Total Vehicle Minutes Traveled / Trip:** This performance measure represents the average time a motorist spends in their vehicle per trip. When the Vehicle Minutes Traveled/Trip remains consistent between the Base and Future year scenarios, changes in the Vehicle Minutes Traveled/ Trip performance measure can indicate increased or decreased congestion on the system.
- **Average Peak Hour Travel Speed:** This performance measure indicates the average travel speed a motorist experiences on a facility during the peak hour. When aggregated over a study area, change in average peak hour travel speed is indicative of system-wide increases or decreases in congestion and is usually inversely proportional to total peak hour vehicle hours of delay.
- **Congested Travel Time between Key O&D Pairs along Corridor:** Changes in travel time between origin and destination (O&D) pairs is a direct indicator of delay – and excluding incidents, also indicates congestion. Known origins and destinations along the corridor were selected, focusing on those that would primarily utilize the interstate corridor. Using the traffic analysis zones (TAZs) most representative of each origin and destination, Base and Trend congested travel times were pulled from the TSM and reported in minutes. These will be compared to travel times with the Build scenario.
- **Peak Hour Density at Improved Interchanges (Specified locations):** Based on deficiencies identified in Technical Memorandum 2, spot locations were identified for further traffic analysis using HCS, Synchro, and/or Transmodeler. Peak hour density for improved freeway segments, weave areas, merge areas, and diverge areas is directly indicative of level of service for the facility. Peak hour density will be measured for Trend and Build scenarios.
- **Average and Max Queues at Improved Ramp Intersections (Specified Locations):** Based on deficiencies identified in Technical Memorandum

2, spot locations were identified for further traffic analysis using HCS, Synchro, and/or Transmodeler. Exit ramp queue length will be measured for each interchange within the spot locations and compared to the existing storage provided. Queues that extend past the available storage significantly impact mainline traffic operations and safety. Average and Max exit ramp queue lengths will be measured for Trend and Build scenarios.

Safety

- **Crash Reduction in Safety "Hot Spots":** This performance measure is used to represent the relative safety benefit associated with each proposed improvement. Hot spots, as defined in Technical Memorandum 2, are areas along the interstate corridor where calculated crash rates are significantly above the statewide average. The crash reduction potential for each recommended improvement was explored through the research of crash modification factors (CMFs), which estimates a safety countermeasure's ability to reduce crashes and crash severity. Based on data provided by the CMF clearinghouse, each recommendation was categorized as having above or below average crash reduction potential, specific to the I-75 corridor. Note that the reduction potential is only applicable for crash types that would be prevented by implementation of improvements.

Operations and Maintenance

- **Bridge Condition (sufficiency rating):** This performance measure is used to represent the structural benefit of proposed solutions, including those with the primary goal of addressing safety, capacity, or other needs. Highway bridges eligible for FHWA Bridge Replacement and Rehabilitation Program must have a sufficiency rating of 80 or less. A sufficiency rating that is less than 50 is eligible for replacement, and one that is less than 80 but greater than 50 is eligible for rehabilitation. The sufficiency rating is based on structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use. This measure is reported as a percentage of the total number of bridges (per corridor) within each sufficiency rating range.
- **Pavement Condition (resurfacing):** Pavement condition is directly tied to resurfacing. This performance measure is used to capture the ride quality benefit associated with solutions proposed primarily for safety and capacity deficiencies, for which resurfacing will be necessary.

Multimodal

- **Pedestrian and Bicycle Accommodations:** Geometric limitations created by interstate structures often result in discontinuous or unsafe pedestrian and bicycle accommodations on cross-streets through an interchange. In turn, this discourages multimodal connectivity. The Pedestrian and Bicycle Accommodations performance measure indicates the benefit that proposed safety and operational solutions may have on multimodal accessibility and connectivity at interchanges. Data collected for this performance measure is limited to interchanges with federal highways and state routes.
- **Freight (Truck Parking):** Truck parking is a critical component of supply chain operations, particularly with new service rules requiring drivers to stop after 14 hours. Without available parking, trucks often stop on highway on- and off-ramps, which is unsafe and illegal. This performance measure is indicative of compliance and safety improvements associated with truck parking solutions.

4. Traffic Operations

Section 3 of Technical Memorandum 2 documented future highway capacity needs based on a high-level, TSM analyses of the 2040 Trend Scenario. Within the I-75 corridor, seven multi-mile sections of interstate were projected to be nearing or over capacity by 2040:

1. I-75 between the US-64 bypass and SR-60 (Bradley County, 4.54 miles)
2. I-75 between SR-72 and I-40 (Loudon County, 12.72 miles)
3. I-40/I-75 between I-40 and I-640 (Knox County, 17.39 miles)
4. I-75 between Western Avenue and I-275 (Knox County, 2.25 miles)
5. I-75 between Callahan Drive and SR-131 (Knox County, 1.72 miles)
6. I-75 between SR-170 and US-441 (Knox/Anderson County, 11.33 miles)
7. I-75 between US-441 and SR-63 (Anderson/ Campbell counties, 6.35 miles)

The shared segment of I-40/I-75 in Knox County will be evaluated as part of TDOT's ongoing I-40/I-81 Multimodal Corridor Study. No solutions for this portion of I-75 will be discussed in this memo. Potential widening solutions for the other six independent sections were evaluated via further TSM analyses.

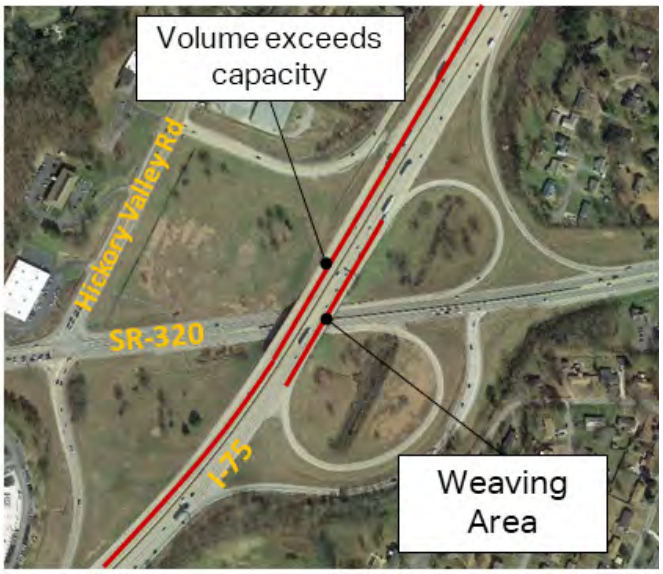
According to the TSM Trend analysis output, volumes at three additional spot locations were projected to exceed capacity by 2040:

1. I-75, between the I-24/I-75 interchange and the Georgia state line, Hamilton County
   - Modifications to the I-75 /I-24 interchange are currently under construction. These modifications include improvements to I-75

I-75 at Ringgold Road

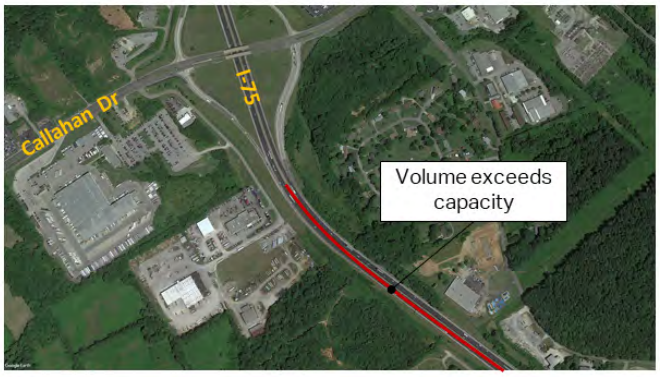
between I-24 and Ringgold Road. However, through the Ringgold Road interchange and south to the Georgia state line, I-75 will maintain the existing three travel lanes in each direction. According to the TSM Trend Scenario output, projected 2040 traffic volumes will exceed the capacity of this six-lane cross-section (see Figure 3-10 of Technical Memorandum 2).

2. I-75, between SR-153 and SR-320, Hamilton County
   - The I-75/SR-320 interchange provides two, adjacent cloverleaf movements for the northbound I-75 on- and off-ramps. This creates a weaving area of approximately 620 feet on I-75. Congestion caused by slow moving traffic near these ramps is compounded by that caused by merge/weave areas associated with SR-153 interchange ramps, less than one mile to the north. The SR-153 interchange is a system-to-system interchange and provides a collector-distributor road southbound from SR-153 to SR-320. As shown in Figure 3-10 of Technical Memorandum 2, future volumes are expected to exceed capacity between these interchanges, most evidently in the southbound direction.
3. I-75, between Merchants Drive and Callahan Drive, Knox County
   - I-75 currently provides three travel lanes in each direction between Merchants Drive and Callahan Drive, a distance of approximately 1.75 miles. As noted in Section 3.4 of Technical



I-75 at SR-320 (Brainerd Road)

I-75 at SR-153



I-75 at Callahan Drive

I-75 at Merchants Drive

Memorandum 2, field observations of queuing on I-75 northbound between SR-131 and Merchants Drive support TSM projections of capacity issues on this segment of interstate.

Note that during the January 16, 2020 public meeting, a stakeholder also identified the need for improvements to the southbound I-75 off-ramp at Shallowford Road, which they stated routinely queues onto the interstate. The currently programmed project at the Hamilton Place Mall interchange includes modifications to the Shallowford Road interchange, which will address this ramp queue issue.[1]

Possible solutions to be considered at the 10 identified locations are outlined in Table 4-1 and Figure 4-1. The reasonableness of these solutions will be evaluated through the screening and prioritization process included in Technical Memorandum 4. For each of the seven, independent multi-mile segments (C1-C7) the need is clearly additional capacity; therefore, further analyses of widening options will be conducted using the TSM. Operations between I-75 and the Georgia state line and between Merchants Drive and Callahan Drive involve more complicated ramp intersections, weaving and merge/diverge movements; therefore, HCS and Synchro will be used to measure traffic operations under the 2040 Trend and Build conditions. Due to insufficient availability of traffic data, further operational analysis of the SR-320 to SR-153 segment was deferred to future study. The recommendation (C9) will continue to move forward in the Universe of Alternatives as "Evaluate options for increasing capacity and improving merge/diverge and weave areas between the SR-320 and SR-153 interchanges."

Table 4-1. Potential Traffic Operations Improvements — I-75

ID	County	Termini (From)	Termini (To)	Description	Source of Recommendation
C1	Bradley	US-64 Bypass	SR-60	Widen existing four lane section	Data Analysis
C2	Loudon	SR-72	I-40	Widen existing four lane section	Data Analysis
C3	Knox	I-40	I-640	(Evaluated as part of I-40/I-81 Multimodal Corridor Study)	Data Analysis
C4	Knox	Western Ave.	I-275	Widen existing six lane section	Data Analysis
C5	Knox	Callahan Drive	SR-131	Construct auxiliary lane NB between interchanges	Data Analysis
C6	Knox/Anderson	SR-170	US-441	Widen existing four lane section; consider truck climbing lanes	Data Analysis
C7	Anderson/ Campbell	US-441	SR-63	Widen NB lanes; consider truck climbing lanes	Data Analysis
C8	Hamilton	I-75/I-24 Interchange	Georgia State Line	Widen/Apply TSM&O and/or Arterial Management Strategies to address forecasted congestion	Data Analysis
C9	Hamilton	Near SR-320 and SR-153 Interchanges		Extend SB on-ramp from SR-153 as 4th lane to SR-320 on-ramp; shift SR-320 on-ramp to west. Reconfigure loop ramps at SR-320 to eliminate short weave area. Construct collector-distributor NB between interchanges.	Data Analysis
C10	Knox	Merchants Drive	Callahan Drive	Widen existing six lane section	Data Analysis

1- Interchange Modification Study, Interstate 75 at Hamilton Place Blvd, 2013. Current project PIN#123105.00.

Figure 4-1a. Potential Traffic Operations Improvements — I-75 (north)

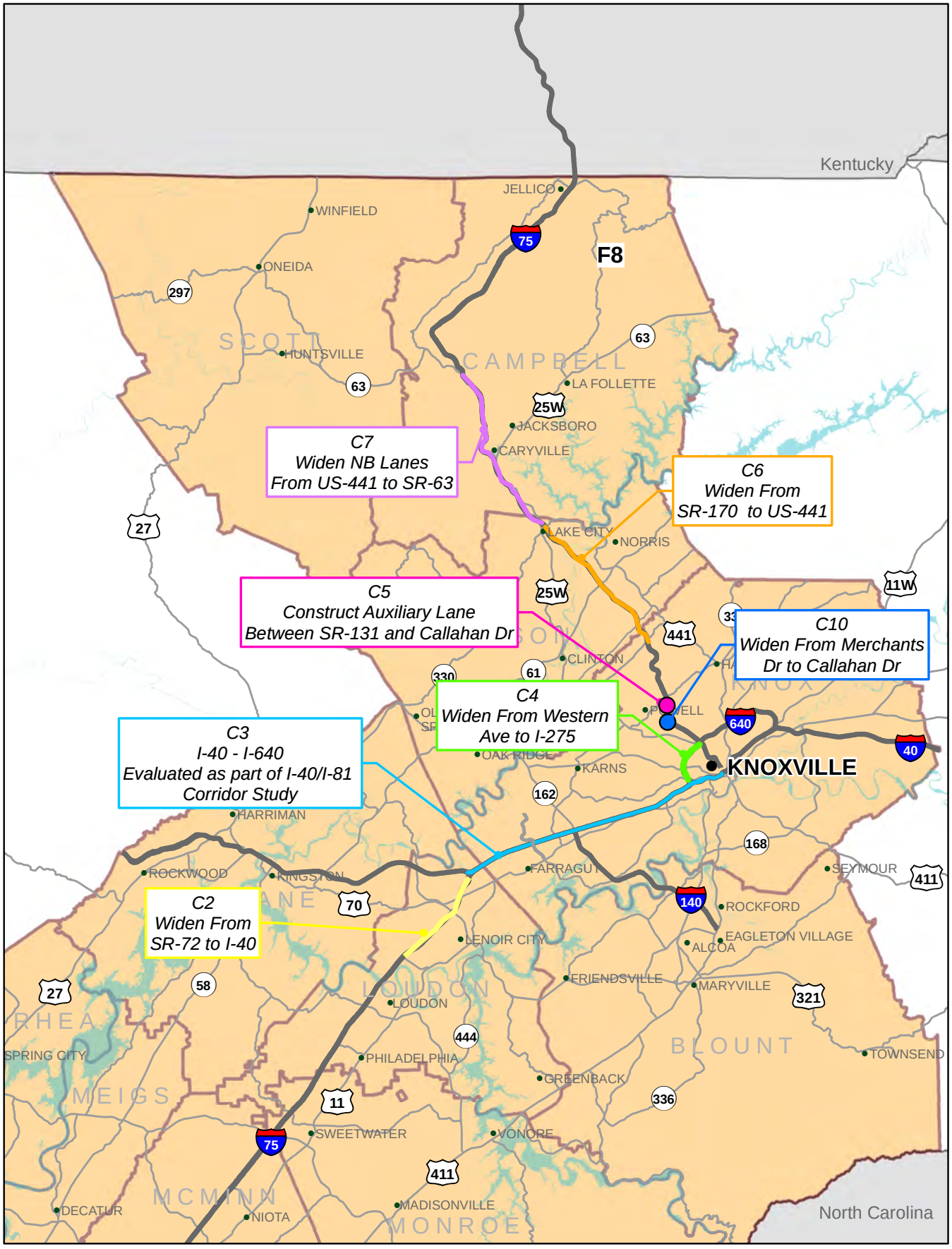
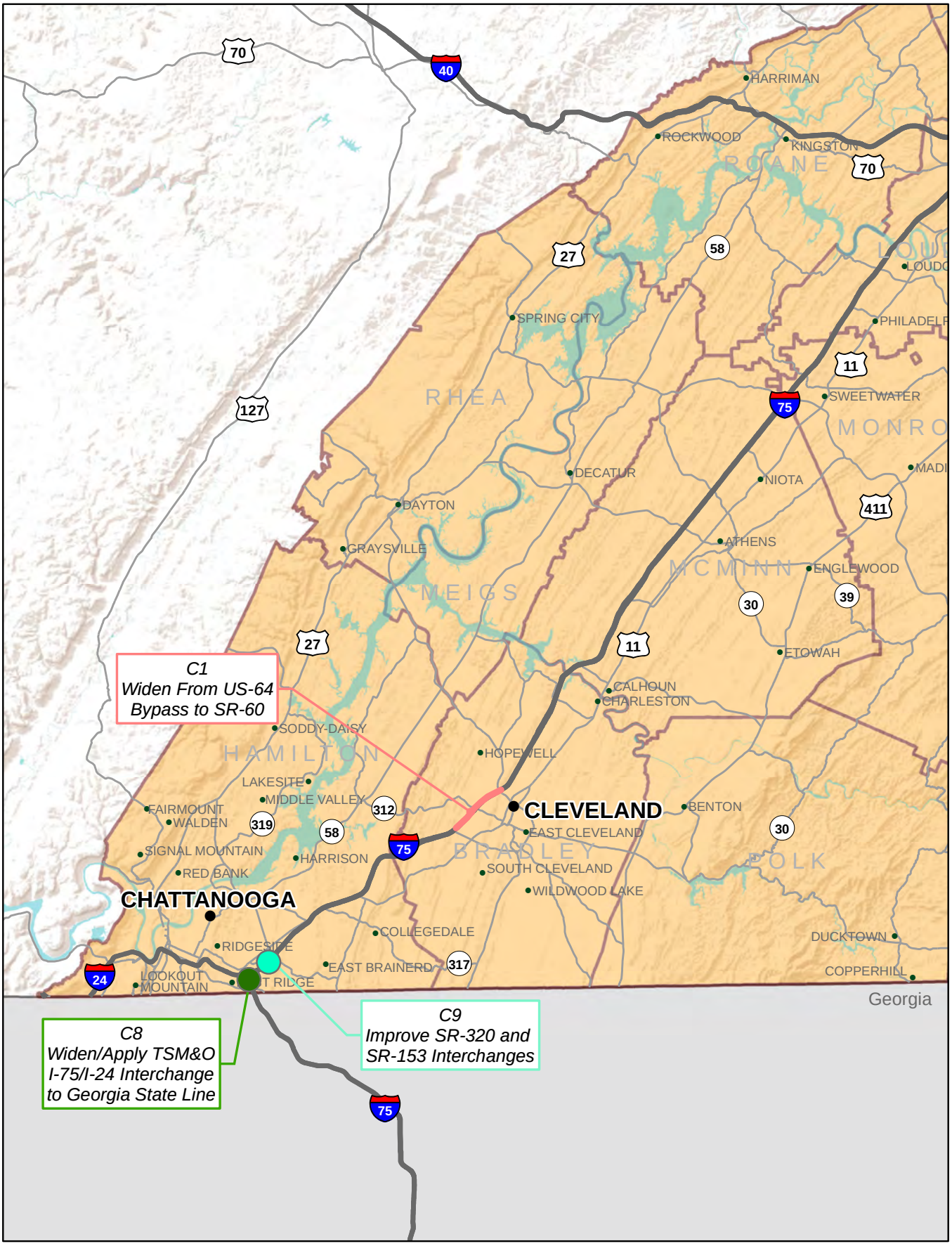


Figure 4-1b. Potential Traffic Operations Improvements — I-75 (south)



5. Safety

As documented in Technical Memorandum 2, an analysis was undertaken to identify areas along the I-75 corridor where safety issues may be present. These locations were identified as 'hot spots' and included segments along the corridor where the calculated crash rate was more than double the statewide average for similar facility types. Inclusive within this analysis was the identification of potential factors that may contribute to the higher frequency of crashes in these areas. For the I-75 corridor, potential factors commonly identified included ramp density that creates conflicts with merging and weaving movements, urban congestion, steep grades that may encourage speeding, and limited visibility of median barriers in rural areas.

As a first step in identifying safety solutions to address these factors along the I-75 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-75. However, there are a number of other types of projects along the corridor including, severe weather detection systems, ITS expansions, truck climbing lanes, as well as various interchange and corridor capacity improvements. With the location of these projects in mind, the potential crash factors were reviewed for each hot spot in tandem with public comments as well as aerial and street-level photography to identify potential solutions.

It is important to note that there are some hot spots identified in Technical Memorandum 2 that do not have a corresponding recommendation here. This primarily occurs in locations where no apparent crash trends or solutions were identifiable with the available data, when a relatively recent roadway improvement had been made in the vicinity of the hot spot, or when a major capacity project is being undertaken in the hot spot that will improve safety in the area.

- HS75-4, which is located in Knox County and includes the portion of I-75 from Merchants Drive to I-640 Interchange, is under review through TDOT's Interchange Access Request (IAR) process. It was assumed that the analysis of the I-75/I-640 interchange would result in both capacity and safety improvements to this section of the corridor.
- HS75-8, which is located in Bradley County and includes the interchange at US-64/74, has undergone recent improvements to the ramps and may also be impacted with TDOT's planned widening of I-75, as programmed in the Cleveland MPO TIP.
- HS75-10 includes the portion of I-75 near the I-24 interchange in Chattanooga. This interchange is currently under construction to address capacity- and safety-related issues; therefore, no additional recommendations are made in this location.

In addition to the analysis of crash hot spots outlined in Technical Memorandum 2, a field review of the I-75 corridor was undertaken to identify potential safety issues. Where crash data supported an observed safety issue and where no improvements are currently planned, additional recommendations were made to address these deficiencies. These are presented in Table 5-1 and illustrated in Figures 5-1a-c.

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-75 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.

Table 5-1. Potential Safety Improvements — I-75

ID	County	Location	Description	Crash Reduction Potential
*S1	Campbell	South 5th Street Interchange	Install Retroreflective Markers/Increased Pavement Friction Layer	Below Average
*S2	Campbell	Jellico Mountain Area	Speed Limit Reduction/Warning Signage/Retroreflective Markers	Below Average
S3	Campbell	SR-63/Oneida Interchange	Extend Length of SB Deceleration and NB Acceleration Lanes	Below Average
S4	Campbell	SR-63/Caryville Interchange	Extend Length of NB and SB Deceleration Lanes	Below Average
S5	Anderson	SR-61 (Charles G Seivers Blvd.) Interchange	Add Right-Turn Only Lane	Below Average
S6	Knox	Western Avenue Interchange	Add Pavement Markings	Above Average
S7	Loudon	US-321	Extend Length of NB Deceleration Lane	Below Average
S8	McMinn	McMinn County Rest Area	Install Additional Lighting on NB Exit Ramp	Above Average
S9	Bradley	SR-60	Increase Length of NB and SB Deceleration lanes/Install Advanced Signage	Below Average
S10	Hamilton	SR-320 (Brainerd Rd.)	Install Advanced Signage and Increase Capacity of NB Exit Ramp/Modify Interchange	Above Average

*2017 TDOT Road Safety Audit (PIN 125015.00) recommended improvements to I-75 from the Kentucky State Line to the Rarity Mountain Interchange. Recommendations included median drainage improvements, re-lensing existing pavement markers, additional LED pavement markers, median barrier delineation, and warning signage. Recommended improvements are currently in the Design Phase.

Figure 5-1a. Potential Safety Improvements — I-75 (north)

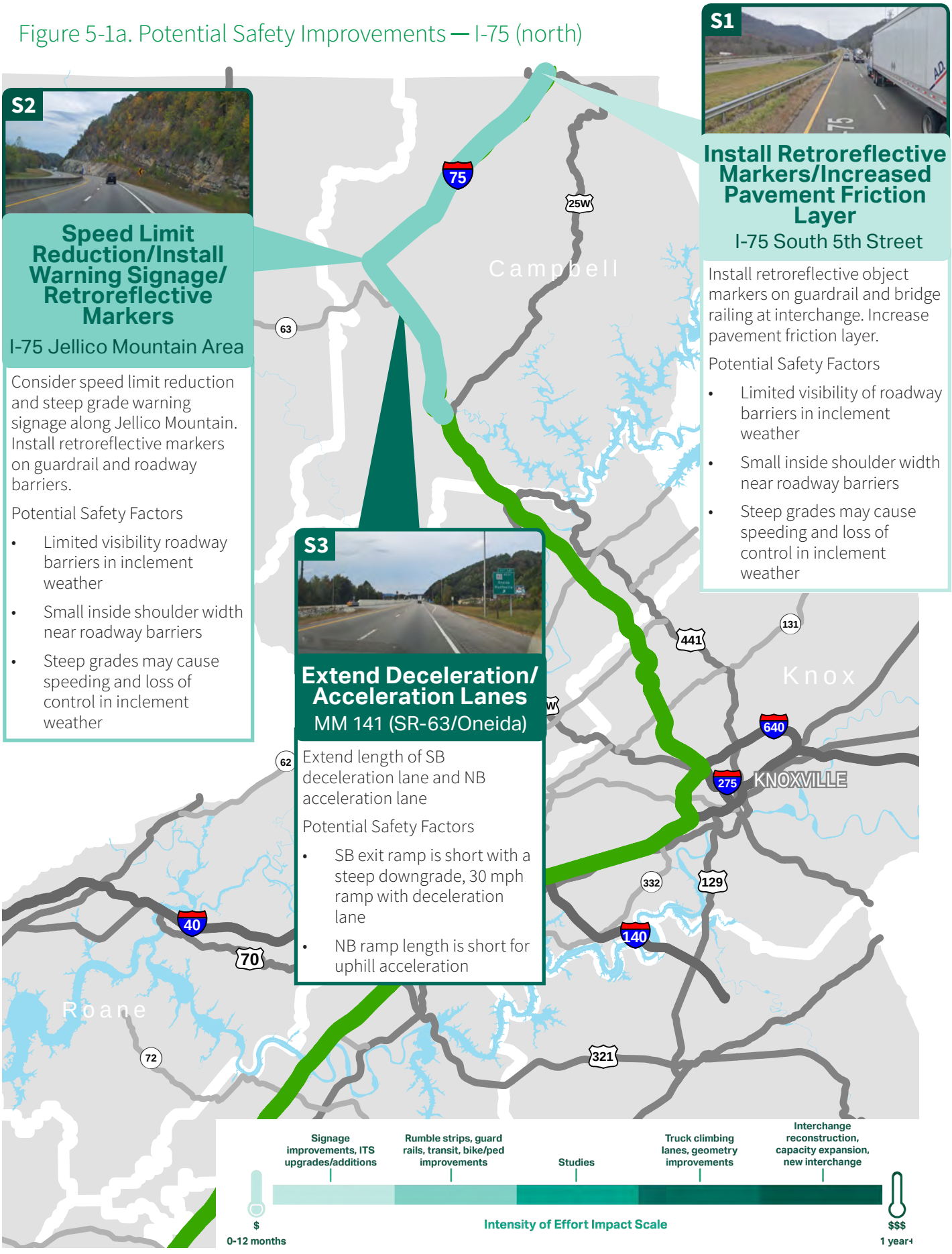


Figure 5-1b. Potential Safety Improvements — I-75 (north)

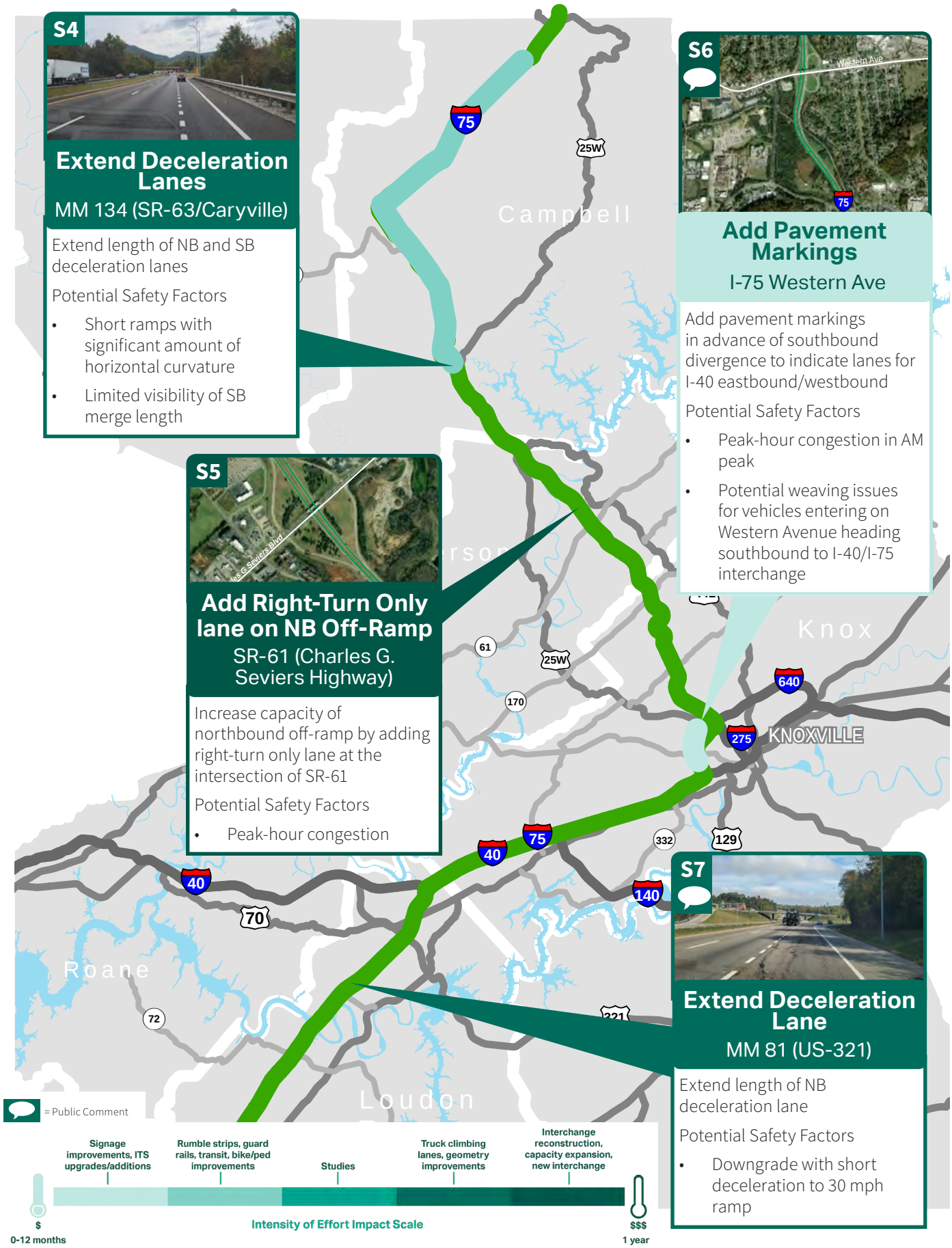


Figure 5-1c. Potential Safety Improvements — I-75 (south)

6. Transportation System Management & Operations

Transportation Systems Management and Operations (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-75 corridor is a prime candidate for such strategies; for most of the corridor, 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 technical memorandum would also be considered TSM&O solutions:

- Multimodal Solution, BP1: Consider a study to identify bicycle and pedestrian connectivity and safety improvements at existing U.S. and State Route interchanges.
- Multimodal Solution, BP2: Construct Midtown Pathway along Brainerd Rd between Spring Creek Road and Greenway View Drive.
- Multimodal Solution, BP2: Construct pedestrian/ bike trail connection providing access from Camp Jordan Park facilities to those west of I-75.

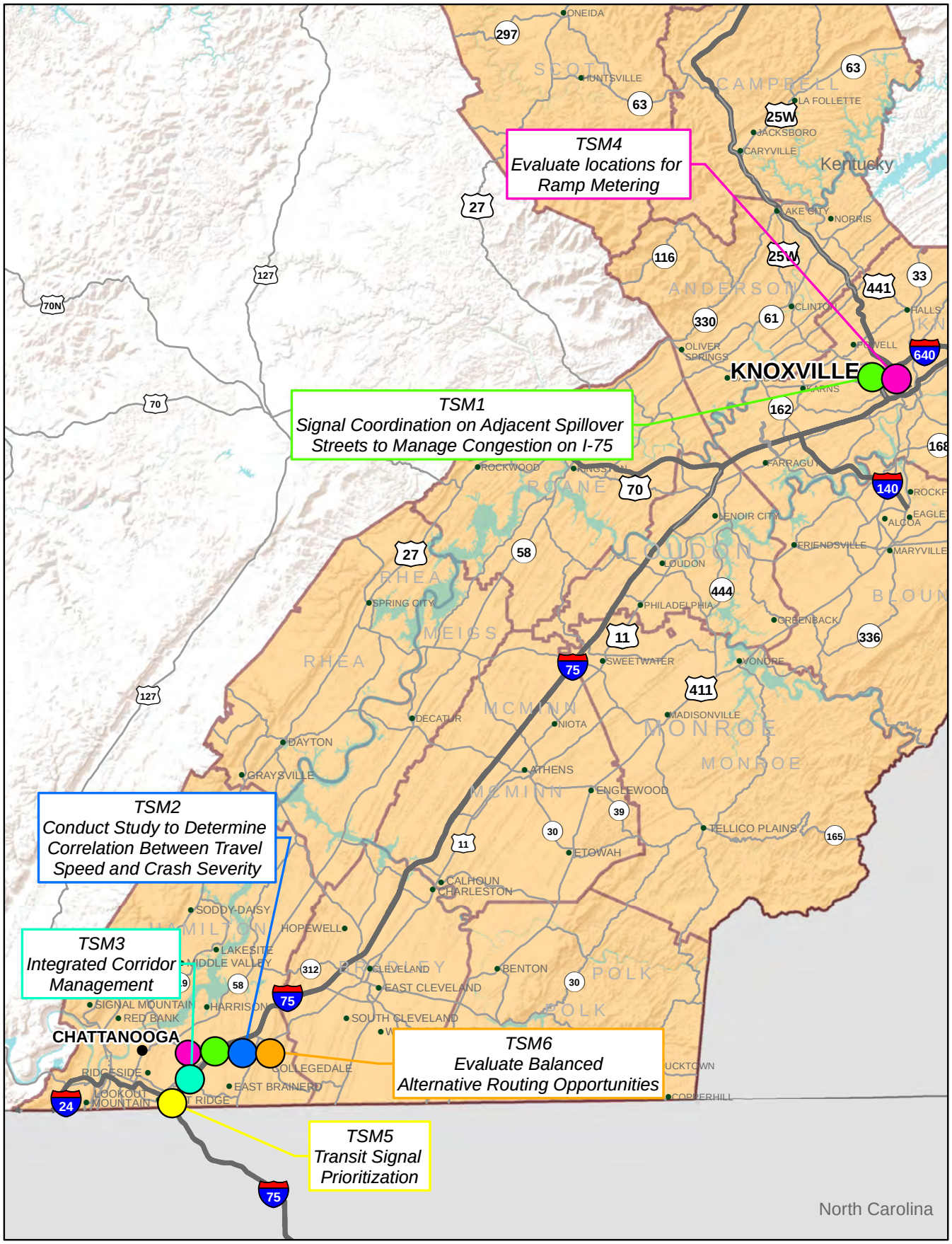
Additional solutions were developed via review of existing plans, public / stakeholder feedback, and field observations. Note that the City of Chattanooga Department of Transportation offered specific TSM&O solutions in a letter to TDOT Office of Community Transportation in November 2019. Possible TSM&O solutions identified for the I-75 Corridor are outlined in Table 6-1 and Figure 6-1.

Queues at an I-75 ramp intersection. Improved signal timing and coordination could reduce congestion at on- and off-ramps.

Table 6-1. Potential Transportation System Management & Operations Improvements — I-75

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
TSM1	Hamilton / Knox	Brainerd Rd, Shallowford Rd, Harrison Rd, Kingston Pk, Central Ave Pk		Signal coordination on adjacent spillover streets to manage on- and off-ramp congestion	Data Analysis
TSM2	Hamilton	I-75 and adjacent, parallel arterials		Conduct study to evaluate correlation between travel speed and crash severity.	Public/ Stakeholder
TSM3	Hamilton	Ringgold Rd	Shallowford Rd	Integrated Corridor Management (with real-time technology platform)	Public/ Stakeholder
TSM4	Hamilton / Knox	Urban areas of Chattanooga and Knoxville		Evaluate locations that would benefit from ramp metering and queue detection systems.	Public/ Stakeholder
TSM5	Hamilton	Ringgold Rd		Transit Signal Prioritization	Public/ Stakeholder
TSM6	Hamilton	Throughout		Evaluate balanced alternative routing opportunities	Public/ Stakeholder

Figure 6-1. Potential TSM&O Solutions — I-75



7. Freight

Freight movement is an important element of a regional and national economy. More efficient modes and routes for freight transportation enable improved logistics and result in reduced transportation costs; these cost savings can then be reallocated to growth, providing better jobs and higher wages. Technical Memorandum 2 identified existing and future deficiencies. This memorandum presents potential measures to improve freight mobility and support efficient and safe freight movement, now and into the future. Potential options include infrastructure improvements, such as truck climbing lanes and intersection redesigns, as well as management and operation strategies, such as lane restrictions and communication strategies.

Traditional infrastructure improvements, such as interstate capacity expansions, benefit all traffic and are addressed in Section 4 of this memo. Other infrastructure improvements can be made specifically to benefit freight movement. These include truck parking and climbing lanes.

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. 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 I-75 Welcome Centers at the Tennessee/Georgia and Tennessee/Kentucky state lines have 12 truck parking spots each. The rest areas in Athens (north and southbound) have 74 spots. Other nearby rest areas include the Georgia Visitor Center on I-75 south with 24 spots and the Kentucky Welcome Center on I-75 north with 23 spots. It should be noted that parking at welcome centers and rest areas in Tennessee is limited to 2 hours maximum, with no overnight parking. The website www.truckstopguide.com lists 13 truck stops along I-75 in Tennessee, nine of which have overnight parking, with a total of 1,161 truck parking spots. While five are located in Knoxville (861 spots along the shared I-75/I-40 corridor), none are in Chattanooga. The closest I-75 truck stop with overnight parking to Chattanooga is at Exit 20 in Cleveland with 75 spots.

According to the FHWA *Model Development for National Assessment of Commercial Vehicle Parking*[2], I-75 should have 410 rest area parking spots and 1,370 truck stop parking spots. The 25-mile segment around Knoxville should have 95 rest area spots and 315 truck stop spots, and the 7.5-mile segment around Chattanooga should have 27 rest area spots and 90 truck stop spots. Overall, the corridor should have over 500 more parking spaces than what is currently available.

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.

According to the American Association of State Highway and Transportation Officials (AASHTO) guidelines, a climbing lane is warranted if all three of the criteria below are satisfied.

1. Upgrade traffic flow rate in excess of 200 vehicles per hour
2. Upgrade truck flow rate in excess of 20 vehicles per hour
3. One of the following conditions exist:
   a. A 10 mph or greater speed reduction is expected for a typical heavy truck
   b. Level-of-Service E or F exists on the grade
   c. A reduction of two or more levels-of-service is experienced when moving from the approach segment to the grade

The entire I-75 corridor within Tennessee has enough traffic to meet the first two criteria; therefore, any segment that has a combination of percent upgrade and length of grade that cause a speed reduction of 10 mph or greater would be an appropriate place for a climbing lane. Stakeholder outreach noted the need

1- https://pdfs.semanticscholar.org/6f5a/768cd762956af1febf82beaf6a602dac1095.pdf
2- Exhibit 3-63, AASHTO A Policy on Geometric Design of Highways and Streets, 2001

for a truck climbing lane over White Oak Mountain (southbound), south of US-74. This need is addressed by a programmed TDOT project (see Technical Memorandum 2, project 3 in Table 1-1).

Interchange Improvements

I-75 in Tennessee has a number of interchanges that are expected to see high growth over the next 20 years, many of which serve commercial and/or industrial areas in Hamilton, Bradley, and Knox Counties. These include:

- Shallowford Road
- Volkswagen Drive
- US-64
- SR-60
- Paul Huff Parkway
- SR-308
- Watt Road
- Campbell Station Road
- SR-170
- SR-162/I-140

Several of these interchanges already operate at poor levels of service. Some techniques that can be implemented to help relieve congestion at interchanges are listed below.

On-ramp signals: Also called ramp meters, on-ramp signals are stop-and-go signals used during peak congestion times to control, or meter, the number of vehicles merging onto an already congested freeway. The signals allow one or two cars every few seconds to merge onto the freeway, avoiding the congestion that occurs when large numbers of vehicles attempt to merge with traffic already on a highway.

Dynamic zipper merge: As its name suggests, a dynamic zipper merge is intended to work like a zipper. When traffic is heavy and slowed at a lane reduction point, signs direct drivers to use both lanes until reaching the merge point, where they merge into a single lane. By taking turns at the merge point, drivers experience smoother merging conditions, which reduces traffic backups.

Turbine interchange: A turbine interchange design circles all left-turning traffic around a central bridge in a counterclockwise direction, like a whirlpool, allowing a high volume of traffic to travel between two interstates at highway speed. Since it features smaller bridges with smaller supports and lower roadway profiles than a traditional interchange, a turbine interchange has less impact to traffic during construction, and costs less to build and maintain than other types of interchanges.

An interchange deficiency analysis for any of these high growth interchanges could determine whether any interchange modifications could be implemented to relieve congestion, especially considering their importance for freight traffic. In addition, the analyses should consider how to eliminate weaving areas, whether additional ramp capacity is necessary, and whether signal coordination/freight truck signal prioritization on adjacent arterial streets could reduce congestion at these on- and off-ramps.

Automation & Truck Platooning

Many technologies are being developed that help drivers by providing their vehicles with information about their environment. The first widespread implementation of automation technology is likely to be semi-autonomous truck platooning. Platooning became permitted on Tennessee roads in April 2017. This allows freight trucks to use a system that automatically controls speed and braking by communicating between participating vehicles. This not only improves efficiency by increasing aerodynamics as the trucks can drive closer together, but also safety because the system will automatically apply brakes if it senses a hazard. However, widespread use of truck platooning may require some infrastructure upgrades, specifically regarding bridges.

The load dynamics created by a truck platoon are different than for a conventional truck. Bridge spans must be able to handle more weight as more trucks are able to fit on a smaller space. They may also experience more wear on pavement and bridge elements due to new and different load dynamics, and existing railings may be too weak to withstand a crash by several trucks. The design of protective barriers might not be strong enough for a two or more-truck platoon with nearly no headway. Although accidents are expected to be rare, they might happen and in that case the barriers must be able to withstand the extra forces.[3]

It should also be noted that truck platooning may not be efficient or advisable in urban areas with higher traffic volumes. Under congested conditions, vehicles are more likely to try to cut between trucks in a platoon, reducing the platoon's efficiency and increasing the potential for crashes.

Managed Lanes and Lane Restrictions

Some common management techniques for congestion relief include managed lanes, speed modification, and lane restrictions. However, these techniques may not always be appropriate and may be counter-productive from a freight standpoint. For example, lane restrictions that force trucks to remain in the right lane can cause safety issues with drivers merging and weaving at on-and off-ramps. Additionally, studies have not produced consistent results on the safety of differential speed limits.

Similarly, studies of toll lanes have also not produced consistent results. Many truck operators are reluctant to use toll lanes because the toll costs, unlike gas taxes,

cannot be recouped in the current pricing structure. An additional consideration is that different commodities may be more or less sensitive to tolls based on the differing pricing structures for transportation of bulk versus containerized or breakbulk goods and may be more likely to switch to alternate routes or remain in the general purpose (non-tolled) lanes. However, a shift of some auto travelers to a high-occupancy vehicle (HOV) lane or toll lane could generate additional capacity for freight operators in the remaining lanes. There are many different ways to implement managed lanes, and any implementation should be preceded by a comprehensive investigation of the desired objectives for a particular stretch of roadway and various options to achieve those objectives.

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 Knoxville when traveling between Chattanooga and the Kentucky state line via US-27. Depending on the starting point within Chattanooga, drivers can save 10 to 15 miles, although it adds about 20 minutes of travel time. However, in general, diverting truck traffic from interstate highways to lower order roads will increase potential safety problems, pavement wear, and traffic disruption.

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. Truck drivers can be trained to drive in ways that save fuel, reduce emissions, and reduce noise so that night deliveries do not disturb neighbors.

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.

Potential Freight Mobility Solutions

Suggested freight improvements for the I-75 corridor are shown in Table 7-1 and Figure 7-1a and 7-1b.

Table 7-1. Potential Freight Improvements — I-75

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
F1	Hamilton	Georgia State Line	Bradley County Line	Add overnight truck parking in or near Chattanooga	Data Analysis
F2	Hamilton	Georgia State Line	Bradley County Line	Resurface so that at least 90% of the corridor has good ride quality	Data Analysis
F3	Loudon	Tennessee River Bridge		Address bridge deficiency to maintain appropriate load carrying capacity	Data Analysis
F4	Knox	Campbell Station Road interchange		Add lanes; Redesign to reduce flooding	Tennessee Freight Plan (2018 Amended 2019)
F5	Knox	I-40	I-275	Add lanes	Tennessee Freight Plan (2018 Amended 2019)
F6	Anderson	Bridge over E. Wolf Valley Road		Address bridge deficiency to maintain appropriate load carrying capacity	Data Analysis
F7	Campbell	Bridge over Bruce Gap Road		Address bridge deficiencies to maintain appropriate load carrying capacity	Data Analysis

3- Physical Infrastructure Needs for Autonomous & Connected Trucks, Johan Tobias Paulsen, June 2018

Figure 7-1a. Potential Freight Improvements — I-75 (north)

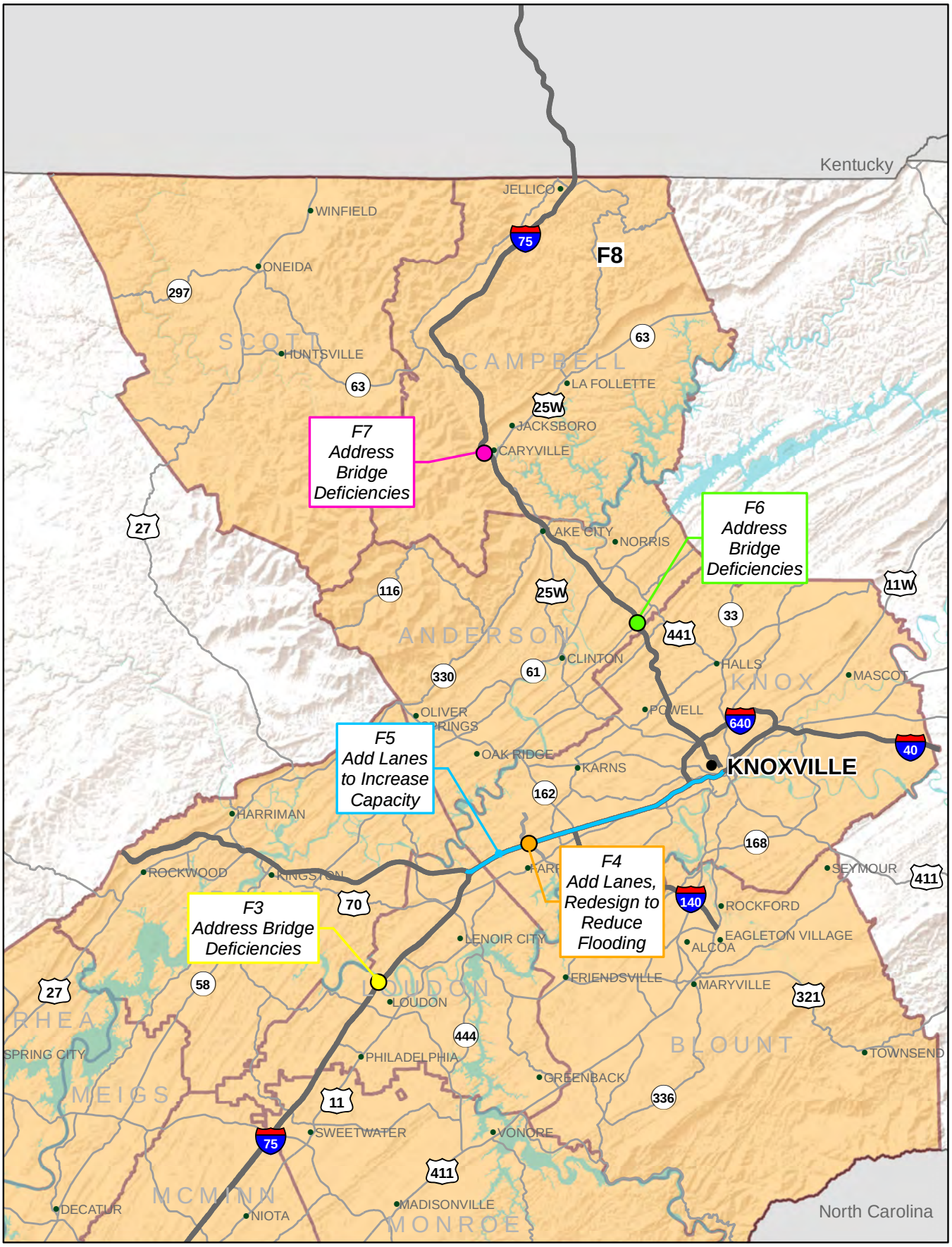
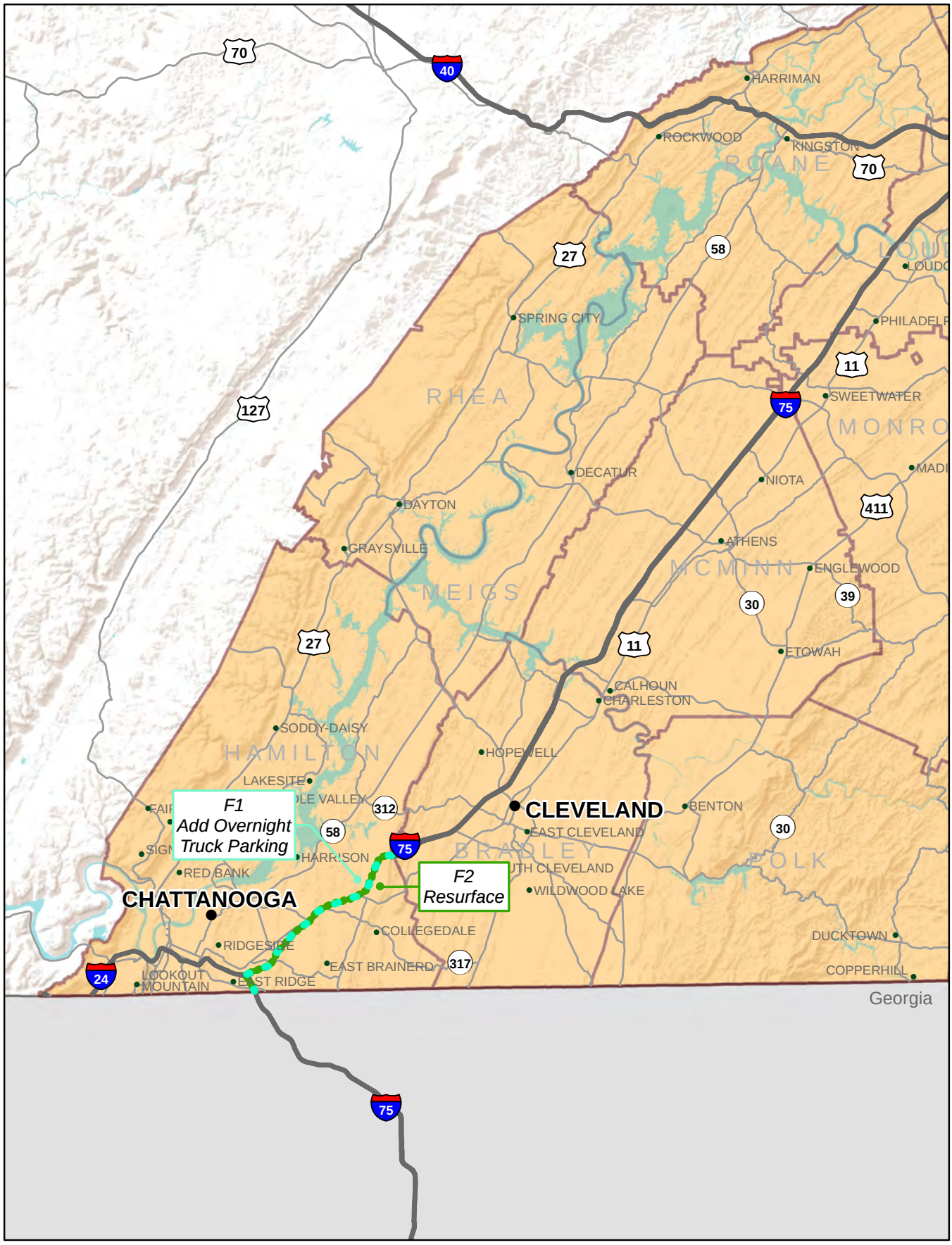


Figure 7-1b. Potential Freight Improvements — I-75 (south)



8. 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.

To assess needs and develop a universe of potential actions that support economic development, the study team interviewed key stakeholders and analyzed future employment projections to determine economic development focus areas in each corridor. Areas forecasted to see significant employment growth were noted in Technical Memorandum 1. Stakeholder input was collected specific to economic development potential along the corridor, including areas that may benefit from additional Interstate access points in the future. Studies of these areas that may be subject to development pressure were included in the universe of potential solutions. Other potential solutions that impact regional economic development are included in the capacity, safety, operations, and freight sections of this report.

Population and employment growth in the I-75 corridor, along with changes in land use, are expected to be greatest around the fringes of the corridor's three major urbanized areas: Knoxville, Cleveland and Chattanooga. Notable locations include the areas along I-75 near SR-61, between I-75 and Oak Ridge, along the interstate between Chattanooga and Cleveland, and at the southeastern edge of the Chattanooga area, near Collegedale. Interestingly, the northern end of the corridor, in Scott and Campbell Counties is forecasted to see substantial population and household growth, but also a much slower growth – or even reduction – in the number of jobs, which could lead to increased commuting between that part of the study area and employment centers around Knoxville.

Regional transportation and economic development experts confirm these data findings, noting in Knoxville that the area between I-75 and Oak Ridge is already experiencing rapid economic growth. However, they believe that interstate access to this area is sufficient, but interchange performance should be closely monitored. In the southern end of the corridor, it was noted that the growing area between Ooltewah and Cleveland may demand an additional access point on I-75 in Bradley County. See Table 8-1 and Figure 8-1 for a summary of potential alternatives to support economic development.

Figure 8-1. Potential Economic Development Improvements — I-75

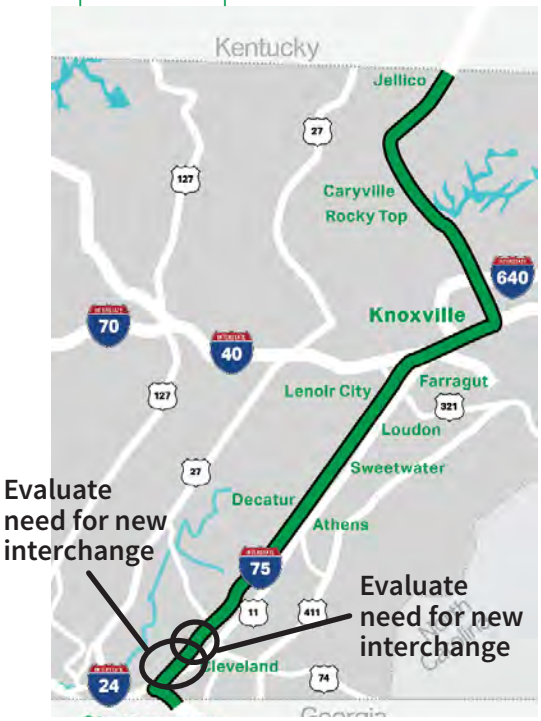


Table 8-1. Potential Economic Development Improvements — I-75

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
ED1	Bradley	SR-60	US-74	Evaluate need for additional interstate access point to accommodate economic growth	Public/Stakeholder
ED2	Hamilton	Ooltewah	Cleveland	Evaluate need for new interchange to accommodate growth (consider existing Ooltewah/Georgetown Road overpass)	Public/Stakeholder

9. Transit/Bicycle and Pedestrian/TDM

While driving is the mode of choice throughout the I-75 corridor, it is important to ensure that multimodal transportation options exist. As discussed in Technical Memorandum 2, there are several deficiencies along I-75 including missed regional transit connections between Cleveland and Chattanooga and Knoxville and outlying suburbs. Meaningful transportation choices provide mobility opportunities for all users and can help alleviate user congestion along I-75. A complete multimodal network includes transit, bicycle and pedestrian infrastructure, and additional resources including park-and-ride facilities that promote carpooling and transit use.

Table 9-1 and 9-2 below list identified transit, transportation demand management (TDM), and bike/ped projects that would help support mobility in the I-75 corridor. The list of recommendations was compiled from existing transit plans, bike/ped plans, public/stakeholder input, and best practice recommendations resulting from this corridor study's data analysis.

Several of the identified projects have been starred. The starred projects are those that most strongly relate to the I-75 corridor including, T9, T10, T13, and T21. These recommendations include the establishment of a regional transit authority, creation of a park-and-ride facility, extension of an express route and consideration for a regional commuter study. Both the regional commuter study and regional transit authority work towards addressing the regional transit deficiencies highlight in Technical Memorandum 2.

- T9: Knoxville Regional Transit Authority – The creation of a regional transit authority in the greater Knoxville area would allow inter-county transit services to occur more easily. Knoxville is growing in population and employers are expanding beyond Knox County, in order to provide transit access to employment concentrations, transit service will need to extend beyond Knox County.
- T10: Solway Park-and-Ride – The creation of a park-and-ride facility north of Knoxville will help alleviate forecasted congestion along I-75 and will serve commuters and residents of the greater Knoxville region.
- T13: Route 4 / I-75 Express Extension – Extending one of CARTA's existing transit routes further north on I-75 will help alleviate congestion on I-75 and better serve Chattanooga's growing population.
- T21: Regional Transit Access - Consider conducting a study to determine the feasibility of a commuter route between Cleveland and Chattanooga. The two cities are roughly 30 miles apart and analysis shows there are a number of commuters who currently rely on using I-75. By offering a commuter route, congestion on I-75 could be alleviated. Regional transit access would likely require implementation of a Regional Transit Authority.
- BP1: 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, including:
    - 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
  - Studies could further be expanded to include all interchanges and identify locations where new pedestrian/bicycle crossings may be appropriate.

Table 9-1. Potential Transit Improvements — I-75

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solutions
T1	Knox	Knoxville Transit Center (downtown)	Kingston Pike/ Watt Rd.	Recommended Corridor: The Cumberland/ Kingston Pike corridor consists of a wide range of land uses and built environments.	Knoxville Regional Transit Corridor Study
T2	Knox	Knoxville Transit Center (downtown)	North Broadway/ Black Oak Ridge Lane	Recommended Corridor: The North Broadway corridor contains a mix of commercial, residential, light office, and industrial land uses.	Knoxville Regional Transit Corridor Study

Table 9-1. Potential Transit Improvements — I-75 (continued)

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solutions
T3	Knox	Throughout Network		Evaluate the current signal timing throughout each of the corridors or the entire KAT bus system to see if they can be optimized.	Knoxville Regional Transit Corridor Study
T4	Knox	Throughout Network		Queue Jump Lanes: Allow buses the ability to jump in front of automobiles queued at an intersection and cross that intersection before automobiles can proceed.	Knoxville Regional Transit Corridor Study
T4	Knox	Throughout Network		Transit Signal Priority: Gives an advantage to transit vehicles operating along a roadway. Signal priority can be used all day, during peak hours or at some other defined time period.	Knoxville Regional Transit Corridor Study
T5	Knox	Throughout Network		Evaluate each of the corridors to see if a dedicated or designated bus lane would be appropriate.	Knoxville Regional Transit Corridor Study
T6	Knox	Throughout Network		Providing riders with the most up-to-date schedule information and next bus arrival times would help attract additional ridership. This can be achieved through various forms of communication including Tennessee's 511 program, variable message signs, Twitter alerts, email, etc.	Knoxville Regional Transit Corridor Study
T7	Knox	Throughout Network		Evaluate, either through the ridership model or through an actual live test, increasing the frequency of bus service along the corridors.	Knoxville Regional Transit Corridor Study
*T9	Knox	Throughout Network		A Regional Transit Authority will need to be formed in order to provide inter-county transit service, especially for transit investments along the Pellissippi Pkwy. and Alcoa Hwy.	Knoxville Regional Transit Corridor Study
*T10	Anderson	TVA Boat Launch along SR-170		Improve and expand existing parking area located at the TVA boat launch along SR-170 (Edgemoor Rd.) to accommodate park-and-ride opportunities.	Mobility 2040: Connecting People and Places
T11	Knox	Downtown Knoxville (via US-441/ N Broadway St.)	Fountain City (via US-441/ N Broadway St.)	Implementation of traffic signal and transit enhancements to create a new express BRT route along existing KAT Route 22. Includes transit signal priority technology, new BRT stops equipped with passenger information systems, and potential queue jump applications.	Mobility 2040: Connecting People and Places
T12	Knox	Throughout Network		Technology upgrades including improved automated vehicle location (AVL), electronic passenger information systems, on-board WiFi, automated passenger counters, mobile fare payment, bus diagnostics, safety systems, traffic management and communication systems.	Mobility 2040: Connecting People and Places
*T13	Hamilton	Hamilton Place	Lee Highway Interchange Park-and-Ride	Extend CARTA Express Route 4 further north on I-75 to Lee Highway.	Chattanooga-Hamilton County/ North Georgia 2045 Regional Transportation Plan Update
T14	Hamilton	3rd and Hotzclaw	Shuttle Park North	New shuttle route downtown between aquarium area and Erlanger Hospital; Extend further east if light rail line built at Hotzclaw; Extend Mocs Express.	Chattanooga-Hamilton County/ North Georgia 2045 Regional Transportation Plan Update

Table 9-1. Potential Transit Improvements — I-75 (continued)

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solutions
T15	Hamilton	Future Hamilton Place Mall	Circular Route	New shuttle route in the Hamilton Place Mall area; Follows circular route from mall going down Gunbarrel Rd., E. Brainerd Rd., etc.	Chattanooga-Hamilton County/ North Georgia 2045 Regional Transportation Plan Update
T16	Catoosa and Hamilton	Ringgold (I-75/SR-151 Interchange	Downtown Chattanooga	New premium bus express route connecting Ringgold, GA with downtown Chattanooga via I-75 and I-24.	Chattanooga-Hamilton County/ North Georgia 2045 Regional Transportation Plan Update
T17	Macon and Hamilton	Rossville Blvd.	Ellis Rd.	Extend CARTA Route 9 across state line down McFarland Ave. in Georgia to Ellis Rd.	Chattanooga-Hamilton County/ North Georgia 2045 Regional Transportation Plan Update
T18	Macon and Hamilton	TN/GA State Line	US-27/Cloud Springs Rd.	North Georgia/East Ridge/Airport: GA portion of new local bus service through North GA to Eastgate Town Center and Airport.	Chattanooga-Hamilton County/ North Georgia 2045 Regional Transportation Plan Update
T19	Macon and Hamilton	TN/GA State Line	Fort Oglethorpe, GA	US-27/SR-2/Battlefield Pkwy.: GA portion of new local bus service connecting City of Fort Oglethorpe, GA to Downtown Chattanooga via US-27.	Chattanooga-Hamilton County/ North Georgia 2045 Regional Transportation Plan Update
T20	Hamilton	TN/GA State Line	I-75 - Cloud Spring Rd. Park-and-Ride	US-41/Ringgold Rd.: New local bus service connecting East Ridge, TN to Downtown Chattanooga.	Chattanooga-Hamilton County/ North Georgia 2045 Regional Transportation Plan Update
*T21	Hamilton and Bradley	Throughout Network		Regional Transit Access: Consider conducting a study to determine the feasibility of a commuter route between Chattanooga and Cleveland. Regional transit access would likely require implementation of a Regional Transit Authority	Data Analysis

*Improvements with the highest potential to impact travel on I-75. These alternatives will be included in the universe of alternatives for I-75.

Table 9-2. Potential Bicycle and Pedestrian Improvements — I-75

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solutions
BP-1	All	Throughout Network		Consider conducting a study to identify bicycle and pedestrian connectivity and safety improvements at existing U.S. and State Route interchanges.	Data Analysis
*BP-2	Hamilton	Spring Creek Rd.	Greenway View Dr.	Midtown Pathway (along Brainerd Rd.)	Public/Stakeholder
BP-3	Hamilton	Facilities west of I-75	Camp Jordan Park	Trail connector	Public/Stakeholder

10. Universe of Alternatives

Sections 4 through 9 of this technical memorandum detail development of possible solutions to identified deficiencies in the areas of capacity, safety, transportation system management, freight, economic development, and multi-modal options. Table 10-1 and Figure 10-1 gather these potential solutions into the total universe of alternatives for the I-75 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 10-1. Potential Solutions By Category — I-75

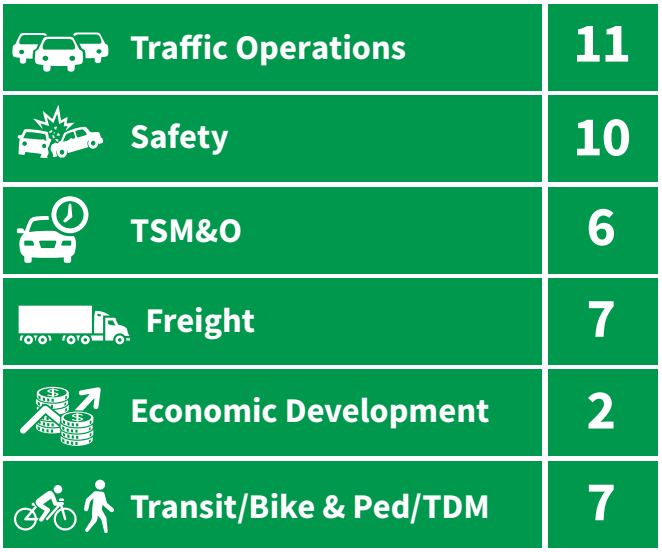


Table 10-1. Universe of Alternatives — I-75

	ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
Traffic Operations	C1	Bradley	US-64 Bypass/US-74	SR-60	Widen existing four lane section	Data Analysis
	C2	Loudon	SR-72	I-40	Widen existing four lane section	Data Analysis/I-75 Corridor Feasibility Study
	C3	Knox	I-40	I-640	(Evaluated as part of I-40/I-81 Corridor Study)	Data Analysis
	C4	Knox	Western Ave	I-275	Widen existing six lane section	Data Analysis
	C5	Knox	Callahan Drive	SR-131	Construct auxiliary lane NB between interchanges	Data Analysis
	C6	Knox / Anderson	SR-170	US-441	Widen existing four lane section; consider truck climbing lanes	Data Analysis, TN Freight Plan (2018), I-75 Corridor Feasibility Study
	C7	Anderson / Campbell	US-441	SR-63	Widen NB lanes; consider truck climbing lanes	Data Analysis
	C8	Hamilton	I-75/I-24 Interchange	Georgia State Line	Widen / Apply TSM&O and/or Arterial Management Strategies to address forecasted congestion	Data Analysis, TN Freight Plan (2018), Cratt-Hamilton Co/N. Georgia 2045 RTP Update

Table 10-1. Universe of Alternatives cont. — I-75

	ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
Traffic Operations	C9	Hamilton	Near SR-320 and SR-153 Interchanges		Evaluate options for increasing capacity and improving merge/diverge and weave areas between the SR-320 and SR-153 interchanges.	Data Analysis
	C10	Knox	Merchants Drive	Callahan Drive	Widen existing six lane section	Data Analysis
	C11	Hamilton	Shallowford Rd Interchange		Evaluate ramp queue on southbound I-75 off-ramp.	Public/ Stakeholder
Safety	S1*	Campbell	South 5th Street Interchange		Install retroreflective markers and increased pavement friction layer	Data Analysis
	S2*	Campbell	Jellico Mountain Area		Speed limit reduction/warning signage/ retroreflective markers	Data Analysis
	S3	Campbell	SR-63 (Oneida) Interchange		Extend length of SB deceleration and NB acceleration lanes	Data Analysis
	S4	Campbell	SR-63 (Caryville) Interchange		Extend length of NB and SB deceleration lanes	Data Analysis
	S5	Anderson	SR-61 (Charles G Seivers Blvd) Interchange		Add right-turn only lane on NB off-ramp	Data Analysis
	S6	Knox	Western Ave Interchange		Add pavement markings to indicate lanes for I-40 junction	Public/ Stakeholder
	S7	Loudon	US-321 Interchange		Extend length of NB deceleration lane	Public/ Stakeholder
	S8	McMinn	McMinn County Rest Area		Install additional lighting on NB exit ramp	Data Analysis
	S9	Bradley	SR-60 Interchange		Increase length of NB and SB deceleration lanes/Install advanced signage for NB off-ramp	Data Analysis
	S10	Hamilton	SR-320 (Brainerd Rd) Interchange		Install advanced signage and increase capacity of NB exit ramp / Modify interchange to remove weave caused by loop ramps	Data Analysis
TSM&O	TS1	Hamilton / Knox	Brainerd Rd, Shallowford Rd, Harrison Rd, Kingston Pk, Central Ave Pk		Signal coordination on adjacent spillover streets to manage on- and off-ramp congestion	Public/ Stakeholder
	TS2	Hamilton	I-75 and adjacent, parallel arterials		Conduct study to evaluate correlation between travel speed and crash severity.	Public/ Stakeholder
	TS3	Hamilton	Ringgold Rd	Shallowford Rd	Integrated Corridor Management (with real-time technology platform)	Public/ Stakeholder
	TS4	Hamilton / Knox	Urban areas of Chattanooga and Knoxville		Evaluate locations that would benefit from ramp metering and queue detection systems.	Public/ Stakeholder
	TS5	Hamilton	Ringgold Rd		Transit Signal Prioritization	Public/ Stakeholder
	TS6	Hamilton	Throughout		Evaluate balanced alternative routing opportunities	Public/ Stakeholder

Table 10-1. Universe of Alternatives cont. — I-75

	ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
Freight	F1	Hamilton	Georgia State Line	Bradley County Line	Add overnight truck parking in or near Chattanooga	Data Analysis
	F2	Hamilton	Georgia State Line	Bradley County Line	Resurface so that at least 90% of the corridor has good ride quality	Data Analysis
	F3	Loudon	Tennessee River Bridge		Address bridge deficiency to maintain appropriate load carrying capacity	Data Analysis
	F4	Knox	Campbell Station Road Interchange		Add lanes; Redesign interchange to reduce flooding	Tennessee Freight Plan (2018 amended 2019)
	F5	Knox	I-40	I-275	Add lanes	Tennessee Freight Plan (2018 amended 2019)
	F6	Anderson	East Wolf Valley Road Interchange		Address bridge deficiency to maintain appropriate load carrying capacity	Data Analysis
	F7	Campbell	Bruce Gap Road Bridge		Address bridge deficiencies to maintain appropriate load carrying capacity	Data Analysis
Economic Development	ED1	Bradley	SR-60	SR-74	Evaluate need for additional interstate access point to accommodate economic growth	Public/ Stakeholder
	ED2	Hamilton	Ooltewah	Cleveland	Evaluate need for new interchange to accommodate growth between Ooltewah and Cleveland (consider existing overpass for Ooltewah/ Georgetown Rd)	Public/ Stakeholder
Multimodal	T9	Knox	Throughout Network		Establish a Regional Transit Authority to provide inter-county transit service	Knoxville Regional Transit Corridor Study
	T10	Anderson	TVA Boat Launch along SR-170		Improve and expand parking area at TVA boat launch for park-and-ride opportunities	Mobility 2040: Connecting People and Places
	T13	Hamilton	Hamilton Place	Lee Highway Interchange Park-and-Ride	Extend CARTA Express Route 4	Chattanooga-Hamilton County/ North Georgia 2045 Regional Transportation Plan Update
	T21	Hamilton / Bradley	Throughout Network		Study commuter route between Chattanooga and Cleveland. Regional transit access would likely require implementation of a Regional Transit Authority.	Data Analysis
	BP1	All	Throughout Network		Study to identify bike/ped connectivity and safety at existing U.S. and State Route interchanges	Data Analysis
	BP2	Hamilton	Spring Creek Road	Greenway View Drive	Midtown Pathway (Along Brainerd Road)	Public/ Stakeholder
	BP3	Hamilton	Facilities west of I-75	Camp Jordan Park	Trail connector	Public/ Stakeholder

*2017 TDOT Road Safety Audit (PIN 125015.00) recommended improvements to I-75 from the Kentucky State Line to the Rarity Mountain Interchange. Recommendations included median drainage improvements, re-lensing existing pavement markers, additional LED pavement markers, median barrier delineation, and warning signage. Recommended improvements are currently in the Design Phase.

11. Solutions Screening Process Methodology

Technical Memorandum 4 for the Study will filter the I-75 universe of alternatives through a solutions screening and prioritization process (see Figure 11-1). This process will evaluate solutions based on their impact on mobility and safety, potential environmental impacts, cost, and potential economic impacts. Ultimately, the prioritized solutions will both resolve the identified deficiencies and have a high benefit/cost ratio.

Phase 1 Alternative Screening

The Phase 1 alternatives screening process is intended to eliminate solutions with evident fatal flaws. This two-phase process will evaluate each possible solution 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 receive a "NO" response for questions 1, 2, or 3, or a "YES" response for questions 4 or 5 will be eliminated and will not move forward to the Phase 2 alternative screening. Exceptions include projects where the potential is high for environmental/cultural impact mitigation.

Phase 2 Alternative Screening

The Phase 2 alternatives screening process will utilize performance measures identified in Section 3 to further refine the list of feasible alternatives. Additionally, a benefit/cost analysis will be conducted. Potential solutions that pass the Phase 1 Screening will be evaluated against the following questions:

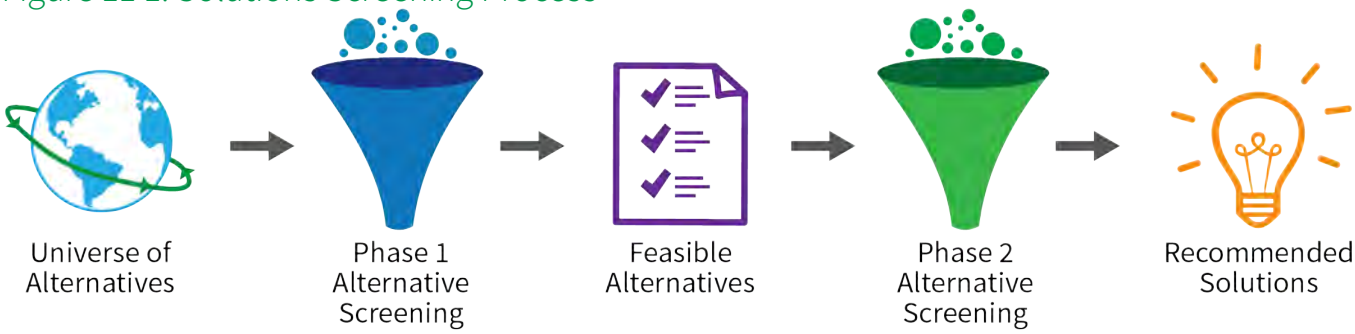
1. Does the proposed solution improve level of service on the interstate corridor?
2. Does the proposed solution improve peak hour travel speeds on the interstate corridor?
3. Does the proposed solution improve travel times between key O&D pairs along the corridor?
4. Does the proposed solution improve 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 improve incident management?
12. Does the proposed solution provide potential economic development opportunities?
13. Does the proposed solution have the potential to reduce VMT?
14. Does the benefit/cost ratio of the proposed solution exceed 1.0?

Projects which receive only "NO" responses will be eliminated and will not move forward as feasible multimodal solutions.

Identification of Recommended Solutions

Potential solutions which receive a "Yes" in the Phase 2 screening will be carried forward to the list of recommended solutions. The recommended solutions will move into the project prioritization phase, wherein recommended solutions will be ordered based on their effectiveness, potential for solving identified deficiencies, and benefit/cost ratio.

Figure 11-1. Solutions Screening Process



I-26 Corridor

▶ Development of Feasible Multimodal Solutions

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I-26 Corridor

1. Introduction

The I-26 corridor serves as a backbone for economic development and growth in the northeast Tennessee region. As population and employment continue to grow, 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 threaten the corridor's ability to sustain future growth.

A previous technical memorandum (Technical Memorandum 1) provided a data and information inventory for the corridor. Technical Memorandum 2 assessed existing and future deficiencies and needs along the I-26 corridor, focusing on traffic operations, safety, and multimodal conditions. These identified deficiencies are re-visited briefly in Section 2 of this corridor report. However, the primary focus of Technical Memorandum 3 is the development of 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, is ultimately established.

To supplement the technical analysis performed during this process, public workshops and surveys were used to generate feedback from citizens and stakeholders located throughout the corridor. A series of detailed interviews were also conducted with transportation and development officials. The resulting universe of alternatives is 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. The forthcoming Technical Memorandum 4: Project Priorities will report on the evaluation and strategic prioritization of the potential solutions described here.

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

2. Overview of Existing Deficiencies and Future Needs

Technical Memorandum 2: Assessment of Existing and Future Deficiencies, defined the trend scenario for the I-26 corridor – an effort that predicts existing and future conditions if current practices and plans remain unchanged. The trend scenario includes population and employment projections, capital projects currently programmed for construction in either Tennessee Department of Transportation's (TDOT) Statewide Transportation Improvement Program (STIP) or one of the Metropolitan Transportation Planning Organizations (MTPO) Transportation Improvement Program (TIP), recent MPO travel demand model projections, and Transearch freight projections.

Evaluation of the trend scenario, coupled with feedback from citizens and stakeholders, brought to light existing deficiencies and future needs for which solutions have not yet been programmed. These deficiencies align with economic development projections and fall into the following six categories, which are summarized in Figure 2-1 and detailed in Figures 2-2a, b, c and d.

- Traffic Operations
- Safety
- Transportation System Management
- Freight
- Transit / Bike & Ped / TDM
- Pavement & Structures

The content of Figure 2-1 and Figures 2-2a, b, c, and d was presented to the public on January 7, 2020 at a public meeting in Kingsport. Public and stakeholder responses recognized two additional deficiencies: 1) the need for controls to mitigate speeding on I-26, specifically between Eastern Star Road and Boones Creek Road, and 2) the need for median breaks to accommodate emergency management system (EMS) vehicles in Unicoi County, south of Erwin.

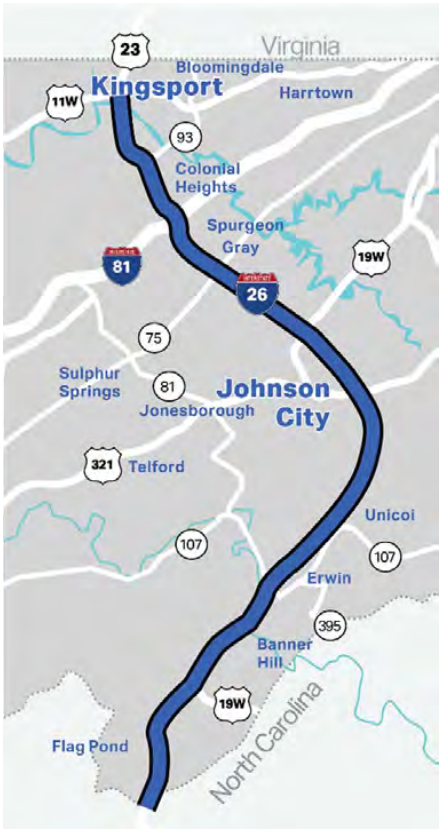
The remaining chapters of this technical memorandum document the development of feasible multimodal solutions to address the complete list of existing and future deficiencies.

Figure 2-1. Existing Deficiencies and Future Needs — I-26

INTERSTATE 55 75 26 CORRIDOR STUDY

I-26 Existing Deficiencies and Future Needs

Additional information about the existing deficiencies and future needs for the I-26 corridor can be found in Technical Memorandum 2.



Legend:
- Deficiencies and needs supported by data analysis
- Deficiencies and needs identified by stakeholders

Traffic Operations

- Geometric issues at I-26 & I-81 interchange. Inadequate ramp length contributes to congestion at the merge/diverge areas.
- Traffic bottleneck identified between I-26 interchanges with SR-91 and SR-400.
- "Visibility issues due to sun glare on I-26 near Eastern Star Rd. interchange."
- "Truck climbing lanes desired at the following locations:
  - Eastbound I-26 near Unaka Ave./Watauga Ave.
  - Westbound I-26 near Eastern Star Rd., State of Franklin Rd., and Unaka Ave./Watauga Ave."
- "Congestion identified at the following I-26 interchanges:
  - I-81
  - SR-75 (Suncrest Dr.)
  - SR-381 (State of Franklin Rd.)
  - US-11E / SR-36 (N. Roan St.)"

Safety

- Higher crash rates potentially related to roadway geometry, animal crossings, narrow shoulders and inadequate lighting identified between US-11W and SR-347.
- Bicycle/pedestrian crashes are present near the I-26 and SR-91 interchange.
- Higher crash rates near the SR-91 and US-321 interchanges. Likely rear end collisions and weaving/congestion related issues.
- North and south of the community of Flag Pond near the North Carolina border there are curves/steep inclines, narrow shoulders and weather-related crashes.

Freight

- Insufficient overnight truck parking.
- Projected increase in truck percentage between Kingsport and Johnson City.
- Freight bottlenecks between Kingsport and I-81.
- Freight bottleneck located between Flag Pond Rd. and North Carolina border near the interchange with Upper Higgins Creek Rd.
- Freight bottleneck located at Clear Branch Access between Boones Creek Rd. and State of Franklin Rd.

Economic Development

- Employment growth projected at the interchanges with I-81 and SR-75.
- "Employment growth is anticipated in Johnson City."

Transit / Bike & Ped / TDM

- Minimal park and ride facilities.
- Lack of regional transit connection between Johnson City and Kingsport.
- Lack of bicycle and pedestrian accommodations at interchanges.

Transportation System Management

- Identify locations for additional ITS elements such as CCTV cameras.
- Consider systems to improve incident management response.

Pavement & Structures

- As of 2017, Washington County had the lowest pavement quality in the study area.
- 15 bridges eligible for rehabilitation.

TN TDOT Department of Transportation **I-55/75/26 Corridor Study**

Figure 2-2a. Traffic Operations & Structural Deficiencies — I-26

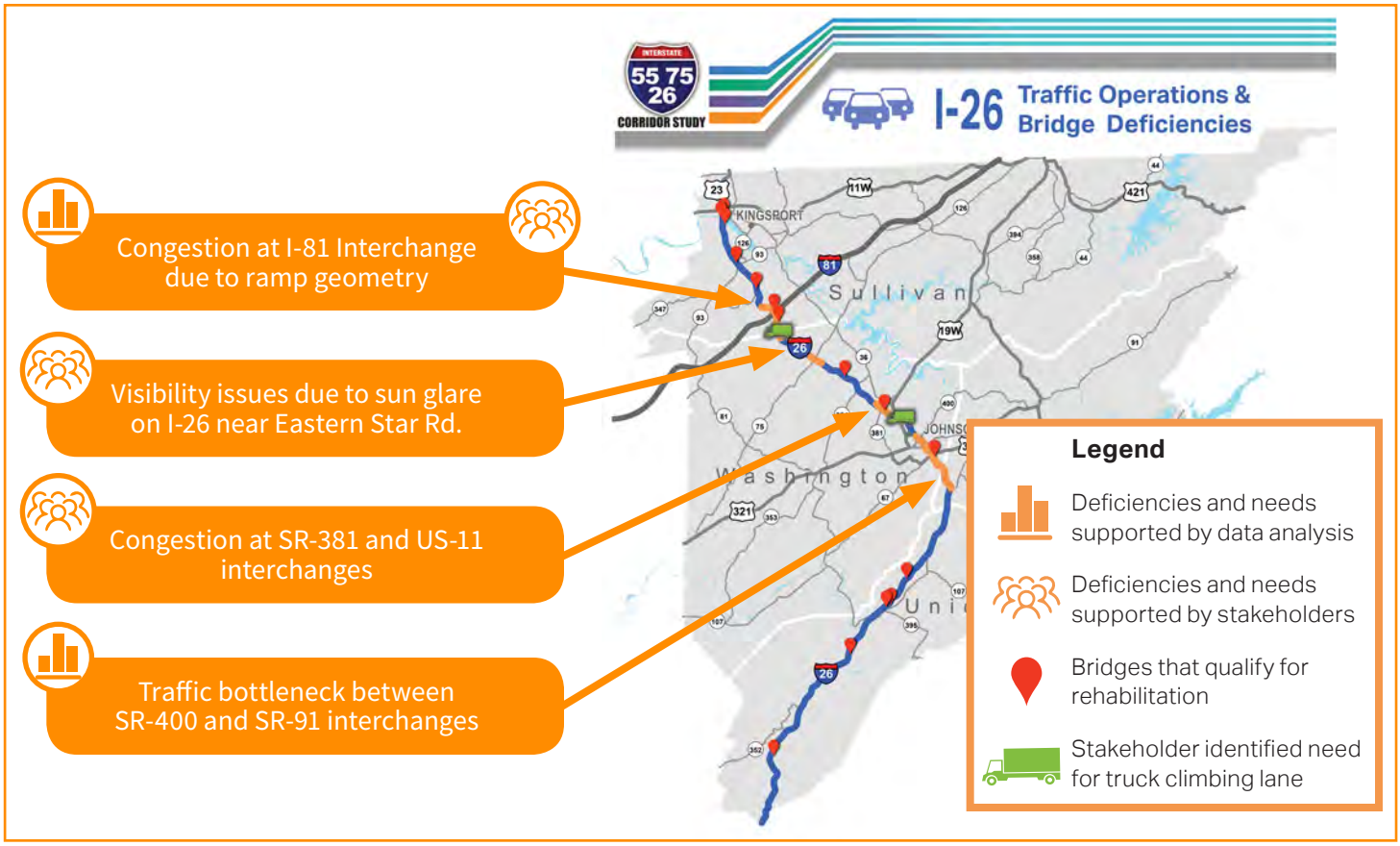


Figure 2-2b. Safety Issues — I-26

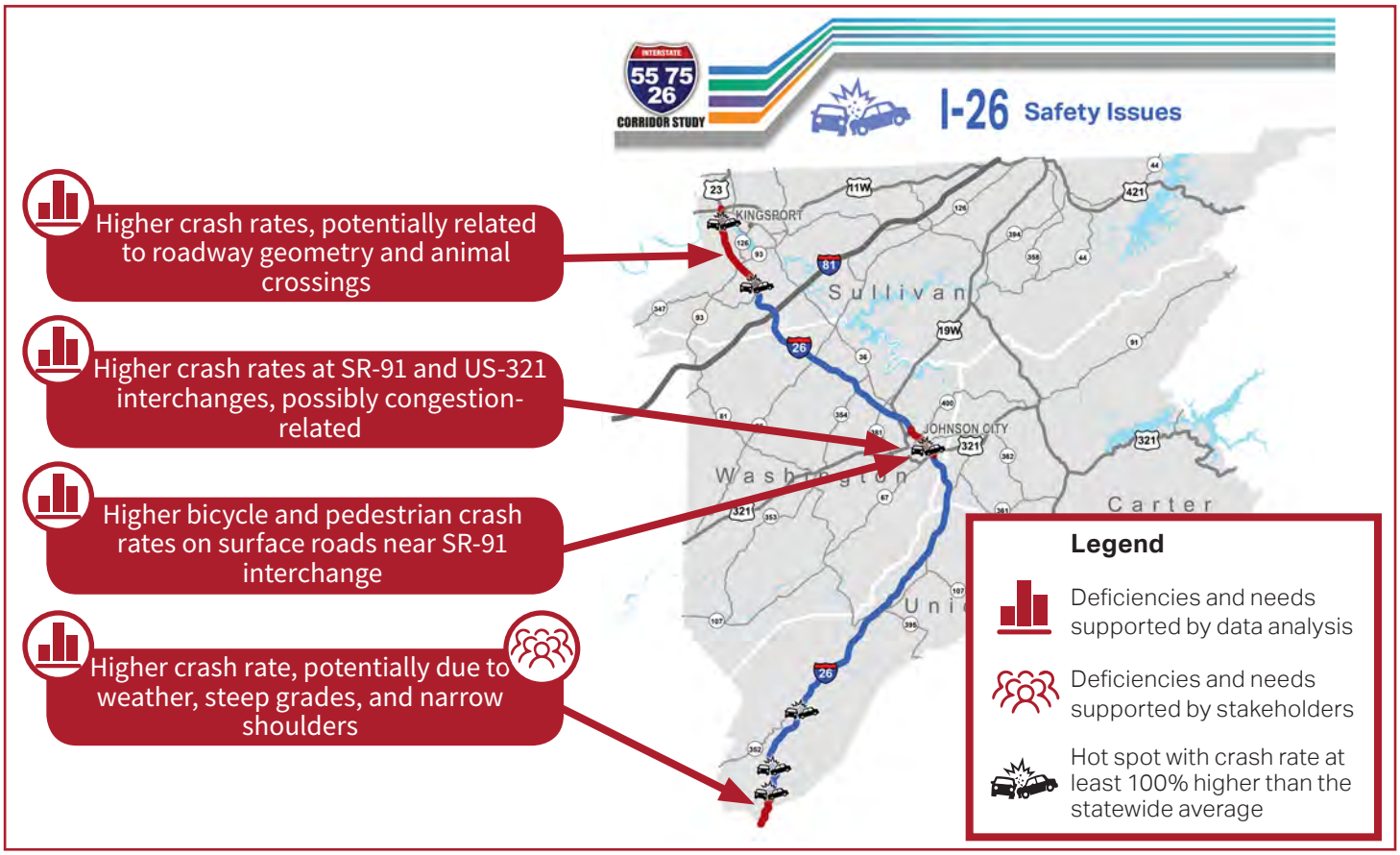


Figure 2-2c. Multimodal Issues — I-26

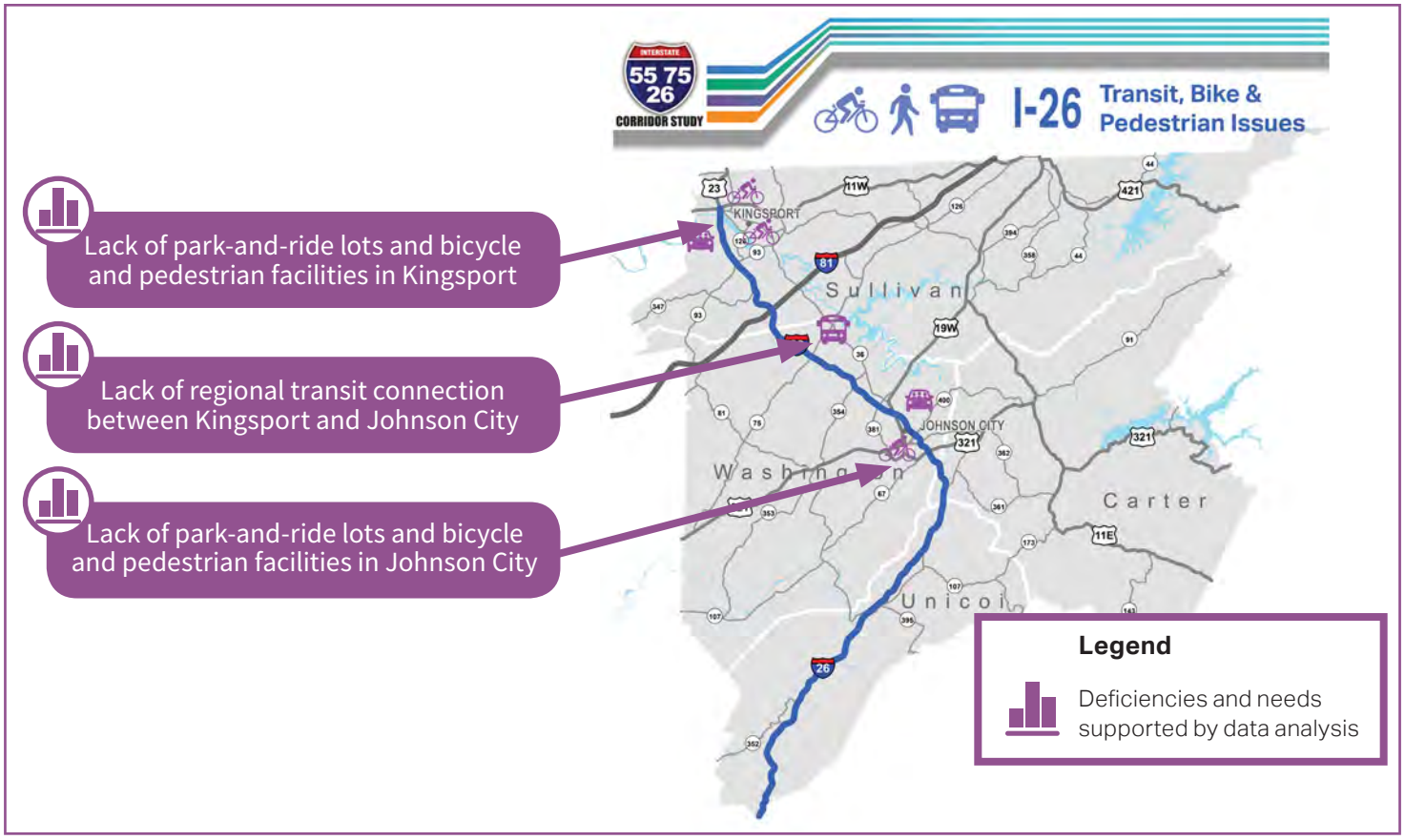
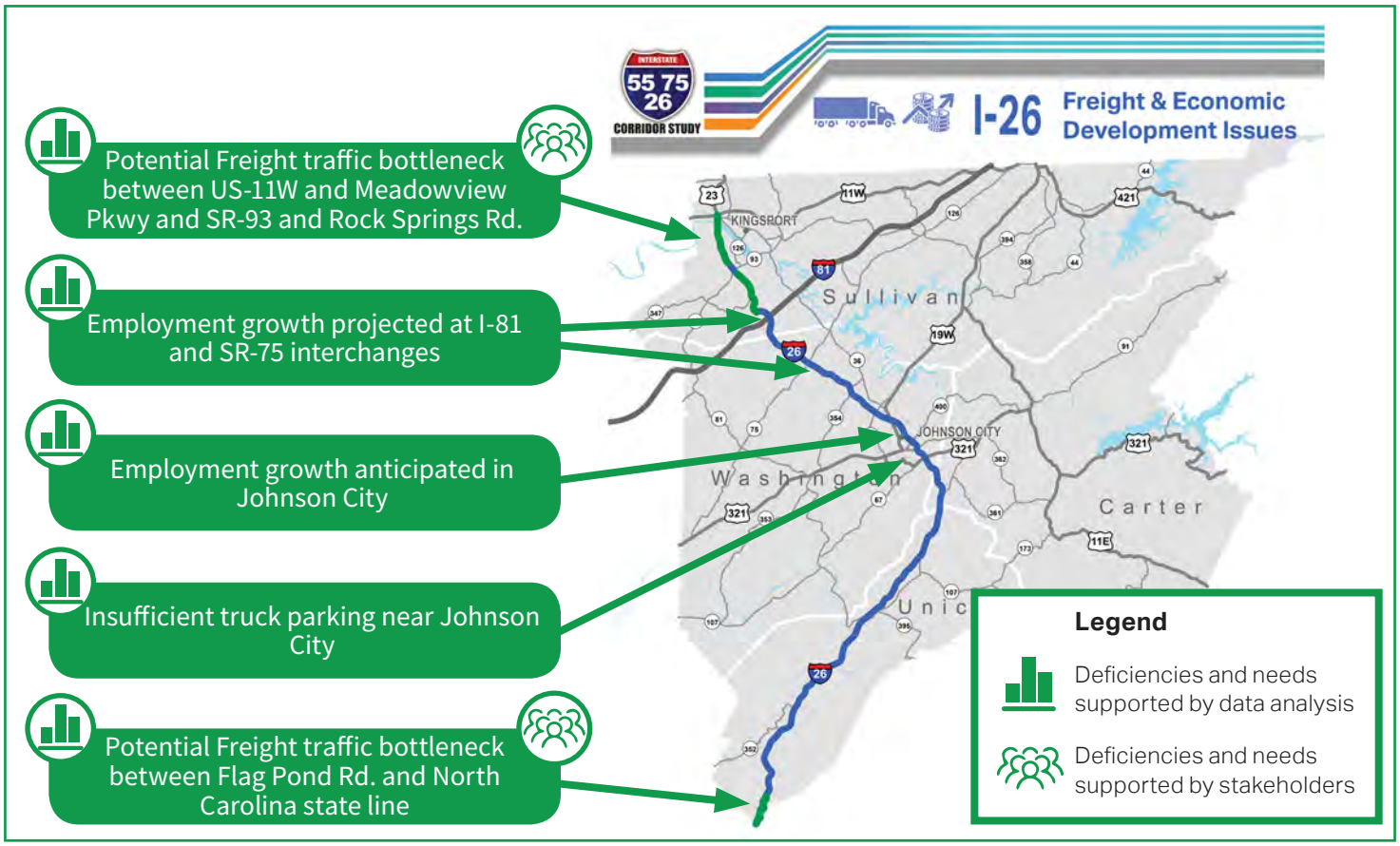


Figure 2-2d. Freight & Economic Development Issues — I-26



3. 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 3-1, the 5 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)[1], Trend (2040) and Build (2040) scenarios. Table 3-2 outlines the performance measures established for the I-26 corridor and includes results for the Base and Trend Scenarios. As indicated, the measures fall into four categories (Traffic Operations, Safety, Operations & Maintenance, and Multimodal), which directly support the objectives identified in Table 3-1. Results for the Build Scenario will be included in Technical Memorandum 4.

It is important to note that many of these performance measures represent the corridor as a whole – aggregating the benefit of the potential solutions in the Build year. Exceptions include the "Crash reduction in safety hot spots", "Peak hour density at improved interchanges", and "Average & max queues at improved interchanges." These performance measures were applied at isolated locations where the universe of alternatives for addressing deficiencies may be larger. For example, in Technical Memorandum 2, the section of I-26 between SR-91 and SR-400 was identified both as a safety hot spot and a traffic bottleneck. Several potential solutions were developed to address the deficiencies, including increasing spacing between ramps, creating a collector-distributor system, constructing braided ramps, or widening on and off-ramps to provide option lanes. Additional traffic operational analyses were necessary to evaluate the benefit of each potential solution, and these specific performance measures were used to guide that evaluation.

The following section is a glossary of the specific performance measures, providing the definitions, and details regarding how the measure was calculated or assessed.

Table 3-1. 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		

1- The Statewide Travel Demand Model (TSM) uses a 2010 base year for this study. The study team determined the TSM was producing results comparable to regional models with more recent base years- creating better model efficiency.

Table 3-2. Performance Measure Summary — I-26

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

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.

Description of Performance Measures

Traffic Operations

- **Traffic on Interstate Operates at LOS D or Better:** Defined by percent of the interstate corridor where operations are level of service (LOS) A, B or C. This measure provides insight into the amount of congestion experienced on the interstate corridor, reflecting the following relationship between volume-to-capacity and level of service, as defined in Technical Memorandum 2 for the previously completed I-65 corridor study (February 2017):
  - V/C < 0.7 (LOS A-B)
  - V/C 0.7 – 0.8 (LOS C)
  - V/C 0.8 – 0.9 (LOS D)
  - V/C 0.9 – 1.0 (LOS E)
  - V/C > 1.0 (LOS F)

  Segments of interstate where Base and/or Trend TSM output indicated LOS E or F were identified for further analyses/evaluation of potential solutions. Additionally, rural segments with LOS D in 2040 were also identified, recognizing that delay associated with LOS D on a four-lane facility through rolling/mountainous terrain is perceived differently than LOS E or F on a six or eight lane urban cross-section. One of these locations was identified along the I-26 Corridor: Between SR-381 and SR-75. While no specific recommendations are made for this rural segment at this time, delay and level-of-service should be monitored at this location into the future.
- **Total Daily Vehicle Miles Traveled (VMT):** Detailed by urban and rural functional classifications within the Technical Memorandums, this performance measure indicates the total vehicle miles traveled each day within the study area. It is used to measure growth and ultimately sheds light on the efficiency of the system post-improvements, as a comparison of Build vs. Trend scenarios can indicate shifts in miles traveled on various functional types.
- **Total Daily Vehicle Hours of Travel (VHT):** Vehicle hours of travel is a measure of total time motorists are spending on the road each day. This performance measure is broken down by urban and rural functional classification. When compared to daily VMT, daily VHT can indicate increased or decreased delay on a system.
- **Total Peak Hour Vehicle Hours of Delay (VHD):** Also detailed by urban and rural functional classifications, peak hour VHD measures congestion of a facility during the peak hour. Typically, it is inversely proportional to travel speeds – as peak hour VHD increases, peak hour travel speeds decrease.
- **Total VMT/Trip:** Representing the system as a whole, total daily VMT divided by total daily vehicle trips, measures motorists average trip length (in miles/trip). Within a study area, changes in this performance measure can reflect changes in land use (which may promote shorter trip lengths, for example) or new / improved access to common destinations. Therefore, this performance measure must be evaluated in conjunction with an understanding of programmed roadway projects and planned developments in the study area.
- **Total Vehicle Minutes Traveled / Trip:** This performance measure represents the average time a motorist spends in their vehicle per trip. When the Vehicle Minutes Traveled/Trip remains consistent between the Base and Future year scenarios, changes in the Vehicle Minutes Traveled/ Trip performance measure can indicate increased or decreased congestion on the system.
- **Average Peak Hour Travel Speed:** This performance measure indicates the average travel speed a motorist experiences on a facility during the peak hour. When aggregated over a study area, change in average peak hour travel speed is indicative of system-wide increases or decreases in congestion and is usually inversely proportional to total peak hour vehicle hours of delay.
- **Congested Travel Time between Key O&D Pairs along Corridor:** Changes in travel time between origin and destination (O&D) pairs is a direct indicator of delay – and excluding incidents, also indicates congestion. Known origins and destinations along the corridor were selected, focusing on those that would primarily utilize the interstate corridor. Using the traffic analysis zones (TAZs) most representative of each origin and destination, Base and Trend congested travel times were pulled from the TSM and reported in minutes. These will be compared to travel times with the Build scenario.
- **Peak Hour Density at Improved Interchanges (Specified locations):** Based on deficiencies identified in Technical Memorandum 2, spot locations were identified for further traffic analysis using HCS, Synchro, and/or Transmodeler. Peak hour density for improved freeway segments, weave areas, merge areas, and diverge areas is directly indicative of level of service for the facility. Peak hour density will be measured for Trend and Build scenarios.
- **Average and Max Queues at Improved Ramp Intersections (Specified Locations):** Based on deficiencies identified in Technical Memorandum 2, spot locations were identified for further traffic

analysis using HCS, Synchro, and/or Transmodeler. Exit ramp queue length will be measured for each interchange within the spot locations and compared to the existing storage provided. Queues that extend past the available storage significantly impact mainline traffic operations and safety. Average and Max exit ramp queue lengths will be measured for Trend and Build scenarios.

Safety

- **Crash Reduction in Safety "Hot Spots":** This performance measure is used to represent the relative safety benefit associated with each proposed improvement. Hot spots, as defined in Technical Memorandum 2, are areas along the interstate corridor where calculated crash rates are significantly above the statewide average. The crash reduction potential for each recommended improvement was explored through the research of crash modification factors (CMFs), which estimates a safety countermeasure's ability to reduce crashes and crash severity. Based on data provided by the CMF clearinghouse, each recommendation was categorized as having above or below average crash reduction potential, specific to the I-26 corridor. Note that the reduction potential is only applicable for crash types that would be prevented by implementation of improvements.

Operations and Maintenance

- **Bridge Condition (sufficiency rating):** This performance measure is used to represent the structural benefit of proposed solutions, including those with the primary goal of addressing safety, capacity, or other needs. Highway bridges eligible for FHWA Bridge Replacement and Rehabilitation Program must have a sufficiency rating of 80 or less. A sufficiency rating that is less than 50 is eligible for replacement, and one that is less than 80 but greater than 50 is eligible for rehabilitation. The sufficiency rating is based on structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use. This measure is reported as a percentage of the total number of bridges (per corridor) within each sufficiency rating range.
- **Pavement Condition (resurfacing):** Pavement condition is directly tied to resurfacing. This performance measure is used to capture the ride quality benefit associated with solutions proposed primarily for safety and capacity deficiencies, for which resurfacing will be necessary.

Multimodal

- **Pedestrian and Bicycle Accommodations:** Geometric limitations created by interstate structures often result in discontinuous or unsafe pedestrian and bicycle accommodations on cross-streets through an interchange. In turn, this discourages multimodal connectivity. The Pedestrian and Bicycle Accommodations performance measure indicates the benefit that proposed safety and operational solutions may have on multimodal accessibility and connectivity at interchanges. Data collected for this performance measure is limited to interchanges with federal highways and state routes.
- **Freight (Truck Parking):** Truck parking is a critical component of supply chain operations, particularly with new service rules requiring drivers to stop after 14 hours. Without available parking, trucks often stop on highway on- and off-ramps, which is unsafe and illegal. This performance measure is indicative of compliance and safety improvements associated with truck parking solutions.

4. Traffic Operations

Section 3 of Technical Memorandum 2 documented future highway capacity needs based on a high-level, TSM analyses of the Trend Scenario. Within the I-26 corridor, one specific location was identified for more detailed traffic operations analyses and evaluation of possible solutions: eastbound I-26 between SR-400 and SR-91.

As noted in Section 3.4 of Technical Memorandum 2, 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.

Eastbound weave area between SR-400 and SR-91

Possible solutions considered at the identified location are outlined in Table 4-1. As shown, these solutions address the weave area 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

The reasonableness and effectiveness of these solutions will be evaluated through the screening and prioritization process included in Technical Memorandum 4. As part of that evaluation, Highway Capacity Software (HCS) and Synchro analysis software will be used to measure traffic operations under the 2040 Trend and Build conditions.

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 3-6 of Technical Memorandum 2, 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 outlined in Table 4-1 also includes a study to evaluate the need for collector-distributor lanes or other improvements between these interchanges.

Table 4-1. Potential Traffic Operations Improvements — I-26

ID	County	Termini (From)	Termini (To)	Description	Source of Recommendation
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 lane[1]	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

1- per 2009 MUTCD: "Some freeway and expressway splits or multi-lane exit interchanges contain an interior option lane serving both movements in which traffic can either leave the route or remain on the route, or choose either destination at a split, from the same lane." See 2009 MUTCD Figure 2-E4.

5. Safety

As documented in Technical Memorandum 2, an analysis was undertaken to identify areas along the I-26 corridor where safety issues may be present. These locations were identified as 'hot spots' and included segments along the corridor where the calculated crash rate was more than double the statewide average for similar facility types. Included in this analysis was the identification of potential factors that may contribute to the higher frequency of crashes in these areas. For the I-26 corridor, potential factors commonly identified included inadequate lighting and signage in advance of interchange ramps, narrow inside shoulder widths, and steep, winding curvature through the mountainous terrain.

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 were then reviewed for each hot spot, 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. Recommendations for potential safety improvements are presented in Table 5-1.

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.

Information on the following pages in Figures 5-1a and 5-1b depicts each safety recommendation and the crash factors identified previously. Priority should also be given to maintenance of new and existing signage, guardrails, and median cabling. If damaged, these treatments are not effective for safety.

Table 5-1. Potential Safety Improvements — I-26

ID	County	Termini (From)	Termini (To)	Description	Crash Reduction Potential
S1	Sullivan	US-11W/ W. Stone Drive	Meadowview Parkway	Install Fencing by Bays Mountain Nature Preserve	Above Average
S2	Sullivan	SR-93/ Wilcox Drive	SR-347/ Rock Springs Road	Widen Inside Shoulders	Below Average
S3	Washington	SR-91/ E. Main Street/E. Market Street	US-321/University Parkway	Construct EB Auxiliary Lane	Below Average
S4	Unicoi	Tennessee/North Carolina State Line	Unicoi/Carter County Line	Install Road Weather Information System	Below Average
S5	Washington, Sullivan	Kingsport and Johnson City Urbanized Areas		Install Additional Lighting and Signage	Above Average
S6	Washington	State of Franklin Road		Install Additional Overhead Signage	Above Average
S7	All	Throughout Corridor		Install additional guardrail and median cable barrier where roadside recovery area is not available	Above Average
S8	Sullivan	I-81 Interchange		Reconfigure interchange to address ramp geometry	Above Average

Figure 5-1a. Potential Safety Improvements — I-26

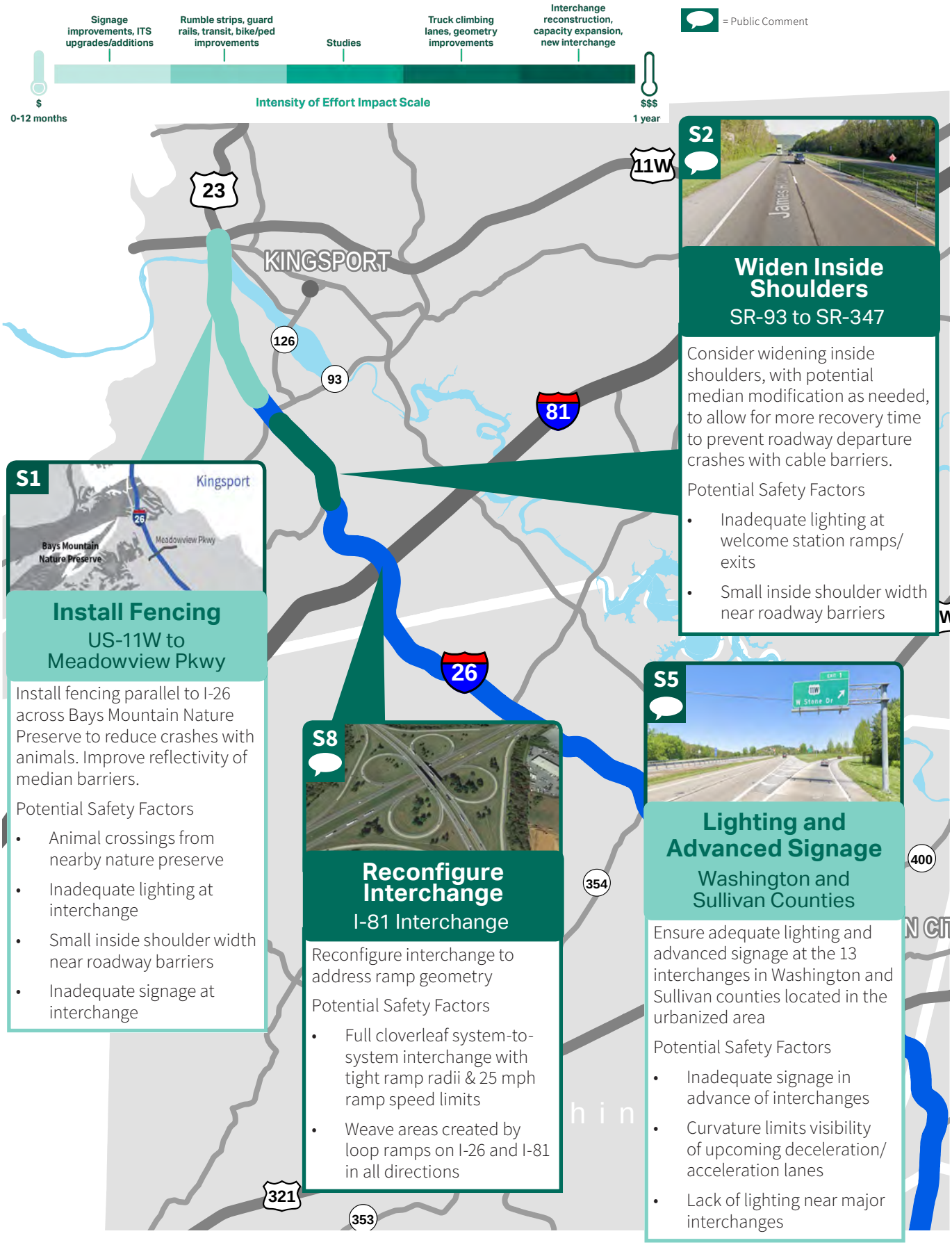
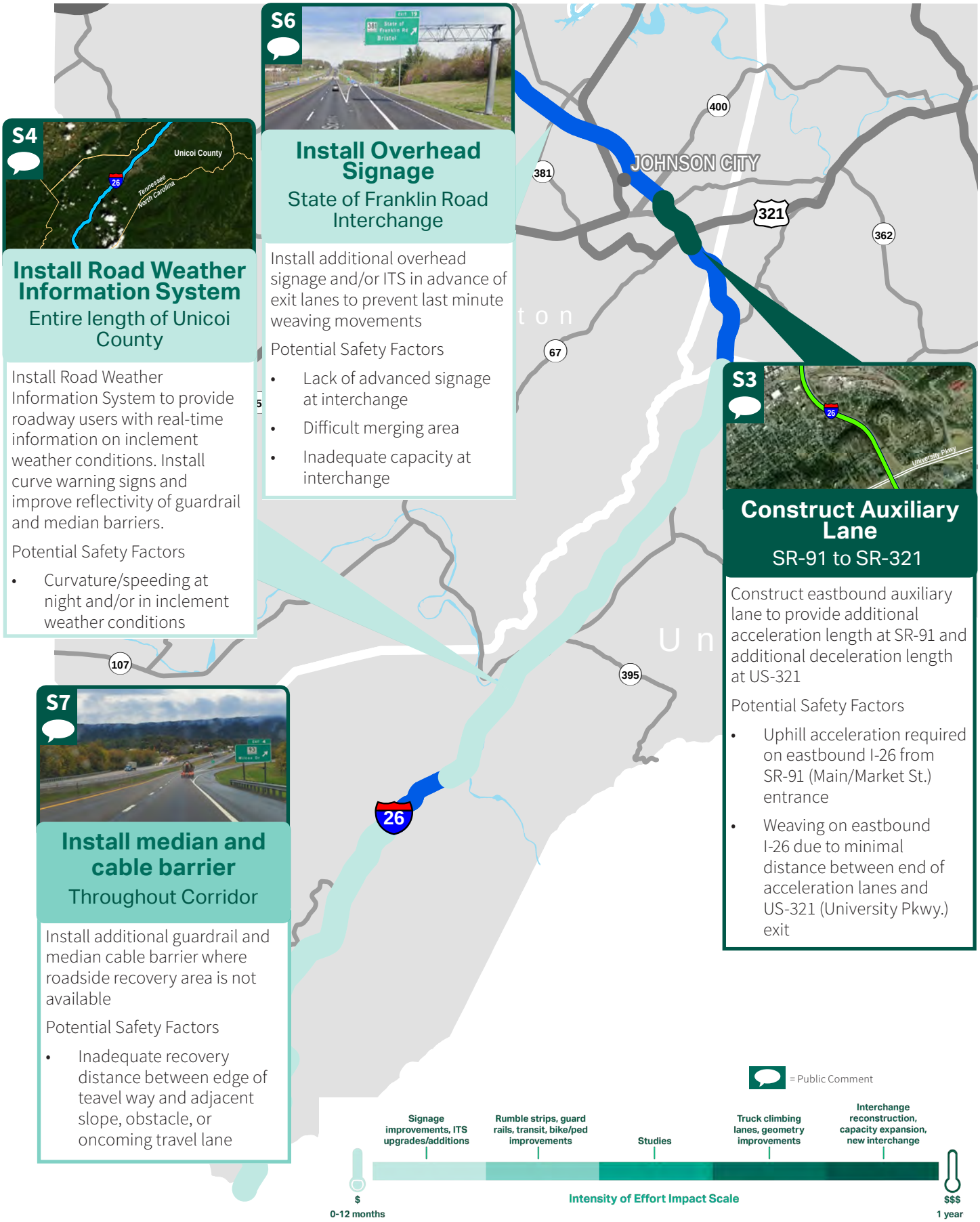


Figure 5-1b. Potential Safety Improvements — I-26



6. Transportation System Management & Operations

Transportation Systems Management and Operations (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 technical memorandum 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: Consider a study to identify bicycle and pedestrian connectivity and safety improvements at existing U.S. and State Route interchanges.

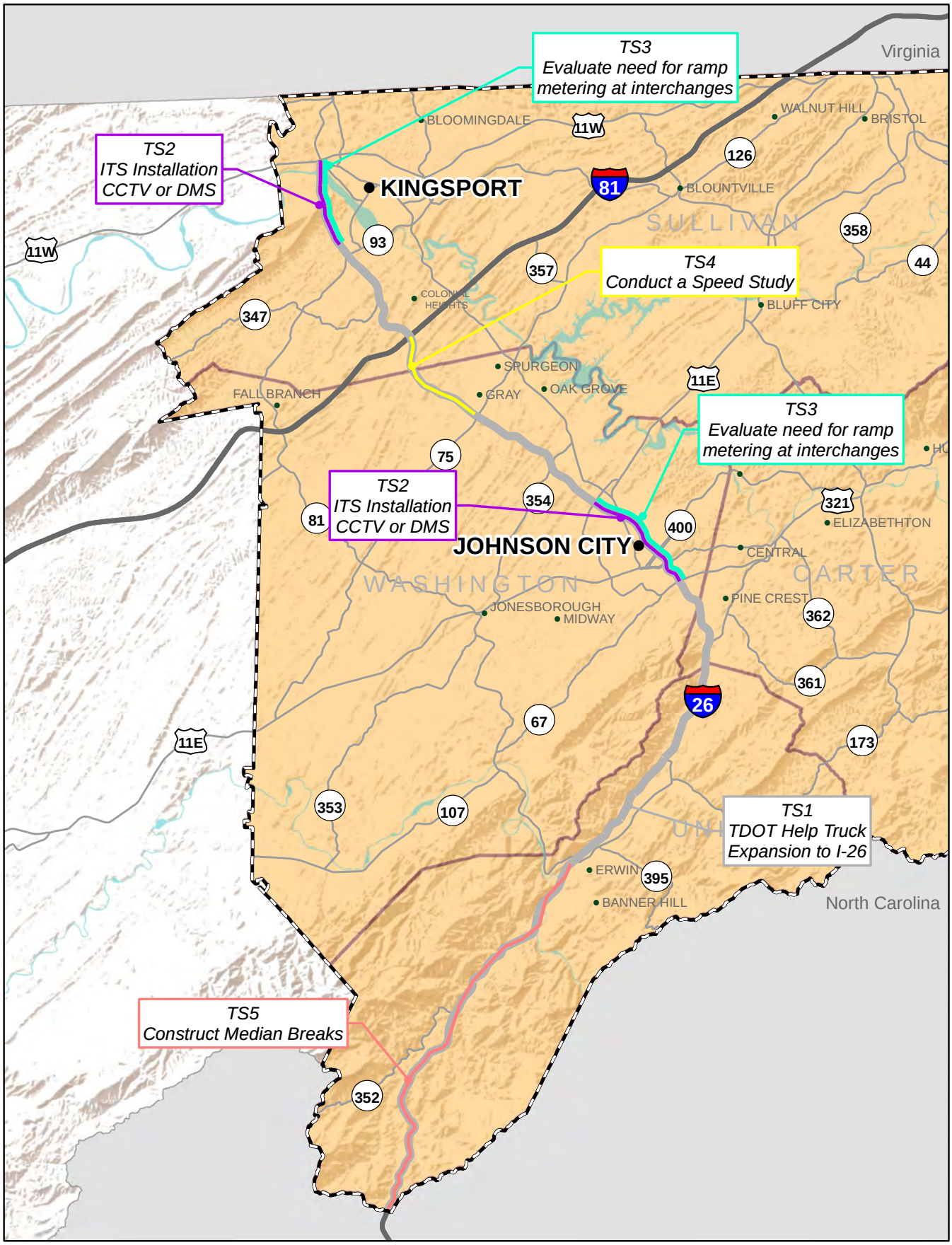
Additional solutions were developed via review of existing plans, public / stakeholder feedback, and field observations. These solutions are outlined in Table 6-1 and Figure 6-1. It should be noted that stakeholders in the Kingsport area acknowledge the importance of providing multiple resources to "refill" 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".

Westbound I-26 at Exit 24

Table 6-1. Potential Transportation System Management & Operations Improvements — I-26

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
TS-1	All	VA State Line	NC State Line	TDOT HELP Truck Expansion to I-26	Public/ Stakeholder
TS-2	Washington, Sullivan	Kingsport and Johnson City Urbanized Areas		ITS installation CCTV and DMS	Public/ Stakeholder
TS-3	Washington, Sullivan	Kingsport and Johnson City Urbanized Areas		Evaluate need for ramp metering at interchanges	Public/ Stakeholder
TS-4	Washington	Eastern Star Road	Boones Creek Road	Conduct a speed study on I-26	Public/ Stakeholder
TS-5	Unicoi	Erwin	NC State Line	Construct median breaks to allow for EMS vehicle turnaround	Public/ Stakeholder

Figure 6-1. Potential TSM&O Solutions — I-26



7. Freight

Freight movement is an important element of a regional and national economy. More efficient modes and routes for freight transportation enable improved logistics and result in reduced transportation costs; these cost savings can then be reallocated to growth, providing better jobs and higher wages. Technical Memorandum 2 identified existing and future deficiencies. This memorandum presents potential measures to improve freight mobility and support efficient and safe freight movement, now and into the future. Potential options include infrastructure improvements, such as truck climbing lanes and intersection redesigns, as well as management and operation strategies, such as lane restrictions and communication strategies. Traditional infrastructure improvements, such as interstate capacity expansions, benefit all traffic and are addressed in Section 4 of this memo. Other infrastructure improvements can be made specifically to benefit freight movement. These include truck parking and climbing lanes.

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.

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.

According to the American Association of State Highway and Transportation Officials (AASHTO) guidelines, a climbing lane is warranted if all three of the criteria below are satisfied.

1. Upgrade traffic flow rate in excess of 200 vehicles per hour
2. Upgrade truck flow rate in excess of 20 vehicles per hour
3. One of the following conditions exist:
    a. A 10 mph or greater speed reduction is expected for a typical heavy truck
    b. Level-of-Service E or F exists on the grade
    c. A reduction of two or more levels-of-service is experienced when moving from the approach segment to the grade

The stretch of I-26 between Johnson City and the North Carolina border has the lowest travel volumes along the corridor, with daily traffic of 8,360 vehicles and 24 percent trucks. Therefore, the entire corridor meets the first two criteria, and any segment that has a combination of percent upgrade and length of grade that cause a speed reduction of 10 mph or greater would be an appropriate place for a climbing lane.

Automation & Truck Platooning

Many technologies are being developed that help drivers by providing their vehicles with information about their environment.

The first widespread implementation of automation technology is likely to be semi-autonomous truck platooning. Platooning became permitted on Tennessee roads in April 2017. This allows freight trucks to use a system that automatically controls speed and braking by communicating between participating vehicles. This not only improves efficiency by increasing

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

aerodynamics as the trucks can drive closer together, but also safety because the system will automatically apply brakes if it senses a hazard. However, widespread use of truck platooning may require some infrastructure upgrades, specifically regarding bridges.

The load dynamics created by a truck platoon are different than for a conventional truck. Bridge spans must be able to handle more weight as more trucks are able to fit on a smaller space. They may also experience more wear on pavement and bridge elements due to new and different load dynamics, and existing railings may be too weak to withstand a crash by several trucks. The design of protective barriers might not be strong enough for a two or more-truck platoon with nearly no headway. Although accidents are expected to be rare, they might happen and in that case the barriers must be able to withstand the extra forces.[3]

Managed Lanes and Lane Restrictions

The lack of significant traffic on I-26 means that managed lanes and lane restrictions would be unlikely to have a large impact on this corridor.

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. Truck drivers can be trained to drive in ways that save fuel, reduce emissions, and reduce noise so that night deliveries do not disturb neighbors.

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.

Potential Freight Mobility Solutions

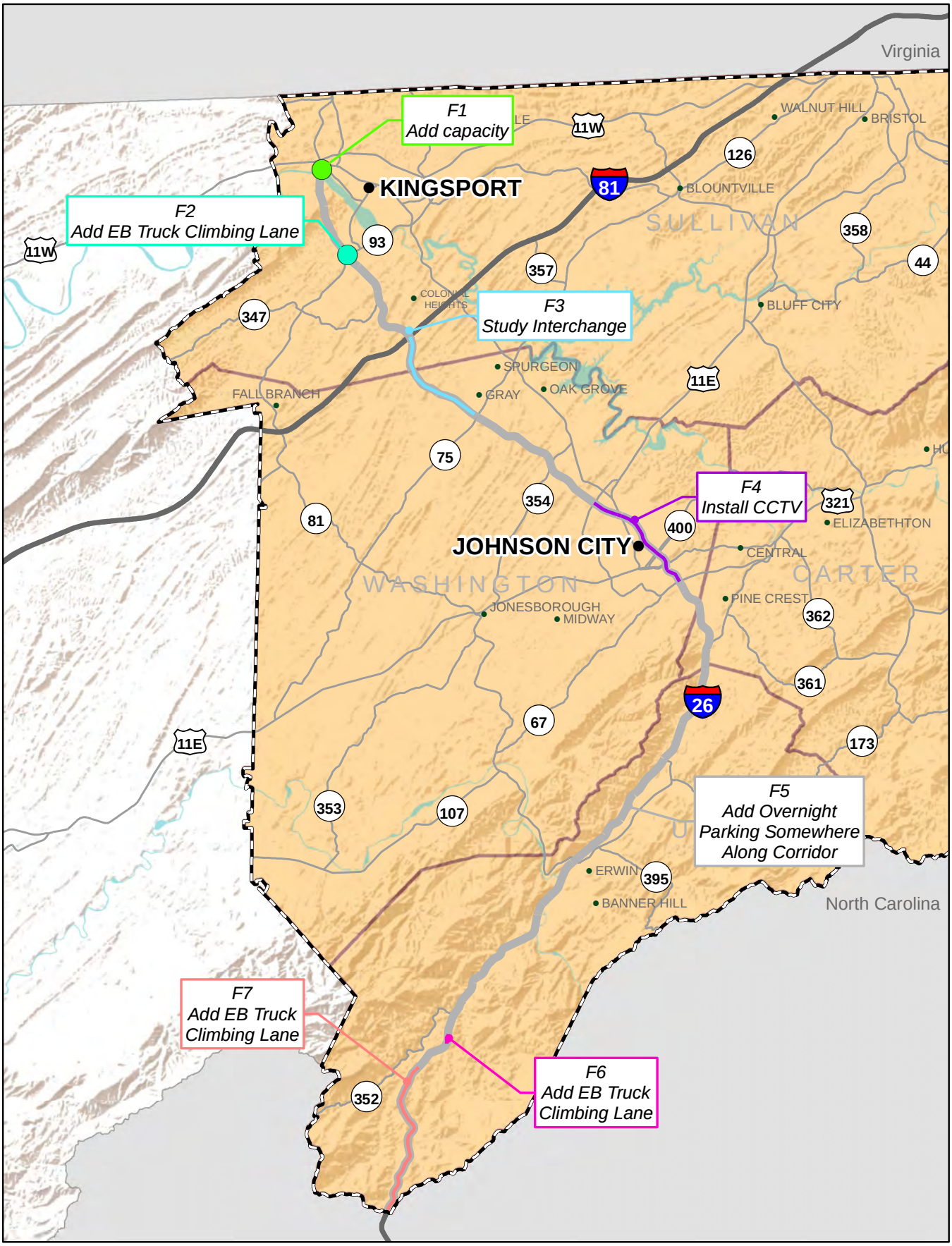
Suggested freight improvements for the I-26 corridor are shown in Table 7-1 and Figure 7-1. These include improvements that were identified in existing transportation plans, via public/stakeholder comments, or through data analysis.

Table 7-1. Potential Freight Improvements — I-26

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
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 MTPO 2040 LRTP
F3	Sullivan	I-81/I-26 Interchange		Study I-81 and I-26 interchange for capacity, design for ease of truck use	Kingsport MTPO 2040 LRTP
F4	Washington	SR-381	SR-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 Rd	NC State Line	Add eastbound truck climbing lane	Tennessee Freight Plan (2018)

3- Physical Infrastructure Needs for Autonomous & Connected Trucks, Johan Tobias Paulsen, June 2018

Figure 7-1. Potential Freight Improvements — I-26



8. 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.

To assess needs and develop a universe of potential actions that support economic development, the study team interviewed key stakeholders and analyzed future employment projections to determine economic development focus areas in each corridor. Areas forecasted to see significant employment growth were noted in Technical Memorandum 1. Stakeholder input was collected specific to economic development potential along the corridor, including areas that may benefit from additional Interstate access points in the future. Studies of these areas that may be subject to development pressure were included in the universe of potential solutions. Other potential solutions that impact regional economic development are included in the capacity, safety, operations, and freight sections of this report.

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. According to the Kingsport MTPO, additional development of open land is also expected in the Meadowview Basin where I-26, SR-126, and SR-93 converge. 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. See Table 8-1 and Figure 8-1 for a summary of potential alternatives to support economic development.

Figure 8-1. Potential Economic Development Improvements — I-26

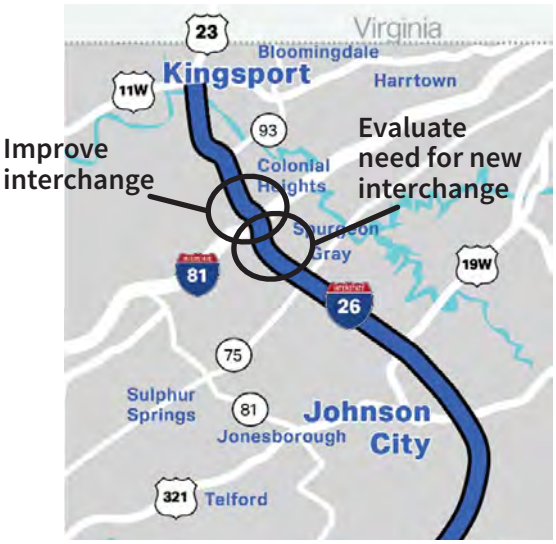


Table 8-1. Potential Economic Development Improvements — I-26

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended solution
ED1	Washington	Eastern Star Rd	SR-75	Evaluate need for additional interstate access point to accommodate economic growth	Public/ Stakeholder
ED2	Sullivan	I-81 Interchange		Improve interchange geometry and capacity to accommodate expected economic growth	Public/ Stakeholder

9. Transit/Bicycle and Pedestrian/TDM

While driving is the mode of choice throughout the I-26 corridor, it is important to ensure that multimodal transportation options exist. Several multimodal related deficiencies were discussed in Technical Memorandum 2, 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.

Tables 9-1 and 9-2 list identified transit, transportation demand management (TDM), and bicycle/pedestrian projects that would help support mobility in the I-26 corridor. The list of recommendations was compiled from existing transit plans, bicycle/pedestrian plans, public and stakeholder comments, as well as best practice recommendations resulting from this corridor study's data analysis.

Several of the projects included in Table 9-1 have been starred. The starred projects are those that most strongly relate to the I-26 corridor and include T3, T9, and T10. These recommendations include a Commuter-Focused Rideshare in Johnson City and Regional Transit Access between Johnson City and Kingsport. All three recommendations work to directly address the regional transit connection deficiency outlined in Technical Memorandum 2.

- 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.
- 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, including:
    - 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
  - Studies could further be expanded to include all interchanges and identify locations where new pedestrian/bicycle crossings may be appropriate.

Table 9-1. Potential Transit Improvements — I-26

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solutions
T1	Washington	Throughout Network		Recommended Fixed-Route System: All-day, fixed-routes would operate on a 60-minute cycle, arriving and departing from the JCT Transit Center. The routes have been designed so that potential bi-directional transit service could be provided in the future.	JCT Comprehensive Analysis
T2	Washington	Throughout Network		Decrease headway times from 60 minutes to 30 minutes during peak service hours.	JCT Comprehensive Analysis
*T3	Washington	JCT Transit Center	Citi Commerce Solutions/ Frontier Health (Gray)	Commuter Focused Rideshare: The two largest employers currently not served by JCT are Citi Commerce Solutions and Frontier Health. They are both located in Gray within 1,000 feet of each other on Bobby Hicks Hwy.	JCT Comprehensive Analysis

Table 9-1. Potential Transit Improvements — I-26

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solutions
T4	Washington	Throughout Network		Service expansion including: • Increased evening service • Same-Day service for ADA clients • Increased evening service for ADA clients • More frequent service • Geographic service expansions within the Urbanized Area • Sunday and Special Event service	Johnson City MTPO 2045 Metropolitan Transportation Plan
T5	Washington	Throughout Network		Increase information and awareness through: • Increased technology use • Increased awareness of transit benefits in the community • Increased coordination between providers • Increased general public outreach related to available services • Educate community leaders on transit needs	Johnson City MTPO 2045 Metropolitan Transportation Plan
T6	Sullivan	Throughout Network		Expand KATS service hours to include weekday early morning and evening service and weekend service.	Kingsport MTPO 2040 LRTP
T7	Sullivan	Throughout Network		Enhance planning activities and public education efforts to raise awareness of transit opportunities within the region.	Kingsport MTPO 2040 LRTP
T8	Sullivan	Throughout Network		Evaluate current accessibility to transit stops and identify ways to improve first-mile and last-mile connections.	Kingsport MTPO 2040 LRTP
*T9	Washington, Sullivan	Johnson City	Kingsport	Study a commuter route between Johnson City and Kingsport.	Data Analysis
*T10	Washington, Sullivan	Various Locations		Designate park-and-ride lots near SR-93, SR-347, and SR-75	Public/Stakeholder

*Improvements with the highest potential to impact travel on I-26. These alternatives will be included in the universe of alternatives for I-26.

Table 9-2. Potential Bicycle and Pedestrian Improvements — I-26

ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solutions
BP1	Washington	E. Watauga/ E. Unaka from Oak St	E. Watauga/ E. Unaka to Elm St	Add bicycle lane/multi-use path on SR-400 through I-26 interchange to accommodate bicycles on proposed state bicycle route (Chattanooga to Mountain City).	Data Analysis
BP2	Sullivan	W. Stone Dr from Stonegate Rd	W. Stone Dr to Union St	Add bicycle lane/multi-use path on SR-1/US-11W (W. Stone Dr) through I-26 interchange to accommodate bicycles on proposed state bicycle route (Nashville to Bristol).	Data Analysis
BP3	All	Throughout Network		Consider conducting a study to identify bicycle and pedestrian connectivity and safety improvements at existing U.S. and State Route interchanges.	Data Analysis

10. Universe of Alternatives

Sections 4 through 9 of this technical memorandum detail development of possible solutions to identified deficiencies in the areas of capacity, safety, transportation system management, freight, economic development, and multi-modal options. Table 10-1 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 10-1. Potential Solutions By Category — I-26

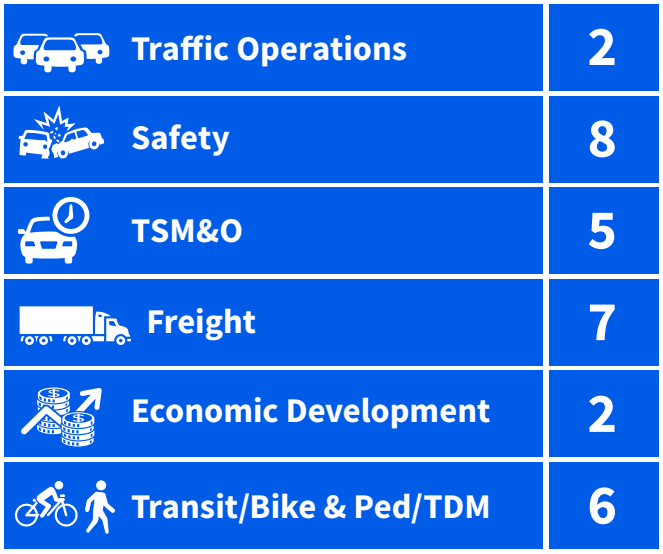


Table 10-1. Universe of Alternatives — I-26

	ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
Traffic Operations	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
	S3	Washington	SR-91/E. Main Street/E. Market Street	US-321/ University Parkway	Construct EB Auxiliary Lane	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)
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

Table 10-1. Universe of Alternatives cont. — I-26

	ID	County	Termini (From)	Termini (To)	Description	Source of Recommended Solution
TSM&O	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 east 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 Kingsport	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		Consider a study to identify 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

11. Solutions Screening Process Methodology

Technical Memorandum 4 for the Study will filter the I-26 universe of alternatives through a solutions screening and prioritization process (see Figure 11-1). This process will evaluate solutions based on their impact on mobility and safety, potential environmental impacts, cost, and potential economic impacts. Ultimately, the prioritized solutions will both resolve the identified deficiencies and have a high benefit/cost ratio.

Phase 1 Alternative Screening

The Phase 1 alternatives screening process is intended to eliminate solutions with evident fatal flaws. This two-phase process will evaluate each possible solution 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 receive a "NO" response for questions 1, 2, or 3, or a "YES" response for questions 4 or 5 will be eliminated and will not move forward to the Phase 2 alternative screening. Exceptions include projects where the potential is high for environmental/cultural impact mitigation.

Phase 2 Alternative Screening

The Phase 2 alternatives screening process will utilize performance measures identified in Section 3 to further refine the list of feasible alternatives. Additionally, a benefit/cost analysis will be conducted. Potential solutions that pass the Phase 1 Screening will be 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 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 improve incident management?
12. Does the proposed solution provide potential economic development opportunities?
13. Does the proposed solution have the potential to reduce VMT?
14. Does the benefit/cost ratio of the proposed solution exceed 1.0?

Projects which receive only "NO" responses will be eliminated and will not move forward as feasible multimodal solutions.

Identification of Recommended Solutions

Potential solutions which receive a "Yes" in the Phase 2 screening will be carried forward to the list of recommended solutions. The recommended solutions will move into the project prioritization phase, wherein recommended solutions will be ordered based on their effectiveness, potential for solving identified deficiencies, and benefit/cost ratio.

Figure 11-1. Solutions Screening Process