Interstate 65 Multimodal Corridor Study

Technical Memorandum 2: Assessment of Existing and Future Deficiencies

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EXECUTIVE SUMMARY

1. Introduction

The Interstate 65 (I-65) corridor supports a wide range of land uses, activity centers, and travel in Tennessee, serving as the backbone for economic development and growth in the region. As population and employment continue to expand in the corridor, new travel demands are placing additional pressures on the interstate as well as parallel and intersecting highways. Consequently, familiar challenges such as increased travel times, traffic congestion, and traffic incidents are becoming the norm, especially during peak periods, and undermining the transportation system's ability to sustain future growth.

The following analysis evaluates transportation deficiencies and needs in the I-65 corridor across a broad spectrum of transportation issues, modes, and services, including:

- Land use and economic development;
- Highway capacity and travel demand;
- Safety;
- Intelligent transportation systems (ITS);
- Freight;
- Transit; and
- Walking and bicycling.

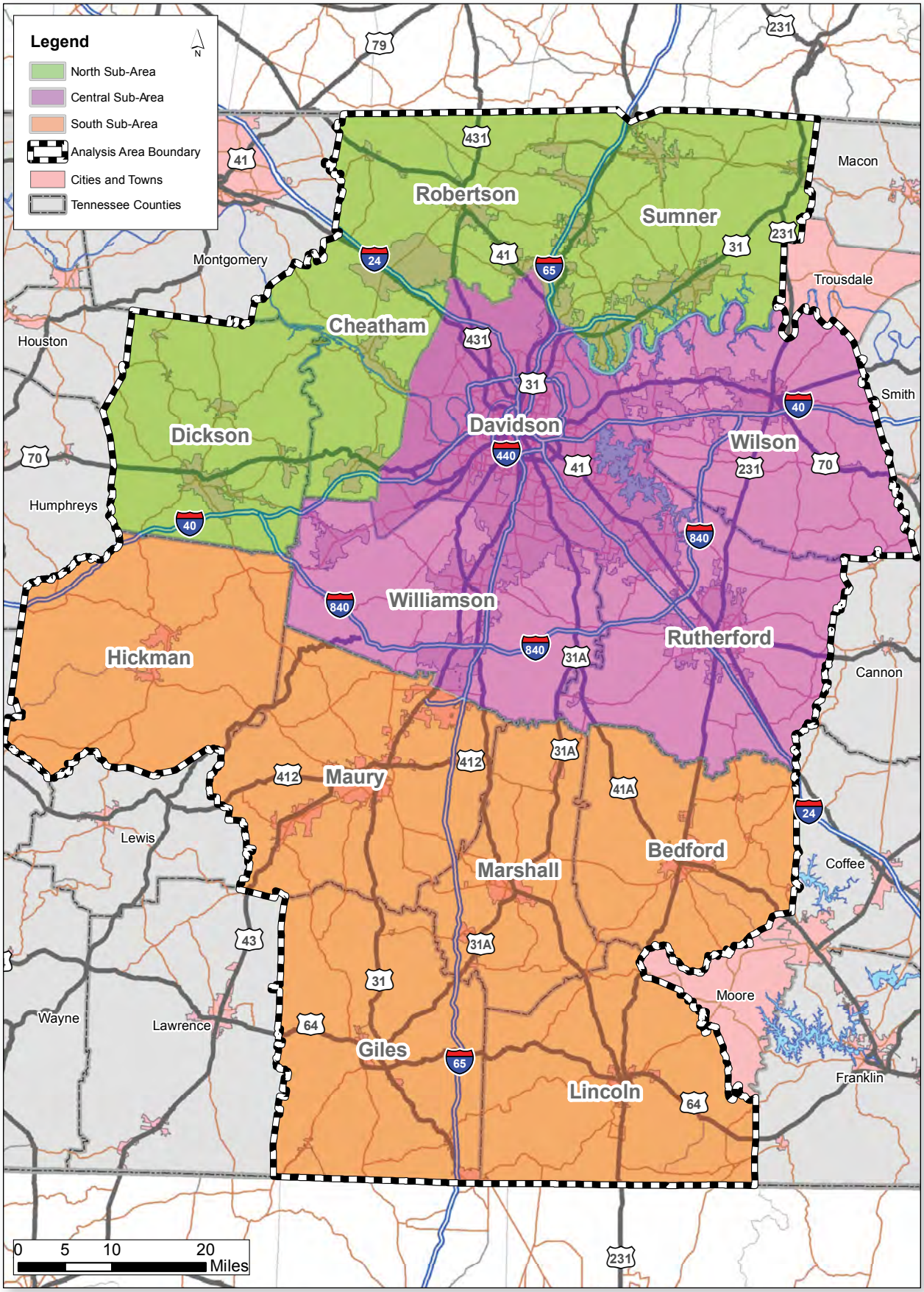
The analysis specifically focuses on the trend scenario for the I-65 corridor – i.e., existing and future conditions if current practices, plans, and policies remain unchanged. Building on population and employment projections from the Tennessee Department of Transportation's (TDOT) and the Nashville Area Metropolitan Planning Organization's (MPO) travel demand models, the trend scenario includes assumptions about major capacity and interchange projects currently programmed for construction. To supplement the technical analysis, public workshops and internet survey tools have generated a large number of comments from stakeholders throughout the corridor.

2. Land Use and Economic Development

Although the focus of the I-65 study is on the corridor's transportation system, the underlying growth and development patterns will largely determine how transportation improvements can and should adapt over time to address deficiencies and meet new needs. Following are key findings related to growth and development in the I-65 corridor.

- Counties in the study area (Figure ES-1) are expected to add approximately 1,215,000 more people and approximately 830,000 more jobs between 2010 and 2040, increases of 69 percent and 77 percent, respectively.
- Growth within one mile of existing I-65 interchanges will strongly tilt toward employment, with three jobs added for every new resident, for a total of approximately 154,000 new jobs within the interchange areas by 2040 – or one in five new jobs in the study area.
- Many significant new developments near I-65 are already in some stage of the planning and development process. Projects such as the North Gateway Corridor in Portland are undertaking land use policy planning while others such as Berry Farms in Franklin are currently phasing construction. Nashville's new comprehensive plan calls for significant increases in development intensities along the corridor to absorb projected growth.

Figure ES-1. Study Area Map with Sub-Areas



3. Highway Capacity and Travel Demand

The population and employment growth projections serve as the foundation for evaluating existing and future highway capacity and travel demand in the trend scenario. While current deficiencies in the corridor tend to be focused between Moore's Lane/SR 441 and downtown Nashville, daily trips are projected to nearly double over the next 25 years leaving much of I-65 in fair to poor operating conditions. Following are key findings from the highway capacity and travel demand analysis.

- Maximum Average Annual Daily Traffic (AADT) along I-65 is 172,104, found in south Nashville between the I-440 and the Harding Place/ SR 255 interchanges. Of note, traffic volumes nearly double south of SR 386 and north of I-840 over volumes immediately adjacent to those locations.
- In 2010, there were 2,532,128 daily trips within 1 mile of the I-65 corridor. Of these daily trips, 130,543, or 5.4 percent, were truck trips. The number of daily trips is expected to increase 82 percent by 2040 to 4,602,348 trips, with the percentage of truck trips remaining constant.
- Daily VMT is projected to increase at near the same rate as population growth between 2010 and 2040. The largest increases will be experienced on both urban and rural arterials within the corridor. However, VMT per capita shows decreases on all interstate facilities, urban arterials, and rural local roads. This reflects increasing urbanization in the corridor as existing regional centers expand and new centers develop in high-growth areas.
- In 2010, most of I-65 functions in good operational conditions, with Level of Service (LOS) A to C. LOS decreases to LOS D and E at select locations around the Nashville area – specifically, near the I-65/SR 386 (Vietnam Veterans Boulevard) interchange, the I-65/I-40 interchange in North Nashville, the I-65/I-40 interchange in downtown Nashville, the I-65/I-440 interchange, and from Harding Place to Cool Springs. By 2040, LOS degrades to LOS D, E, and F for most of I-65 between the Kentucky state line and Spring Hill in Maury County. I-65 is expected to continue to operate well in the rural southern sections of the roadway. It is important to note that the V/C ratios and corresponding LOS reflect daily traffic volumes and do not represent peak travel periods and traffic incidents. Figures ES-2 and ES-3 show 2010 and 2040 LOS in the analysis area, respectively.
- Several parallel arterials are projected to be approaching capacity in 2040, and additional spillover traffic will push them above capacity. Volume increases range from 50 percent on Nolensville Pike/US 41A to 520 percent on Horton Highway/US 31A.
- The corridor features frequent bottlenecks in the AM and PM peak periods in both the northbound and southbound directions, extending as far north as Millersville in Sumner County to Cool Springs in Williamson County.
- Ten Origin-Destination (O-D) pairs, representing key commuting corridors in the analysis area, were analyzed. Travel times are forecasted to increase between 70 and 100 percent in six of the ten O-D pairs analyzed, with the greatest increases occurring in pairs extending from Spring Hill to Nashville. Trips from Franklin to the Nashville core, for example, are projected to double from 29 minutes to 59 minutes, and although a shorter distance, the duration of trips from Franklin to Brentwood will increase from 10 minutes to 21 minutes.

4. Safety

Crashes were analyzed over the three-year period between 2013 and 2015, with crash hotspots identified as locations with crash rates significantly above the statewide average. The safety analysis also examined potential factors at crash hotspots, including crash types, congestion, and roadway geometry. It is important to underscore that geometric designs which are less than optimal are sometimes permitted and constructed due to other factors preventing desired design standards. Key findings of the analysis include the following issues.

- Ten crash hotspots, ranging from individual interchange locations to segments between three and nine miles in length, were

Figure ES-2. 2010 Daily LOS along I-65

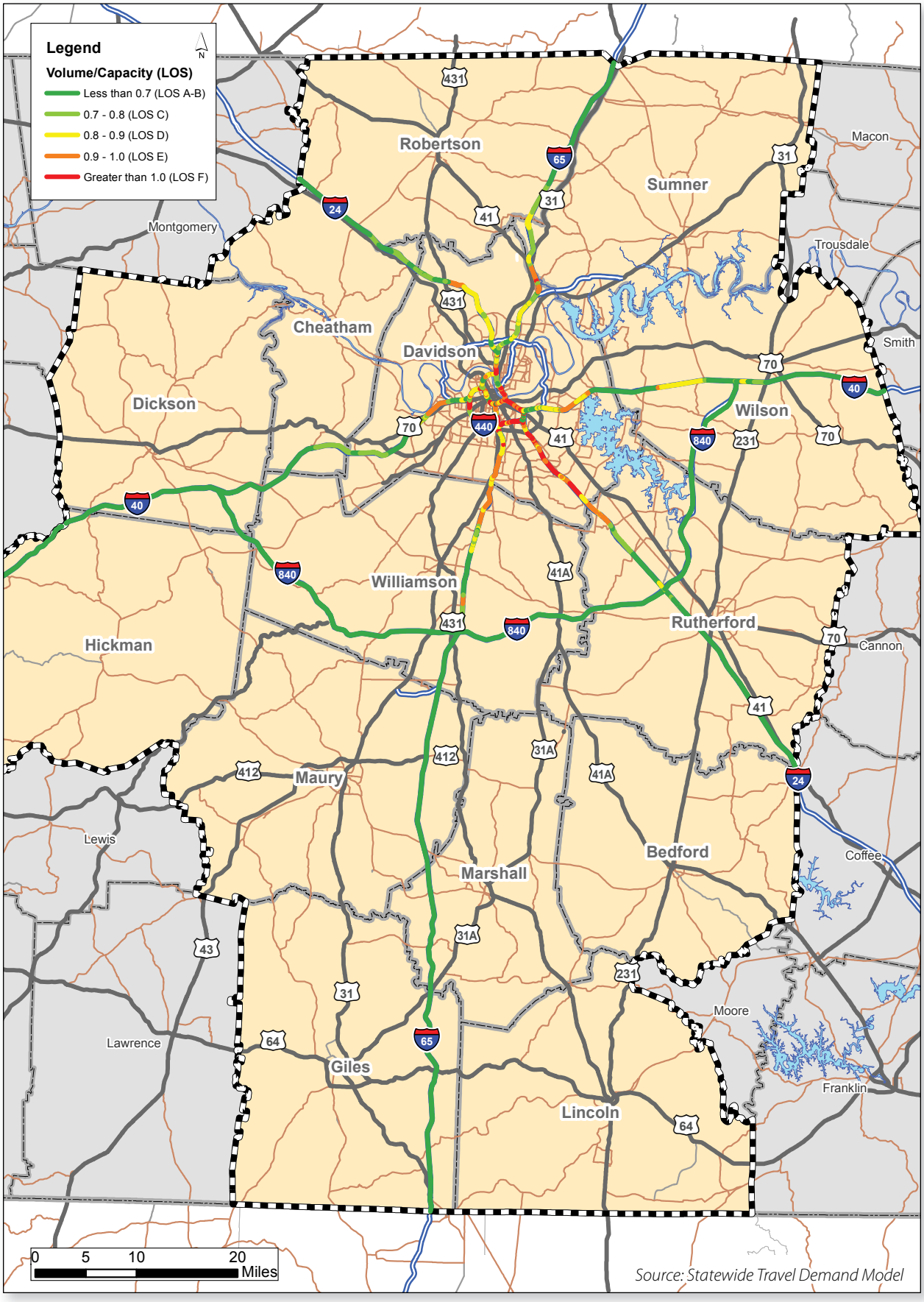
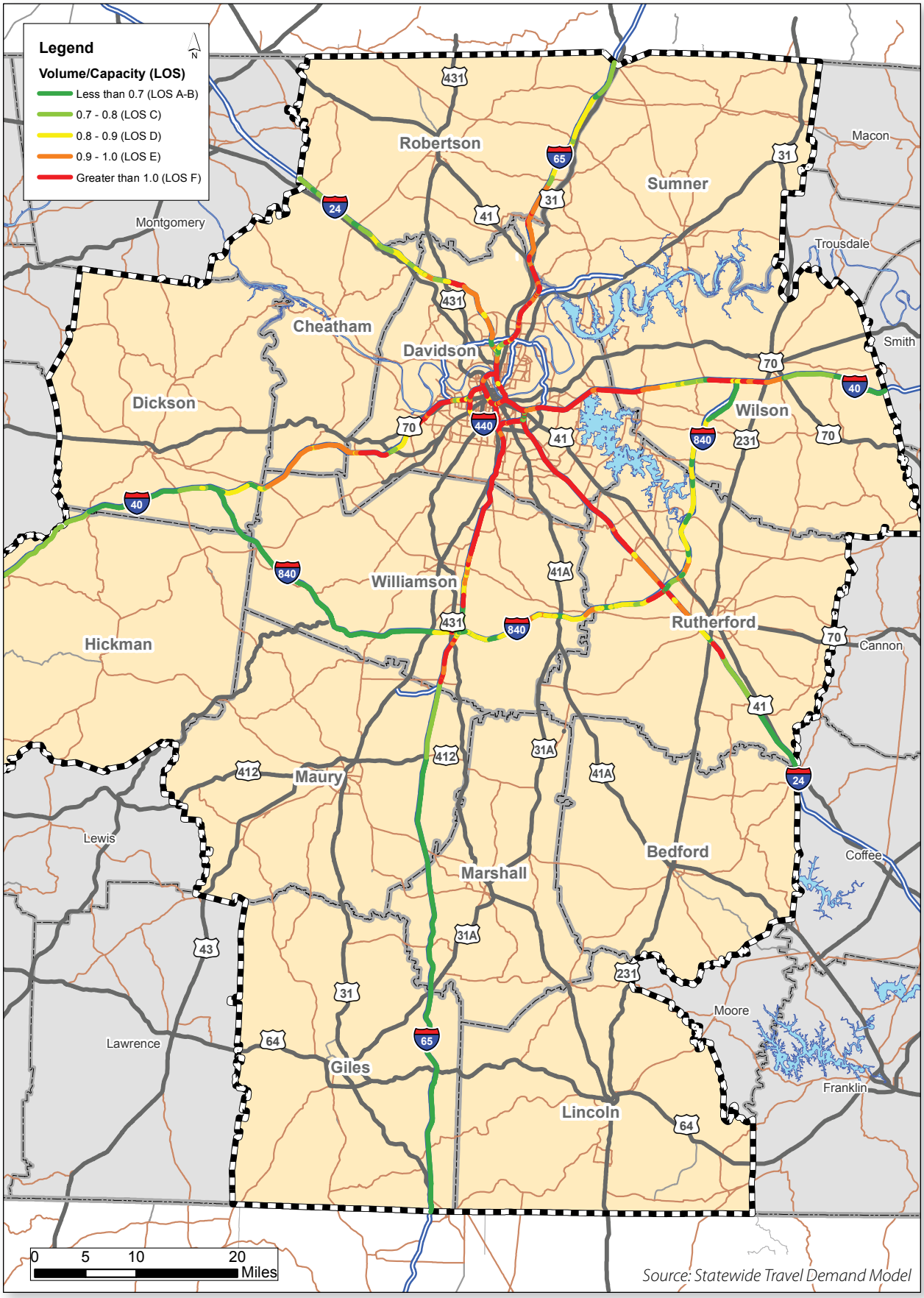


Figure ES-3. 2040 Daily LOS along I-65



documented. Additionally, injuries and fatalities resulting from reported crashes from 2013 to 2015 were compared by travel market, with large increases in the East Nashville/ Madison, Nashville core, and South Nashville travel markets. While the number of fatalities remained consistent from 2013 to 2015, the number of injuries increased by 18 percent.

- Rear-end crashes remain the most common cause of crashes in both congested and non-congested crash hotspots – 42 percent of crashes in congested crash hotspots and 44 percent of crashes in non-congested crash hotspots. However, sideswipes in the same direction make up a larger portion of crashes in congested areas as compared to non-congested areas. Additionally, crashes occurring with no collision with a vehicle (i.e., hitting a fixed object or obstruction) make up a larger portion of crashes in non-congested areas as compared to congested areas.
- Although most of the crash hotspots included geometric deficiencies, additional analysis would be required to determine the full impact of the geometric design on crash history.
- Interstate 65 just north of I-24 and through Franklin and Thompson's Station has traffic annual growth rates over 1.0 percent. The crash hotspots in these areas are a key safety concern as traffic increases over time. The Nashville downtown loop is another area of concern, with annual growth rates between 0.5 and 1.0 percent.
- Three areas of primary concern exist for the impact of a crash to regular operations. including I-65 along the Nashville downtown loop, I-65 through Franklin, and I-65 in Goodlettsville north of the merge with SR 386/ Vietnam Veterans Boulevard.
- Pedestrian and bicycle crashes within one-mile of I-65 were also analyzed for the three-year period 2013-2015. In total, there were 429 crashes involving a pedestrian or bicyclist. Fifteen of the crashes occurred on I-65, and 414 took place within one mile of the interstate. Of the non-interstate crashes, 77 percent involved pedestrians.

5. Operations and Maintenance

Operations and maintenance investments, services, and strategies are pivotal to the long-term safety and efficiency of travel in the I-65 corridor. While operations and maintenance levels are currently meeting basic needs, as the corridor grows and new technologies are introduced, the interstate itself will change and increasingly function as part of a dynamic connected system, rather than as a largely distinct highway facility.

- In 2006, the Federal Highway Administration (FHWA) set standards determining that a good quality roadway must have an International Roughness Index (IRI) of 95 inches per mile or lower. The average IRI for I-65 is 63, with Davidson and Robertson Counties exhibiting the highest scores.
- On I-65, two bridges are classified as structurally deficient, one crossing the Cumberland River in Nashville and the other crossing Fivemile Creek in Williamson County.
- There are numerous Intelligent Transportation System (ITS) devices on I-65 as part of the TDOT Smartway system including Dynamic Message Signs (DMS), Closed Circuit TV (CCTV) cameras, Radar Detection System (RDS), and fiber optic and wireless communications. TDOT has proposed an expansion of the Smartway system along I-65 that would extend coverage from US 31W (Exit 98) to approximately two miles north of the interchange at SR 76 (Exit 108) and approximately one mile south of the I-65 and I-840 interchange (Exit 59).
- ITS state of the practice highlights opportunities to advance ITS in the I-65 corridor, including managed lanes; Active Traffic and Demand Management (ATDM) – such as ramp metering, Dynamic Lane Reversal/ Contraflow Lane Reversal, and Queue Warning deployments; DShL/Hard Shoulder Running/ Temporary Shoulder Use for transit operations; the FRATIS application for freight; truck parking lots; and roadside infrastructure supporting connected and autonomous vehicles on the DSRC bandwidth.

6. Transit

The I-65 Study area is served by a variety of local transit and express commuter routes, including ridesharing options. Currently, however, many of these systems do not complement one another. Providing alternatives to single occupancy vehicle travel by allowing individuals to travel continuously and seamlessly across modes is essential to support growth and development in the I-65 corridor.

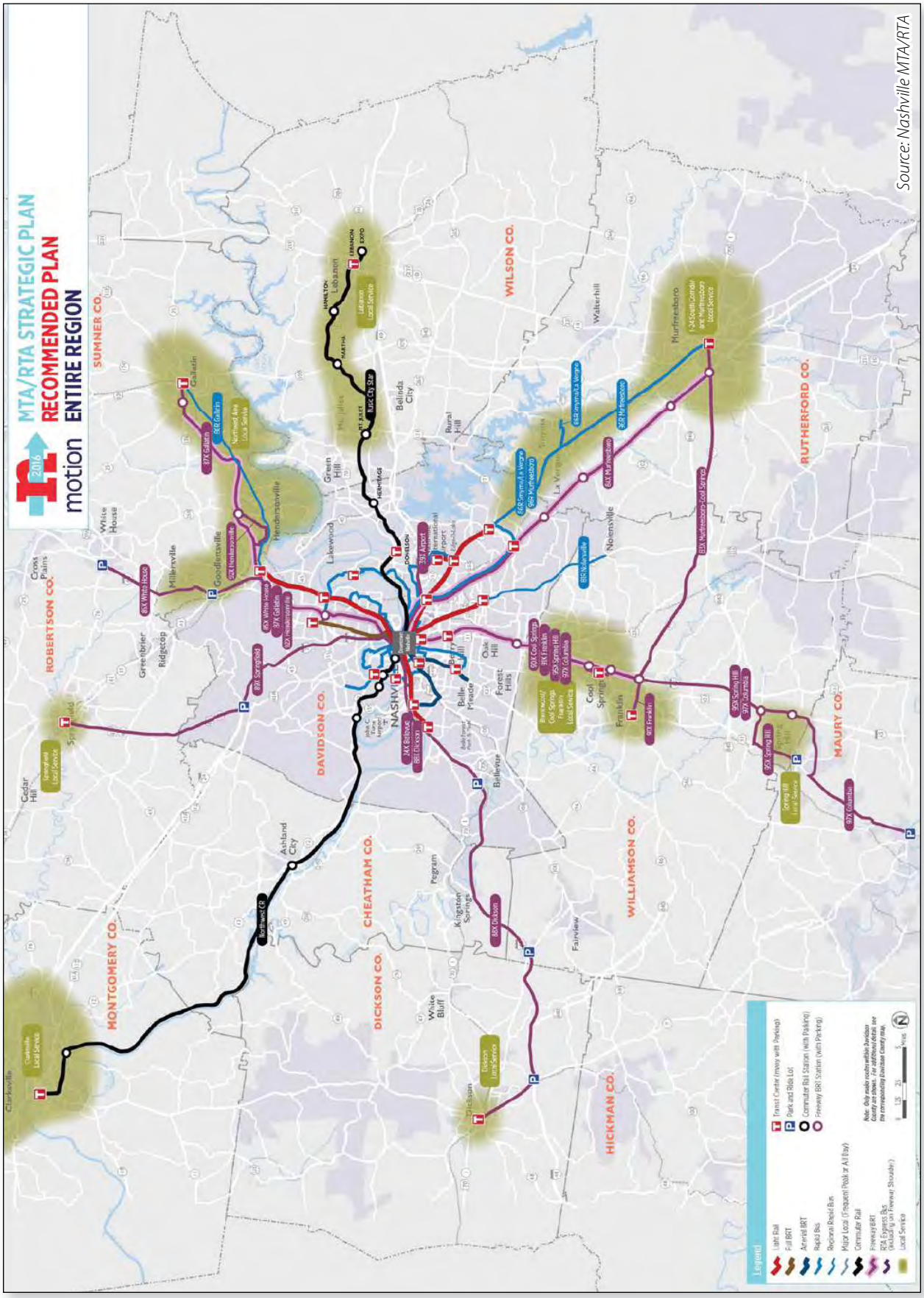
- MTA and RTA services in the I-65 corridor are largely limited to express route service targeting commuters traveling between Maury, Sumner, Robertson, and Williamson Counties and downtown Nashville. All I-65 based express routes are limited to two or three inbound and outbound trips in the morning and afternoon, and because they operate during peak periods, they encounter high levels of congestion. Importantly, existing RTA express routes are not designed either to serve reverse commute trips.
- Existing express bus routes along I-65 serve downtown Nashville, and except for the Spring Hill route (Route 95X), also connect directly to midtown Nashville and Vanderbilt University Medical Center. Beyond the Nashville core, there is an overall lack of access to activity centers, especially in Williamson and Sumner Counties.
- The MTA and RTA recently completed and adopted nMotion, a regional strategic transit plan to improve access and mobility throughout middle Tennessee. The nMotion plan includes more than 24 recommendations for Bus Rapid Transit (BRT), Bus-on-Shoulder Service (BSS), Light Rail Transit (LRT), express bus transit, regional rapid bus, and improved local services in the I-65 corridor. The final recommendations of the nMotion plan are included in Figure ES-4.
- The Cool Springs Multimodal Transportation Study outlines strategies for expanding transportation options and supporting transit riders, bicyclists, pedestrians, and transportation demand management. In addition to expanding express bus route services in the short-term, the study calls for evaluating high-capacity transit as ridership levels grow.
- Through the Mid-Cumberland Human Resource Agency and the South Central Tennessee Development District (SCTDD), demand response transit services are available to anyone regardless of age or income on a first-call, first-served basis Monday through Friday from 6:00 AM to 6:00 PM. Additionally, SCTDD offers deviated fixed route service for Maury County to surrounding areas and fixed route commuter bus service from Lawrenceburg to Nashville and Murfreesboro. Projected population and employment growth in the I-65 corridor will generate additional needs for these services, and private rideshare companies may provide a partnership opportunity for transit providers in lower demand areas.

7. Walking and Bicycling

For walking and bicycling systems to support daily travel, access to everyday needs, and local economic development, they need to be safe, comfortable, and convenient. Bicycle and pedestrian facilities in the I-65 corridor are too often either absent, disconnected, and/or designed to minimum standards.

- Many of the existing state bicycle routes were signed as "Bike Routes" if the highway had paved shoulders four-feet or wider. The newer planned state bicycle routes were defined during the most recent state bicycle route plan update in 2014. Like the existing state bicycle routes, the planned bicycle routes are proposed mostly on US highways in the I-65 corridor, and do not augment local or intercity connections significantly.
- The Nashville Area MPO Regional Bicycle and Pedestrian Study (2009) identifies both sidewalk and bikeway priorities in the five-county region, including the I-65 corridor. In many respects, the 2009 regional bikeway network vision map combines the existing and proposed state bicycle routes into a single plan. Like the traditional approach to designating state bicycle routes, the MPO plan highlights paved shoulders four-feet or greater as the primary bikeway design accommodation. Prioritized sidewalk improvements in the regional study

Figure ES-4. nMotion Recommended Plan



focus on arterials and collectors within urban growth boundaries, and assume five-foot sidewalks on both sides of the road. In addition to the regional study, several communities in the I-65 corridor have developed bicycle, pedestrian, greenway, and trail plans.

- Commercial areas, residential neighborhoods, mixed-use districts, and adjacent transportation systems can all benefit from improved bicycle and pedestrian facilities and networks. Planning for a 20-minute walking (1.0 mile) and bicycling (3.0 miles) travel shed around or near interstate interchanges can help balance competing demands for local and regional and work and non-work travel. Complementing walking and bicycling, transit and shared mobility services can expand and extend transportation options in the I-65 corridor.

8. Transportation Demand Management

Like ITS and ATDM, Transportation Demand Management (TDM) is experiencing dramatic changes as new technologies and services are introduced. Although the I-65 corridor includes some TDM programs and strategies, commuting mode splits in the corridor underscore the opportunity to reduce trips and shift more trips to different modes or different time periods. Moreover, as new technology driven services are introduced, TDM policies and programs will need to adapt to fully maximize the available opportunities.

- Mode splits in the study area for ridesharing are consistent with statewide and national rates. However, in the I-65 corridor's key O-D pairs, ridesharing rates are as much as two-thirds higher than statewide and national averages, specifically from Spring Hill to the Nashville core. Mode splits for transit and other modes of travel, such as bicycle and pedestrian, are significantly below national rates in the study area, and even lower in the key O-D pairs.
- Both the RTA and TMA Group work with regional rideshare partners to manage a fleet of commuter vanpools throughout middle Tennessee, and carried more than 241,000 riders in 2014. While the commuter mode share for ridesharing is high, HOV violation rates and low park-and-ride utilization highlight the opportunities to create move effective ridesharing and transit systems.
- HOV lane violation rates ranged from 63 percent to 96 percent on I-65, similar to other HOV lanes in the region. Nationally, non-barrier separated HOV facilities typically have violation rates between 10 and 20 percent and up to 60 percent during peak periods of congestion in the absence of effective enforcement.
- Park-and-ride lots along the I-65 corridor are generally underutilized compared to the overall system, 36 percent to 53 percent, respectively. Many of the park-and-ride lots lack ADA accessibility and sidewalks, do not have bicycle parking facilities, and are not conveniently located.
- Increasingly, traditional TDM programs are coupled with traffic management programs as new technologies support a more integrated approach to matching travel supply and demand. Within TDM, technologies that support real-time information and individual choice can provide a greater number of travel options throughout the day for a wider variety of people.

9. Freight and Intermodal Facilities

Freight movement varies considerably across the I-65 corridor. The analysis of the available freight data highlights the following deficiencies and needs in the study area's freight network.

- Truck is the major mode for freight movement in the study area and truck volumes are projected to increase by more than 50 percent on most of the study area roadway network between 2010 and 2040. Between 2010 and 2040, truck volumes on I-65 north of Nashville will significantly increase (68 percent), and more than double on I-40 east and west of Nashville (110 percent). The overlap of I-65 and

I-24 is projected to carry nearly 24,000 trucks daily in 2040.

- Inbound and outbound freight to the study area is primarily transported by trucks with inbound tonnage projected to more than double by 2040. Air freight shows a large percentage increase by 2040 for both inbound and outbound volumes. Outbound freight transported by rail is projected to grow by roughly 147 percent by 2040, which may result in rail capacity issues and freight diversion to truck and water.
- Davidson County is the destination for over 40 percent of the total freight tonnage in the study area with I-65 accounting for nearly the combined total of I-24 and I-40 in terms of tonnage. Davidson and Rutherford counties are the origin of roughly 25 and 12 percent of the total freight tonnage, respectively, with a large portion of that exiting the study area by I-65.
- Through truck traffic entering and exiting on I-65 is projected to increase by 89 percent by 2040. Total truck traffic entering I-65, I-24, and I-40 and exiting I-65 is forecasted to increase by 82 percent, which will translate into higher truck volumes on I-65, I-440, and I-840. In 2012, there were over 240 million tons of through freight utilizing the rail network in the study area which is far more than the other modes including trucks. Air freight is projected to increase substantially by both tonnage and value, while water freight will experience more modest increases. Through rail freight, in both tonnage and value, will decrease by 12 and 29 percent, respectively.
- The major air freight generator is the Nashville International Airport in an area with high V/C ratios indicating access issues for inbound and outbound freight by air. The major rail facility, Radnor Yard, is located just south of Nashville along I-65 in an area also with high V/C ratios indicating access issues. The major water facility, the Nashville Port, is located along the Cumberland River in Nashville where the V/C ratios are the highest.
- Freight diversion has a greater potential where there is an existing supply chain for the commodities to be diverted. From an infrastructure/logistics perspective, the potential exists for modal shifts across truck, rail, and water. Gravel and non-metallic minerals are the primary candidates for modal shift among inbound commodities, while waste and scrap is a major outbound commodity with a potential for modal shift. The potential for diversion assumes that rail will have the capacity available to accommodate the additional demand.
- There are only six public locations with truck parking in the study area: three on I-65 south of Nashville, one on I-65 at the border with Kentucky, and two on I-40 west of Nashville.
- The Panama Canal expansion, potential Radnor Yard relocation, and last mile freight are emerging global and national freight issues that will impact freight movement in the I-65 corridor. While the potential impacts are largely uncertain at this time, policy options and scenarios related to each issue should be considered and evaluated.

10. Traditionally Underserved Populations

Transportation facilities, services, and conditions impact people and communities differently. Traditionally underserved populations, particularly communities that are predominately low-income and/or minority, benefit when transportation systems are balanced across modes and offer more transportation choices. Using a high-level analysis of where traditionally underserved populations are located and findings from both the technical analysis and public outreach, several key issues were identified for minority and low-income populations in both urban and rural areas of the corridor.

- Access to employment and activity centers is an issue in both urban and rural areas of the corridors. In urban areas, accessibility to new centers outside the traditional core and land-use policies that promote multimodal options are key. In rural areas, connecting residents in declining employment centers to existing and emerging employment centers will require quality connections to county

seats and town centers, as well as facilities and services for longer distance commuting.

- Transportation choice is also an issue within both urban and rural areas. Traditionally underserved populations in urban areas face barriers to economic and physical well-being when vehicle ownership is out of reach. High quality multimodal choices can help reduce these barriers and help these communities realize transportation cost savings while maintaining high levels of accessibility. Rural residents lack meaningful choices outside of on-demand service. Additional transportation choices that serve commuting needs of rural residents should be examined, including express bus transit, expanded on-demand service, and ridesharing.
- Urban residents face safety concerns when walking or bicycling. Bicycle and pedestrian crash hotspots are concentrated in the urban core of Nashville, overlapping low-income, minority, and public housing communities. Better accommodations for these travelers is needed going forward.

11. Public and Stakeholder Outreach

As part of the existing deficiencies and future needs phase of the I-65 Multimodal Corridor Study, TDOT held three public workshops and met with many stakeholder groups throughout the analysis area to present an overview of the project, discuss preliminary findings, and solicit feedback on corridor vision, priorities, and specific areas of concern. Additionally, two outlets for public comment have been continually offered on the project website. A survey hosted on a Survey Monkey platform has been available for public input since February 2016, and an interactive mapping tool has been available on the project website. A heat map showing the distribution of comments received on the interactive mapping tool is included in Figure ES-5. To date, more than two thousand responses have been received. While the feedback reflects a wide array of concerns, opportunities, and suggestions, the main points are presented below.

- Broadly, the public feedback has largely focused on three overarching themes: congestion, access and connectivity, and safety.
- While the public feedback identified issues throughout the corridor, most of the comments were focused along the I-65 "South Corridor" between downtown Nashville and the Franklin area in Williamson County.

The public has expressed a preference for a multimodal suite of solutions for the corridor, including traditional capacity and reconstruction projects, expanded transportation choices, and improved operations and maintenance. Of those who expressed a preference for expanded transit within the corridor, some form of rail transit was the most preferred mode choice.

12. Summary Map

Figure ES-6 presents a summary map of select major findings. The map focuses on the identified deficiencies and needs that can be tied to specific locations within the analysis area. System-wide deficiencies and needs are not included on the map, but will be equally considered to inform the development of multimodal solutions for the corridor.

Figure ES-5. Geographic Distribution of Wikimaps Comments

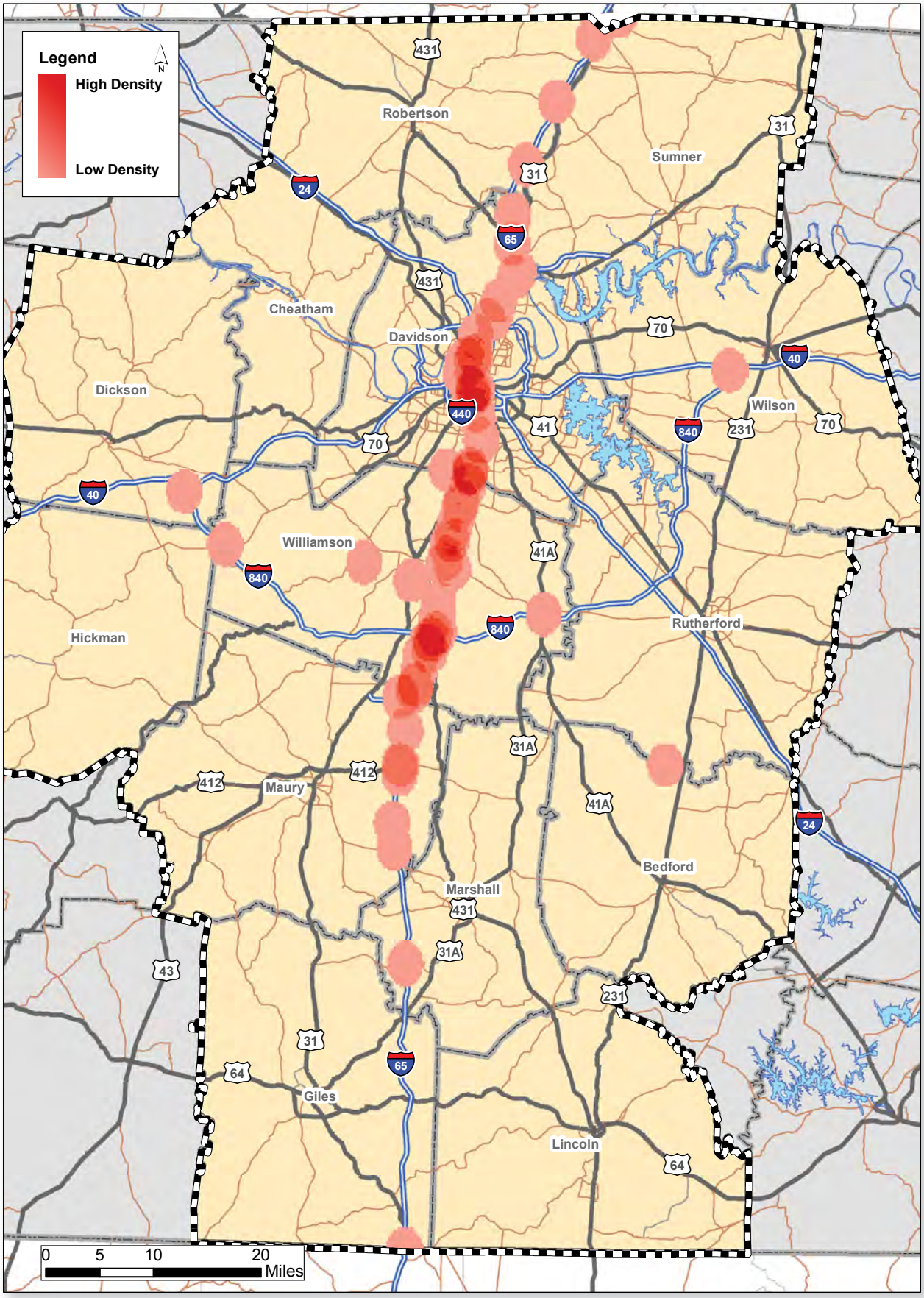


Figure ES-6. Summary of Deficiencies and Opportunities - Analysis Area

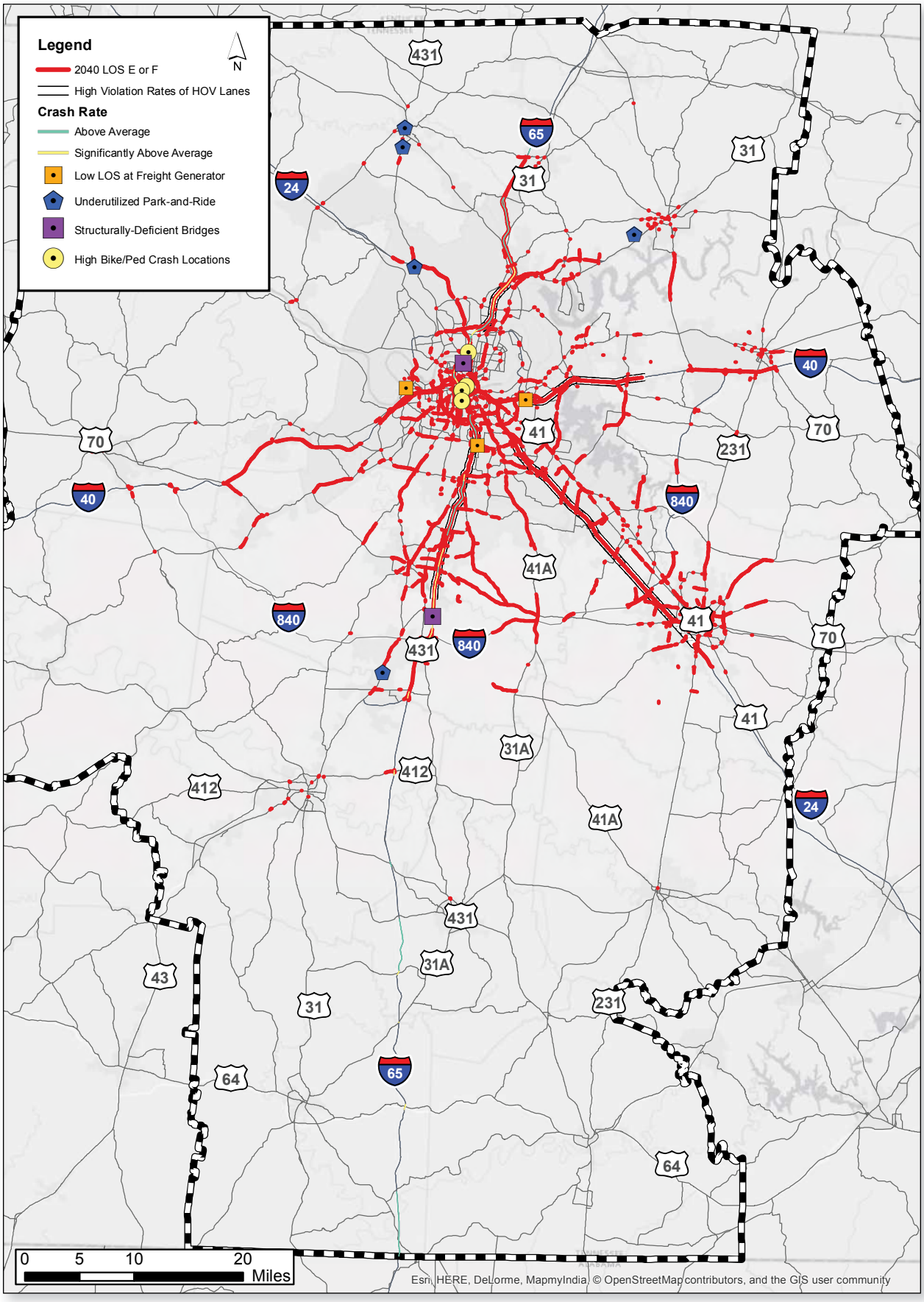
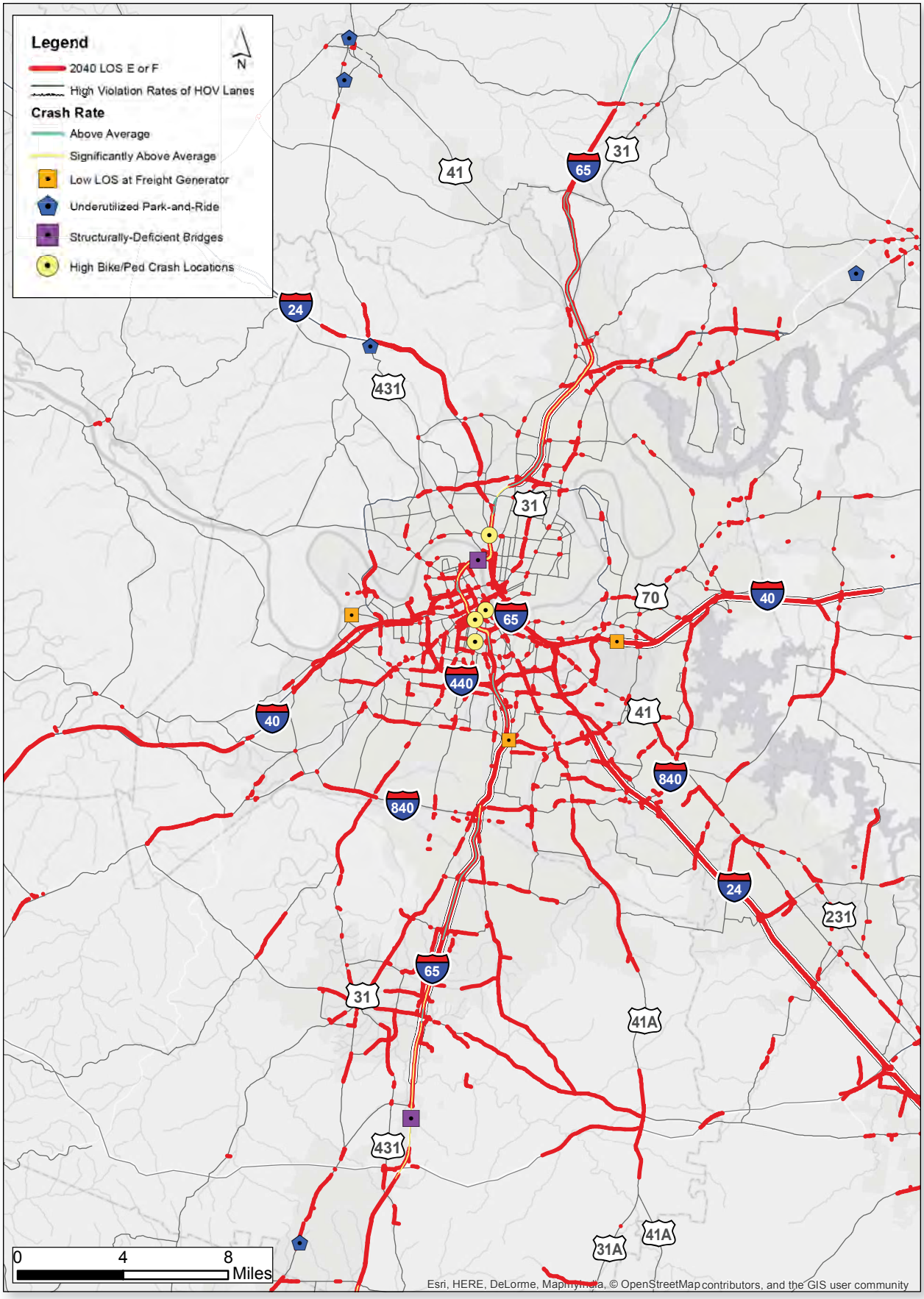


Figure ES-7. Summary of Deficiencies and Opportunities - Davidson County Zoom



I-65 MULTIMODAL CORRIDOR STUDY

TECHNICAL MEMORANDUM 2: ASSESSMENT OF EXISTING AND FUTURE DEFICIENCIES

1. INTRODUCTION

The Interstate 65 (I-65) corridor supports a wide range of land uses, activity centers, and travel in Tennessee, serving as the backbone for economic development and growth in the region. As population and employment continue to expand in the corridor, new travel demands are placing additional pressures on the interstate as well as parallel and intersecting highways. Consequently, familiar challenges such as increased travel times, traffic congestion, and traffic incidents are becoming the norm, especially during peak periods, and undermining the transportation system's ability to sustain future growth.

In the context of substantial change in the region, an assessment of existing and future deficiencies and needs allows all stakeholders to better understand the transportation opportunities and challenges in the I-65 corridor and begin to identify potential solutions and strategies. The following analysis evaluates deficiencies and needs in the I-65 corridor across a broad spectrum of transportation issues, modes, and services, including:

- Land use and economic development;
- Highway capacity and travel demand;
- Safety;
- Intelligent transportation systems (ITS);
- Freight;
- Transit; and
- Walking and bicycling.

The analysis specifically focuses on the trend scenario for the I-65 corridor – i.e., existing and future conditions if current practices, plans, and policies remain unchanged. To supplement the technical analysis, public workshops and internet survey tools have generated a large number of comments from stakeholders throughout the corridor. Together, the technical analysis and public input will form the basis for the subsequent tasks in the Interstate 65 Multimodal Corridor Study, namely the development of potential strategies and solutions to address identified deficiencies and needs.

1.1 Defining the Trend Scenario

The trend scenario establishes the existing and projected transportation conditions in the I-65 corridor, and serves as the baseline for identifying needs and ultimately proposed improvements. Because of the complex array of transportation issues, modes, and services found in an interstate corridor, the trend scenario can be described qualitatively, in terms of plans and policies, as well as quantitatively. To develop the trend scenario, the analysis relies on population and employment projections from the Tennessee Department of Transportation's (TDOT) and the Nashville Area Metropolitan Planning Organization's (MPO) travel demand models.

In addition to the growth forecasts, the trend scenario includes assumptions about major capacity and interchange projects currently programmed for construction in TDOT's State Transportation Improvement Program (STIP) and the Nashville Area MPO's Transportation Improvement Program (TIP). The "Existing plus Committed" (E+C) highway network consists of the existing highway system in the corridor plus two programmed capacity projects and one programmed interchange project. The STIP and TIP also include ITS improvements and expanded transit (Table 1-1).

Table 1-1. I-65 Corridor Programmed Projects

Route and Project Limits	Improvement	Cost	Year	Lead Agency/ Funding Type	TIP# or STIP#
SR-109 Portland Bypass	Construct new 4 lane divided roadway	$72,000,000	2019	TDOT/NHPP	TIP # 2011-51-108
I-65 @ Bethel Road Interchange Lighting Improvements	Install interchange lighting at interchange of I-65 and Bethel Road (SR-257)	$1,021,800	2017	TDOT/U-STBG	TIP # 2016-34-235
NE Corridor Regional Express Bus Service	Transit Capital Expansion	$1,254,000	2018	RTA/CMAQ	TIP # 2012-85-180
Rivergate Parkway Reconstruction	Reconstruction and widening from Dickerson Pike (US-41/ SR-11) to Gallatin Road (US-31E/SR-6)	$16,250,000	2019	Goodlettsville/U-STBG	TIP # 2017-110-013
Express Bus Service from Williamson County	Express bus service from Spring Hill, Franklin, and Brentwood to Nashville and return	$1,100,000	2018	RTA/CMAQ	TIP # 2009-85-012
SR-6/US-31/Franklin Road	Widening, from 2 to 5 lanes, from Concord Road to south of Moore's Lane	$38,000,000	2017	TDOT/NHPP	TIP # 2006-408
McEwan Drive Widening - Phase 4	Widening to 4 lanes from East Cool Springs Drive to Wilson Pike (SR-252)	$36,640,000	2017	Franklin/Local	TIP # 2011-62-011
Columbia Avenue (US-31/SR-6) South Widening	Widening, from 3 to 5 lanes, between Mack Hatcher Blvd (SR-397) and Downs Blvd	$21,000,000	2017	Franklin/U-STBG	TIP # 2014-62-001
SR-247 (Duplex Road) Widening	Widening, from 2 to 3 lanes, from US-31/SR-6 to 0.1 mile west of I-65	$18,040,000	2017	TDOT/STBG	TIP # 2004-051
SR-99 (US 412) Interchange Modification	Modification of the I-65 interchange at SR-99 (US-412)	$8,000,000	2017	TDOT/NHPP	TIP # 2016-84-231
SR-50 (US-431)	Widening, from 2/3 to 5 lanes, from Franklin Pike (US-431/SR-106) to Verona Avenue (US-31A/SR-11)	$34,485,000	2017	TDOT/ACNHPP	STIP # 1759020

Source: 2017-2020 State Transportation Improvement Program, TDOT; 2017-2020 Transportation Improvement Program, Nashville Area MPO.

2. Land Use and Economic Development

Population and employment growth drive public infrastructure and service needs, and the I-65 corridor has been and is facing unprecedented change. Although the focus of the I-65 study is on the corridor's transportation system, the underlying growth and development patterns will largely determine how transportation improvements can and should adapt over time to meet new needs and address deficiencies. Understanding where growth is expected to occur and what form it will take will help inform potential transportation strategies and solutions.

2.1 Population and Employment Projections

The counties in the I-65 corridor study area (Figure 2-1) are expected to experience a significant increase in population and employment over the next 25 years, adding approximately 1,215,000 more people and approximately 830,000 more jobs between 2010 and 2040, increases of 69 percent and 77 percent, respectively. The counties within the Central Sub-Area, which largely anchor the Nashville-Davidson-Murfreesboro-Franklin Metropolitan Statistical Area (MSA), are projected to experience both the highest relative and absolute population and employment increases between 2010 and 2040. The Central Sub-Area is projected to experience an 82 percent increase in population and an 83 percent increase in employment. The North and South Sub-Areas will experience smaller rates of growth, with employment outpacing population growth rates in both areas.

More specifically, two thirds of projected population growth in the corridor is forecasted to occur in three counties, Rutherford, Williamson, and Wilson Counties, which will each more than double their 2010 populations by 2040 to approximately 603,000, 537,000, and 233,000 people, respectively. On the employment side, Davidson, Rutherford, and Williamson Counties will realize much of the growth between 2010 and 2040, adding approximately 326,000, 138,000, and 188,000 jobs, respectively. These counties also comprise most of the population and employment growth over the interim horizon years. Table 2-1 shows projected population and employment by county and sub-area.

Finally, areas in the immediate vicinity, or one mile, of I-65 interchanges (Table 2-2) are anticipated to grow by more than 55,000 people (50 percent increase) and 154,000 jobs (71 percent increase) for an approximate total of 164,500 people and 372,300 jobs by 2040. Interchange areas projected to add more than 10,000 people and/or 10,000 jobs include:

- Downtown Nashville;
- Cool Springs;
- North of Downtown Nashville;
- South of Downtown Nashville;
- Rivergate; and
- SR 254 – Old Hickory Boulevard.

2.2 Planned and Proposed Development

Existing plans and currently proposed development will guide much of the forecasted population and employment growth over the next 25 years. While each of the sub-areas faces unique circumstances and challenges, large scale development is planned throughout the I-65 corridor, especially from Portland on the north to Columbia on the south, representing approximately 75 miles of the 122-mile corridor.

North Sub-Area

Additional growth is planned along both sides of I-65 in Robertson and Sumner Counties. Major employment and activity centers are planned for the new SR 109 interchange with I-65 in Portland immediately south of the Tennessee-Kentucky state line and at the SR 76 interchange at Exit 108 in White House. The scale of development planned at the new SR 109 interchange, the North Gateway Corridor, is significant with a developable land area of approximately 4,000 acres. For comparison, the Cool Springs area in Franklin is approximately 1,200 acres. While the exact nature of development has yet to be determined, the proposed land use plan calls for a regional center with commercial, industrial, residential, and recreational uses. The

Figure 2-1. Study Area Map with Sub-Areas

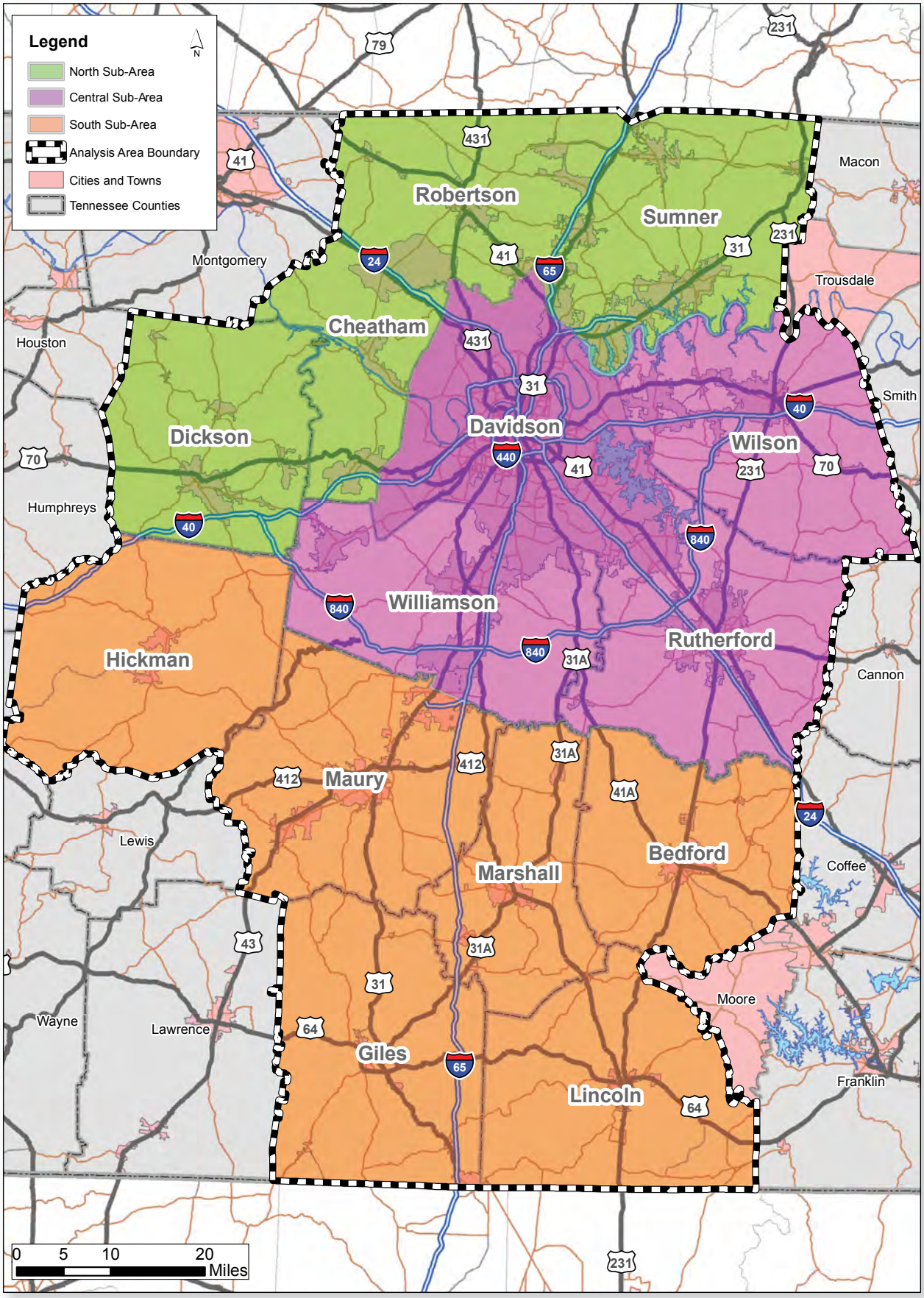


Table 2-1. County Growth Trends

		2010		2020				2030				2040			
		Population	Employment	Population		Employment		Population		Employment		Population		Employment	
Sub-Area	County	Total	Total	Total	Increase from 2010	Total	Increase from 2010	Total	Increase from 2010	Total	Increase from 2010	Total	Increase from 2010	Total	Increase from 2010
North	Cheatham	39,107	15,899	45,334	16%	19,351	22%	51,565	32%	22,813	43%	57,804	48%	26,281	65%
	Dickson	49,664	22,469	55,396	12%	25,839	15%	61,140	23%	29,129	30%	66,896	35%	32,608	45%
	Robertson	66,283	28,067	83,977	27%	33,591	20%	99,100	50%	39,857	42%	112,851	70%	47,190	68%
	Sumner	160,645	55,354	193,105	20%	66,686	20%	218,698	36%	80,227	45%	241,698	50%	95,970	73%
	Sub-Area Total	315,699	121,789	377,812	20%	145,467	19%	430,503	36%	172,026	41%	479,249	52%	202,049	66%
Central	Davidson	626,682	542,773	680,496	9%	635,738	17%	734,958	17%	745,177	37%	780,507	25%	869,137	60%
	Rutherford	262,604	133,803	384,504	46%	170,093	27%	497,364	89%	215,490	61%	602,977	130%	271,416	103%
	Williamson	183,182	120,266	309,328	69%	162,311	35%	426,801	133%	223,802	86%	537,377	193%	307,836	156%
	Wilson	113,993	51,640	157,139	38%	65,133	26%	196,478	72%	81,960	59%	233,085	104%	102,437	98%
	Sub-Area Total	1,186,461	848,481	1,531,467	29%	1,033,275	22%	1,855,601	56%	1,266,429	49%	2,153,946	82%	1,550,826	83%
South	Bedford	45,058	25,809	51,610	15%	29,345	14%	58,175	29%	32,892	27%	64,748	44%	36,448	41%
	Giles	29,485	14,153	31,048	5%	15,658	11%	32,620	11%	17,178	21%	34,199	16%	18,704	32%
	Hickman	24,690	6,543	26,773	8%	7,187	10%	28,866	17%	7,839	20%	30,967	25%	8,495	30%
	Lincoln	33,361	14,892	35,226	6%	16,287	9%	37,100	11%	17,690	19%	38,984	17%	19,104	28%
	Marshall	30,617	12,004	34,072	11%	12,836	7%	37,530	23%	13,672	14%	40,995	34%	14,520	21%
	Maury	80,956	39,996	94,861	17%	47,043	18%	106,276	31%	55,746	39%	116,514	44%	65,609	64%
	Sub-Area Total	244,167	113,397	273,590	12%	128,356	13%	300,567	23%	145,017	28%	326,407	34%	162,880	44%
	STUDY AREA TOTAL	1,746,327	1,083,668	2,182,869	25%	1,307,098	21%	2,586,671	48%	1,583,472	46%	2,959,602	69%	1,915,755	77%

Table 2-2. Interchange Areas: Population and Employment, 2010-2040

Interchange Areas (multiple interchanges)	2010 Population	2040 Population	2010-2040 Population Change	Percentage Population Change	2010 Employment	2040 Employment	2010-2040 Employment Change	Percentage Employment Change
Downtown Nashville	27,999	41,194	13,195	47%	109,480	182,945	73,465	67%
Cool Springs	15,312	31,111	15,800	103%	39,828	69,279	29,451	74%
North of Downtown Nashville	16,926	23,406	6,480	38%	7,388	27,621	20,233	274%
South of Downtown Nashville	19,210	23,707	4,496	23%	36,133	48,153	12,020	33%
Rivergate	9,415	11,750	2,335	25%	9,850	14,863	5,014	51%
SR 254 - Old Hickory Blvd	4,050	5,115	1,065	26%	6,505	11,186	4,681	72%
Concord Road	2,244	3,521	1,278	57%	3,854	7,535	3,681	96%
Madison Sub-Market	4,461	5,366	905	20%	2,589	3,989	1,400	54%
Springfield Road	1,771	2,492	721	41%	980	2,323	1,343	137%
SR 396 - Saturn Pkwy	3,246	4,818	1,573	48%	254	1,390	1,137	448%
I-840	436	3,312	2,876	659%	69	688	618	891%
Bethel Road	1,235	1,739	504	41%	410	967	557	136%
SR 248 - Goose Creek Bypass	836	3,849	3,013	360%	105	634	529	503%
US 31 - Giles County	382	438	56	15%	204	270	66	32%
SR 52	402	637	235	59%	99	159	59	60%
SR 99	377	555	178	47%	31	61	30	98%
SR 25	441	627	185	42%	32	55	23	70%
SR 50	126	163	37	30%	11	31	20	183%
SR 273	92	108	16	17%	19	31	11	59%
SR 129	136	184	48	35%	49	57	7	15%
SR 373	113	151	39	34%	10	15	5	47%
SR 11	111	141	30	27%	53	56	2	4%
US 64	87	101	14	16%	17	13	-4	-22%
TOTAL	109,409	164,487	55,077	50%	217,971	372,321	154,350	71%

interchange area around the SR 76 interchange (Exit 108) is expected to be developed as a highway commercial activity center, with new regional offices or office headquarters and park-and-ride lots.

Central Sub-Area

NashvilleNext, the comprehensive plan for Metro Nashville and Davidson County, includes a land use vision that will largely preserve the general urban character along the I-65 corridor. Development centers are identified at the I-65 interchanges with Vietnam Veterans Boulevard/SR 386 (Exit 95), Briley Parkway/SR 155 (Exit 90), the downtown loop and Midtown areas of Nashville (multiple exits), Harding Place/SR 255 (Exit 78), and Old Hickory Boulevard/ SR 254 (Exit 74). Additionally, I-65 from the downtown loop to Harding Place is identified as an "immediate need" priority corridor, calling for more intense housing and commercial development along the corridor in concert with improvements to high capacity transit service.

In Williamson County, development is planned or proposed adjacent to many of the interchanges on I-65. New or additional development is imminent near the Old Hickory Boulevard interchange, the Franklin/Cool Springs area (Exits 65 through 69), and the Goose Creek Bypass interchange (Exit 61), with the latter two being designated as "Regional Commerce" concept areas in Envision Franklin, the city's most recent land use plan update. A major mixed-use development, including over 300,000 square feet of office space, single- and multi-family housing, and a hotel, is already proposed for the northeast corner of McEwen Drive and Carothers Parkway.

East of I-65 in Williamson County, the "840 Center" is planned for the interchange of US 31A/ US 41A and I-840, and consists of residential and mixed-use development. Additionally, the 780-acre Alexander Farm site off Buckner Lane in Spring Hill was recently re-zoned from agricultural to a "Gateway District," which calls for a mixture of office, residential, and commercial uses. The development potential at the site is high, given that a new interchange at Buckner Lane and I-65 is included in the Nashville Area MPO's 2040 Regional Transportation Plan.

South Sub-Area

Future development in the South Sub-Area is planned for the Bear Creek Pike (Exit 46) and New Lewisburg Highway (Exit 37) interchanges. Planned development is currently identified as highway-oriented commercial development. Development is proposed to be complemented by adjacent employment districts consisting of office parks, technology parks and research facilities, and industrial uses. The interchanges are in predominately rural areas, and new development will increase travel demand at I-65 and on adjacent connecting routes. Additionally, an area of land to the northwest of Columbia is served by a rail spur and is currently zoned for industrial use. This area has been identified as a freight growth area by the Nashville Area MPO.

2.3 Existing and Future Opportunities and Challenges

The existing and projected growth in the corridor will continue to place pressure on I-65 and the transportation system. The following summarizes the key findings related to growth and development.

A. **Corridor Population and Employment Growth:** Communities throughout the I-65 corridor are expected to experience increases in population and employment over the next 25 years, adding approximately 1,215,000 more people and approximately 830,000 more jobs between 2010 and 2040. Both population and employment growth will be heavily concentrated in Davidson, Rutherford, and Williamson Counties, accounting for 70 to 80 percent of new people and jobs. As Williamson and Rutherford Counties, and to a lesser extent Robertson and Sumner Counties, continue to grow as employment centers, new commuting routes, such as I-840 or SR 96, will assume greater importance.

B. **Interchange Area Employment Growth:** Growth within one mile of existing I-65 interchanges will strongly tilt toward employment, with three jobs added for every new resident, for a total of approximately 154,000 new jobs within the interchange areas. Managing travel to, from, and within existing and emerging employment centers near interchanges will continue to present

opportunities and challenges. These growth patterns will also exacerbate already high peak hour demand on I-65 and related interchange facilities.

C. **Planned and Proposed Development:** In addition to the growth projected throughout the corridor and near interchanges, there are many significant developments near I-65 already in some stage of the planning and development process. Projects such as the North Gateway Corridor in Portland are in the earlier stages of land use policy planning while others such as Berry Farms in Franklin are currently phasing construction. In more developed areas like Nashville, long-range plans call for significant increases in development intensities to absorb projected growth and new high capacity transit services to support the higher densities.

3. Highway Capacity and Travel Demand

The population and employment growth projections serve as the foundation for evaluating existing and future highway capacity and travel demand in the trend scenario. The analysis utilizes TDOT's traffic history website, the statewide travel demand model, and origin-destination data from AirSage, Inc. to evaluate the following capacity and demand conditions in the corridor:

- Traffic volumes and projections;
- Travel patterns;
- Volume-to-Capacity ratios;
- Bottlenecks; and
- Travel time and delay for key markets.

3.1 Traffic Volumes and Projections

Traffic volumes along I-65 were collected using TDOT's traffic history website. Traffic history reflects the annual average daily traffic (AADT) at specific count locations along Tennessee roads. Counts were collected at 17 stations along the I-65 corridor, 10 of which surround the Nashville area. Figure 3-1 displays the traffic volumes collected at each of the 17 stations. The maximum AADT along I-65 is 172,104, found in south Nashville, between the I-440 and Harding Place/SR 255 interchanges. Also, of note, traffic volumes nearly double south of SR 386 and north of I-840 over volumes immediately north and south of those locations. As shown, traffic volumes toward the Kentucky state line are considerably higher than volumes near the Alabama state line.

Table 3-1 shows the daily personal vehicle and truck trips in the I-65 corridor. In 2010, there were 2,532,128 daily trips within one mile of the I-65 corridor. Of these daily trips, 130,543, or 5.4 percent, were truck trips. The remaining 2,401,585 trips were personal vehicle trips. The number of daily trips is expected to rise 82 percent by 2040 to 4,602,348 trips. Of the 2040 trips, 231,220, or 5.3 percent, are expected to be truck trips. The remaining 4,371,128 trips are expected to be personal vehicle trips. The total number of truck trips is expected to increase by 77 percent from 2010 to 2040.

Total vehicle miles traveled (VMT) were calculated, by roadway functional class and urban or rural context, for the analysis area for 2010 and 2040. Total VMT for the analysis area is forecasted to increase by 61 percent between 2010 and 2040. The largest percentage increases will be experienced on urban collectors and urban local roads, at 100 and 107 percent, respectively. However, the largest absolute increase is expected on arterials, which will see an increase of approximately 29,000,000 VMT in urban areas and approximately 25,000,000 VMT in rural areas.

VMT per capita shows different trends for different functional classes. Total VMT per capita decreases by five percent for the entire analysis area. Urban interstates and arterials decrease by 20 and nine percent, respectively, while rural interstates and local roads decrease by 11 and 16 percent, respectively. Urban collectors and local roads and rural arterials and collectors experience increases of between 11 and 22 percent. The overall decrease and forecasted decreases on interstate facilities suggests that while VMT is increasing in tandem with population, driving distances in some areas are decreasing. This is consistent with general trends in urbanization as regional centers expand and new centers develop in high-growth areas. Table 3-2 presents the 2010-2040 VMT trends for the analysis area.

3.2 Travel Patterns

Major Trip Destinations (O-D Pairs)

Origin-Destination (O-D) data allows a more detailed analysis of trip patterns than other traditional methods of analysis. O-D data was obtained for 2016 from AirSage, Inc. AirSage processes real-time, cellular signal data points to identify travel patterns and transportation trends. O-D data were obtained for the entire state of Tennessee and were processed, analyzed, and summarized for travel markets in Figure 3-2, which displays the most common trip destination for each travel market with the arrow color correlating with destination. For example, there is a pale purple arrow pointing from Marshall County to Maury County. This indicates that the majority of

Figure 3-1. 2015 Daily Traffic Volumes Along I-65

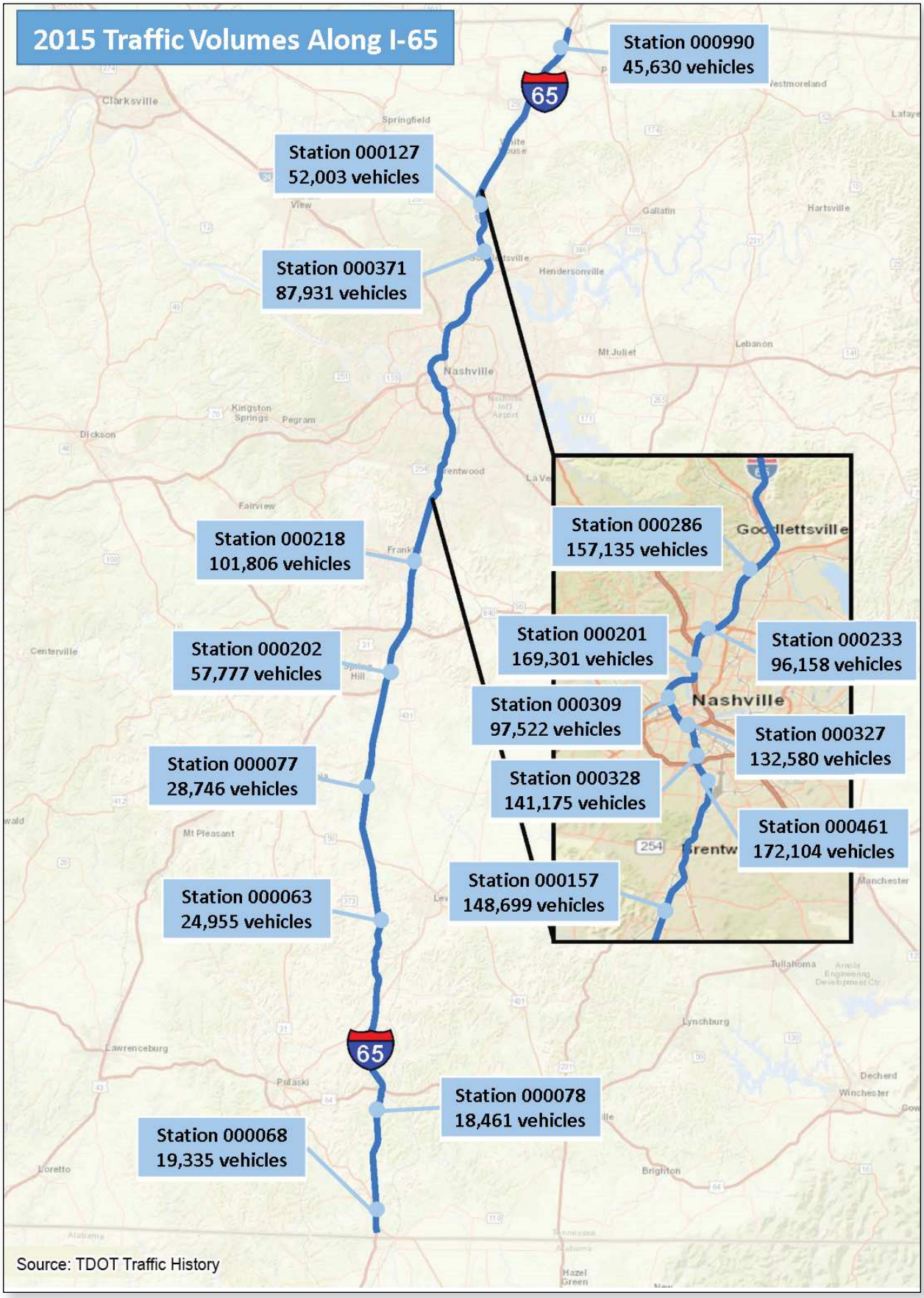


Table 3-1. I-65 Area Daily Trip Breakdown 2010 and 2040

Trip Types	Daily Trips 2010	2040	% Change
Personal Trips	2,401,585	4,371,128	82%
Truck Trips	130,543	231,220	77%
Total (Personal + Trucks) Trips	2,532,128	4,602,348	82%
Percent Truck Trips	5.4%	5.3%	---

Source: Statewide Travel Demand Model

Table 3-2. VMT by Functional Class

	Functional Class Group	Total VMT (1,000s) 2010	2040	Percent Change	VMT per Person 2010	2040	Percent Change
Urban	Interstates	40,196	54,646	35.9%	23	18	-19.8%
	Arterials	52,695	81,525	54.7%	30	28	-8.7%
	Collectors	8,397	16,805	100.1%	5	6	18.1%
	Local Roads	347	720	107.3%	<1	<1	22.3%
Rural	Interstates	26,259	39,563	50.7%	15	13	-11.1%
	Arterials	28,530	53,796	88.6%	16	18	11.3%
	Collectors	16,991	32,365	90.5%	10	11	12.4%
	Local Roads	237	338	42.6%	<1	<1	-15.8%
Analysis Area Total		173,652	279,757	61.1%	99	95	-4.9%

Source: Statewide Travel Demand Model

trips originating in Marshall County end in Maury County. This analysis excludes trips that originate and end in the same travel market. While the Nashville Core is a significant travel destination, as expected, it is not the only significant destination in the study corridor. The most common destinations are the Nashville Core and East Nashville/Madison, followed by Franklin, Spring Hill, and Maury County.

Census County-to-County Work Flow

The US Census compiles county-to-county work flows, which tracks the patterns of work-related trips. This data source does not include other trip purposes such as shopping or recreation trips. Figure 3-3 shows the most common trip generation for each county with arrow color correlating with destination, and the percentage of work trips originating from each county to the primary destination county. This indicates that the majority of trips originating in Cheatham County end in Davidson County. This analysis excludes trips that originate and end in the same key travel market. The most common destination is Davidson County, serving as the most common destination for trips originating in eight of the 13 surrounding counties.

3.3 Volume-to-Capacity Ratios

A volume-to-capacity (V/C) ratio quantitatively assesses the effectiveness of a corridor. The ratio compares the demand for a corridor with the capacity the corridor is designed to accommodate. Level of service (LOS) is a qualitative measure of the operating conditions of a roadway derived, in this case, from V/C ratios. The LOS of a facility is measured by a letter from "A" to "F", with an "A" referring to a facility in excellent operational condition and "F" referring to a facility in unsatisfactory operational condition. Figures 3-4 and 3-5 depict the V/C ratios and LOS for I-65 in 2010 and 2040.

In 2010, most of I-65 functions in good operational conditions, or LOS A to C. LOS decreases to LOS D and E at select locations around the Nashville area – specifically, near the I-65/SR 386 (Vietnam Veterans Boulevard) interchange, the I-65/I-40 interchange in North Nashville, the I-65/I-40 interchange in downtown Nashville, the I-65/I-440 interchange, and from Harding Place to Cool Springs. By 2040, LOS degrades to LOS D, E, and F for most of I-65 between the Kentucky state line and Spring Hill in Maury County. I-65 is expected to continue to operate well in the rural southern sections of the roadway. It is important to note that the V/C ratios and corresponding LOS reflect daily traffic volumes and do not represent peak travel periods and traffic incidents. Degrading daily LOS in the future likely means that peak period and incident related delays will become more prevalent. Figure 3-6 captures directional travel percentages and V/C ratios at the Sumner-Davidson county line and the Davidson-Williamson county line. Daily V/C ratios at the two locations are significantly lower than AM and PM V/C ratios.

Lower future LOS on I-65 may also result in traffic shifting to arterial roadways parallel to the interstate. Several parallel arterials are projected to be approaching capacity in 2040, and additional spillover traffic will push them above capacity. The spillover effect was analyzed at arterials near two key locations along I-65. Figures 3-8 and 3-9 display the resulting traffic volume increases projected for these arterials in 2040. The volume increases range from a 50 percent increase on Nolensville Pike/ US 41A (Figure 3-7) to a 520 percent increase on Horton Highway/US 31A (Figure 3-8). This spillover effect on a typical weekday will likely be even more pronounced when there is an incident on I-65.

Figure 3-2. Existing Year (2016) Major Trip O-D Pairs

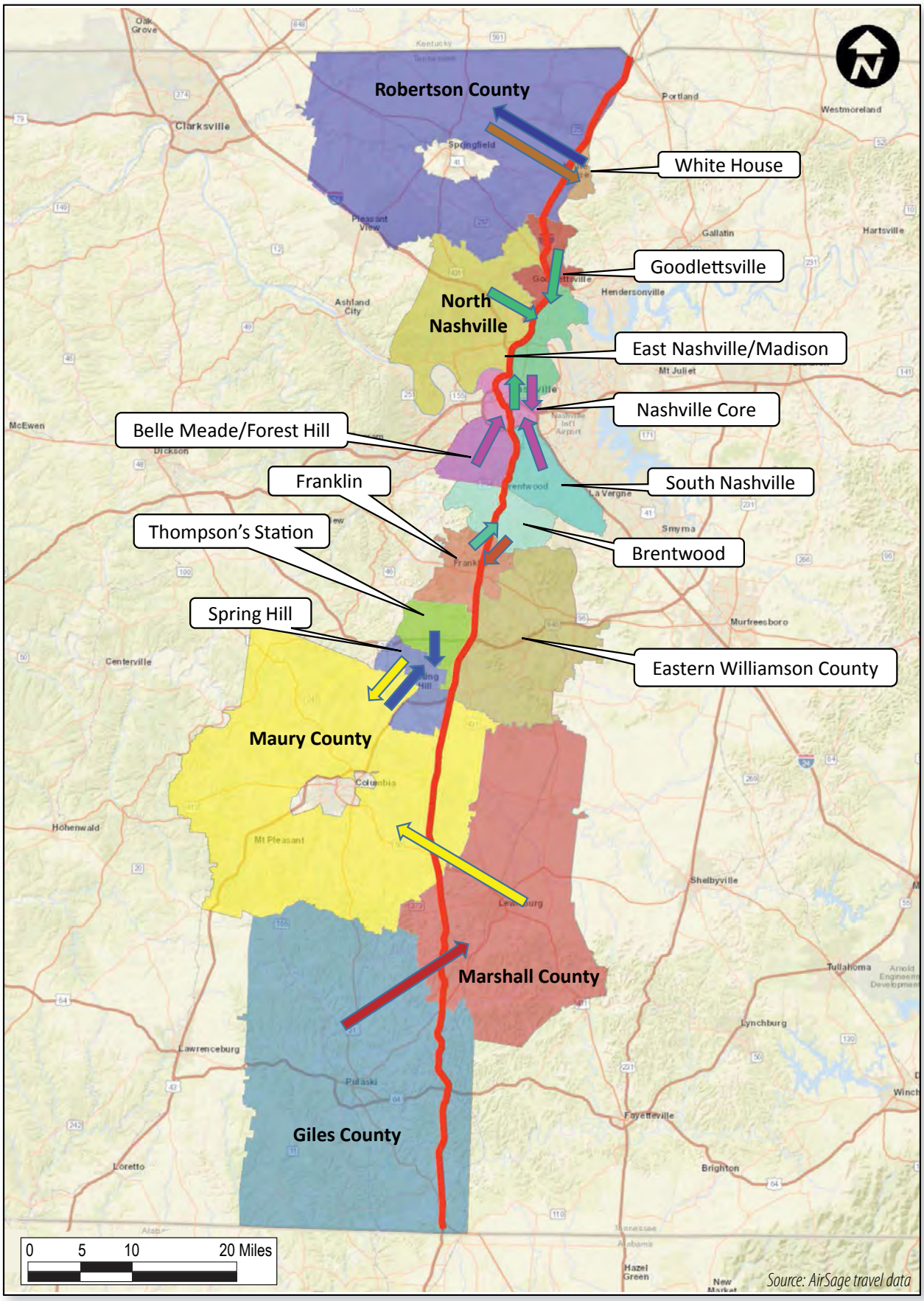


Figure 3-3. Existing Year (2016) County-to-County Work Flow

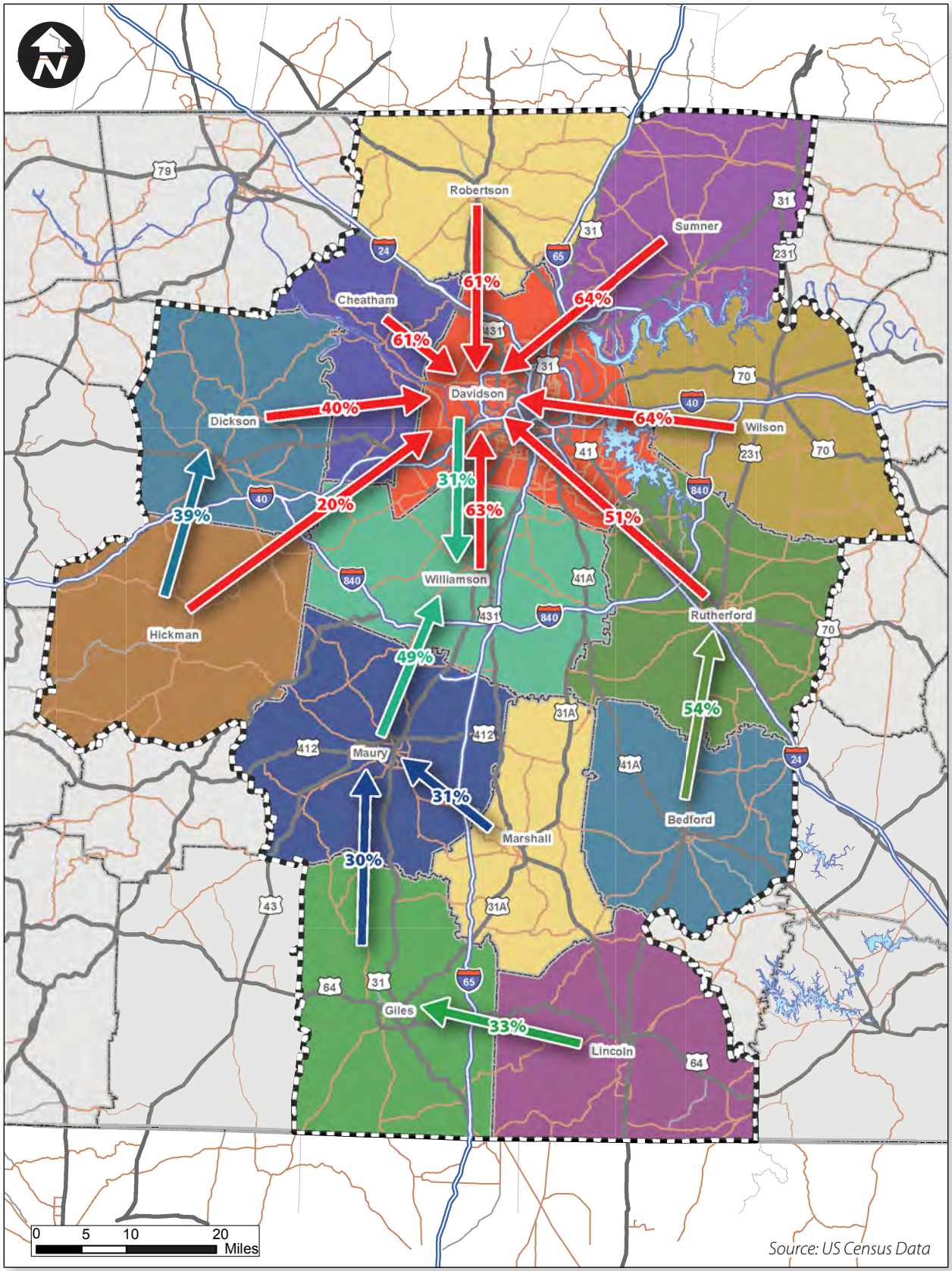


Figure 3-4. 2010 Daily V/C & LOS: Interstates

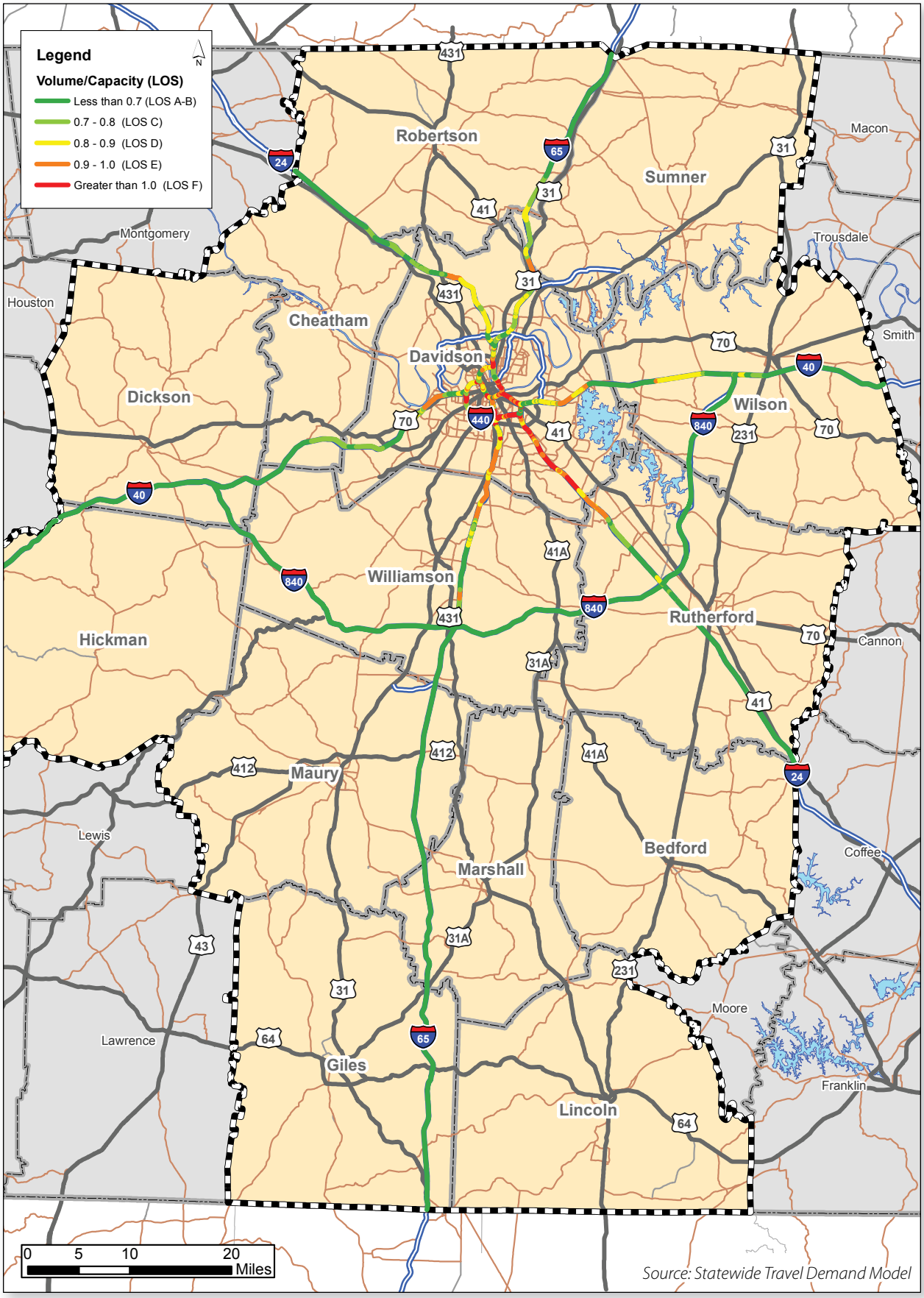


Figure 3-5. 2040 Daily V/C & LOS: Interstates

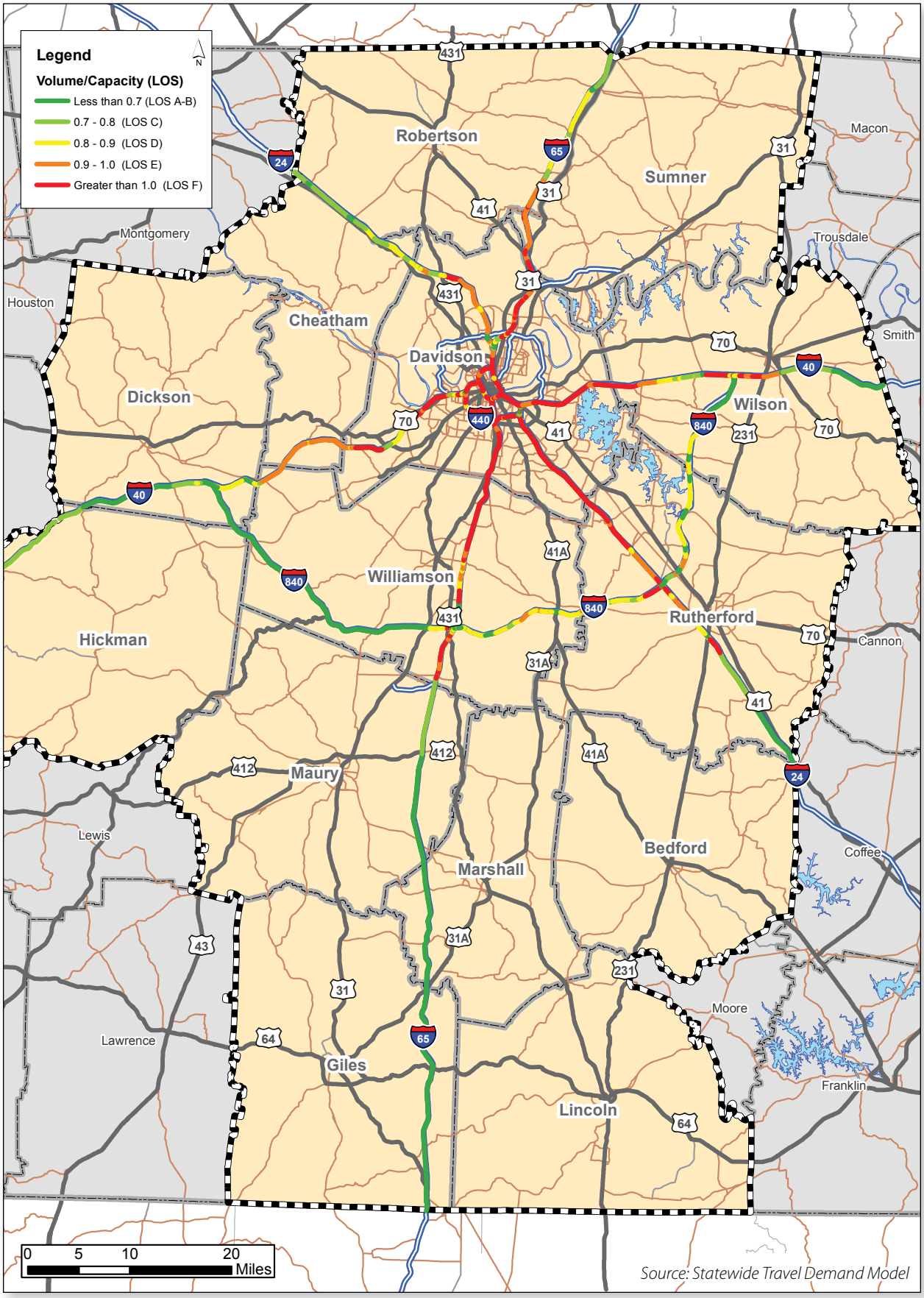
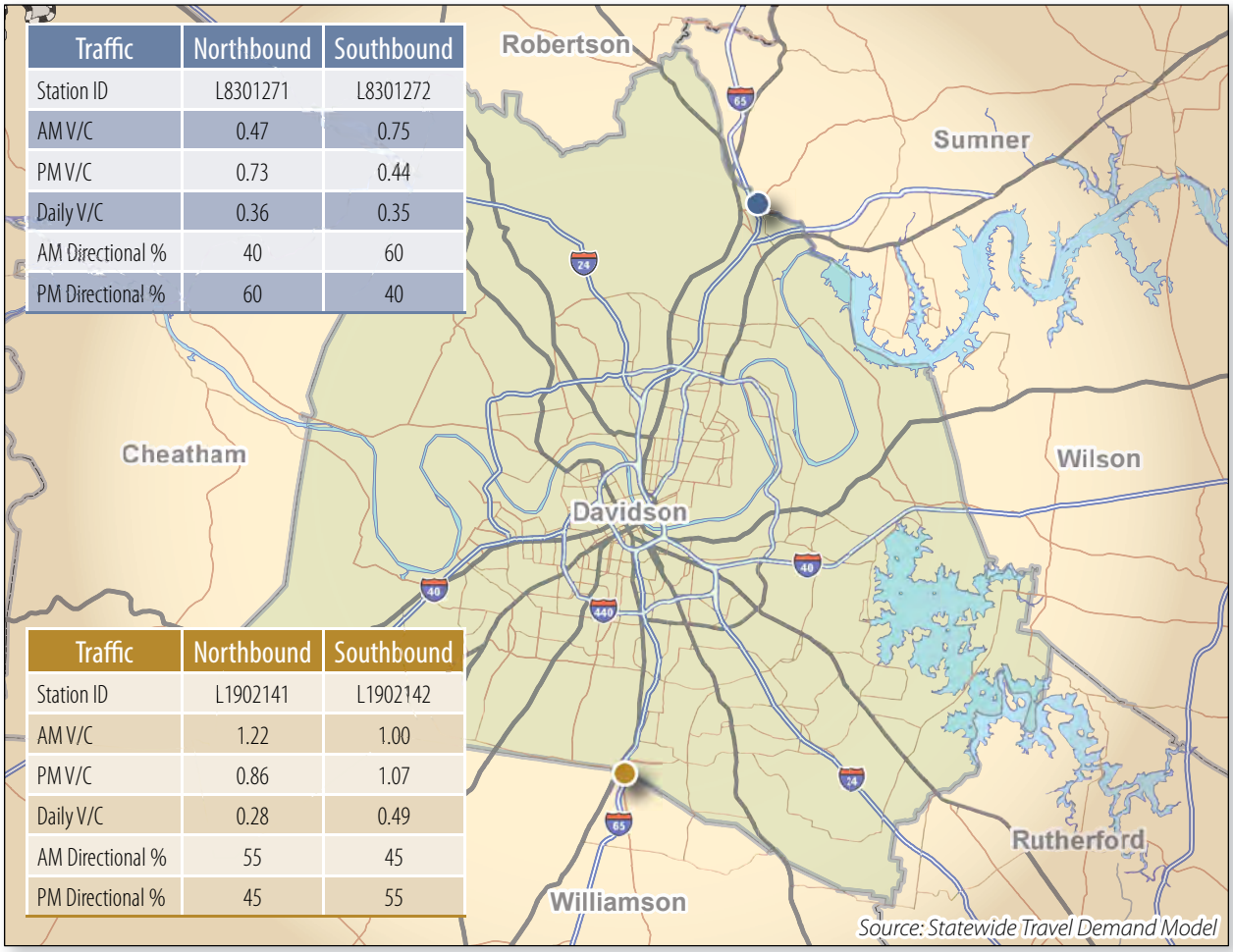


Figure 3-6. I-65 Directional Daily and Peak Traffic Analysis



Traffic	Northbound	Southbound
Station ID	L8301271	L8301272
AM V/C	0.47	0.75
PM V/C	0.73	0.44
Daily V/C	0.36	0.35
AM Directional %	40	60
PM Directional %	60	40

Traffic	Northbound	Southbound
Station ID	L1902141	L1902142
AM V/C	1.22	1.00
PM V/C	0.86	1.07
Daily V/C	0.28	0.49
AM Directional %	55	45
PM Directional %	45	55

Source: Statewide Travel Demand Model

Figure 3-7. Spillover Effect – Davidson/Williamson County Line

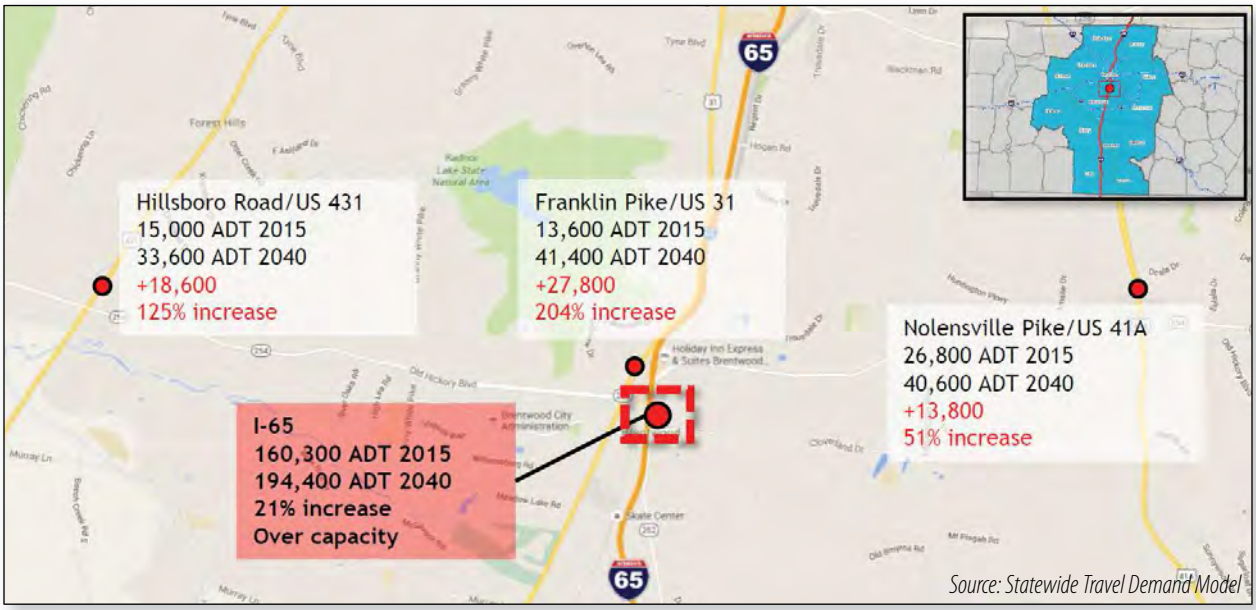
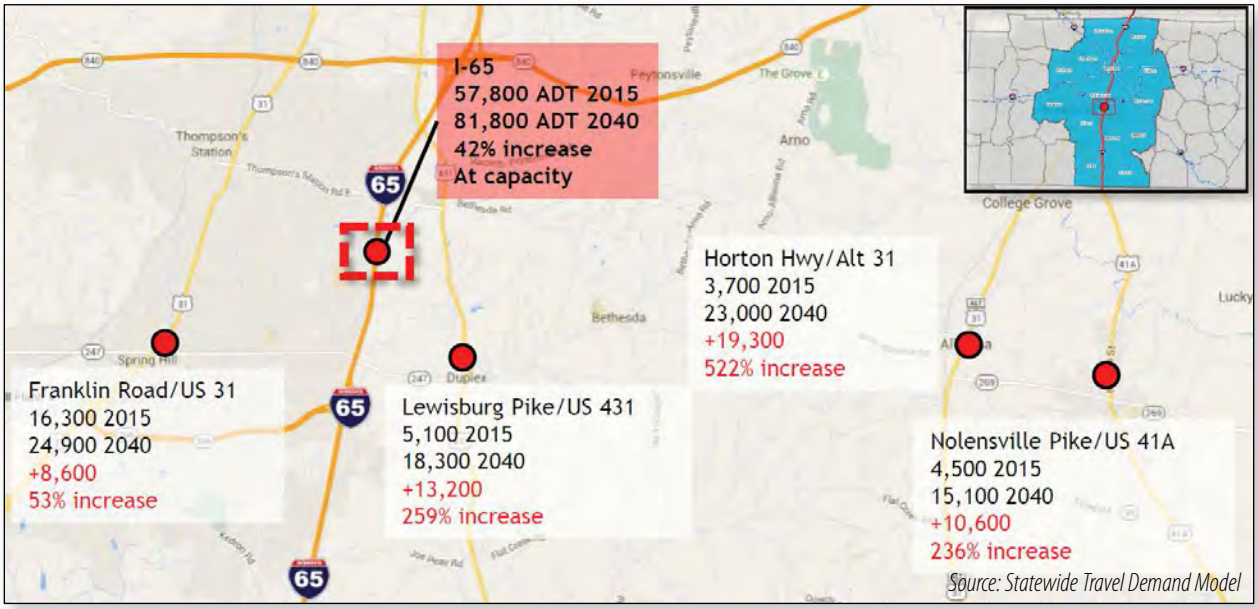


Figure 3-8. Spillover Effect – Spring Hill Area



3.4 Bottlenecks

Bottlenecks are frequently caused by lane drops, interchanges, heavy volumes exceeding capacity, merge segments, and diverge segments. Figures 3-9, 3-10, and 3-11 display bottleneck locations along I-65 and provide explanations for their occurrence. The corridor features frequent bottlenecks in the AM and PM peak periods in both the northbound and southbound directions.

Figure 3-9. Bottlenecks North of Nashville

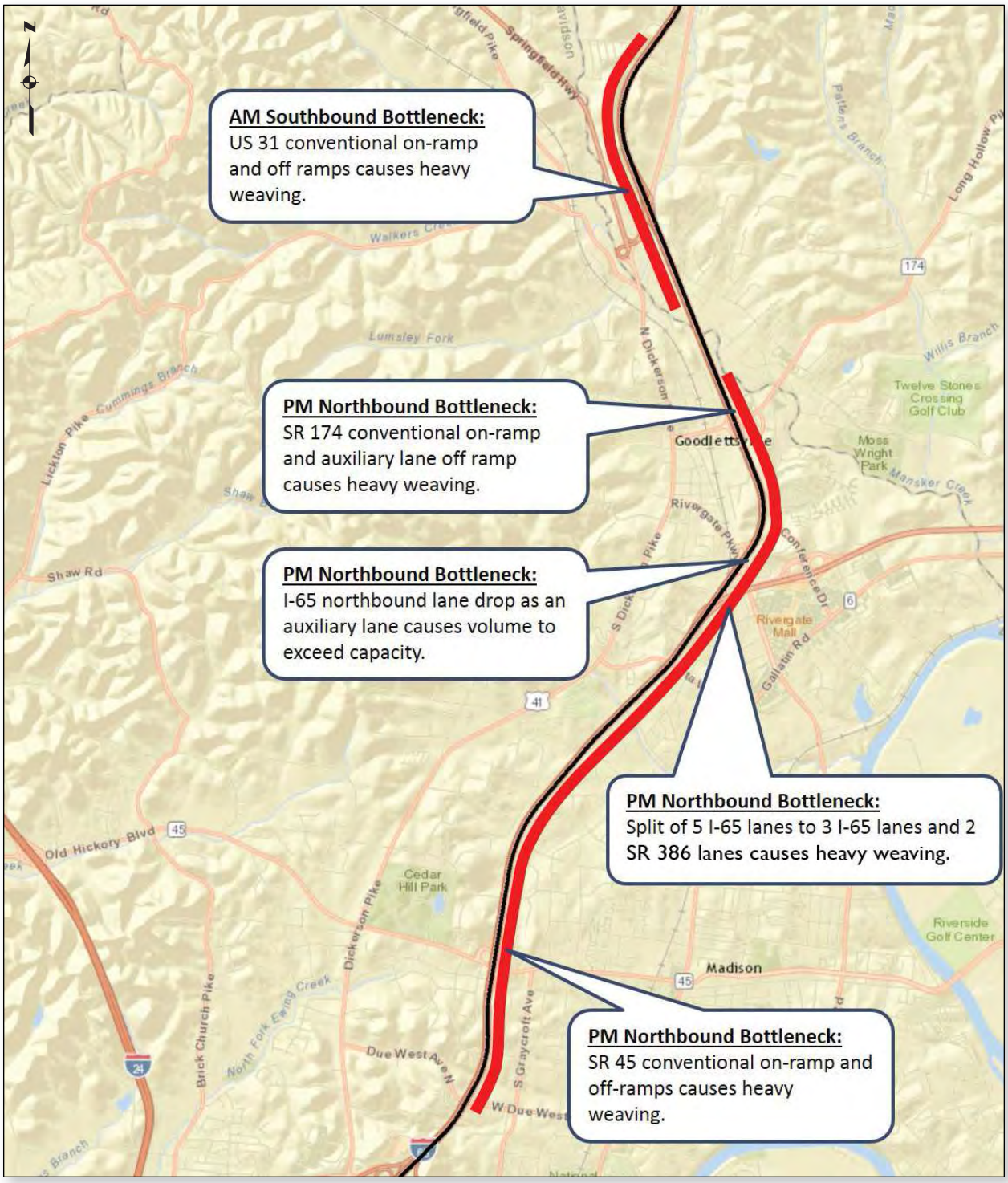


Figure 3-10. Bottlenecks around Nashville

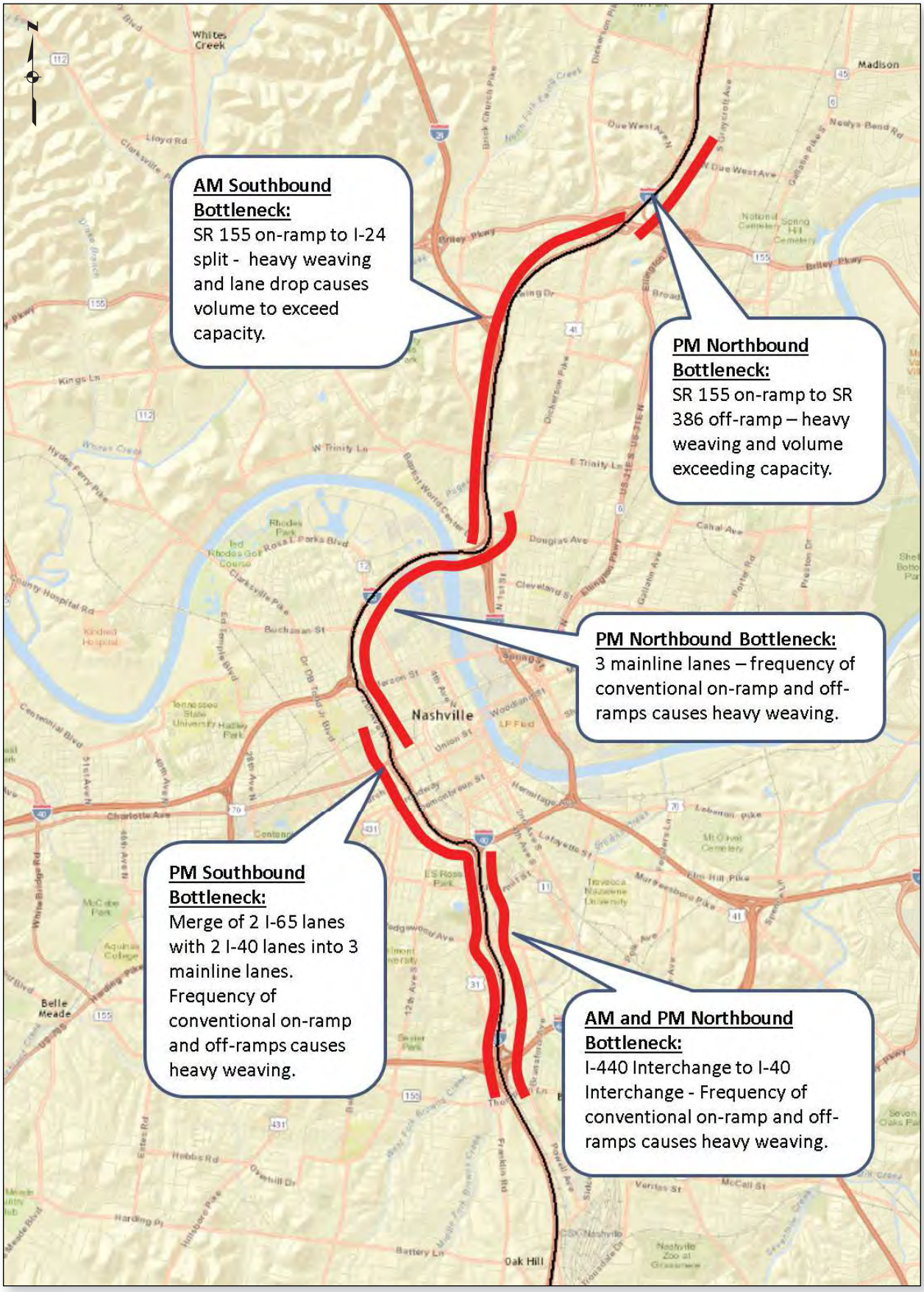
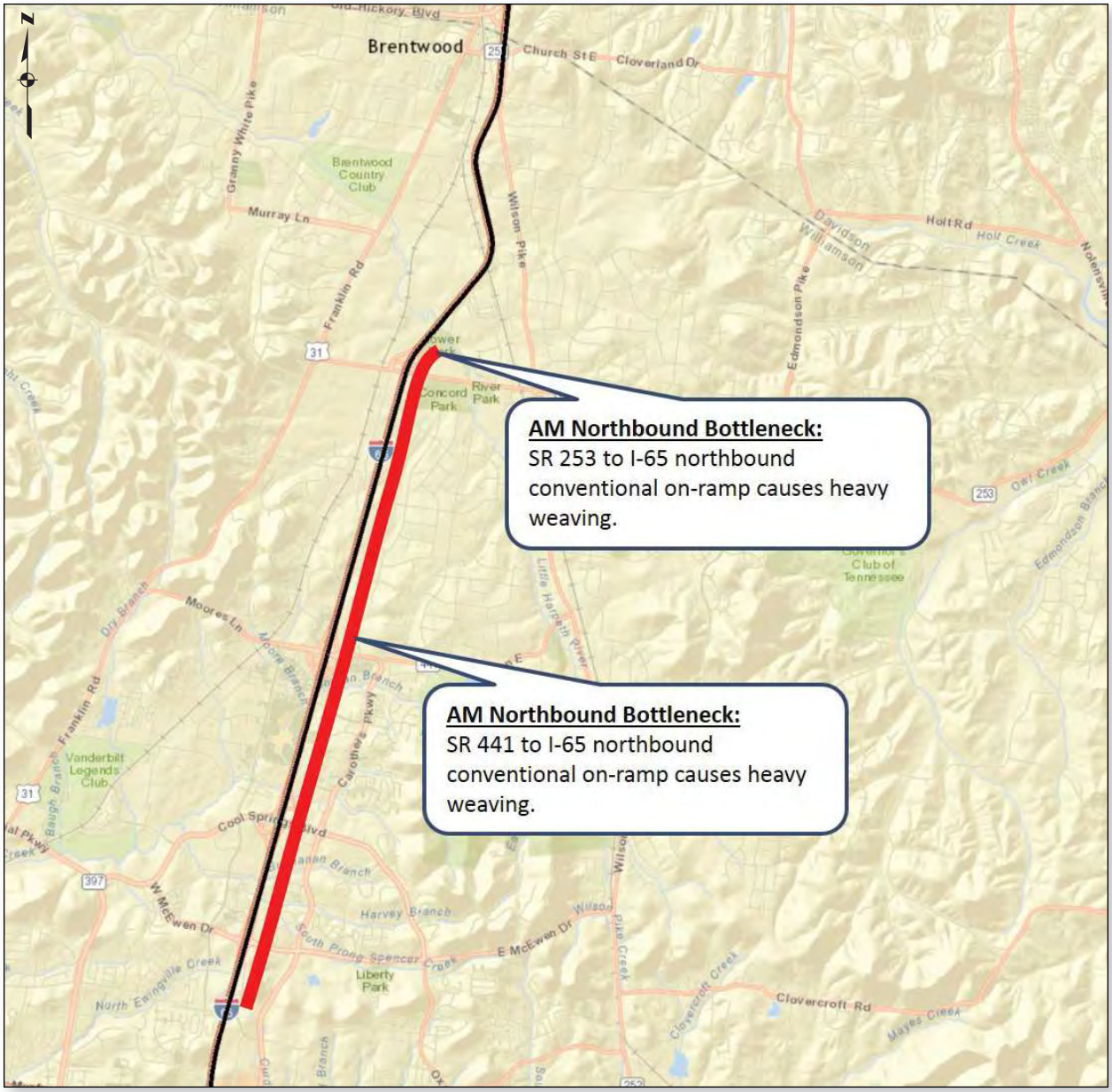


Figure 3-11. Bottlenecks South of Nashville



3.5 Travel Time and Delay

Modeled vehicle hours of travel (VHT) for the 2010 and 2040 baseline conditions are reported in Table 3-3. VHT measures the total amount that automobiles and trucks are traveling on the road system on a typical weekday. VHT trends in the corridor mirror those of VMT. At the analysis area level, total VHT increases by approximately 68 percent. The largest percentage increases are experienced on urban collectors and urban local roads, at 105 and 124 percent, respectively. However, as with VMT, arterials again experience the largest numerical increase at approximately one million hours in urban areas and 460,000 hours in rural areas. Like VMT, VHT on rural interstates and arterials will increase at a faster rate than in urban areas.

VHT per capita, like VMT per capita, also shows different trends for different functional classes. Total VHT per capita decreases by approximately one percent for the entire analysis area. As with VMT per capita, urban interstates and arterials and rural interstates and local roads will see per capita decreases up to 16 percent. Urban collectors and local roads and rural arterials and collectors will see increases of up to 30 percent. As with VMT,

Table 3-3. VHT by Functional Class

	Functional Class Group	Total VHT (1,000s) 2010	2040	Percent Change	VHT per Person 2010	2040	Percent Change
Urban	Interstates	679	1,013	49.2%	0.39	0.34	-12.0%
	Arterials	1,626	2,637	62.2%	0.93	0.89	-4.3%
	Collectors	264	541	105.2%	0.15	0.18	21.1%
	Local Roads	11	25	124.2%	0.01	0.01	32.3%
Rural	Interstates	348	527	51.1%	0.20	0.18	-10.8%
	Arterials	531	994	87.2%	0.30	0.34	10.5%
	Collectors	372	710	91.0%	0.21	0.24	12.7%
	Local Roads	5	8	42.4%	0.00	0.00	-16.0%
	Analysis Area Total	3,836	6,456	68.3%	2.20	2.18	-0.7%

Source: Statewide Travel Demand Model

Table 3-4. VHD by Functional Class

	Functional Class Group	Total VHD 2010	2040	Percent Change	VHD per Person 2010	2040	Percent Change
Urban	Interstates	75,979	200,819	164.3%	0.044	0.068	56.0%
	Arterials	24,018	190,186	691.8%	0.014	0.064	367.2%
	Collectors	874	25,951	2870.0%	0.001	0.009	1652.5%
	Local Roads	52	2,406	4512.8%	0.000	0.001	2621.8%
Rural	Interstates	467	3,357	618.4%	0.000	0.001	323.9%
	Arterials	251	6,401	2446.6%	0.000	0.002	1402.6%
	Collectors	105	2,242	2044.0%	0.000	0.001	1165.1%
	Local Roads	0	22	4887.9%	0.000	0.000	2843.1%
	Analysis Area Total	101,746	431,384	324.0%	0.058	0.146	150.2%

Source: Statewide Travel Demand Model

the reduction in per capita VHT, accompanied by faster increases of total VHT in rural areas, suggests that travel patterns will become increasingly decentralized from downtown Nashville by 2040.

Modeled vehicle hours of delay (VHD) for base year 2010 and future year 2040 are presented in Table 3-4 by functional class. The projected analysis area-wide VHD is projected to increase by 324 percent by 2040, indicating that congestion in the corridor will become more severe going forward. Rural VHD will increase at a significantly higher rate than urban VHD, particularly on interstate and arterial facilities, which will increase by 618 and 2,447 percent, respectively. However, urban interstates and arterials will experience the largest numerical increases, at approximately 125,000 and 166,000 hours, respectively.

A decrease in VHT per capita accompanied by an increase in VHD per capita suggests that commuters will spend less time traveling overall, likely due to a greater jobs-housing balance supported by new employment centers. However,

the amount of time spent in congested conditions, particularly during peak hour, will increase on a per capita basis by 2040.

Average speeds were examined by functional class in both urban and rural areas of the corridor, as seen in Table 3-5. Average speeds corridor-wide are projected to decrease by approximately four percent. Urban roadways will experience decreases between three and ten percent. Rural roadways will largely maintain the existing speeds.

Table 3-6 displays estimated travel times in 2010 and 2040 between select travel markets. Travel time was calculated based on the link level travel time from the statewide loaded model. Travel times are for interchange-to-interchange travel and do not include travel on surface streets. Further, the times represent travel under ideal conditions, for example, with no incidents. Ten O-D pairs were analyzed based on the volume of trips between the pairs. Travel times are forecasted to increase between 70 and 100 percent in six of the ten O-D pairs, with the greatest increases occurring in pairs extending from Spring Hill to Nashville. Trips from Franklin to the Nashville Core, for example, are projected to double from 29 minutes to 59 minutes, and although a shorter distance, the duration of trips from Franklin to Brentwood will increase from 10 minutes to 21 minutes. Table 3-7 displays delay in 2010 for the key O-D pairs. Typical travel time was computed using Google Maps directions for a typical weekday at 12:00 PM. Delay was computed by subtracting the 2010 model travel time from Google's maximum typical travel time.

Table 3-5. Average Speeds by Functional Class

	Functional Class Group	Average Speed 2010	Average Speed 2040	Percent Change
Urban	Interstates	60	56	-6.7%
Urban	Arterials	32	31	-3.1%
Urban	Collectors	32	31	-3.1%
Urban	Local Roads	31	28	-9.7%
Rural	Interstates	75	75	0.0%
Rural	Arterials	54	54	0.0%
Rural	Collectors	46	46	0.0%
Rural	Local Roads	44	44	0.0%
	Analysis Area Average	45	43	-4.4%

Source: Tennessee Statewide Travel Demand Model

Table 3-6. 2010 and 2040 Travel Time for Key O-D Pairs

Market From-To	Travel Time (min) Model 2010	Travel Time (min) Model 2040	% Change
Franklin to Brentwood	10	21	110%
Brentwood to Franklin	11	22	100%
South Nashville to Franklin	22	37	68%
South Nashville to Nashville Core	16	30	88%
Franklin to Nashville Core	29	59	103%
Portland to Nashville Core	41	47	15%
Hendersonville to Nashville Core	25	32	28%
Spring Hill to Nashville Core	36	64	78%
Spring Hill to Franklin	20	36	80%
Giles County to Franklin	56	69	23%

Source: Statewide Travel Demand Model

Table 3-7. 2010 Typical Travel Time and Delay for Key O-D Pairs

Market From-To	Travel Time - 2010 Model (min)	Typical Travel Time (min)	Delay (min)
Franklin to Brentwood	10	10-16	6
Brentwood to Franklin	11	9-14	3
South Nashville to Franklin	22	18-26	4
South Nashville to Nashville Core	16	14-20	4
Franklin to Nashville Core	29	22-35	6
Portland to Nashville Core	41	40-55	14
Hendersonville to Nashville Core	25	22-35	10
Spring Hill to Nashville Core	36	30-40	4
Spring Hill to Franklin	20	18-24	4
Giles County to Franklin	56	55-70	14

Source: Statewide Travel Demand Model and Google

3.6 Existing and Future Deficiencies and Needs

Highway capacity and travel demand vary widely throughout the I-65 corridor. While current deficiencies tend to be focused between Moore's Lane/SR 441 and downtown Nashville, daily trips are projected to nearly double over the next 25 years leaving much of I-65 in fair to poor operating conditions. Following are key findings from the highway capacity and travel demand analysis:

A. **Traffic Volumes:** The maximum AADT along I-65 is 172,104, found in south Nashville between the I-440 and the Harding Place/ SR 255 interchanges. Of note, traffic volumes nearly double south of SR 386 and north of I-840 over volumes immediately adjacent to those locations. Traffic volumes toward the Kentucky state line are considerably higher than volumes near the Alabama state line.

B. **Daily Personal Vehicle and Truck Trips:** In 2010, there were 2,532,128 daily trips within 1 mile of the I-65 corridor. Of these daily trips, 130,543, or 5.4 percent, were truck trips. The number of daily trips is expected to increase 82 percent by 2040 to 4,602,348 trips. Of the 2040 trips, 231,220, or 5.3 percent, are expected to be truck trips.

C. **Vehicle Miles Traveled:** Daily VMT is projected to increase at near the same rate as population growth between 2010 and 2040. The largest increases will be experienced on both urban and rural arterials within the corridor. However, VMT per capita shows decreases on all interstate facilities, urban arterials, and rural local roads. This reflects increasing urbanization in the corridor as existing regional centers expand and new centers develop in high-growth areas.

D. **Major Trip Destinations:** The most common destinations in the I-65 corridor are the Nashville Core and East Nashville/Madison, followed by Franklin, Spring Hill, and Maury County. In effect, the trip destinations highlight the importance of daily trips in a corridor running from Goodlettsville to South Nashville and a second corridor from Brentwood to Columbia.

E. **County-to-County Work Flows:** The most common commuting destination is Davidson County, serving as the primary work destination for trips originating in eight of the 13 surrounding counties. Williamson County is the most common destination for work trips from Davidson and Maury Counties, and Maury County serves the same function for Giles and Marshall Counties.

F. **Volume-to-Capacity Ratios:** In 2010, most of I-65 functions in good operational conditions, with LOS A to C. LOS decreases to LOS D and E at select locations around the Nashville area – specifically, near the I-65/SR 386 (Vietnam Veterans Boulevard) interchange, the I-65/I-40 interchange in North Nashville, the I-65/I-40 interchange in downtown Nashville, the I-65/I-440 interchange, and from Harding Place to Cool Springs. By 2040, LOS degrades to LOS D, E, and F for most of I-65 between the Kentucky state line and Spring Hill in

Maury County. I-65 is expected to continue to operate well in the rural southern sections of the roadway. It is important to note that the V/C ratios and corresponding LOS reflect daily traffic volumes and do not represent peak travel periods and traffic incidents. Daily V/C ratios are typically substantially lower than AM and PM V/C ratios in urban areas.

G. **Spillover Traffic on Arterials:** Several parallel arterials are projected to be approaching capacity in 2040, and additional spillover traffic will push them above capacity. Volume increases range from 50 percent on Nolensville Pike/US 41A to 520 percent on Horton Highway/US 31A. The spillover effect on a typical weekday will likely be even more pronounced when there is an incident on I-65.

H. **Bottlenecks:** Bottlenecks are frequently caused by lane drops, interchanges, heavy volumes exceeding capacity, merge segments, and diverge segments. The corridor features frequent bottlenecks in the AM and PM peak periods in both the northbound and southbound directions, extending as far north as Millersville in Sumner County to Cool Springs in Williamson County.

I. **Travel Times:** Travel times are forecasted to increase between 70 and 100 percent in seven of the ten O-D pairs analyzed, with the greatest increases occurring in pairs extending from Spring Hill to Nashville. Trips from Franklin to the Nashville Core, for example, are projected to double from 29 minutes to 59 minutes, and although a shorter distance, the duration of trips from Franklin to Brentwood will increase from 10 minutes to 21 minutes.

4. Safety

Increasing traffic volumes, vehicle miles traveled, and travel times create the conditions for more traffic incidents. Crashes can, of course, have devastating impacts on individuals and families, and more routinely, generate long travel delays especially where travel options are limited. Crash data was collected throughout the I-65 corridor and analyzed to identify locations with existing safety issues and potential future safety issues.

4.1 Crash Analysis

Crash Rates and Crash Hotspots

Crash rates were collected for the entire I-65 corridor from TDOT for the 2013-2015 three-year period, and are reported in terms of crashes per million vehicle miles travelled. The statewide average crash rate is set at 0.512 crashes per million vehicle miles for rural freeways and 1.036 crashes per million vehicle miles for urban freeways. I-65 crash rates were compared to the Tennessee statewide averages based on the following metrics:

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

Crash hotspots were identified as the locations with crash rates significantly above average, shown in red in Figure 4-1. Table 4-1 lists all crash hotspot locations along I-65 and compares the segment's crash rate with the statewide average crash rate. Table 4-2 reports injuries and fatalities resulting from reported crashes from 2013 to 2015 compared by sub-area. While the number of fatalities remained consistent from 2013 to 2015, the number of injuries increased by 18 percent. However, the three-year total of 34 percent of injuries per crash is consistent through each individual year. On average, over the three-year period, 0.4 percent of crashes led to fatalities.

Crash by Type

Reported crashes are categorized into ten collision types:
0 – No Collision with Vehicle
1 – Rear-end
2 – Head-on
3 – Angle
4 – Sideswipe, Same Direction
5 – Sideswipe, Opposite Direction
6 – Rear to Side
7 – Rear to Rear
8 – Other
9 – Unknown

In total, 9,049 crashes were analyzed over the three-year period of 2013 to 2015. Figure 4-2 details the crash types on I-65 between 2013 and 2015. Over 90 percent of crashes were caused by one of three reasons: no collision with vehicle, rear ending, or side swiping in the same direction.

Potential Crash Factors

Crashes occurring in crash hotspot locations were broken down into two categories to generate insights into potential factors:

- Crashes in congested crash hotspots; and
- Crashes in non-congested crash hotspots.

Figures 4-3 and 4-4 display the crash breakdown by type for each of the two categories listed. Both categories have three main crash causes: rear ending, no collision with a vehicle, and sideswiping in the same direction. These causes are consistent with the overall findings in Figure 4-2, although the percentage breakdown differs between them. Rear-end crashes remain the most common cause of crashes in both congested and non-congested crash hotspots – 42 percent of crashes in congested crash hotspots and 44 percent of crashes in non-congested crash hotspots. However,

Figure 4-1. I-65 Three-Year (2013-2015) Crash Rates

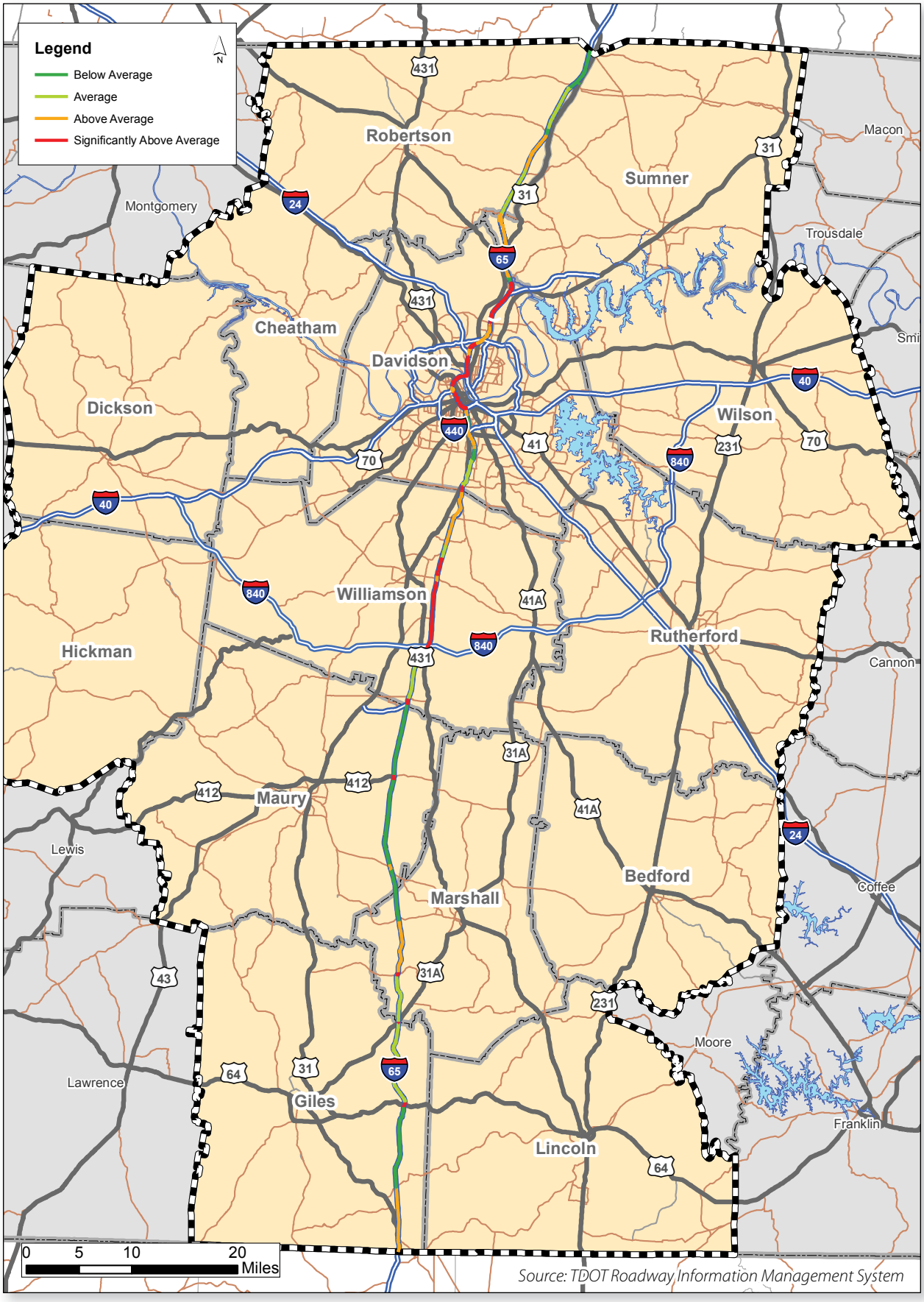


Table 4-1. I-65 Crash Hotspots Table

Hotspot Location Description	Statewide Crash Rate (per million vehicle miles)	Segment Crash Rate (per million vehicle miles)
Exit 97: SR 174/Long Hollow Pike to Exit 92: SR 45/Old Hickory Blvd	0.512	1.16 - 2.248
Exit 90: SR 155/US 41 to Exit 88: I-24 West	1.036	2.395
Nashville Downtown: Exit 88: I-24 West to Exit 210: the I-65/I-40 Interchange	1.036	2.145 - 5.668
Exit 74: SR 254 West/Old Hickory Blvd Interchange	0.512	2.622
Exit 68: Cool Springs Blvd to Exit 59: I-840	0.512	1.312 - 1.778
Exit 53: SR 396/Saturn Pkwy Interchange	0.512	1.559
Exit 46: US 412/SR 99 Interchange	0.512	1.098
Exit 27: SR 129/Lynnville Highway Interchange	0.512	1.035
Exit 22: SR 11/US 31A Interchange	0.512	2.459
Exit 14: US 64/SR 15 Interchange	0.512	1.213

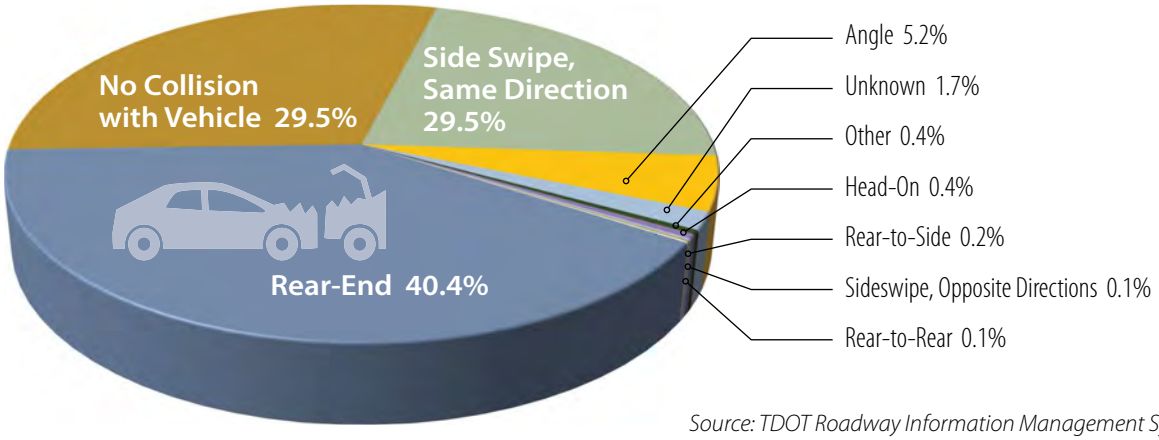
Source: TDOT Roadway Information Management System

Table 4-2. Sub-Area Crash Summary for Reported Crashes along I-65 (2013-2015)

		2013			2014			2015			3 Year Total				
Subarea	County	Total Crashes	Number of Fatalities	Number of Injuries	Total Crashes	Number of Fatalities	Number of Injuries	Total Crashes	Number of Fatalities	Number of Injuries	Total Crashes	Number of Fatalities	Percent of Fatalities per Crash	Number of Injuries	Percent of Injuries per Crash
North	Robertson	157	0	63	163	4	66	182	1	68	502	5	1.0%	197	39%
	Sumner	92	0	34	101	1	39	101	0	34	294	1	0.3%	107	36%
Central	Davidson	1,757	8	621	1,600	5	549	2,234	5	738	5,591	18	0.3%	1908	34%
	Williamson	586	2	164	691	1	217	714	4	230	1,991	7	0.4%	611	31%
South	Giles	85	1	36	86	0	42	91	2	25	262	3	1.1%	103	39%
	Marshall	61	2	28	52	0	22	64	1	40	177	3	1.7%	90	51%
	Maury	83	0	38	69	1	22	80	0	33	232	1	0.4%	93	40%
	Total	2,821	13	984	2,762	12	957	3,466	13	1,168	9,049	38	0.4%	3,109	34%

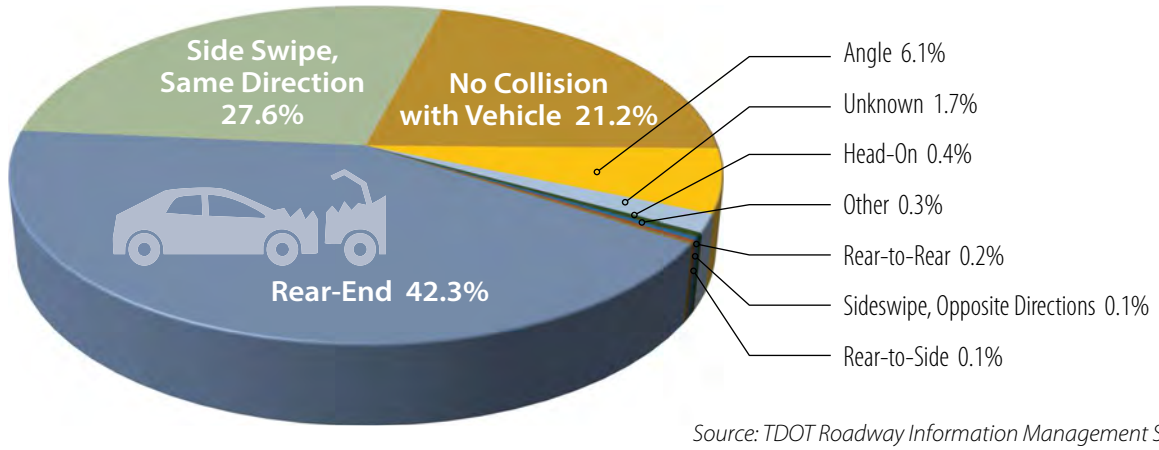
Source: TDOT Roadway Information Management System

Figure 4-2. I-65 Three-Year (2013-2015) Crash Breakdown by Type



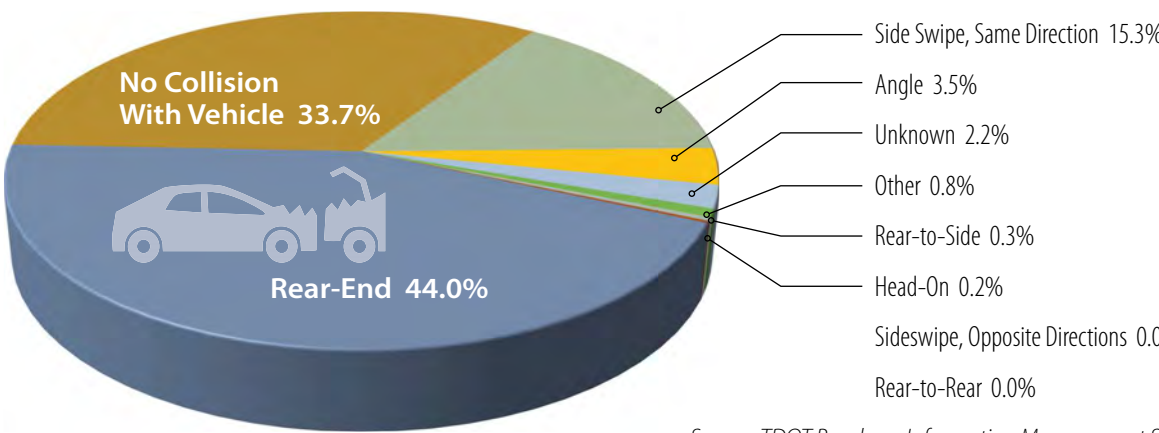
Source: TDOT Roadway Information Management System

Figure 4-3. 2013-2015 Crash Breakdown in Segments with High Crash Rates and Congestion



Source: TDOT Roadway Information Management System

Figure 4-4. 2013-2015 Crash Breakdown in Segments with High Crash Rates and No Congestion



Source: TDOT Roadway Information Management System

sideswipes in the same direction make up a larger portion of crashes in congested areas as compared to non-congested areas. These crashes comprise 28 percent of crashes in congested crash hotspots, but only 15 percent of crashes in non-congested crash hotspots. Additionally, crashes occurring with no collision with a vehicle (i.e., hitting a fixed object or obstruction) make up a larger portion of crashes in non-congested areas as compared to congested areas – 33 percent of crashes in non-congested crash hotspots and only 21 percent of crashes in congested hotspots.

The roadway geometry for I-65 was also analyzed for deficiencies that could be causes in crash hotspots. The roadway geometric conditions analyzed are horizontal alignment, vertical alignment, outside shoulder width, inside shoulder width, and median width. The locations of areas with deficiencies were overlaid with high crash rate areas to analyze if geometric deficiencies could be the cause of high crash rates. Figure 4-5 compares the locations with crash rates significantly above the statewide average with locations of geometric design deficiencies.

The northernmost crash hotspot on I-65 occurs around the SR 386 interchange. The majority of this hotspot location does not meet inside shoulder width and median width standards. For the crash hotspot just north of the I-24 and I-65 merge to the southern merge point of I-40 and I-65, sections do not meet standards for inside shoulder width, outside shoulder width, and median width. Additionally, the southern I-24 and I-65 merge does not meet horizontal alignment standards. I-65 leaving Davidson County is a crash hotspot that does not meet standards for horizontal alignment, vertical alignment, outside shoulder width, and median width.

I-65 from north of SR 96 through south of I-840 is another crash hotspot location. The majority of this hotspot location does not meet the median width standard, with portions not meeting the inside shoulder width standard. Another crash hotspot occurs as I-65 crosses Williamson County's southern border. This location does not meet the outside shoulder width and median width standards. The interchange at I-65 and US 412/ Bear Creek Pike interchange is also a crash hotspot. This location does not meet the inside shoulder width and outside shoulder width standards. The I-65 at SR 129/Lynnville Highway and I-65 at US 31A interchanges are crash hotspots. These locations meet all analyzed geometric design standards. I-65

The Following Standards Have Been Utilized in Color Coding the Geometric Design Deficiencies

Horizontal Alignment Standard

Distances between successive curves to ensure that proper superelevation transitions:

- Meets standard
- Deficient

Vertical Alignment Standard

Allowable grade for the terrain type of the study area (level, rolling, or mountainous):

- Meets standard
- Within AASHTO allowable one percent grade for urban/mountainous area
- Deficient

Inside Shoulder Width Standard

TDOT & AASHTO recommend 4-foot inside shoulder widths for four lane roadways and 10-foot inside shoulder widths for six lane roadways; portions where truck traffic exceeds 250 DDHV should consider 12-feet:

- Meets stricter standard for truck traffic greater than 250 DDHV
- Meets TDOT & AASHTO standard of 10-foot for 6-lane section
- Meets TDOT & AAHSTO standard of 4-foot for 4 lane section
- Deficient; less than 10 feet on a 6-lane section
- Deficient; less than 4 feet on a 4-lane section

Outside Shoulder Width Standard

TDOT and AASHTO recommend 10-foot shoulders; portions where truck traffic exceeds 250 DDHV should consider 12-feet:

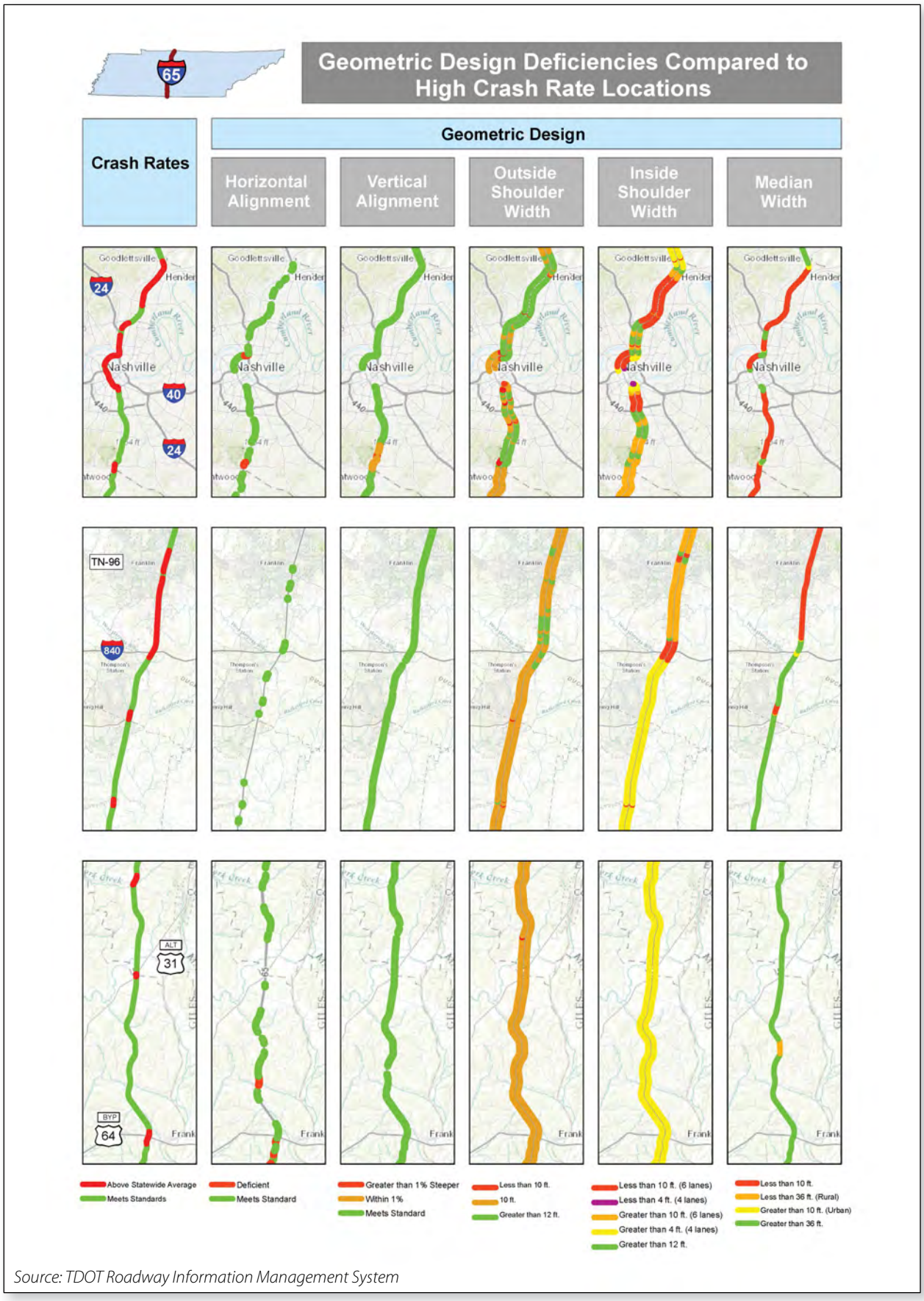
- Meets stricter 12-foot standards for truck traffic greater than 250 DDHV
- Meets TDOT and AASHTO 10-foot standard
- Deficient

Median Width Standard

AASHTO recommends 10 feet in urban areas and 36 feet in rural areas:

- Meets the rural standard of 36 feet
- Meets the urban standard of 10 feet
- Deficient; less than 36 feet in rural section
- Deficient; less than 10 feet in urban section

Figure 4-5. Geometric Deficiencies and Crash Hotspots



Source: TDOT Roadway Information Management System

at the US 64 Bypass route is a crash hotspot. This location does not meet the horizontal alignment standard.

It is important to emphasize that geometric designs which are less than optimal are sometimes permitted and constructed due to other factors preventing desired design standards. Further analysis would be required to determine the full impact of the geometric design deficiencies on crash history. Lastly, in considering future changes to the corridor, consideration should be given to whether any of these deficiencies can be corrected as part of other projects in the corridor. It should also be noted that most of these same segments also have high traffic volumes, which is also likely a contributing factor to the number of crashes.

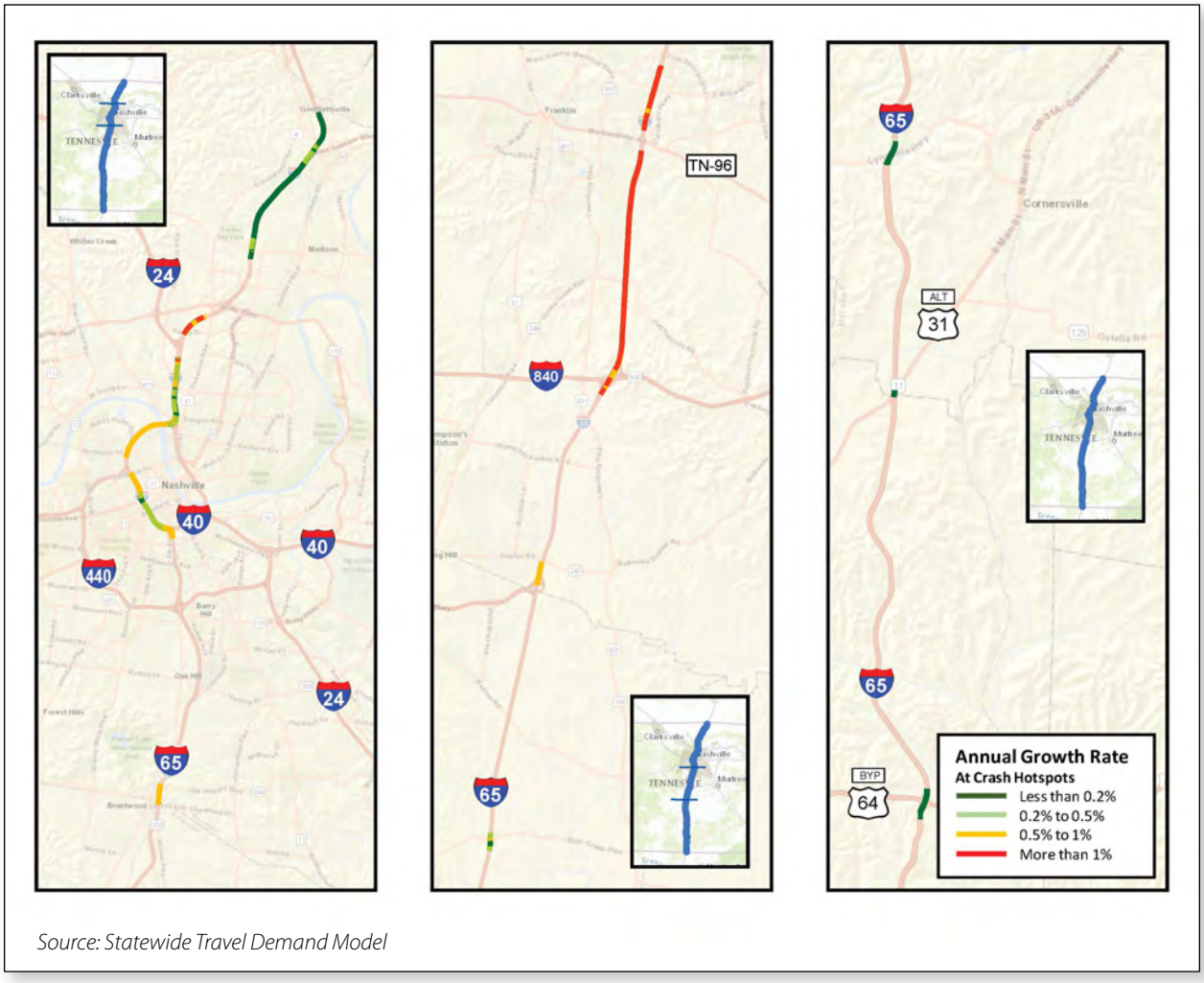
Traffic Increases at Hotspots

Annual growth rates (AGR) for traffic volumes were calculated for each crash hotspot along I-65 using projected 2040 volumes. Figure 4-6 displays the AGRs grouped into four categories: less than 0.2 percent, 0.2 to 0.5 percent, 0.5 to 1.0 percent, and greater than 1.0 percent. Interstate 65 just north of I-840 and through Franklin and Thompson's Station has AGRs of over 1.0 percent. The crash hotspots in these areas are a key safety concern as traffic increases over time. The Nashville downtown loop is another area of concern, with growth rates between 0.5 and 1.0 percent.

Impacts to Regular Operations

Crashes impact regular operations by reducing the number of lanes accessible to traveling vehicles and therefore reducing roadway capacity. The number

Figure 4-6. Traffic Increase at Hotspots



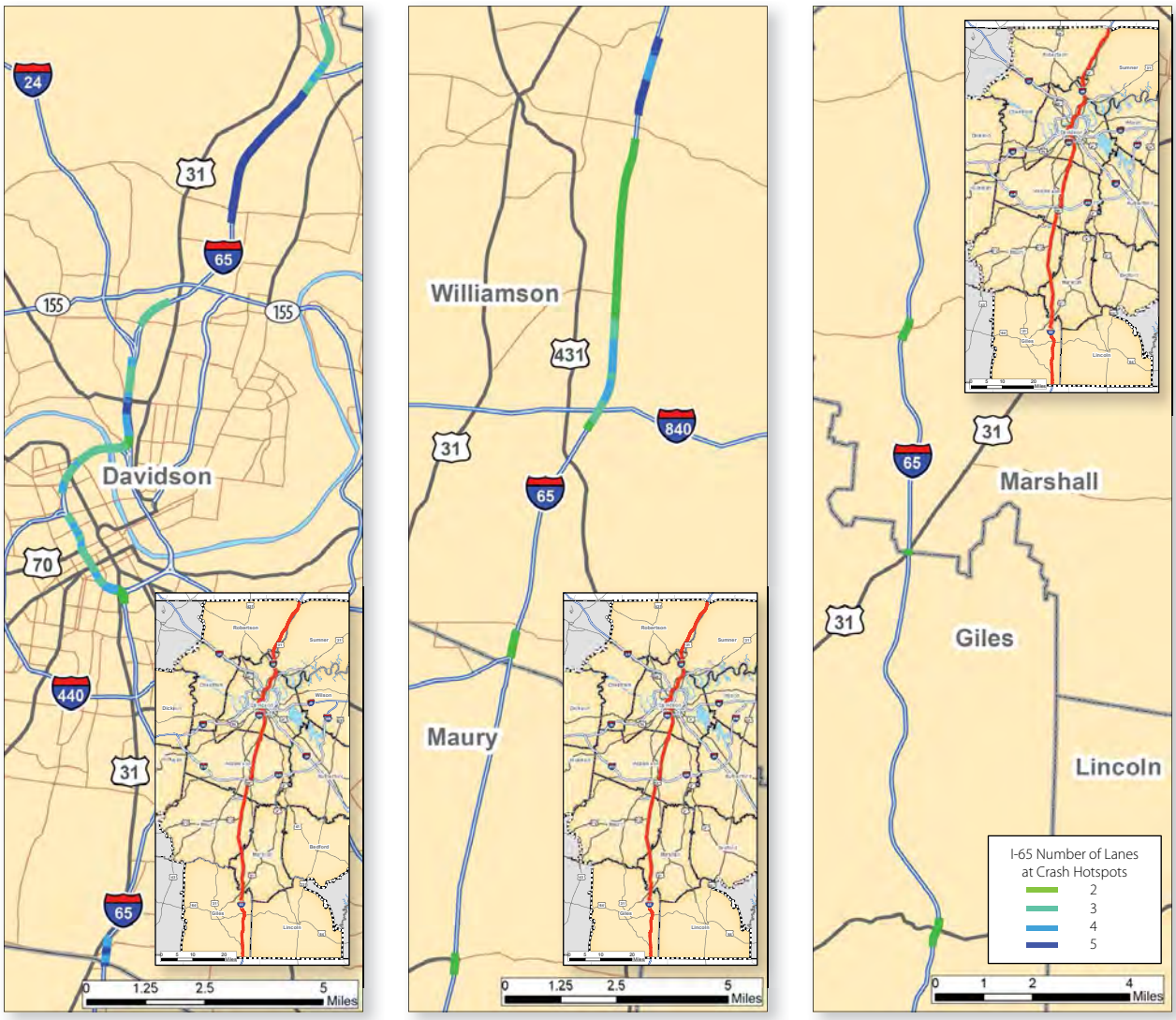
Source: Statewide Travel Demand Model

of lanes on I-65 varies from two to five lanes. If a crash occurs during AM or PM peak hours, the crash can impact the roadway for several hours and reduce roadway capacity between 20 and 50 percent. Figure 4-7 displays the number of lanes on I-65 at crash hotspots. Three areas of concern exist for the impact of a crash to regular operations. First, I-65 along the Nashville downtown loop has many crash hotspots. The loop's northern diverge with I-24 and southern diverge with I-40 are sharp curves with only two lanes. The roadway curvature coupled with the fact that this is a high-volume urban area make crashes in this area a primary concern. Next, I-65 through Franklin, between SR 96 and I-840 has a two lane stretch and crash hotspot. While curvature is not a concern at this location, the length of the crash hotspot still leaves this as an area of concern. Lastly, I-65 in Goodlettsville north of the merge with SR 386/ Vietnam Veterans Boulevard has a three-lane crash hotspot stretch. The curvature of this area makes this an area of concern, as a crash could greatly hinder traffic flow.

Pedestrian and Bicycle Crashes

Pedestrian and bicycle crashes within one-mile of I-65 were also analyzed for the three-year period 2013-2015. In total, there were 429 crashes involving a pedestrian or bicyclist (Figure 4-8). Fifteen of the crashes occurred on I-65, and 414 took place with one mile of the interstate. Figures 4-9 and 4-10 illustrate the location of crashes in the higher incident areas of I-65 and

Figure 4-7. I-65 Number of Lanes at Crash Hotspots



Source: TDOT Roadway Information Management System

Figure 4-8. 2013-2015 Pedestrian and Bicycle Crashes

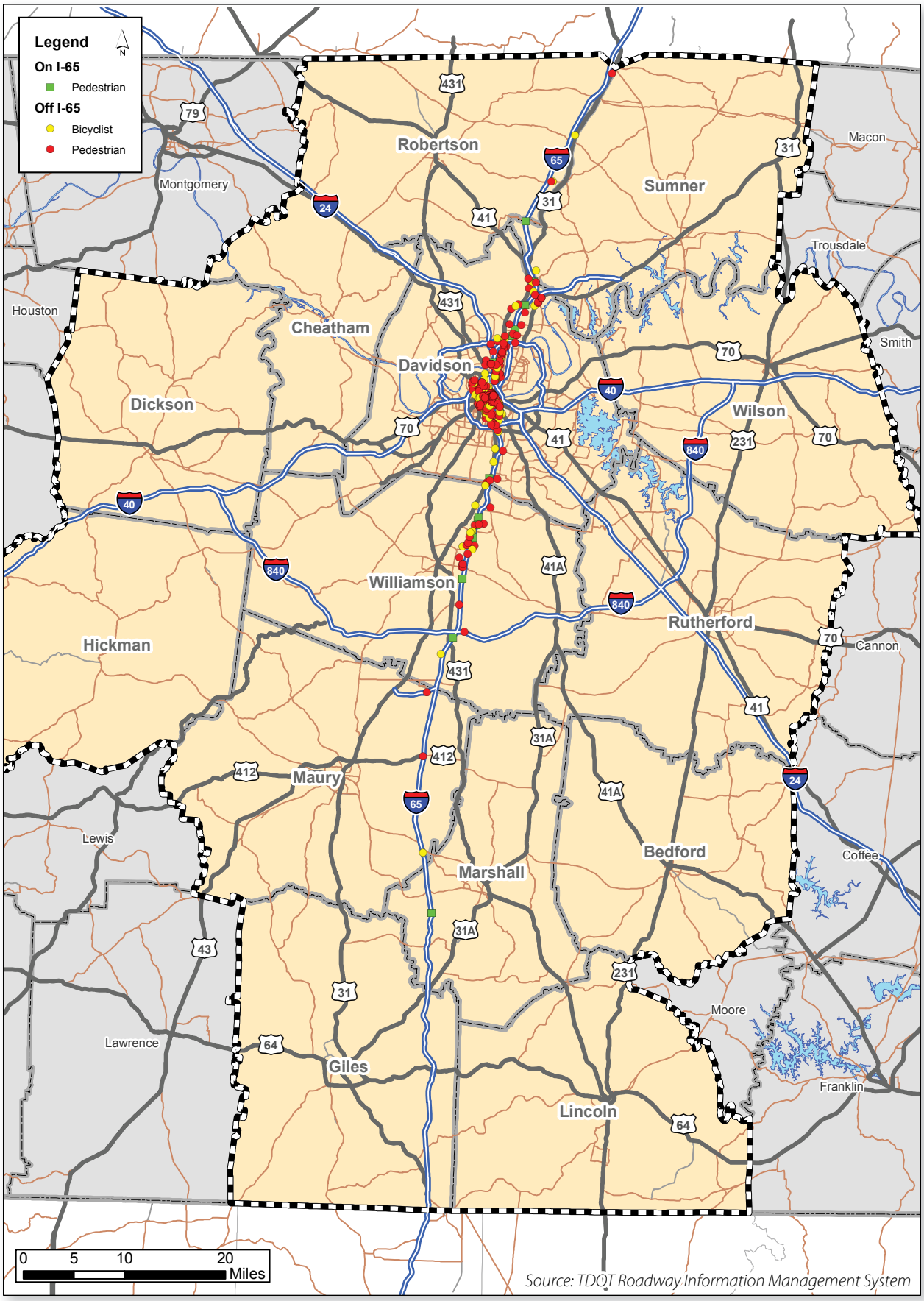


Figure 4-9. 2013-2015 Pedestrian and Bicycle Crashes: Nashville Core

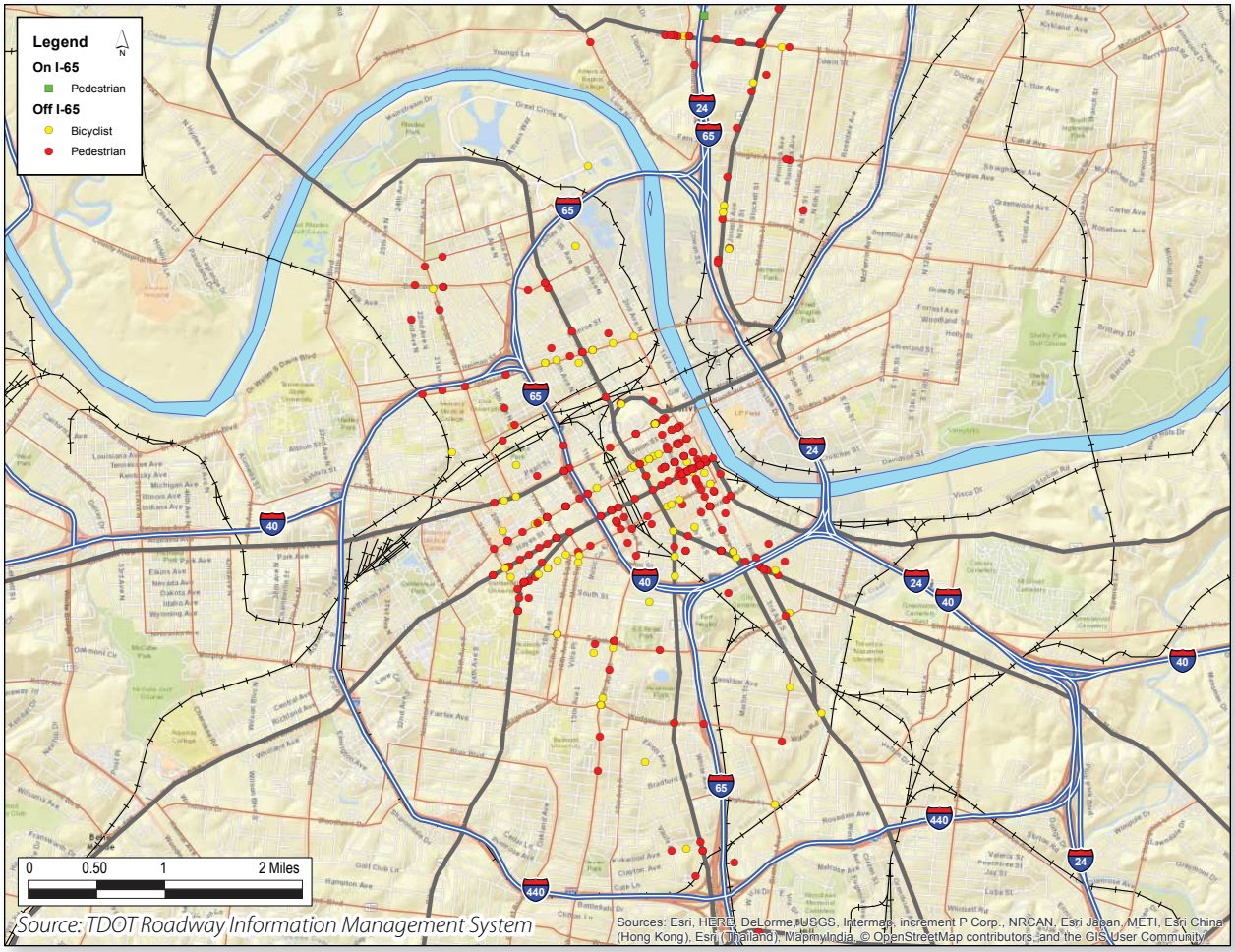
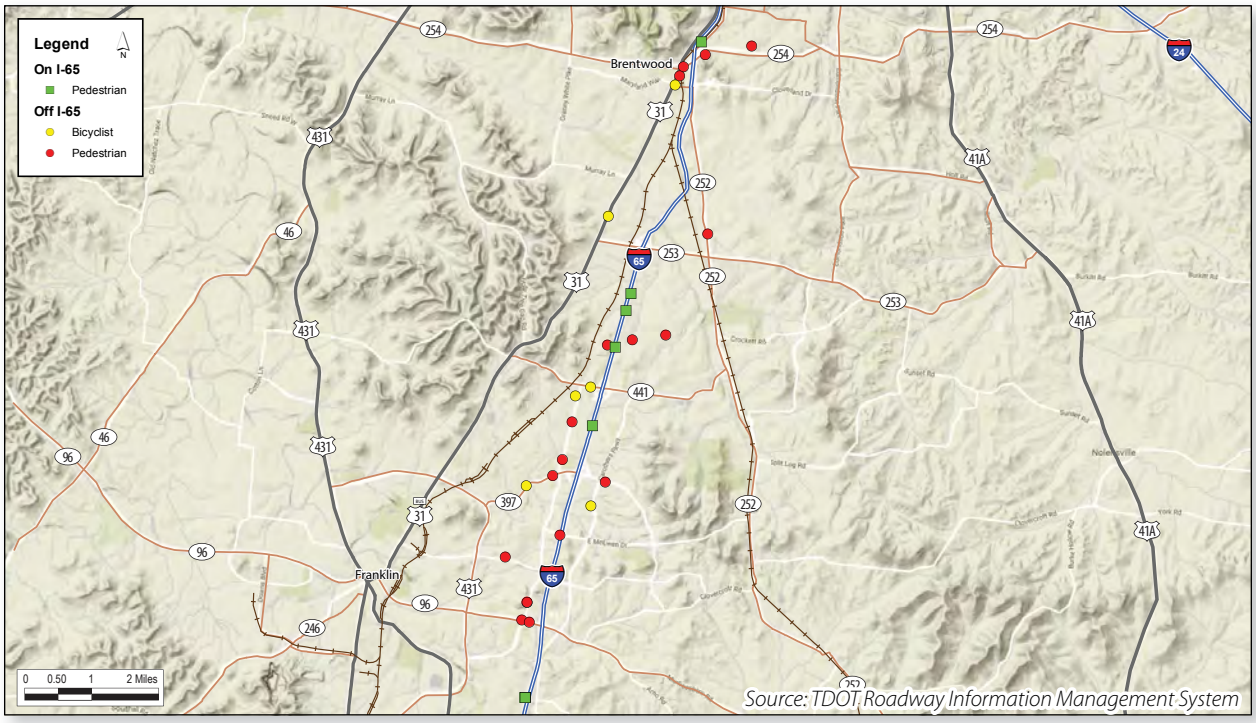


Figure 4-10. 2013-2015 Pedestrian and Bicycle Crashes: Williamson County



Trinity Lane (Exit 87), I-65 and downtown Nashville, and I-65 between Old Hickory Boulevard and Moore's Lane. While most of the crashes did not occur on the interstate, pedestrian and bicycle safety on streets that parallel and intersect I-65 impacts the effectiveness of the transportation system to provide travel options throughout the corridor, including the important first and last mile to transit. Of the non-interstate crashes, 77 percent involved pedestrians (Table 4-3).

Table 4-3. Non-Interstate Pedestrian and Bicycle Crash Locations

Vicinity of Crash	Pedestrian	Bicycle
Driveway, Alley Access, etc.	11	7
Entrance/Exit Ramp	3	1
Intersection	159	56
On Roadway	146	31
TOTAL	319	95

Source: TDOT Roadway Information Management System

4.2 Existing and Future Deficiencies and Needs

Crashes were analyzed over the three-year period of 2013 to 2015, with crash hotspots identified as locations with crash rates significantly above the statewide average. The safety analysis also examined potential factors at crash hotspots, including crash types, congestion, and roadway geometry. It is important to underscore that geometric designs which are less than optimal are sometimes permitted and constructed due to other factors preventing desired design standards. Further analysis would be required to determine the full impact of the geometric design deficiencies on crash history. Key findings of the analysis include:

A. **Crash Rates and Hotspots:** Crash hotspots were identified as the locations with crash rates significantly above the statewide average for similar facilities. Ten hotspots, ranging from individual interchange locations to segments between three and nine miles in length, were documented. Additionally, injuries and fatalities resulting from reported crashes from 2013 to 2015 were compared by travel market, with large increases in the East Nashville/ Madison, Nashville Core, and South Nashville travel markets. While the number of fatalities remained consistent from 2013 to 2015, the number of injuries increased by 18 percent.

B. **Crash Types:** Rear-end crashes remain the most common cause of crashes in both congested and non-congested crash hotspots – 42 percent of crashes in congested crash hotspots and 44 percent of crashes in non-congested crash hotspots. However, sideswipes in the same direction make up a larger portion of crashes in congested areas as compared to non-congested areas. These crashes comprise 28 percent of crashes in congested crash hotspots, but only 15 percent of crashes in non-congested crash hotspots. Additionally, crashes occurring with no collision with a vehicle (i.e., hitting a fixed object or obstruction) make up a larger portion of crashes in non-congested areas as compared to congested areas – 33 percent of crashes in non-congested crash hotspots and only 21 percent of crashes in congested hotspots.

C. **Roadway Geometry:** The roadway geometry for I-65 was also analyzed for deficiencies that could be potential factors in crash hotspots. The roadway geometric conditions analyzed were horizontal alignment, vertical alignment, outside shoulder width, inside shoulder width, and median width. Although most of the crash hotspots included geometric deficiencies, additional analysis would be required to determine the full impact of the geometric design on crash history.

D. **Traffic Increases:** Interstate 65 just north of I-24 and through Franklin and Thompson's Station has annual traffic growth rates over 1.0 percent. The crash hotspots in these areas are a key safety concern as traffic increases over time. The Nashville downtown loop is another area of concern, with annual growth rates between 0.5 and 1.0 percent.

E. **Impacts to Regular Operations:** Three areas of primary concern exist for the impact of a crash to regular operations. First, I-65 along the Nashville downtown loop has many crash hotspots. Next, I-65 through Franklin, between SR 96 and I-840 has a two lane stretch and crash hotspot. Last, I-65 in Goodlettsville north of the merge with SR 386/Vietnam Veterans Boulevard has a three-lane crash hotspot stretch. The curvature of this area makes this an area of concern, as a crash could greatly hinder traffic flow.

F. **Pedestrian and Bicycle Crashes:** Pedestrian and bicycle crashes within one-mile of I-65 were also analyzed for the three-year period 2013-2015. In total, there were 429 crashes involving a pedestrian or bicyclist. Fifteen of the crashes occurred on I-65, and 414 took place with one mile of the interstate. Of the non-interstate crashes, 77 percent involved pedestrians.

5. Operations and Maintenance

5.1 State of Good Repair

Pavement Sufficiency Rating

Data was collected from the Tennessee Roadway Information Management System (TRIMS) and the Highway Performance Monitoring System (HPMS) to assess current I-65 assets. TRIMS is a TDOT database containing information regarding roadway traffic, geometry, history, maintenance features, and more. The HPMS is a national highway information system containing data on all public roads, including performance, condition, use, and operating characteristics. Table 5-1 details the operations and maintenance data collected by TRIMS and HPMS for I-65 by county.

Pavement smoothness is a key factor in determining roadway ratings, measured in this analysis using the International Roughness Index (IRI). The IRI is the most widely accepted indicator of pavement performance. The IRI measures suspension movement over a longitudinal distance in units of inches per mile, with a score of "0" referring to a perfectly smooth roadway. In 2006, FHWA set standards determining that a good quality roadway must have an IRI of 95 inches per mile or lower. The average IRI for I-65 is 63, with Davidson and Robertson Counties exhibiting the highest scores.

Bridge Conditions

Data was collected from TDOT's TRIMS database to analyze the conditions of all bridges in the I-65 corridor. Bridges were classified as having structural deficiencies, no structural deficiencies, or data unavailable. Figure 5-1 displays the classifications for all bridges along I-65, and shows two bridges with structural deficiencies.

5.2 Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) improve transportation safety and mobility and enhance productivity through advanced management and communication technologies. ITS capabilities can both address spot problem areas in corridors as well as support integrated management.

ITS Device Inventory

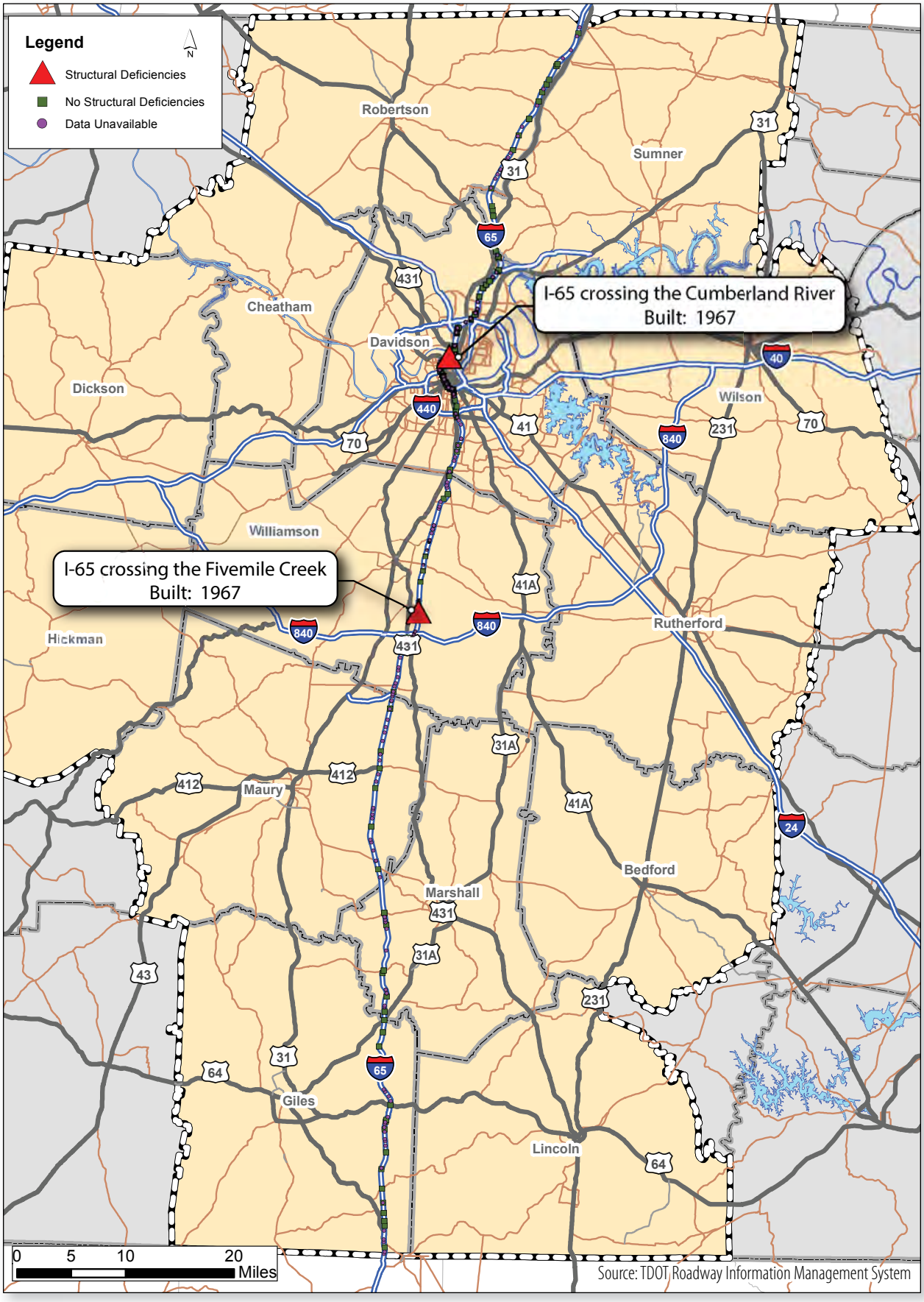
TDOT has deployed numerous ITS devices along I-65 as part of their Smartway system including Dynamic Message Signs (DMS), CCTV cameras, Radar Detection System (RDS), and fiber optic and wireless communications. These devices are instrumental in facilitating the needs of the system and the motoring public, as well as for future opportunities for increasing the efficient use of the existing capacity. Currently, there are no devices that have been deployed in the North and South Sub- Areas of the corridor. However, within the Central Sub-Area, there are 40 CCTVs, 123 RDSs, and 15 DMSs. These devices are connected via the

Table 5-1. I-65 Operations and Maintenance by County

County	Average International Roughness Index	Most Recent Resurfacing	Sign Inventory (as % of total # signs)				Max AADT	Max Directional Distribution
			Good	Fair	Poor	N/A		
Davidson	76	2000	47%	1%	-	52%	172,100	65%
Giles	64	1998	36%	0%	0%	64%	20,260	59%
Marshall	54	1993	36%	0%	1%	63%	26,160	55%
Maury	55	1994	26%	-	1%	73%	35,250	54%
Robertson	74	2000	47%	2%	0%	51%	52,320	58%
Sumner	65	1994	35%	1%	-	64%	82,710	62%
Williamson	55	1994	47%	1%	0%	52%	148,820	67%
OVERALL AVERAGE	**63**	-	**39%**	**1%**	**0%**	**60%**	**76,803**	**60%**

Source: TDOT Roadway Information Management System; Highway Performance Monitoring System

Figure 5-1. I-65 Bridge Conditions



previously mentioned fiber optic communications to the Region 3 Traffic Management Center (TMC) located in Nashville, which operates 24 hours a day, seven days a week.

Through the deployed devices, the Smartway system can collect information on how traffic along I-65 is moving through the RDS, which detect the presence of vehicles in each lane providing information on the capacity of I-65 as well as the speed along the facility. The CCTVs are used to verify the data received from the RDSs and to monitor I-65 for incidents and other potential roadway hazards. The information is then used by TMC operators to display information on the DMS about incidents, construction, travel speeds, and other relevant driving messages, and to deploy incident management services along I-65 where needed. There are 33 HELP vehicles that patrol middle Tennessee, including the area of I-65 from SR 96 (Exit 65) to SR 155 (Exit 90). In addition to the DMS along I-65, the SmartWay website provides users pre-trip information.

TDOT has proposed an expansion of the Smartway system along I-65 that would add CCTVs, RDSs, and DMSs to the North and South Sub-Areas. For the North Sub-Area, nine CCTVs and four DMSs are proposed, which will extend coverage from US 31W (Exit 98) to approximately two miles north of the interchange at SR 76 (Exit 108). The South Sub-Area has 13 CCTVs, four DMS, and 29 RDSs that are proposed for the I-65 corridor, extending the system coverage to approximately one mile south of the I-65 and I-840 interchange (Exit 59).

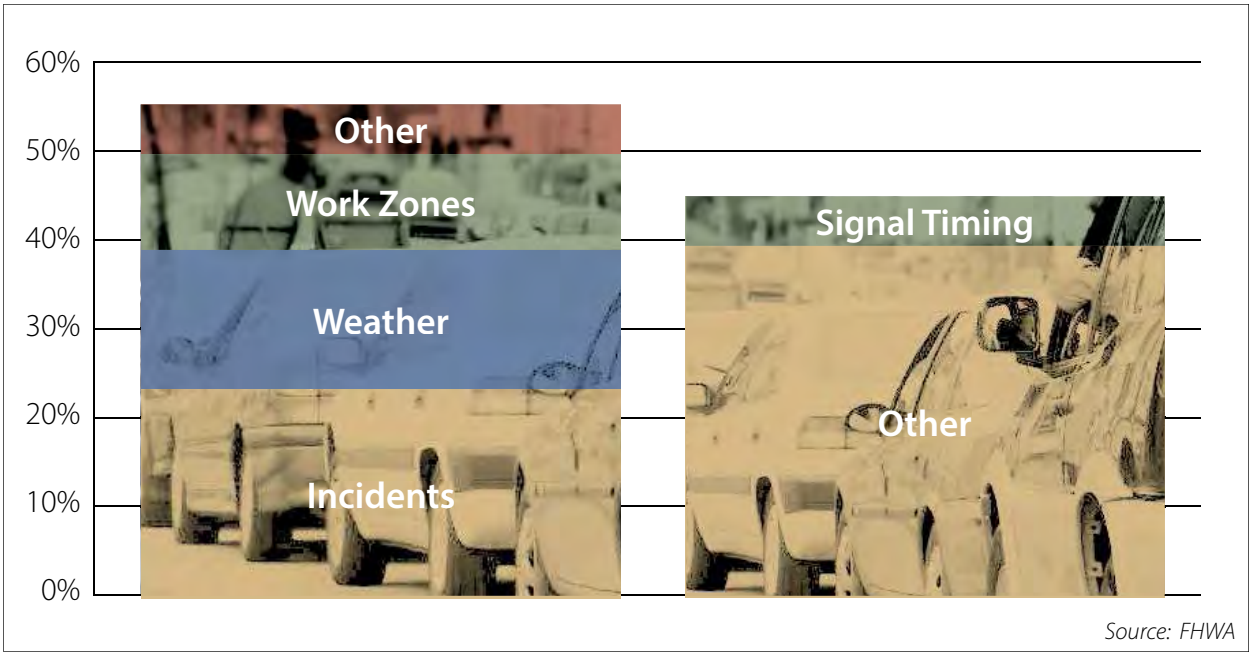
5.3 ITS State of the Practice

The I-65 corridor in Tennessee currently employs many ITS applications and strategies to improve safety and operations. As with all technology, trends in ITS strategies are rapidly changing. Reviewing the state of the practice nationally can highlight opportunities to advance ITS in the I-65 corridor.

Transportation System Management and Operations (TSM&O)

Given constraints on adding new capacity, it is increasingly important to maximize existing transportation networks, especially "taking back" capacity lost to congestion, incidents, construction, weather, and poor ramp signalization. Figure 5-2 illustrates the common sources of congestion. TSM&O can provide an integrated program to optimize the performance of existing infrastructure through the implementation of systems and services that preserve capacity and improve reliability and safety. The associated activities focus on well-known strategies including incident management, traffic signal timing, ramp metering, road weather management, and others.

Figure 5-2. Congestion Contributors



Source: FHWA

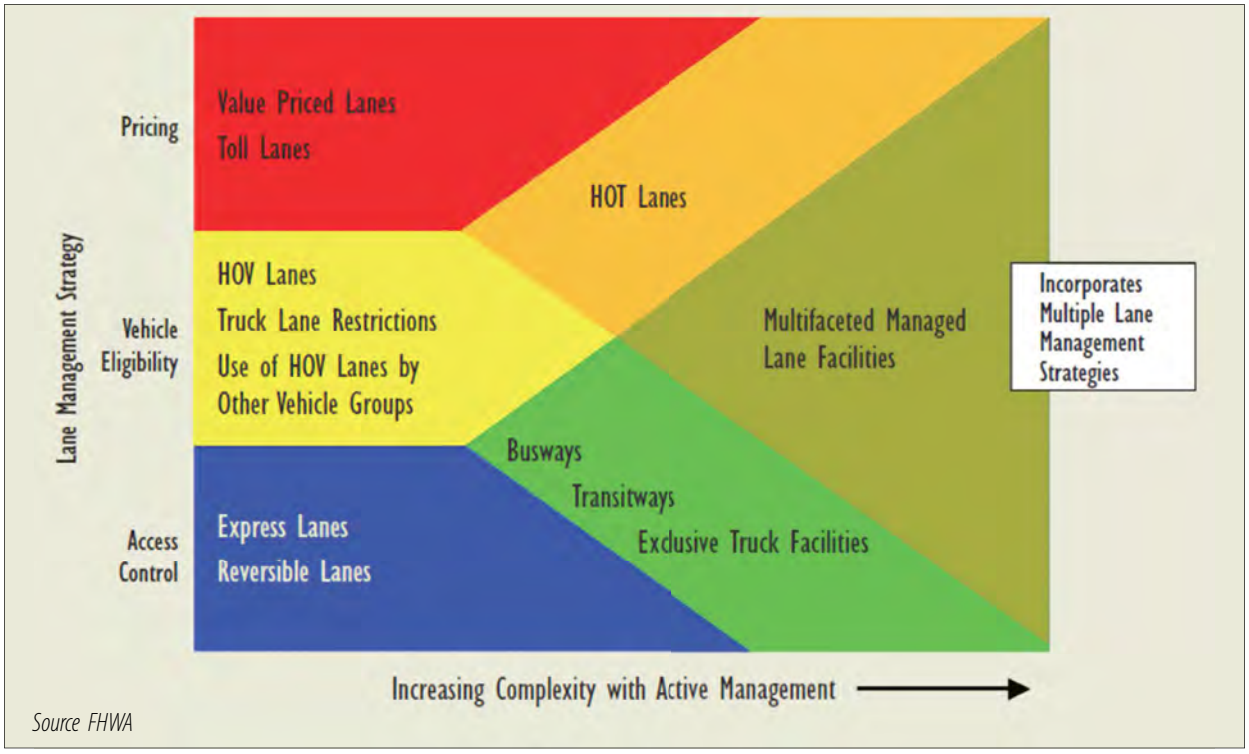
Best practices in TSM&O across the U.S. and internationally highlight many possible ITS and ITS related operations and safety programs, strategies, and applications that may be appropriate for use now, or in the future, on all or portions of the I-65 corridor. These opportunities include:

- Managed Lanes;
- Active Traffic and Demand Management (ATDM);
  - Active Traffic Management (ATM)
  - Active Demand Management (ADM)
  - Active Parking Management (APM)
- Freight Applications;
  - Freight Advanced Traveler Information System (FRATIS)
  - Freight Signal Priority
  - Truck Parking, Truck Parking Guidance, and Rest Areas
- Work Zone Mobility and Safety;
- Traffic Incident Management (TIM);
- Integrated Corridor Management; and
- Connected and Autonomous Vehicles Technology.

Managed Lanes

Managed lanes are defined as highway facilities or a set of lanes where operational strategies are proactively implemented and managed in response to changing conditions. The managed lane concept is typically a "freeway-within-a-freeway" where a set of lanes within the freeway cross section is separated from the general-purpose lanes. The facility incorporates a high degree of operational flexibility so that over time operations can be actively managed to respond to growth and changing needs. The operation of and demand on the facility is managed using a combination of tools and techniques to continuously achieve an optimal condition, such as free-flow speeds. The principal management strategies can be categorized into three groups: pricing, vehicle eligibility, and access control. Examples of operating managed lane projects include high-occupancy vehicle (HOV) lanes, value priced lanes, high-occupancy toll (HOT) lanes, or exclusive or special use lanes. Figure 5-3 shows the potential lane management applications. On the left are the applications that are made up of a single strategy. As you move from left to right on the graphic, the strategies increase complexity. The Nashville Area MPO examined the feasibility of

Figure 5-3. Managed Lane Applications



Source FHWA

these strategies for the Middle Tennessee region in its *Managed Lanes Preliminary Feasibility Assessment*.

Active Traffic and Demand Management (ATDM)

ATDM is a strategy area that encompasses the dynamic management, control, and influence of travel demand, traffic demand, and traffic flow of transportation facilities. Using available tools and assets, traffic flow is managed and traveler behavior is influenced in real-time to achieve operational objectives, such as preventing or delaying breakdown conditions, improving safety, promoting sustainable travel modes, reducing emissions, or maximizing system efficiency. The notion of dynamically managing the trip chain is the ultimate vision of ATDM.

Active management of transportation and demand can include multiple approaches spanning demand management, traffic management, parking management, and the efficient utilization of other transportation modes and assets. There are three major categories of strategies in the ATDM framework:

- Active Traffic Management (ATM) - manages recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions;
  - Adaptive Traffic Signal Control (ATSC)
  - Dynamic Lane Assignment (DLA)/Dynamic Lane Use Control
  - Dynamic Speed Limit (DSpL)/Variable Speed Limit
  - Queue Warning (QW)
- Active Demand Management (ADM) - manages demand and has the potential to redistribute travel to less-congested times of the day or routes and/or to reduce the overall vehicle trips by influencing a change in mode choice;
  - Dynamic High-Occupancy Vehicle (HOV)/ Managed Lanes
  - Dynamic Routing
  - On-Demand Transit
  - Predictive Traveler Information
- Active Parking Management (APM) - manages parking facilities in a region to optimize performance and utilization of those facilities while influencing travel behavior at various stages along the trip making process.

Freight Applications

Improved systems are being developed for the freight community throughout the US. These new systems identify the specific needs of the community and attempt to address them through various ITS applications, including:

- Freight Advanced Traveler Information System (FRATIS) - provides real-time information to freight companies to support dynamic planning and efficient decision making;
  - Freight-Specific Dynamic Travel Planning and Performance
  - Drayage Optimization
- Freight signal priority - provides signal priority to freight vehicles near freight facilities with a goal of reducing delays, increasing travel time reliability, and enhancing safety at critical intersections;
- Truck parking and truck parking guidance – provides truck parking availability information to trucking companies and drivers with the potential to facilitate spot reservations; and
- Enhanced rest areas – provide better service to the trucking community and general population by including alternative refueling stations, Wi-Fi, and information kiosks.

Work Zone Mobility and Safety

Work zone safety is of paramount importance to TDOT. During construction, it is necessary to effectively manage traffic to minimize travel delays, ensure safety for motorists and workers, as well as complete road work on time, particularly in high-impact areas like metropolitan regions and corridors. FHWA's Every Day Counts (EDC) initiative, which is in its third iteration, specifically targets work zone safety via its Smarter Work Zones strategies that focus on project coordination and technological applications. The technological applications focus on queue management and speed management, and both involve the deployment of ITS for the dynamic management of work zone traffic impacts and aim to improve motorist and work safety and mitigate against congestion.

Traffic Incident Management (TIM)

TIM consists of a planned and coordinated multi-disciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safely and quickly as possible. Effective TIM reduces the duration and impacts of traffic incidents and improves the safety of motorists, crash victims and emergency responders. Planning and coordination includes numerous public and private partners including law enforcement, fire and rescue, emergency medical services, transportation departments, public safety communications, emergency management, towing and recovery, hazardous materials contractors, and traffic information media.

Integrated Corridor Management (ICM)

ICM is comprised of the coordinated operation of multiple transportation networks and cross-network connections encompassing a corridor and the synchronization of the institutions responsible for corridor accessibility and mobility. With an objective of improving accessibility, mobility, safety, and other transportation related goals for travelers and goods, ICM is comprised of several activities including cooperative and integrated policy among corridor operational stakeholders, improving the efficiency of cross-network junctions and interfaces, providing accessibility and mobility opportunities from a route and mode perspective, real-time monitoring and information distribution, congestion and incident management, travel demand management, and transportation pricing and payment opportunities.

Active management and integration are fundamental concepts used within ICM. Active management requires the monitoring and assessing of the performance of the system against defined performance metrics, while dynamically implementing actions and services in response to changes in demand. Information must be provided to system operators and users, allowing them to make the most informed decisions and choices for a successful system. Integration requires system assets be managed in a unified manor to ensure that actions can be taken that benefit the entire corridor.

Connected and Autonomous Vehicles Technologies

Harnessing technological advances to provide a safer roadway system has been a goal for both public and private enterprises. Within the USDOT, the ITS Joint Program Office (JPO), National Highway Traffic Safety Administration (NHTSA), and numerous other agencies have been coordinating and fostering the advancement of connected vehicle technologies with a goal of addressing transportation safety, mobility, and the environment. On the private side, auto manufactures, original equipment manufacturers (OEMs), and tech companies, including Google and Tesla, have been providing game changing opportunities for the transportation community including the autonomous vehicle. Initially, it was believed that the connected vehicle technology would be introduced to the market first with the autonomous feature following closely behind. However, technological advances and public acceptance has sped up the deployment of autonomous vehicles within the US and these two tracks of vehicle advancements have now converged into concurrent efforts.

Connected Vehicle Technology

Through the utilization of connected vehicle technology, vehicles, roads and other infrastructure, and smartphones will be able to communicate and share vital transportation information with each other. The communication will be based on dedicated short-range communications (DSRC), primarily, which is like Wi-Fi. While many vehicles today are currently "connected" through cellular technology, DSRC provides unique opportunities for fast, secure, and reliable communications, which is not vulnerable to interference. When there is near 100 percent penetration of DSRC, vehicles will be able to attain a 360-degree awareness of their surroundings and can communicate with equipment installed in and along roadways providing drivers with information on work zones, congestion warning messages, incidents, traffic signal timing changes, railroad crossings, and school zones.

In the fall of 2015, three pilot connected vehicle deployment sites were announced by the USDOT as part of their Connected Vehicle Pilot Development Program. These locations are

examining the effects of connected vehicle technologies on the safety and efficiency of truck movements along interstates, the abilities of vehicle-to-vehicle (V2V) and intersection communication to improve vehicle flow and pedestrian safety, and the impacts of safety and mobility applications on and in proximity to reversible freeway lanes.

Autonomous Vehicle Technology

Using radar, LIDAR, GPS, Odometry, and computer vision, autonomous vehicles sense the surrounding environment and navigate without the need for human input. NHTSA and DOT support states, other governmental agencies, and industry to ensure that testing takes place and provides for safety on today's roadways. Currently, autonomous cars are being tested on public streets in various locations. Tesla Motor vehicles provide drivers an autopilot feature that allow vehicles to navigate the roadway system and even change lanes without the driver's control. Uber, a ridesharing company, will be testing its autonomous fleet beginning in Pittsburg. The University of Michigan's Mcity test facility is being utilized for autonomous testing by major auto manufacturers as well as startup companies. The trucking industry is also testing autonomous features that are similar to the auto industry. This technology can be utilized for truck platooning, allowing multiple trucks to be accelerated and decelerated as one unit, which has economic, environmental, and safety benefits associated.

5.4 Existing and Future Deficiencies and Needs

Operations and maintenance investments, services, and strategies are pivotal to the long-term safety and efficiency of travel in the I-65 corridor. Whether it is ongoing pavement management or the deployment of state-of-the-art information and communications technologies, operations and maintenance bookend both the quality and flexibility of the transportation system. While operations and maintenance levels are currently meeting basic needs on I-65, as the corridor grows and new technologies are introduced, the interstate itself will change and increasingly function as part of a dynamic connected system, rather than as a largely distinct highway facility.

A. **Pavement Sufficiency Rating:** Pavement smoothness is a key factor in determining roadway ratings, measured in this analysis using the International Roughness Index (IRI). In 2006, FHWA set standards determining that a good quality roadway must have an IRI of 95 inches per mile or lower. The average IRI for I-65 is 63, with Davidson and Robertson Counties exhibiting the highest scores.

B. **Bridge Conditions:** Bridges were classified as having structural deficiencies, no structural deficiencies, or data unavailable. On I-65, two bridges are classified as structurally deficient, one crossing the Cumberland River in Nashville and the other crossing Fivemile Creek in Williamson County.

C. **ITS Devices:** There are numerous ITS devices on I-65 as part of the TDOT Smartway system including Dynamic Message Signs (DMS), CCTV cameras, Radar Detection System (RDS), and fiber optic and wireless communications. TDOT has proposed an expansion of the Smartway system along I-65 that would add CCTVs, RDSs, and DMSs to the North and South Sub-Areas. For the North Sub-Area, nine CCTVs and four DMSs are proposed, which will extend coverage from US 31W (Exit 98) to approximately two miles north of the interchange at SR 76 (Exit 108). The South Sub-Area has 13 CCTVs, four DMS, and 29 RDSs that are proposed for the I-65 corridor, extending the system coverage to approximately one mile south of the I-65 and I-840 interchange (Exit 59).

D. **ITS Strategies:** ITS state of the practice highlights opportunities to advance ITS in the I-65 corridor, including:

   - Within the TSM&O strategies, operations such as managed lanes and ATDM would be applicable in the Central Sub-Area with limited additional ITS devices needed. Another ATDM tool is ramp metering, which would require metering technologies on all ramps and special consideration paid to acceleration lengths as well as upstream volume detection if none exists. DLR/Contraflow Lane Reversal and QW deployments could also be appropriate for the I-65 corridor, particularly

where there is high directional flow in the AM and PM peaks or where congestion on arterials creates backups onto the interstate.

- For transit operations, DShL/Hard Shoulder Running/Temporary Shoulder Use could be deployed along I-65 to encourage transit usage and would require minimal additional ITS and signing deployments.
- Freight TSM&O strategies could also be deployed in the I-65 corridor. The FRATIS application could help address congestion by providing the trucking community with live traffic conditions, incidents, road closures and work zones, and truck parking opportunities via a shared data platform with the Regional TMC.
- There are currently no dedicated TDOT truck parking lots along I-65, and creating these with proper monitoring and communication infrastructure would likely require a significant ITS deployment.
- To harness the benefits of connected vehicles, roadside infrastructure supporting communication among vehicles on the DSRC bandwidth will be needed throughout the transportation network. Areas along I-65 that already have devices deployed could be retrofitted with DSRC enabled devices that also support current detection technologies. As the sections of I-65 to the North and South become equipped with ITS technologies, consideration should be given to including DSRC technology and/or other connected vehicle platforms (e.g., 5G).

6. Transit

The I-65 study area is served by a variety of local transit and express commuter routes, and includes ridesharing options. Currently, however, many of these systems do not complement one another. Providing alternatives to single occupancy vehicle travel by allowing individuals to travel continuously and seamlessly across modes is essential to support growth and development in the I-65 corridor.

6.1 Existing Transit Service

The Regional Transportation Authority (RTA) of Middle Tennessee partners with the Nashville Metropolitan Transit Authority (MTA) to provide transit services in the I-65 corridor, with most routes concentrated in the Nashville core. RTA services in the I-65 corridor are limited to express route service targeting commuters traveling between Maury, Sumner, Robertson, and Williamson Counties and downtown Nashville. Table 6-1 reports the number of trips and average daily ridership on the existing commuter express routes that use the I-65 corridor to travel on a portion, or all, of their routes.

All I-65 based express routes are limited to two or three inbound and outbound trips in the morning and afternoon, and because they operate during peak periods, they experience high levels of congestion. Importantly, existing RTA express routes are also not designed either to serve reverse commute trips. Morning service on all express routes only travels in-bound to Metro Nashville's Music City Central station. Table 6-2 provides 2040 ridership projections for four existing express routes in the I-65 corridor. Projected ridership could increase nearly fivefold over existing ridership on routes to and from Williamson County. Such an increase in ridership would necessitate service improvements to simply meet such demand.

Outside of Davidson County, local transit service near I-65 is only available in Franklin, however, both the RTA express and Franklin local services run limited schedules and do not complement one another, making it difficult for an individual to transfer. For example, the first Franklin Transit bus serving the park and ride lot at the Williamson Medical Center arrives at 7:20 AM, after the last

Table 6-2. I-65 RTA Regional Bus Service: 2040 Projected Daily Ridership

Route	Name	County	2040 Projected Daily Ridership
89X	Springfield/Joelton Express	Robertson	59
91X	Franklin Express	Williamson	797
92X	Hendersonville Express	Sumner	235
95X	Spring Hill Express	Maury	417
	Projected Daily Ridership:		1,508

Note: Route 87X was not included in the model output that was used to generate these projections.

Source: Nashville Area MPO Travel Demand Model

Table 6-1. I-65 RTA Regional Bus Service: 2014-2015 Average Daily Ridership

Route	Name	County	AM / PM Trips	Existing Average Daily Ridership
87X	Gallatin Express	Davidson	2/3	96
89X	Springfield/Joelton Express	Robertson	2/2	79
91X	Franklin Express	Williamson	3/3	172
92X	Hendersonville Express	Sumner	2/3	115
95X	Spring Hill Express	Maury	2/2	90
		Total Existing Average Daily Ridership:		552

Source: RTA Ridership Data – February 2014 to January 2015

commuter express bus leaves the medical center at 7:11 AM.

6.2 Access to Activity Centers

Transit systems support access to everyday needs, such as work, school, and shopping, as well as leisure activities, including entertainment and tourism. Existing express bus routes along I-65 serve downtown Nashville, and except for the Spring Hill route (Route 95X), also connect to midtown Nashville and Vanderbilt University Medical Center. Riders can access other areas of Nashville via a transfer, but it is less convenient or practical from a travel time standpoint. Beyond the Nashville core, there is an overall lack of access to activity centers, especially in Williamson and Sumner Counties.

Projected population and employment increases in the I-65 corridor, especially job growth near I-65 interchanges, will also generate greater demand for new or expanded regional transit services to and from Nashville and other major activity centers. Given current county-to-county work flows, reverse commute and all day service along I-65 south of Nashville, connecting to Brentwood, Cool Springs, Franklin, and Spring Hill, demonstrates the greatest potential. Additional services should be considered for Goodlettsville, Hendersonville, and Gallatin.

6.3 Nashville MTA/RTA Strategic Plan: nMotion

The MTA and RTA recently completed and adopted nMotion, a regional strategic transit plan to improve access and mobility throughout middle Tennessee. The recommended regional plan is shown in Figure 6-1. The nMotion plan includes recommendations for Bus Rapid Transit (BRT), BUS on-Shoulder Service (BSS), Light Rail Transit (LRT), express bus transit, regional rapid bus, and improved local services.

In the I-65 corridor, proposed improvements can be divided between proposed services north and south of downtown Nashville. To the north, proposed improvements include:

- Freeway BRT to Gallatin, Hendersonville, Springfield, and White House;
- Express bus/BSS to White House north of the I-65/SR 386 interchange and Springfield;
- LRT on Gallatin Pike to Rivergate area;
- Regional rapid bus from Gallatin and Hendersonville to the LRT on Gallatin Pike;
- BRT on Dickerson Pike; and
- Local service in Gallatin, Goodlettsville, Hendersonville, and Millersville.

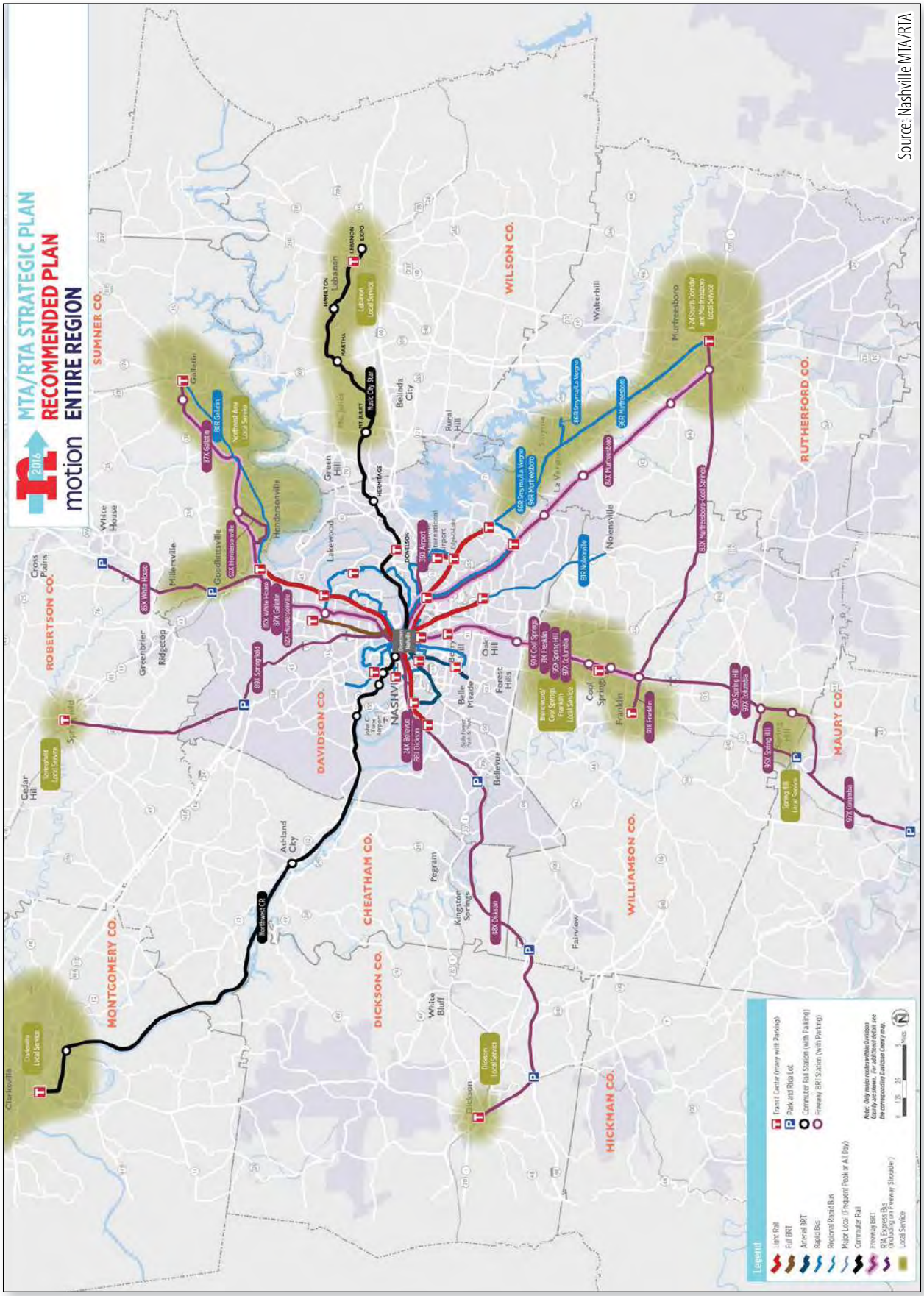
Proposed improvements in the I-65 corridor south of downtown Nashville include:

- Freeway BRT to Columbia, Cool Springs, Franklin, and Spring Hill;
- LRT on Nolensville Pike to Harding Place;
- Regional rapid bus from Nolensville to the LRT on Nolensville Pike;
- Express bus/BSS from Columbia, Murfreesboro, and Spring Hill to the freeway BRT in Franklin; and
- Local service in Brentwood, Cool Springs, Franklin, and Spring Hill.

One route in each corridor (Route 91X Franklin Express and Route 87X Gallatin Express) is also recommended to provide all day reverse commute service. In addition, nMotion recognizes that the first and last mile to and from transit are a significant barrier in the region. MTA and RTA plan to implement and participate in efforts to improve bicycle and pedestrian facilities and more convenient park-and-ride lots. Finally, the plan calls for MTA and RTA to work with local communities and businesses to provide new connections to transit services. New connections include the development of Transportation Management Associations (TMAs) to provide private services, private rideshare services such as Uber and Lyft, and car share/private short-term car rental companies, such as ZipCar and Car2Go.

Additionally, the Nashville Area MPO will be examining transit alternatives along I-65 between Nashville and Maury County. The *South Corridor Transit Alternatives Analysis* is intended to provide the transit agencies, community leadership, and stakeholders within the MPO area a series of short-, mid-, and long-term recommendations to implement the vision for rapid transit between Nashville and communities along the south corridor into Maury County, as defined by the MPO's *2040 Regional Transportation Plan* and the *nMotion Strategic Plan*.

Figure 6-1. nMotion Recommended Plan



6.4 Cool Springs Multimodal Transportation Study

The Cool Springs Multimodal Transportation Study outlines strategies for expanding transportation options and supporting transit riders, bicyclists, pedestrians, and transportation demand management. Short-term recommendations focus on:

- Extending and reconfiguring local Franklin Transit routes to better serve the Cool Springs area;
- Adding express bus services (Figure 6-2);
- Introducing a free lunchtime shuttle;
- Enhancing area bus stops with shelters and concrete pads;
- Establishing a new park-and-ride lot;
- Providing pedestrian infrastructure, additional bike lanes, and off-street trails; and
- Working closely with area employers, property managers, and developers to establish a transportation demand management program.

Longer term recommendations focus on regional connectivity. Depending on improved express bus route ridership levels, the study calls for evaluating a variety of high-capacity transit services to enhance connectivity between Nashville, Franklin, and Spring Hill, including bus rapid transit, commuter rail, light rail, and maglev rail. A proposed transit center east of I-65 on SR 96 is also recommended, allowing express and local bus riders to connect with vanpools, airport shuttles, carsharing and bikesharing stations, and intercity bus lines. Additional bike and pedestrian enhancements, including proposed pedestrian bridges over I-65, would focus on connecting Cool Springs with the rest of Franklin and the greater region.

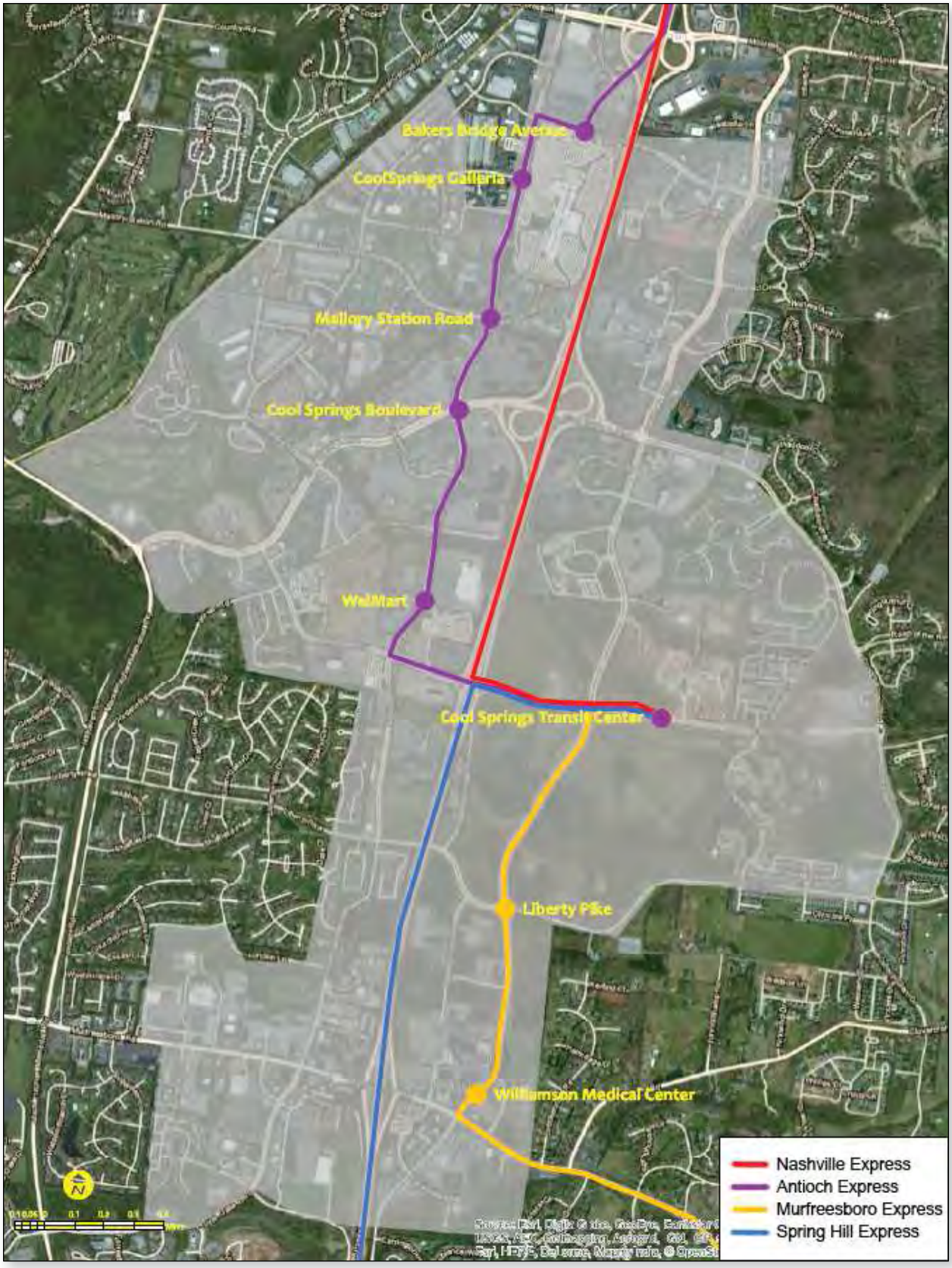
6.5 Rural Transit Services

Rural transit in the study area is provided by the Mid-Cumberland Human Resource Agency (MCHRA) and the South Central Tennessee Development District (SCTDD) primarily as demand response systems. Generally, the North and Central Sub-Area counties of Cheatham, Dickson, Robertson, Rutherford, Sumner, Williamson, and Wilson are serviced by MCHRA. MCHRA does transport customers to destinations in Davidson County from outside counties, however, it does not provide service within Davidson County. The South Sub-Area, consisting of Bedford, Giles, Lincoln, Marshall, and Maury counties, is serviced by SCTDD. As demand response systems, riders must make reservations to use either of the services. Demand response transit services are available to anyone regardless of age or income on a first-call, first-served basis. Both MCHRA and SCTDD operate Monday through Friday from 6:00 AM to 6:00 PM. There is currently no demand response service on weekdays after 6:00 PM or on weekends.

Additionally, SCTDD offers deviated fixed route service for Maury County to surrounding areas. The service includes four routes running hourly. Two routes provide services from the Columbia area to Mt. Pleasant and to Spring Hill. These routes connect to two routes in downtown Columbia. Deviated service is offered to anyone within 3/4-mile radius of the regular scheduled route. Finally, SCTDD offers fixed route commuter bus service from Lawrenceburg to Nashville and Murfreesboro. Two daily round trips from Lawrenceburg to Nashville are made on Monday, Tuesday, Thursday, and Friday. Trips from Lawrenceburg to Murfreesboro are scheduled on Wednesdays. SCTDD provided nearly 14,000 passenger trips on their commuter bus routes in 2014.

While future population and employment densities in the rural areas of the I-65 corridor will not support conventional fixed route transit services, population and employment growth in the I-65 corridor will generate needs for additional services. Increased services may come in the form of expanded service hours or service areas. The markets served by demand response providers, however, present significant operating challenges due to specialized trips for the elderly and people with disabilities and longer distances required to serve destinations. Private rideshare companies, such as Uber and Lyft, may provide a partnership opportunity for transit providers in lower demand areas. While the development of these types of partnerships is still in the very early stages, they provide the potential to start service more quickly, provide service at lower costs, and better tie expenditures to utilization levels.

Figure 6-2. Cool Springs Transportation Study Regional Express Bus Recommendations



6.6 Existing and Future Deficiencies and Needs

Throughout the country, there has been an increased emphasis on the development of higher capacity transit services to support population and employment growth in metropolitan regions. Building on existing local and regional services, similar efforts are underway in the I-65 corridor.

A. **Existing Transit Services:** MTA and RTA services in the I-65 corridor are largely limited to express route service targeting commuters traveling between Maury, Sumner, Robertson, and Williamson Counties and downtown Nashville. All I-65 based express routes are limited to two or three inbound and outbound trips in the morning and afternoon, and because they operate during peak periods, they encounter high levels of congestion. Importantly, existing RTA express routes are not designed either to serve reverse commute trips. Also, services from different providers need to be better aligned to provide more seamless regional transit service for commuters.

B. **Access to Activity Centers:** Existing express bus routes along I-65 serve downtown Nashville, and except for the Spring Hill route (Route 95X), also connect directly to midtown Nashville and Vanderbilt University Medical Center. Riders can access other areas of Nashville via a transfer, but it is less convenient or practical from a travel time standpoint. Beyond the Nashville core, there is an overall lack of access to activity centers, especially in Williamson and Sumner Counties.

C. **Nashville MTA/RTA Strategic Plan:** The MTA and RTA recently completed and adopted nMotion, a regional strategic transit plan to improve access and mobility throughout middle Tennessee. The nMotion plan includes more than 24 recommendations for Bus Rapid Transit (BRT), BUS on-Shoulder Service (BSS), Light Rail Transit (LRT), express bus transit, regional rapid bus, and improved local services in the I-65 corridor.

D. **Cool Springs Multimodal Transportation Study:** The Cool Springs Multimodal Transportation Study outlines strategies for expanding transportation options and supporting transit riders, bicyclists, pedestrians, and transportation demand management. In addition to expanding express bus route services in the short-term, the study calls for evaluating high-capacity transit as ridership levels grow.

E. **Rural Transit:** Through MCHRA and SCTDD, demand response transit services are available to anyone regardless of age or income on a first-call, first-served basis Monday through Friday from 6:00 AM to 6:00 PM. There is currently no demand response service on weekdays after 6:00 PM or on weekends. Additionally, SCTDD offers deviated fixed route service for Maury County to surrounding areas and fixed route commuter bus service from Lawrenceburg to Nashville and Murfreesboro. Projected population and employment growth in the I-65 corridor will generate needs for these services. Importantly, private rideshare companies may provide a partnership opportunity for transit providers in lower demand areas. While the development of transit-ridesharing partnerships is still in the very early stages, they can provide the potential to start service more quickly, provide service at lower costs, and better tie expenditures to utilization levels.

7. Walking and Bicycling

For walking and bicycling systems to support daily travel, they need to be safe, comfortable and convenient. Overall, bicycle and pedestrian facilities in the I-65 corridor are too often either absent, disconnected, and/or designed to minimum standards. Moreover, the lack of walking and bicycling facilities undermines potential transit use. While the development of bicycle and pedestrian networks relies primarily on local governments, either through standalone projects or land development regulations, federal and state transportation facilities represent critical opportunities and challenges as high demand corridors, barriers, or gaps in local and regional systems.

7.1 State Bicycle Routes

A bicycle route is any roadway or bikeway designated with a unique route designation or "Bike Route" sign. A bicycle route network is a system of suggested routes to reach specific destinations, and should include wayfinding and destination information. Bicycle route designation indicates to bicyclists that the route provides advantages over other non-designated routes – including roadway factors (e.g., adequate width, high quality pavement, good sight distance), traffic factors (e.g., traffic volumes, posted speed limits, percentage of trucks), and network factors (e.g., high demand destinations, directness, available services).

It is also important to note that a bicycle route system differs from the routine pedestrian and bicycle accommodation required by the United States Department of Transportation (USDOT) Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations on federal-aid projects. Effectively, the USDOT policy calls for the provision of pedestrian and bicycle facilities as a matter of routine, except where pedestrians and bicyclists are prohibited by law from using a roadway, cost is excessively disproportionate to the need or probable use, and in sparsely populated areas. A bicycle route system builds on routine accommodation improvements to identify preferred routes.

There are both existing and planned state bicycle routes throughout the I-65 corridor, although the two categories do not align in all cases (Figure 7-1). Many of the existing state bicycle routes were signed as "Bike Routes" if the highway had paved shoulders four-feet or wider. The newer planned state bicycle routes were defined during the most recent state bicycle route plan update in 2011. Within the limited definition of an existing state bicycle route, several existing state bicycle routes provide connectivity through the I-65 corridor, notably:

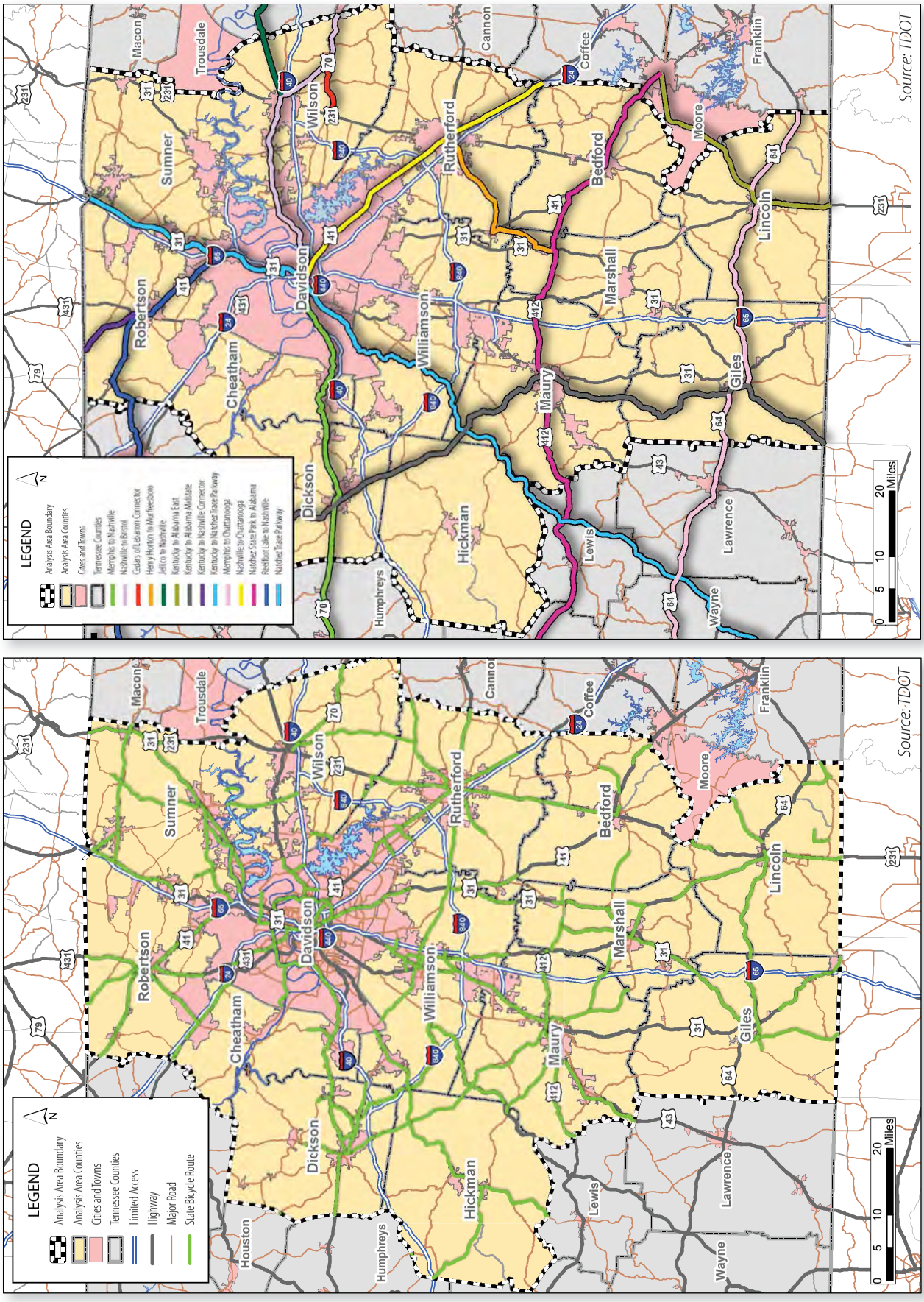
- US 31W in Robertson and Sumner Counties;
- SR 52 in Sumner County;
- US 41 in Robertson County;
- Dickerson Pike (US 31W) in Davidson County;
- Franklin Pike/Columbia Pike (US 31) in Williamson and Maury Counties;
- SR 96 in Rutherford and Williamson Counties;
- US 412 in Maury and Marshall Counties;
- US 31/US 31A in Giles and Marshall Counties,
- US 64 in Giles and Lincoln Counties; and
- US 431 in Lincoln and Marshall Counties.

Like the existing state bicycle routes, the planned bicycle routes are proposed mostly on US highways in the I-65 corridor, but do not augment local or intercity connections significantly. Finally, TDOT established US Bicycle Route (USBR) 23 in 2013 as part of the US Bicycle Route System. USBR 23 travels in the I-65 corridor from Kentucky to Alabama on lower volume roads through Lewisburg, Franklin, Nashville, Goodlettsville, Millersville, White House, and Portland.

7.2 Regional and Local Bicycle and Pedestrian Plans

The Nashville Area MPO Regional Bicycle and Pedestrian Study (2009) identifies both sidewalk and bikeway priorities in the five-county MPO region, including the I-65 corridor. In many respects, the 2009 regional bikeway network vision map (Figure 7-2) combines the existing and proposed state bicycle routes into a single plan. The primary exceptions are the greater number of routes, especially Old Hickory Boulevard (SR 254),

Figure 7-1. Existing and Planned State Bicycle Routes



in Davidson County. Like the traditional approach to designating state bicycle routes, the MPO plan highlights paved shoulders four-feet or greater as the primary bikeway design accommodation.

Prioritized sidewalk improvements in the regional study focus on arterials and collectors within urban growth boundaries. Pedestrian improvements are assumed to include five-foot sidewalks on both sides of the road, and as proposed, 662 miles of sidewalks would be added. While the sidewalk improvements would result in a connected network of pedestrian facilities in the I-65 corridor, they too represent a minimum design standard. Bicycle and pedestrian planning and design have changed substantially since 2009, and now place a much greater emphasis on users of all ages and abilities and a broader range of facility design options.

In addition to the regional bicycle and pedestrian study, several communities in the I-65 corridor have developed bicycle, pedestrian, greenway, and trail plans, including Franklin, Hendersonville, Metro Nashville, and Sumner County. While some of the local plans, like the regional study, are more than five years old, Metro Nashville is currently drafting an update to its bicycle and pedestrian plan. Nashville's WalknBike plan is reviewing national best practices and should serve as a template for state-of-the-art bicycle and pedestrian networks.

7.3 20-Minute Walking and Bicycling Districts

The lack of well-connected and well-designed bicycle and pedestrian systems makes it difficult for individuals to walk and bike to destinations or to other modes such as transit. Accordingly, commercial areas, residential neighborhoods, mixed-use districts, and adjacent transportation systems can all benefit from improved bicycle and pedestrian facilities and networks. Planning for a 20-minute walking (1.0 mile) and bicycling (3.0 miles) district around or near interstate interchanges, in particular, can help balance competing demands for local and regional, work and non-work travel. Benefits of establishing walking and bicycling districts, zones, or priority areas include:

- Reduced traffic congestion and pollution;
- Reduced parking requirements for development;
- Reduced personal transportation costs;
- Increased access to everyday needs;
- Increased development opportunities;
- Increased property values;
- Increased consumer spending; and
- Increased markets for transit services.

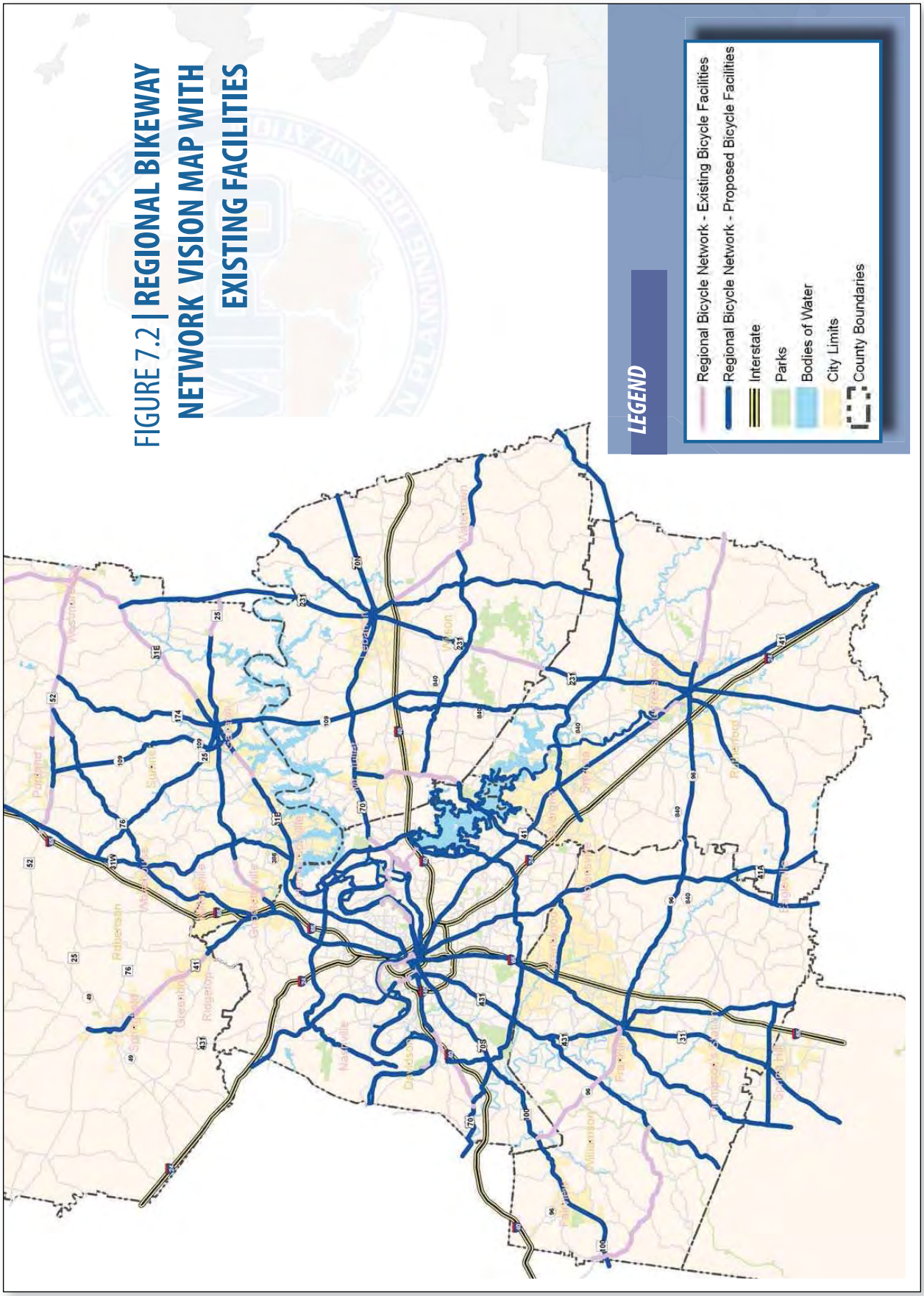
Complementing walking and bicycling, transit and shared mobility services can expand and extend bicycle and pedestrian networks in the I-65 corridor. For commuters, RTA express buses can accommodate bicycles in their luggage compartments, and for travelers without bicycles, the Nashville B-Cycle bike sharing program allows individuals to rent a bicycle throughout the city. Similarly, the TMA Group has been awarded funding to start a bike share program in Franklin, which is expected to begin soon. Nevertheless, as with any bicycle travel, bike share programs will be constrained by the safety, comfort, and convenience of the underlying bikeway network.

Finally, as noted in both the MPO regional bicycle and pedestrian study and the nMotion plan, one of the most significant pedestrian obstacles facing communities is the number of sidewalk facilities that are not compliant with the Americans with Disabilities Act (ADA) guidelines. Many sidewalks lack adequate flared sides, transitions, curb ramps, and other components that allow those with disabilities greater accessibility. Furthermore, many sidewalks have obstacles such as utility poles, mailboxes, or other impediments that make it difficult for individuals with mobility impairments.

7.4 Existing and Future Deficiencies and Needs

Walking and, increasingly, bicycling are fundamental components of a multimodal transportation system, especially for communities experiencing strong growth like many cities and towns in the I-65 corridor. For walking and bicycling systems to support daily travel, access to everyday needs, and local economic development, they need to be safe, comfortable and convenient. Existing bicycle and pedestrian facilities in the I-65 corridor are too often either absent, disconnected, and/or designed to minimum standards.

Figure 7-2. Nashville Area MPO: Regional Bikeway Network Vision



A. **State Bicycle Routes:** There are both existing and planned state bicycle routes throughout the I-65 corridor, although the two categories do not align in all cases. Many of the existing state bicycle routes were signed as "Bike Routes" if the highway had paved shoulders four-feet or wider. The newer planned state bicycle routes were defined during the most recent state bicycle route plan update in 2014. Like the existing state bicycle routes, the planned bicycle routes are proposed mostly on US highways in the I-65 corridor, and do not augment local or intercity connections significantly.

B. **Regional and Local Bicycle and Pedestrian Plans:** The Nashville Area MPO Regional Bicycle and Pedestrian Study (2009) identifies both sidewalk and bikeway priorities in the five-county MPO region, including the I-65 corridor. In many respects, the 2009 regional bikeway network vision map combines the existing and proposed state bicycle routes into a single plan. Like the traditional approach to designating state bicycle routes, the MPO plan highlights paved shoulders four-feet or greater as the primary bikeway design accommodation. Prioritized sidewalk improvements in the regional study focus on arterials and collectors within urban growth boundaries, and assume five-foot sidewalks on both sides of the road. Bicycle and pedestrian planning and design have changed substantially since 2009, and now place a much greater emphasis on users of all ages and abilities and a broader range of facility design options. In addition to the regional study, several communities in the I-65 corridor have developed bicycle, pedestrian, greenway, and trail plans.

C. **20-Minute Walking and Bicycling Districts:** Commercial areas, residential neighborhoods, mixed-use districts, and adjacent transportation systems can all benefit from improved bicycle and pedestrian facilities and networks. Planning for a 20-minute walking (1.0 mile) and bicycling (3.0 miles) travel shed around or near interstate interchanges, in particular, can help balance competing demands for local and regional, work and non-work travel. Complementing walking and bicycling, transit and shared mobility services can expand and extend transportation options in the I-65 corridor.

8. Transportation Demand Management

Like ITS and ATDM, in particular, Transportation Demand Management (TDM) is experiencing dramatic changes as new technologies and services are introduced. TDM is largely a congestion relief strategy, attempting to reduce travel and shift trips across modes and across time periods. While TDM has traditionally focused on recurring congestion and associated with car and van pools, telecommuting, and transit benefits, the range of tools has expanded and now includes efforts to help manage non-recurring congestion (e.g., traffic incidents, weather events, special events, and work zones) as well.

TDM measures improve mobility, reduce congestion during peak commuting hours, and can improve local air quality by reducing CO2, NOx and VOC pollutants which can trigger a variety of health problems including bronchitis, emphysema and asthma. In addition, TDM offers an alternative to building new roadway facilities, encouraging commute alternatives and better balancing transportation systems.

An underlying objective of TDM is shifting trips away from single occupancy vehicles and managing the transportation system more effectively. Table 8-1 identifies commuter mode split from the US Census Bureau's 5-year American Community Survey (2006-2010). Mode splits in the study area for ridesharing are consistent with statewide and national rates. However, in the I-65 corridor's key Origin-Destination pairs, ridesharing rates are as much as two-thirds higher than statewide and national averages, specifically from Spring Hill to the Nashville Core. Mode splits for transit and other modes of travel, such as bicycle and pedestrian, are significantly below national rates in the study area, and even lower in the key O-D pairs.

Figure 8-1 illustrates the existing hourly traffic volumes on I-65 at the Davidson-Williamson county line. There are only a few hours in the morning and afternoon each day where the interstate approaches capacity, resulting in congestion and delay. Conversely, there are many times during the morning, mid-day, and evening when I-65 has adequate capacity. TDM strategies can help

Table 8-1. Commuter Mode Split

Origin-Destination Pair	Mode			
	Single Occupancy Vehicle	Rideshare	Transit	Other Travel Mode (Bike,Ped, Etc.)
Franklin to Brentwood	86.9%	12.1%	0.6%	0.5%
Brentwood to Franklin	89.4%	10.4%	0.6%	0.0%
Giles to Franklin	76.4%	23.6%	0.0%	0.0%
South Nashville to Franklin	86.3%	13.3%	0.0%	0.3%
South Nashville to Nashville Core	85.8%	10.6%	1.6%	1.8%
Franklin to Nashville Core	86.0%	14.0%	0.2%	0.0%
Portland to Nashville Core	85.8%	14.2%	0.0%	0.0%
Hendersonville to Nashville Core	86.6%	11.8%	1.0%	0.2%
Spring Hill to Nashville Core	83.2%	15.9%	0.0%	0.9%
Spring Hill to Franklin	87.2%	12.4%	0.0%	0.4%
Study Area	**82.2%**	**10.4%**	**0.9%**	**6.4%**
Tennessee	**83.9%**	**9.6%**	**0.8%**	**5.8%**
Nationwide	**76.4%**	**9.7%**	**5.0%**	**8.8%**

Source: US Census, 5-Year American Community Survey, 2006-2010

balance travel demand across a day and improve system management and operations.

The Transportation Management Association Group (TMA Group) works with employers in the Nashville region on TDM strategies, including the VanStar vanpool program, staggered work hours, flexible scheduling, and transit subsidies. The State of Tennessee and Vanderbilt University are major employers in the region that utilize TDM. Additional efforts supported by Franklin Intermediate School and the Williamson County Chamber of Commerce Mobility Week demonstrate existing locally focused programs where TDM service provisions are likely better served due to direct, established relationships with employers and commuters.

8.1 Vanpools

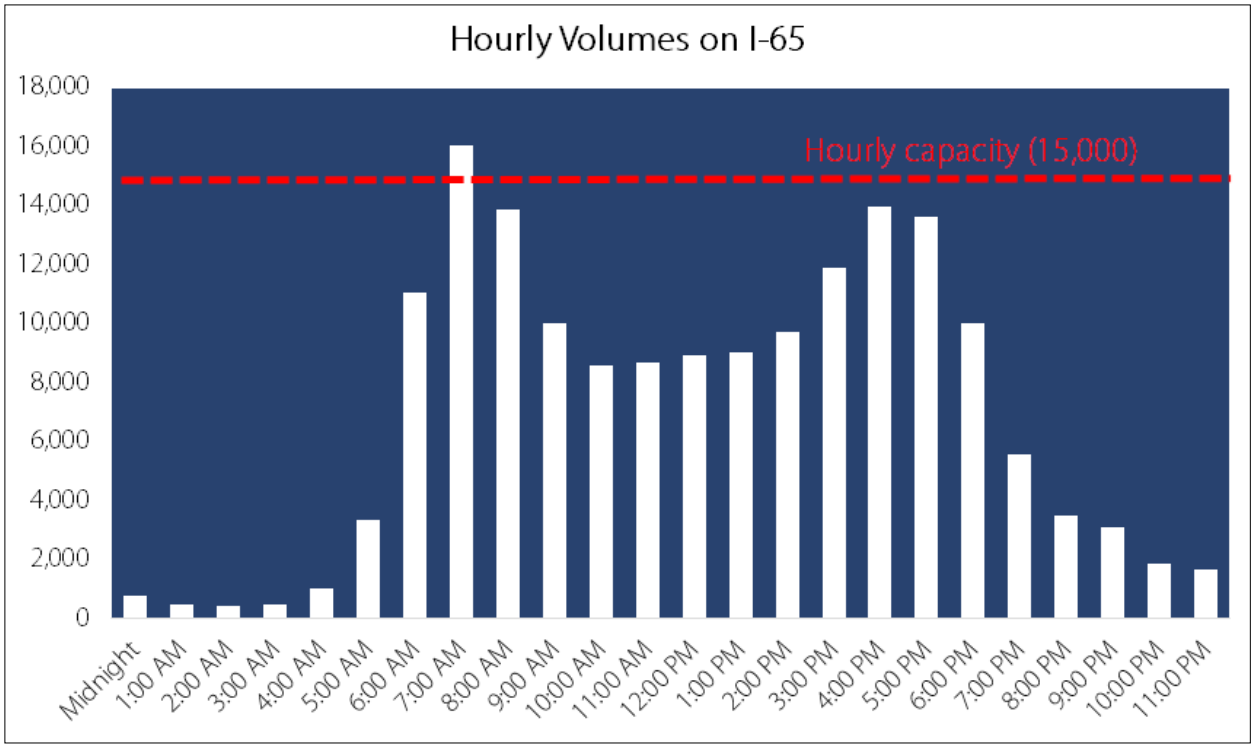
Both the RTA and TMA Group work with regional rideshare partners to manage a fleet of commuter vanpools throughout middle Tennessee. Twelve, fourteen, and fifteen-passenger vans carry riders from park-and-ride lots to workplaces. Riders pay a monthly fare, saving on fuel, parking, and maintenance costs associated with cars. A van driver, in exchange for driving and recording the vanpool's performance, can commute for free. According to the FTA's National Transit Database, vanpool ridership in the study area in 2014 was 241,000 trips.

8.2 HOV Lanes

High occupancy vehicle (HOV) lanes are another TDM tool currently used in the I-65 corridor. An HOV lane is a restricted traffic lane reserved at peak travel times for the exclusive use of vehicles with a driver and one or more passengers, including car or vanpools and transit vehicles. HOV lanes are typically implemented on freeways to increase vehicle occupancies and reduce traffic congestion and air pollution. Since 1993, Tennessee has used HOV lanes to promote ridesharing. Each vehicle that travels in an HOV lane in Tennessee must carry a minimum of two people or be an inherently low emission vehicle with a Smart Pass sticker. Motorcycles are also allowed to travel in the HOV lane.

Table 8-2 lists the existing HOV lane limits for the Nashville region. All existing HOV facilities are immediately adjacent to general purpose lanes and are identified by pavement markings consisting

Figure 8-1. I-65 Hourly Traffic Volumes: Davidson-Williamson County Line



Source: Statewide Travel Demand Model

Table 8-2. HOV Lane Limits in the Nashville Region

Route	Begin HOV Lanes	End HOV Lanes
Interstate 24 (East of Nashville)	SR 255 (Harding Place)	US 231 (Shelbyville Highway)
Interstate 40 (East of Nashville)	SR 155 (Briley Parkway)	SR 109
Interstate 65 (North of Nashville)	SR 155 (Briley Parkway)	SR 386 (Vietnam Veterans Parkway)
Interstate 65 (South of Nashville)	I-840	SR 255 (northbound) Armory Drive (southbound)

Source: Tennessee Department of Transportation

of a white skip line and standard HOV diamonds. Posted signs indicating the minimum required occupancy (2+ persons) and the hours of operation (7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM on weekdays) are present along each of the segments.

Table 8-3. HOV Lane Observed Violation Rates

Route	Limit	Inbound Rate	Outbound Rate
Interstate 24 (East of Nashville)	Haywood Lane	89 %	80 %
	SR 266 (Sam Ridley Pkwy)	65 %	65 %
Interstate 40 (East of Nashville)	SR 45 (Old Hickory Blvd)	74 %	68 %
Interstate 65 (North of Nashville)	SR 45 (Old Hickory Blvd)	96 %	94 %
Interstate 65 (South of Nashville)	Cool Springs Boulevard	71 %	63 %
	SR 253 (Concord Road)	82 %	85 %
	SR 254 (Old Hickory Blvd)	77 %	96 %

Source: Tennessee Department of Transportation

Violation Rates

In July and August 2012, data was collected on the existing HOV lanes in the Nashville region as part of an effort by TDOT to document the system's operational performance. The data collected included vehicle classification and occupancy traffic counts, as well as travel speeds. Table 8-3 lists the observed violation rates for HOV lanes in the Nashville region. Violation rates ranged from 63 percent to 96 percent on I-65, similar to other HOV lanes in the region. According to FHWA, non-barrier separated HOV facilities typically have violation rates between 10 and 20 percent and up to 60 percent during peak periods of congestion in the absence of effective enforcement.

Speeds

Table 8-4 shows the average speed of vehicles in the HOV lane during peak periods on I-65. Based on the data, I-65 southbound in southern Davidson County and I-65 northbound in northern Davidson County may be approaching degradation. FHWA defines degradation as failing to maintain a minimum average operating speed 90 percent of the time over a consecutive 180-day period during peak periods. Minimum average operating speed is defined as 45 mph for HOV facilities with a speed limit of 50 mph or greater.

Table 8-4. Observed HOV Lane Speeds

Route	Direction/ Location	Time	Speed
Interstate 65 (South of Nashville)	Northbound – Northern Davidson County	PM	39.5
	Southbound – Southern Davidson County	PM	48.4
	Southbound – Williamson County	PM	61.0
	Southbound – Northern Davidson County	AM	61.2
	Northbound – Southern Davidson County	AM	66.9
	Northbound – Williamson County	AM	67.4

Source: Tennessee Department of Transportation

8.3 Park-and-Ride Facilities

Park-and-ride facilities can support HOV lanes by providing parking for transit services and car or vanpool programs. Park-and-ride facilities can also promote other TDM strategies such as high capacity transit services and other managed lanes concepts. In the fall of 2015, MTA/RTA conducted an inventory of the region's park-and-ride facilities. The lots were inventoried on weekdays (Tuesday – Thursday) during the months of October and November. The occupancy count was made after the last inbound bus departure between 8:00 AM and 11:00 AM. Table 8-5 lists the park-and-ride facilities that serve commuter fixed routes and travel via I-65 for all or some portion of their route. All the lots, except for the Greensboro North lot, are parking facilities shared with other uses (e.g., churches and shopping centers).

The usage rates for lots range from 82 percent, for the Kohls Hendersonville lot serving the express bus Route 92X, to 3 percent, for the Greensboro North Park-and-Ride serving Route 87X. Park-and-ride lots along the I-65 corridor are generally underutilized compared to the overall system, 36 percent to 53 percent, respectively. Many of the park-and-ride lots also lack ADA accessibility and sidewalks. None of the lots have bicycle parking facilities. Further, only the Hendersonville-Drakes Creek Park and Franklin park-and-ride lots are connected to bikeways. However, the bikeways are not part of a comprehensive network and only serve one direction of travel.

Assessments of the Nashville region's park-and-ride lots have also been completed as part of the nMotion plan. The plan found that most park-and-ride lots are located at places where

Table 8-5. Park-and-Ride Lot Inventory

Route	Agency	Name	County	Approx. # of Parking Stalls	Occupancy During Field Visit	Usage Rate	ADA Accessible	Sidewalks	Bicycle Parking
87X	RTA	Greensboro North Park-and-Ride	Davidson	144	4	3%	✓	✓	---
87X	RTA, MTA	Gallatin Walmart	Sumner	50	29	58%	---	---	---
89X	RTA	Joelton Park-and-Ride	Rutherford	50	10	20%	---	---	---
89X	RTA	Downtown Springfield Park-and-Ride	Robertson	30	6	20%	✓	✓	---
89X	RTA	Springfield Walmart	Robertson	50	16	32%	✓	✓	---
91X	RTA	Franklin-Williamson Medical Center (WMC)	Williamson	50	40	80%	✓	✓	---
92X	RTA, MTA	Kohls Hendersonville	Sumner	50	41	82%	---	---	---
92X	RTA	Drakes Creek Park	Sumner	Unknown	---	---	---	---	---
95X	RTA	Spring Hill – Church of the City	Williamson	50	8	16%	---	---	---
95X	RTA	Spring Hill Kroger	Maury	50	33	66%	---	---	---
		Total along I-65:		524	187	36%	40%	40%	0%
		Total RTA Systemwide:*		883	467	53%	25%	25%	0%

** RTA systemwide totals do not include lots serving the Music City Star commuter train*

Source: Nashville MTA/RTA

local businesses, churches, or other organizations have agreed to share use of their lots. While these lots may be less expensive to construct and maintain, they may also be at locations that are less convenient to users. Consequently, many people either travel out of direction, or would have to travel out of direction, to access express bus services, increasing travel times and deterring individuals from using transit services.

8.4 TDM State of the Practice

As noted earlier, increasingly, traditional TDM programs are coupled with traffic management programs as new technologies support a more integrated approach to matching travel supply and demand. Active Traffic and Demand Management or ATDM now combines demand management, traffic management, parking management, and other transportation modes and assets. Within TDM, technologies that support real-time information and individual choice can provide a greater number of travel options throughout the day for a wider variety of people. Traditional TDM programs are typically organized around commuting and include:

- Travel options (e.g., transit, ridesharing, walking, and bicycling);
- Financial and time incentives (e.g., transit benefits, parking policies, flexible work hours, employer incentives, telecommuting, and land use planning);
- Information and education programs (e.g., trip planning, ride matching, maps, and websites); and
- Public-private partnerships.

While continuing to emphasize a reduction in single occupancy vehicle commute trips, ATDM utilizes ITS systems and consumer information and communication technologies to expand the traditional set of TDM programs and improve travel reliability. Emerging TDM-oriented technologies are currently focusing on:

- Pre-trip and in route travel information (e.g., road conditions, optimal departure times, dynamic routing, travel choices, and comparative real-time information);

- Parking management (e.g., real-time parking information, variable pricing, and guidance systems);
- Road pricing (e.g., zone pricing and managed lanes);
- Ridesharing and ridesourcing (e.g., real-time passenger information, variable pricing, and automated payment); and
- Transit technologies (e.g., real-time arrival/departure information, automated fare payment, dynamic routing, and vehicle amenities).

Beyond the technology changes remaking TDM programs and services, there are also strategic policies that can strengthen TDM performance across different scales and over time. Policy best practices include:

- Integrating TDM programs regionally and across the public and private sectors;
- Measuring and reporting performance on a quarterly or annual basis;

Table 8-6. Impact of Selected Employer-Based TDM Strategies

Strategy	Details	Employee Vehicle Trip Reduction Impact
Parking Charges	Previously free parking	20%-30%
Information Alone	Information on available alternatives	1.4%
Services Alone	Ridematching shuttles, guaranteed ride home	8.5%
Monetary Incentives Alone	Subsidies for carpool, vanpool, transit	8%-18%
Services and Monetary Incentives	Example: transit vouchers and guaranteed ride home	24.5%
Cash Out	Cash benefit offered in lieu of accepted free parking	17%

Source: Smart Growth America

- Incorporating TDM into land use planning and development review processes; and
- Establishing comprehensive customer marketing and information programs.

Combining traditional TDM goals and strategies with new technologies and best practices can have a substantial impact on trip making and recurring and non-recurring congestion. Table 8-6 highlights estimated reductions of various employer-based TDM strategies.

8.5 Existing and Future Deficiencies and Needs

Although the I-65 corridor includes some TDM programs and strategies, commuting mode splits in the corridor underscore the opportunity to reduce trips and shift more trips to different modes or different time periods. Moreover, as new technology driven services are introduced, TDM policies and programs will need to adapt to fully maximize the available opportunities.

A. **Commute Mode Split:** Mode splits in the study area for ridesharing are consistent with statewide and national rates. However, in the I-65 corridor's key Origin-Destination pairs, ridesharing rates are as much as two-thirds higher than statewide and national averages, specifically from Spring Hill to the Nashville Core. Mode splits for transit and other modes of travel, such as bicycle and pedestrian, are significantly below national rates in the study area, and even lower in the key O-D pairs.

B. **Vanpools:** Both the RTA and TMA Group work with regional rideshare partners to manage a fleet of commuter vanpools throughout middle Tennessee. According to the FTA's National Transit Database, vanpool ridership in the study area in 2014 was 241,000 trips. While the commuter mode share for ridesharing is high, high HOV violation rates and low park-and-ride utilization highlight the opportunities to create move effective ridesharing and transit systems.

C. **HOV Lanes:** HOV lane violation rates ranged from 63 percent to 96 percent on I-65, similar to other HOV lanes in the region. Nationally, non-barrier separated HOV facilities typically have violation rates between 10 and 20 percent and up to 60 percent during peak periods of congestion in the absence of effective enforcement.

D. **Park-and-Ride Lots:** Park-and-ride lots along the I-65 corridor are generally underutilized compared to the overall system, 36 percent to 53 percent, respectively. Many of the park-and-ride lots lack ADA accessibility and sidewalks, do not have bicycle parking facilities, and are not conveniently located.

E. **TDM State of the Practice:** increasingly, traditional TDM programs are coupled with traffic management programs as new technologies support a more integrated approach to matching travel supply and demand. Within TDM, technologies that support real-time information and individual choice can provide a greater number of travel options throughout the day for a wider variety of people. Combining traditional TDM goals and strategies with new technologies and best practices, then, can have a substantial impact on trip making and recurring and non-recurring congestion.

9. Freight and Intermodal Facilities

Freight movement varies considerably across the I-65 corridor. Current and future truck volumes, network deficiencies, potential for freight diversion, intermodal freight facilities, and possible impacts from the increase of e-commerce, the Panama Canal expansion, and the relocation of the Radnor Rail Yard are analyzed based on data from AirSage, Transearch, InfoUSA, and the Tennessee Statewide Travel Demand Model.

9.1 Freight Movement

Truck is the major mode for freight movement in the study area and truck volumes are projected to increase by more than 50 percent on most of the study area roadway network between 2010 and 2040 (Figure 9-1). These increases will affect the entirety of I-65 as well as most of the connecting and supporting routes throughout the corridor. Between 2010 and 2040, truck volumes on I-65 north of Nashville will significantly increase (68 percent), and more than double on I-40 east and west of Nashville (110 percent). Interstate 24 south of Nashville currently serves more than 10,000 trucks daily, but demand is projected to be nearly 17,000 trucks by 2040. The overlap of I-65 and I-24 is projected to carry nearly 24,000 trucks in 2040.

9.2 Inbound/Outbound Freight Demand: 2012 and 2040

Inbound and outbound freight to the study area (Table 9-1) is primarily transported by trucks with inbound tonnage projected to more than double by 2040. Air freight shows a large percentage increase by 2040 for both inbound and outbound volumes, but this represents a relatively small increase in tonnage as compared to other modes. Outbound freight transported by rail is projected to grow by roughly 147 percent by 2040 which may result in rail capacity issues and freight diversion to truck and water.

Inbound/Outbound Freight by Commodity: 2012 and 2040

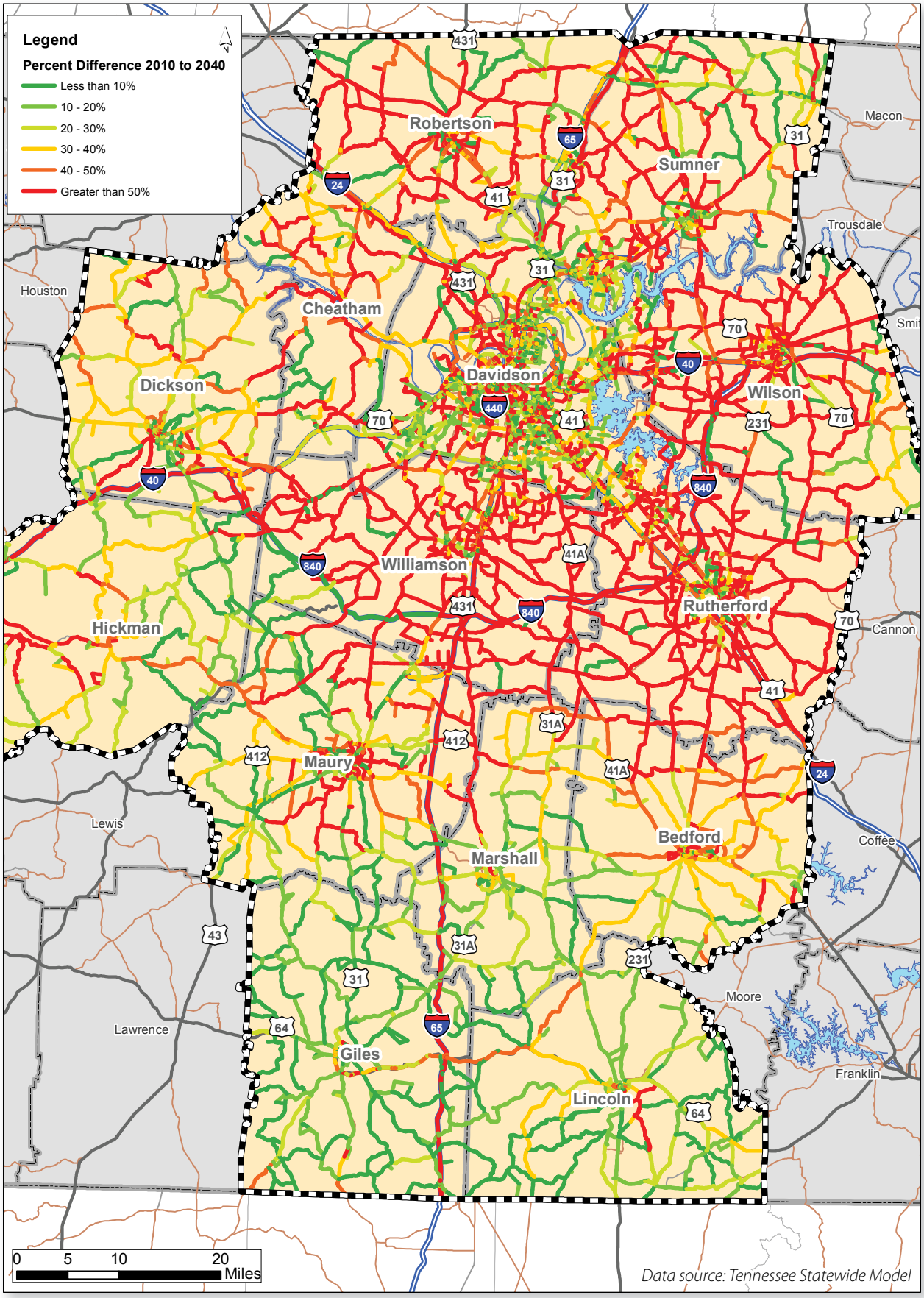
A review of the Transearch database indicates that the top ten commodities, both inbound and outbound, are largely similar between 2012 and 2040. Coal (SCTG 15), gravel (SCTG 12), motorized and other vehicles (SCTG 36), and waste products (SCTG 41) dominate both the inbound and outbound movements by tonnage and are

Table 9-1. Inbound and Outbound Freight Volumes by Mode for the Years 2012 and 2040

		2012		2040		
	Mode	Tons (millions)	Value (millions)	Tons (millions)	Value (millions)	Percent Increase
Inbound	Trucks	46.9	49.9	101.9	129.4	117%
	Air	0.017	2.2	0.035	5.9	109%
	Water	7.8	0.8	12.8	1.1	64%
	Rail	2.1	5.6	3.6	10.1	70%
	TOTAL	56.8	58.4	118.3	146.6	108%
Outbound	Trucks	39.1	42.1	62.5	95.9	60%
	Air	0.023	2.2	0.043	4.8	88%
	Water	0.4	0.1	0.2	0.09	-57%
	Rail	1.3	8.1	3.2	22.3	147%
	TOTAL	40.8	52.4	65.9	123.7	62%

Data source: Tennessee Statewide Model

Figure 9-1. Percent Difference in Truck Volume from Year 2010 to 2040



mostly transported by truck followed by water, which primarily carries coal and gravel. Electronic components and parts, media and entertainment components, motor vehicles, and scrap metal tend to be the highest value inbound and outbound freight commodities.

Major Truck Origin-Destination Pairs by Entry/Exit Road: 2012 vs. 2040

Table 9-2 and Table 9-3 show inbound and outbound freight tonnage by entry/exit road and destination/origin county. Davidson County is the destination for over 40 percent of the total freight tonnage in the study area with I-65 accounting for nearly the combined total of I-24 and I-40 in terms of tonnage. Davidson and Rutherford counties are the origin of roughly 25 and 12 percent of the total freight tonnage, respectively, with a large portion of that exiting the study area by I-65. The data indicates that I-65 carries a similar share of outbound freight (49 percent) as it does inbound freight (53 percent).

Table 9-4 shows multi-unit (MUT) and single-unit truck (SUT) trips produced and attracted from/to the study area counties for 2010. Davidson and Rutherford Counties produce and attract the most MUT and SUT trips, which is expected given the many intermodal freight facilities in those two counties.

Freight Generating Facilities

According to InfoUSA employment and revenue data, Davidson, Rutherford, Williamson, and Sumner counties account for roughly 74 percent of the total employment in the I-65 corridor study area with the majority allocated to retail and manufacturing activities. Davidson, Rutherford, Robertson, and Williamson Counties account for roughly 70 percent of the total revenue in the study area with the majority produced by manufacturing and wholesale and retail trade. Retail, manufacturing, and construction account for roughly 76 percent of the total employment, while manufacturing and wholesale and retail trade account for roughly 90 percent of the revenue in the study area.

Major Origin-Destination Pairs by Other Modes: 2012 vs. 2040

A review of the Transearch Database indicates that Davidson County is the dominant origin and destination in the region for all modes with two notable exceptions. Sumner County has a higher inbound tonnage by water and a much lower inbound value by water. Rutherford County has a high outbound value by rail and lower outbound tonnage by rail.

Through Traffic: 2012 and 2040

I-65 and I-40 serve as major routes for freight transported by truck through the study area (Table 9-5). Through truck traffic entering and exiting on I-65 is projected to increase by 89 percent by 2040. Total truck traffic entering I-65, I-24, and I-40 and exiting I-65 is forecasted to increase by 82 percent, which will translate into higher truck volumes on I-65, I-440, and I-840. Significant increases are also projected for truck traffic that either enters or exits the study area through I-40 and uses I-65 (113 and 130 percent, respectively). I-65 also carries a significant amount of through traffic entering Tennessee from other states (e.g., approximately 5,000 and 8,300 thousand tons of through truck traffic enter Tennessee using I-75 and exit using I-65 in 2012 and 2020, respectively).

Table 9-6 shows through freight traffic by tonnage and value for air, water, and rail in 2012 and 2040. In 2012, there were over 240 million tons of through freight utilizing the rail network in the study area which is far more than the other modes including trucks. Air freight is projected to increase substantially by both tonnage and value, while water freight will experience more modest increases. Rail freight, in both tonnage and value, will decrease by 12 and 29 percent, respectively.

9.3 Intermodal Facilities: Air, Rail, and Water

Figure 9-2 shows the locations of air, rail, and water facilities with the V/C ratio for the roadway network. The major air freight generator is the Nashville International Airport in an area with high V/C ratios indicating access issues for inbound and outbound freight by air. The major rail facility, Radnor Yard,

Table 9-2. Inbound Freight Tonnage and Value for 2012 and 2040 by Entry Road and Destination County

Tons (in thousands)

Destination County	2012 Entry Road I-24	2012 Entry Road I-40	2012 Entry Road I-65	2012 Grand Total	2040 Entry Road I-24	2040 Entry Road I-40	2040 Entry Road I-65	2040 Grand Total
Bedford	121	56	224	401	253	151	564	968
Cheatham	112	67	202	381	214	171	501	887
Davidson	2,246	1,868	4,269	8,382	3,161	2,866	7,361	13,387
Dickson	115	139	197	450	195	278	471	944
Giles	54	63	191	308	102	124	384	610
Hickman	11	29	43	83	15	49	94	158
Lincoln	72	54	104	230	151	113	284	548
Marshall	72	74	286	432	82	105	367	554
Maury	165	205	528	897	353	412	1,376	2,142
Robertson	176	169	663	1,009	434	624	1,891	2,950
Rutherford	1,039	728	473	2,240	2,825	2,282	1,258	6,366
Sumner	318	291	1,144	1,752	906	866	3,894	5,666
Williamson	666	698	1,622	2,986	1,459	1,666	4,564	7,688
Wilson	306	329	125	761	600	799	293	1,693
Grand Total	5,472	4,770	10,071	20,313	10,752	10,507	23,303	44,562

Value (in millions)

Destination County	2012 Entry Road I-24	2012 Entry Road I-40	2012 Entry Road I-65	2012 Grand Total	2040 Entry Road I-24	2040 Entry Road I-40	2040 Entry Road I-65	2040 Grand Total
Bedford	$131	$102	$310	$542	$358	$368	$902	$1,628
Cheatham	$55	$80	$138	$272	$129	$308	$364	$800
Davidson	$1,909	$3,262	$4,840	$10,010	$3,546	$7,983	$9,765	$21,294
Dickson	$98	$187	$214	$499	$189	$537	$571	$1,298
Giles	$36	$81	$168	$286	$76	$235	$343	$655
Hickman	$7	$26	$27	$59	$9	$53	$53	$115
Lincoln	$55	$69	$109	$233	$133	$232	$342	$706
Marshall	$39	$86	$180	$305	$65	$283	$320	$668
Maury	$149	$444	$700	$1,293	$201	$1,127	$1,322	$2,651
Robertson	$148	$293	$724	$1,166	$414	$1,650	$2,862	$4,926
Rutherford	$1,044	$2,011	$485	$3,540	$3,387	$8,755	$1,126	$13,268
Sumner	$203	$399	$885	$1,487	$438	$1,449	$2,425	$4,312
Williamson	$342	$968	$1,113	$2,423	$812	$3,085	$2,999	$6,895
Wilson	$133	$408	$73	$614	$321	$1,385	$191	$1,896
Grand Total	$4,348	$8,416	$9,965	$22,729	$10,079	$27,450	$23,585	$61,113

Data source: Transearch Database

Table 9-3. Outbound Freight Tonnage and Value for 2012 and 2040 by Exit Road and Destination County

Tons (in thousands)

Destination County	2012 Entry Road I-24	2012 Entry Road I-40	2012 Entry Road I-65	2012 Grand Total	2040 Entry Road I-24	2040 Entry Road I-40	2040 Entry Road I-65	2040 Grand Total
Bedford	354	142	801	1,296	796	194	918	1,907
Cheatham	89	64	177	331	144	125	372	641
Davidson	1,101	1,093	2,825	5,020	1,251	1,709	3,438	6,397
Dickson	88	187	258	533	137	352	345	835
Giles	75	149	493	716	112	273	623	1,007
Hickman	50	157	299	505	63	193	293	548
Lincoln	79	112	118	308	241	266	325	832
Marshall	113	188	681	982	177	225	649	1,051
Maury	91	293	486	870	163	552	699	1,414
Robertson	591	316	1,430	2,336	708	620	2,159	3,487
Rutherford	1,010	590	562	2,162	1,518	956	695	3,168
Sumner	160	216	730	1,107	273	625	1,793	2,690
Williamson	216	523	754	1,493	299	775	1,123	2,197
Wilson	233	521	328	1,081	356	1,055	414	1,825
Grand Total	4,249	4,552	9,940	18,741	6,236	7,920	13,844	28,000

Value (in millions)

Destination County	2012 Entry Road I-24	2012 Entry Road I-40	2012 Entry Road I-65	2012 Grand Total	2040 Entry Road I-24	2040 Entry Road I-40	2040 Entry Road I-65	2040 Grand Total
Bedford	$277	$153	$523	$953	$1,046	$447	$1,564	$3,057
Cheatham	$122	$218	$199	$538	$187	$347	$411	$945
Davidson	$1,713	$2,031	$3,238	$6,982	$2,187	$4,182	$5,904	$12,272
Dickson	$110	$218	$283	$611	$252	$559	$632	$1,443
Giles	$68	$153	$347	$568	$160	$413	$900	$1,473
Hickman	$19	$75	$84	$179	$37	$159	$205	$401
Lincoln	$94	$127	$194	$414	$325	$339	$597	$1,261
Marshall	$117	$183	$404	$704	$229	$333	$822	$1,383
Maury	$99	$290	$351	$741	$246	$744	$945	$1,935
Robertson	$672	$506	$1,776	$2,954	$902	$1,330	$3,941	$6,173
Rutherford	$895	$1,105	$370	$2,369	$1,745	$3,110	$693	$5,548
Sumner	$246	$471	$936	$1,653	$425	$1,437	$2,444	$4,305
Williamson	$144	$404	$497	$1,045	$337	$1,127	$1,584	$3,048
Wilson	$95	$276	$60	$431	$246	$1,044	$149	$1,439
Grand Total	$4,670	$6,211	$9,262	$20,143	$8,324	$15,571	$20,790	$44,684

Source: Transearch Database

Table 9-4. MUT and SUT Productions and Attractions by County for 2010 (daily trips)

County	MUT		SUT	
	Attractions	Productions	Attractions	Productions
Bedford	2,424	2,383	2,219	2,059
Cheatham	860	840	1,443	1,496
Davidson	34,239	32,343	54,458	53,859
Dickson	2,480	2,277	3,410	3,513
Giles	1,162	1,100	1,953	2,016
Hickman	242	265	1,166	1,301
Lincoln	762	801	1,965	1,840
Marshall	1,241	1,241	2,082	2,139
Maury	2,889	3,050	4,969	4,877
Robertson	4,138	3,849	2,938	2,969
Rutherford	17,089	18,371	15,679	15,808
Sumner	5,829	6,479	8,591	9,382
Williamson	6,814	6,821	10,392	10,254
Wilson	6,120	5,790	5,171	5,257

Data source: AirSage Database

Table 9-5. Through Truck Traffic Tonnage (in Thousands) by Entry and Exit Road for 2012 and 2040

Entry Road	2012				2040				% Change 2012 to 2040			
	Exit Road			Grand Total	Exit Road			Grand Total	Exit Road			Grand Total
	I-24	I-40	I-65		I-24	I-40	I-65		I-24	I-40	I-65	
I-24	0	2,491	2,156	4,647	0	4,252	3,104	7,357	-	71%	44%	58%
I-40	2,575	3,765	7,237	13,576	4,505	5,822	15,396	25,723	75%	55%	113%	89%
I-65	1,128	8,549	20,771	30,447	1,634	19,639	36,323	57,596	45%	130%	75%	89%
Grand Total	3,702	14,805	30,163	48,671	6,139	29,713	54,823	90,676	66%	101%	82%	86%

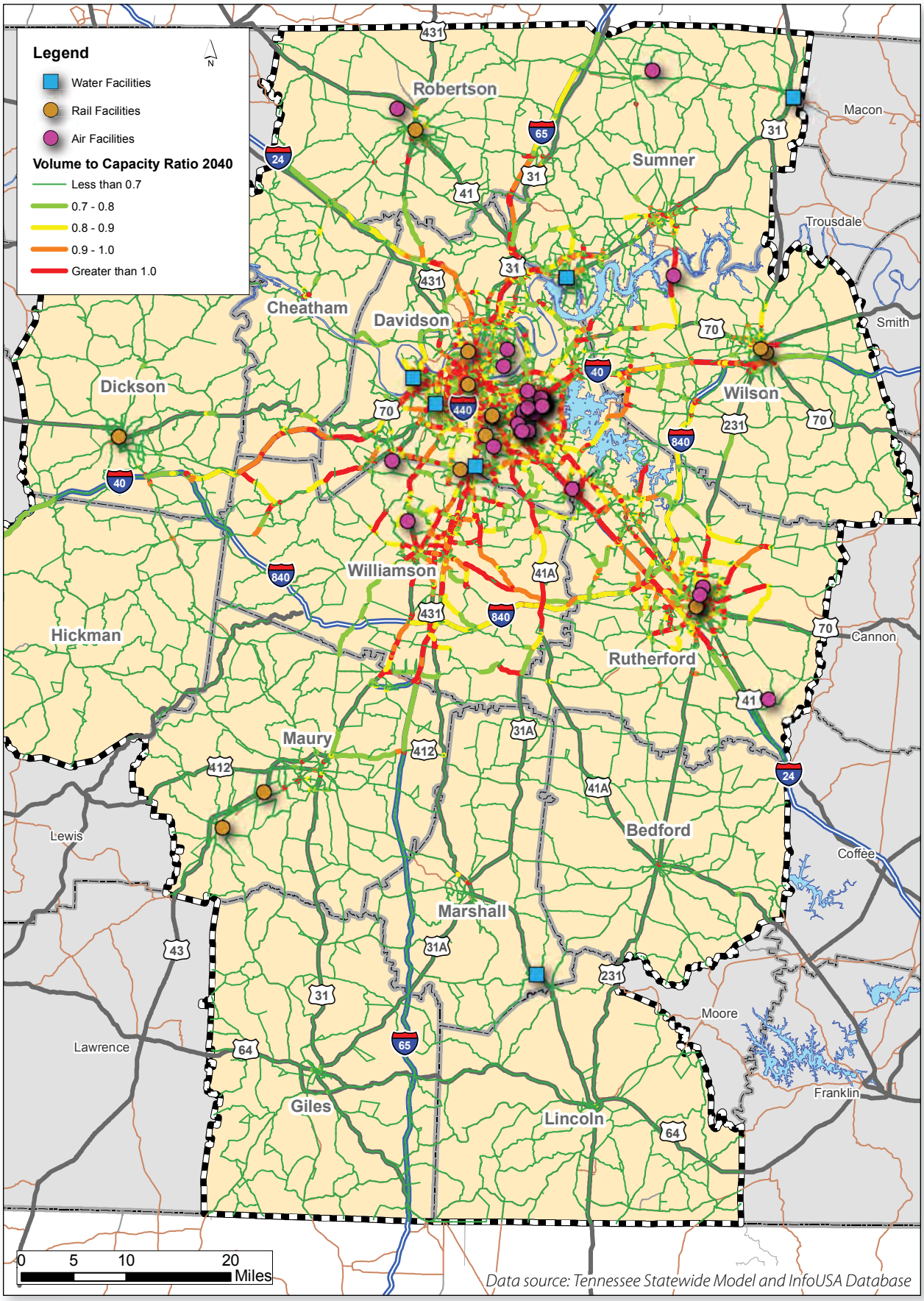
Source: Transearch Database

Table 9-6. Through Freight Tonnage (in Thousands) and Value (in Millions) for Air, Water, and Rail for 2012 and 2040

	2012		2040		% Change	
	Tons	Value	Tons	Value	Tons	Value
Air	0.1	$16	0.4	$55	300%	244%
Water	926	$271	1,150	$322	24%	19%
Rail	240,205	$259,534	211,486	$184,495	-12%	-29%
Total	241,132	$259,820	212,636	$184,871	-12%	-29%

Source: Transearch Database

Figure 9-2. Air, Rail, and Water Facility Locations with V/C Ratio for 2040



is located just south of Nashville along I-65 in an area also with high V/C ratios indicating access issues. The major water facility, the Nashville Port, is located along the Cumberland River in Nashville where the V/C ratios are the highest.

9.4 Freight Diversion: From Truck to Rail/Water

The two main requirements for freight diversion are: (1) existing infrastructure for an alternate mode and (2) competitiveness of alternate modes. Different commodities may require different handling procedures and technology, and therefore, freight diversion has a greater potential where there is an existing supply chain for the commodities to be diverted. The following two subsections focus on the potential for freight diversion of inbound and outbound freight. A lack of data available on logistic costs and mode utilization do not allow for a freight diversion model to be developed.

Freight Diversion Potential: Existence of Supply Chains

Table 9-7 shows major commodities based on total tonnage inbound to the study area moved by truck, rail, and water. From an infrastructure/ logistics perspective, the potential exists for modal shift with all three modes. For example, gravel is transported from Kentucky to Davidson County by both truck (978,907 tons) and water (446,809 tons). Table 9-7 also indicates that the potential exists for modal shift for two major commodities, gravel and non-metallic minerals. In most cases, either commodity is primarily moved by truck with little volume travelling by rail or by water, highlighting the potential for freight diversion. Other commodities are not considered fit for modal shift because existing supply chains are either heavily committed to a single mode or transport very little tonnage.

Table 9-8 shows waste and scrap as a major outbound commodity moved by truck, rail, and water with a potential for modal shift. In most cases, waste and scrap is primarily moved by rail or by water with little volume travelling by truck. Assuming rail and water facilities are not at capacity, a potential for freight diversion may exist. For example, waste and scrap is transported from Davidson County to Alabama by rail (31,884 tons), truck (86,634 tons), and water (102,646 tons). Other commodities are not considered fit for modal shift since the existing supply chains are either heavily committed to a single mode or transport very little tonnage

Table 9-7. Inbound Freight Diversion Potential

Commodity	Destination County	Origin State	Mode	Tons	Value
 GRAVEL	Davidson	KY	Truck	978,907	$7,954,900
			Water	446,809	$3,418,087
		MO	Truck	304,490	$2,656,107
			Water	66,227	$506,633
		OH	Rail	20,000	$1,741,592
			Truck	173,565	$1,360,607
	Sumner	KY	Truck	192,392	$1,534,914
			Water	27,027	$206,755
 NON-METALLIC MINERAL	Davidson	AL	Rail	3,080	$1,652,672
			Truck	45,726	$21,092,477
		IL	Truck	10,568	$3,453,007
			Water	101,195	$14,275,856
		IN	Rail	17,440	$1,495,423
			Truck	46,878	$12,726,710
		KY	Rail	3,760	$763,220
			Truck	48,498	$9,639,233
			Water	3,294	$454,191
		MO	Rail	7,840	$1,719,743
			Truck	7,134	$2,493,319
			Water	317,929	$37,074,134

Data source: Transearch Database

Table 9-8. Outbound Freight Diversion Potential

Commodity	Origin County	Destination State	Mode	Tons	Value
 WASTE AND SCRAP	Davidson	AL	Rail	31,884	$8,040,356
			Truck	86,634	$22,904,555
			Water	102,646	$28,430,172
		GA	Rail	23,000	$4,535,408
			Truck	52,822	$13,925,077
		IA	Rail	3,432	$1,016,589
			Truck	935	$247,955
		IL	Rail	5,236	$1,550,950
			Truck	26,541	$7,597,963
			Water	112	$30,903
		IN	Rail	3,600	$1,066,352
			Truck	47,927	$12,839,206
			Water	7	$2,014
		KY	Truck	124,340	$31,495,958
			Water	76,423	$21,167,063
		LA	Truck	5,122	$1,434,757
			Water	28,369	$7,857,373
		OH	Truck	29,142	$6,956,751
			Water	1,670	$462,594
		OK	Rail	2,320	$556,077
			Truck	1,393	$380,503
		PA	Air	0	$13,314
			Truck	6,509	$1,616,371
			Water	1,130	$312,959
		SC	Rail	840	$201,338
			Truck	13,446	$3,815,767
		TX	Truck	5,138	$1,725,920
			Water	4,647	$1,287,083
	Dickson	AL	Rail	16,960	$5,023,702
			Truck	4,481	$1,163,499
		MS	Rail	4,480	$1,327,016
			Truck	1,652	$446,169
	Marshall	GA	Rail	1,440	$345,151
			Truck	3,188	$841,590
	Rutherford	AL	Rail	6,456	$1,912,324
			Truck	35,123	$9,473,104
		MS	Rail	30,376	$8,997,640
			Truck	2,849	$798,353
	Sumner	IL	Rail	4,040	$968,341
			Truck	7,876	$2,459,062

Data source: Transearch Database

Freight Diversion Potential: Freight Volume Projections

Tables 9-9 and 9-10 show the modal split of inbound/outbound commodities by modes for 2040. Rail has the greatest future potential for attracting outbound diverted freight as it is the primary transport mode for basic chemicals, paper products, and motor vehicles. The remainder of outbound commodities are overwhelmingly (greater than 90 percent) transported by trucks. For inbound freight, paper products, basic chemicals, and base metal have the greatest future potential for diversion since they are heavily transported by truck and by rail. The potential for diversion assumes that rail will have the capacity available to accommodate the additional demand.

Table 9-9. Top Inbound Commodities Transported by Multiple Modes for the Year 2040

Commodity	Modal Split			
	Truck	Air	Water	Rail
Coal	<1%	0%	99%	0%
Fertilizers	5%	0%	47%	48%
Pulp, Newsprint, Paper and Paperboard	21%	0%	0%	79%
Basic Chemicals	33%	0%	0%	66%
Base Metal	55%	0%	13%	31%
Transportation Equipment	79%	0%	4%	17%
Plastics and Rubber	80%	0%	0%	19%
Motorized and Other Vehicles	82%	0%	0%	18%
Milled Grain Products	87%	0%	0%	13%
Alcoholic Beverages	88%	0%	0%	12%
Other Chemical Products	89%	0%	0%	11%
Other Non-Metallic Minerals	90%	0%	9%	1%
Natural Sands	91%	0%	9%	1%
Animal Feed	91%	0%	0%	9%

Data source: Transearch Database

Table 9-10. Top Outbound Commodities Transported by Multiple Modes for the Year 2040

Commodity	Modal Split			
	Truck	Air	Water	Rail
Coal	<1%	0%	99%	0%
Fertilizers	5%	0%	47%	48%
Pulp, Newsprint, Paper and Paperboard	21%	0%	0%	79%
Basic Chemicals	33%	0%	0%	66%
Base Metal	55%	0%	13%	31%
Transportation Equipment	79%	0%	4%	17%
Plastics and Rubber	80%	0%	0%	19%
Motorized and Other Vehicles	82%	0%	0%	18%
Milled Grain Products	87%	0%	0%	13%
Alcoholic Beverages	88%	0%	0%	12%
Other Chemical Products	89%	0%	0%	11%
Other Non-Metallic Minerals	90%	0%	9%	1%
Natural Sands	91%	0%	9%	1%
Animal Feed	91%	0%	0%	9%

Data source: Transearch Database

9.5 Truck Parking

Figure 9-3 shows the locations in the study area for rest areas and trucks stops. There are only six public locations with truck parking in the study area: three on I-65 south of Nashville, one on I-65 at the border with Kentucky, and two on I-40 west of Nashville. Figure 9-3 highlights the lack of truck parking and rest areas along I-840. There are only private rest areas east of Nashville on I-40 and along I-24. With I-24 poised to see significant increases in truck volumes by the year 2040, the lack of public truck parking could create safety issues ranging from trucks parking illegally on ramps to increased accidents from drowsy driving.

9.6 Other Emerging Freight Issues

There are several emerging global and national freight issues that will impact freight movement in the I-65 corridor. While the potential impacts are largely uncertain at this time, policy options and scenarios related to each issue should be considered and evaluated.

Impact of Panama Canal Expansion

The addition of a new wider lane to the Panama Canal is predicted to make large changes to freight logistics. The new lane can allow Neo-Panamax ships to pass with a capacity of 14,000 20-foot equivalent units (TEU), almost three times the previous Panamax ships at 5,000 TEU's. With the more efficient capacity, the costs to ship cargo from Asia to US ports on the gulf and east coasts will be decreased, and could entice traffic to shift from west coast ports to east coasts ports. Despite a projected 10 percent shift in traffic from west coast to east coast ports, however, freight traffic on west coast ports is expected to increase due to the rising demand for containerized transport. Moreover, it will remain faster to ship to west coast ports and then utilize rail transport. For example, shipping from Shanghai to New York takes 19-22 days using west coast ports and rail, but the same shipment takes 25-26 days using the Panama Canal.

Boston Consulting Group estimates that the battleground region upon which US ports compete for customers will expand west to encompass Memphis, Chicago, and Columbus, representing 15 percent of the national GDP. In this region, customers will weigh the trade-offs of time and cost to determine which coast to import/export their cargo. Most of Tennessee falls within the battleground region, meaning the state will see cargo being brought from both east and west coast ports. Another important consideration is that many of the east coast ports are not prepared for the larger capacity ships and are currently undergoing improvements that are to be completed by 2020.

As supply chains settle into a new reality of liner shipping overcapacity, volatile rates, alliances, bankruptcies, new port infrastructure, e-commerce growth, and changing warehousing technologies and policies, improved data will be able to provide a more quantitative analysis of the Panama Canal expansion. It is interesting to note that recent data shows a reallocation of capacity from the Suez-US East Coast to routes through the Panama Canal while at the same time the Panama Canal authority is preparing to build a 5 million TEU container terminal, which most likely will result in additional reallocation of capacity to take advantage of transshipment capabilities.

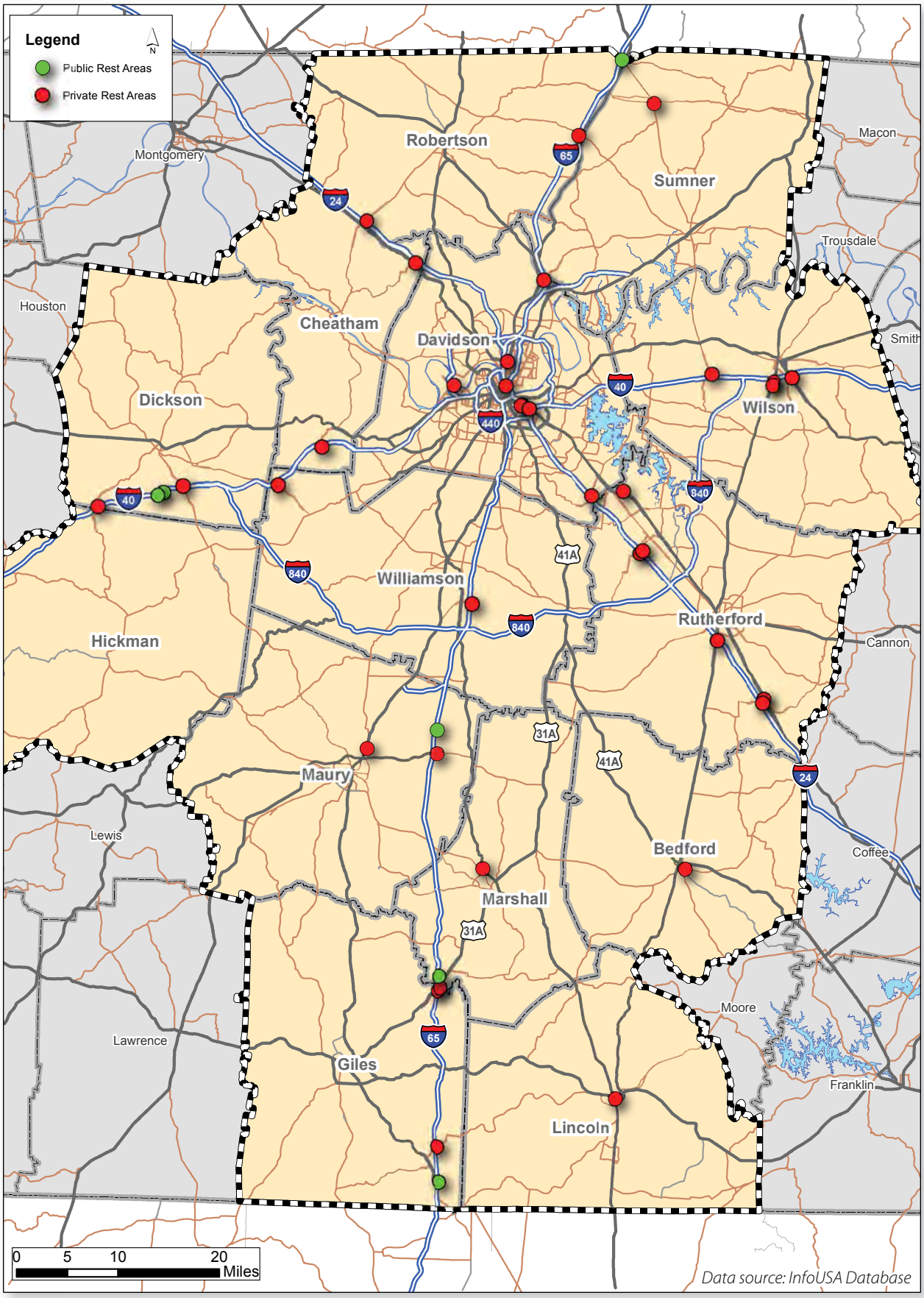
Radnor Yard – Potential for Freight Diversion

The Radnor Rail Yard is the second largest CSX railyard in the southeast residing on 517-acres in Nashville immediately adjacent to I-65. In terms of access, it is in a prime location next to the interstate, but the railyard is landlocked by nearby residential and industrial areas. Due to expansion constraints, the railyard operates as a bottleneck for the CSX railroad which has led to discussions of relocating the railyard. Another motivation for relocation is growing interest in regional passenger trains. To date, TDOT, the Nashville Area MPO, and the Nashville Chamber of Commerce have either identified the relocation of Radnor Yard as a future project and/or regional priority. Relocating Radnor Yard, estimated to cost $767 million in TDOT's multimodal freight plan, to the I-24 corridor near Smyrna would potentially reduce conflicts due to lower population densities and easy access to major interstates.

Last Mile Freight

Last mile freight connections have become increasingly complex for both urban pick-up and

Figure 9-3. Truck Rest Areas in the Study Area (Public and Private)



delivery and major intermodal terminals. In urban areas, multiple stakeholders, goods, and transport modes add up to a wide range of competing interests and objectives including transportation costs, traffic congestion, pollution, and safety, security, and neighborhood impacts. Arthur D. Little's Future of Urban Mobility Lab outlines the four key elements of a comprehensive urban logistics strategy:

- Regulatory and land planning – restricted access, time slots, exclusivity zones, and retail and logistic clusters;
- Infrastructure – urban distribution centers, dedicated loading spaces, and e-commerce pick-up points;
- Financial incentives – urban congestion charges and freight infrastructure subsidies and tax deductions; and
- Equipment and technology – green trucks, alternative freight delivery modes, and ITS.

9.7 Existing and Future Deficiencies and Needs

The analysis of the available freight data highlights deficiencies and needs in the study area's freight network.

A. **Freight Movement:** Truck is the major mode for freight movement in the study area and truck volumes are projected to increase by more than 50 percent on most of the study area roadway network between 2010 and 2040. Between 2010 and 2040, truck volumes on I-65 north of Nashville will significantly increase (68 percent), and more than double on I-40 east and west of Nashville (110 percent). Interstate 24 south of Nashville currently serves more than 10,000 trucks daily, but demand is projected to be 17,000 trucks by 2040. The overlap of I-65 and I-24 is projected to carry nearly 24,000 trucks in 2040.

B. **Inbound/Outbound Freight Demand:** Inbound and outbound freight to the study area is primarily transported by trucks with inbound tonnage more than doubling by 2040. Air freight shows a large percentage increase by 2040 for both inbound and outbound volumes. Outbound freight transported by rail is projected to grow by roughly 147 percent by 2040 which may result in rail capacity issues and freight diversion to truck and water.

C. **Major Origin-Destination Pairs:** Davidson County is the destination for over 40 percent of the total freight tonnage in the study area with I-65 accounting for nearly the combined total of I-24 and I-40 in terms of tonnage. Davidson and Rutherford counties are the origin of roughly 25 and 12 percent of the total freight tonnage, respectively, with a large portion of that exiting the study area by I-65. Davidson and Rutherford Counties produce and attract the most MUT and SUT trips. Davidson County is also the dominant origin and destination in the region for all modes with two notable exceptions. Sumner County has a higher inbound tonnage by water and a much lower inbound value by water. Rutherford County has a high outbound value by rail and lower outbound tonnage by rail.

D. **Through Traffic:** Through truck traffic entering and exiting on I-65 is projected to increase by 89 percent by 2040. Total truck traffic entering I-65, I-24, and I-40 and exiting I-65 is forecasted to increase by 82 percent, which will translate into higher truck volumes on I-65, I-440, and I-840. Significant increases are also projected for truck traffic that either enters or exits the study area through I-40 and uses I-65. In 2012, there were over 240 million tons of through freight utilizing the rail network in the study area which is far more than the other modes including trucks. Air freight is projected to increase substantially by both tonnage and value, while water freight will experience more modest increases. Through rail freight, in both tonnage and value, will decrease by 12 and 29 percent, respectively.

E. **Intermodal Facilities:** The major air freight generator is the Nashville International Airport in an area with high V/C ratios indicating access issues for inbound and outbound freight by air. The major rail facility, Radnor Yard, is located just south of Nashville along I-65 in an area also with high V/C ratios indicating access issues. The major water facility, the Nashville Port, is located along the Cumberland River in Nashville where the V/C ratios are the highest.

F. **Freight Diversion:** Freight diversion has a greater potential where there is an existing supply chain for the commodities to be diverted. From an infrastructure/logistics perspective, the potential exists for modal shifts across truck, rail, and water. Gravel and non-metallic minerals are the primary candidates for modal shift among inbound commodities, while waste and scrap is a major outbound commodity with a potential for modal shift. In 2040, rail has the greatest potential for attracting outbound diverted freight serving as the primary transport mode for basic chemicals, paper products, and motor vehicles. For inbound freight, paper products, basic chemicals, and base metal have the greatest future potential for diversion since they are heavily transported by truck and by rail. The potential for diversion assumes that rail will have the capacity available to accommodate the additional demand.

G. **Truck Parking:** There are only six public locations with truck parking in the study area: three on I-65 south of Nashville, one on I-65 at the border with Kentucky, and two on I-40 west of Nashville.

H. **Other Emerging Freight Issues:** The Panama Canal expansion, potential Radnor Yard relocation, and last mile freight are emerging global and national freight issues that will impact freight movement in the I-65 corridor. While the potential impacts are largely uncertain at this time, policy options and scenarios related to each issue should be considered and evaluated.

10. Traditionally Underserved Populations

Transportation facilities, services, and conditions impact people and communities differently. Traditionally underserved populations, particularly communities that are predominately low-income and/or minority, benefit when transportation systems are balanced across modes and offer more transportation choices. In the I-65 corridor, the distribution of traditionally underserved populations throughout the study area suggests that equity, the provision of transportation facilities and services to all residents regardless of race, ethnicity, or income level, is best examined in both urban and rural contexts.

Minority populations reside primarily in Nashville, with smaller concentrations in the various smaller town centers in the corridor. Low-income populations live throughout the analysis area, with concentrations common within urban and small town centers as well as the most rural portions of the corridor in Giles, Hickman, and Lincoln Counties. Using a high-level analysis of where traditionally underserved populations are located and findings from both the technical analysis and public outreach, several key issues were identified for minority and low-income populations in both urban and rural areas of the corridor.

Additional environmental justice (EJ) analysis, as it relates to Title VI of the 1964 Civil Rights Act, will be conducted during the "fatal flaws" assessment in the next phase of the study. Additionally, detailed EJ analysis, consistent with the National Environmental Policy Act (NEPA), will be conducted for all projects advanced by TDOT on a project-by-project basis.

10.1 Urban Equity

Three equity issues facing minority and low-income communities within urban areas of the I-65 corridor are access to employment and activity centers, transportation choices, and safety. These topics are discussed in greater detail below.

Access to Employment and Activity Centers

Existing employment and activity centers within the corridor are projected to grow and new centers are planned and under development. Importantly, the new and growing centers will reshape the region's development and travel patterns, continuing the shift from a traditional hub-and-spoke form long defined by downtown Nashville to a network of multiple centers. As employment centers emerge and expand beyond Davidson County, affordable transportation and high levels of accessibility will be increasingly vital for workers at low- and moderate-income levels. Reverse commuting, already identified as a need between Davidson and Williamson Counties, will continue to grow among counties within the study area. Accordingly, local land use policies that support job-housing connections and a seamless multimodal transportation system with strong transit, TDM, pedestrian, and bicycle facilities and services are critical to ensure people of all ages and abilities can travel safely and efficiently throughout the corridor.

Transportation Choice

Closely related to access is the issue of transportation choice. Transportation systems that focus on optimizing automobile travel generate high individual, household, and community costs, including safety, congestion, environmental, and health costs. Additionally, automobile ownership is expensive, costing as much as ten times more than riding transit, and consequently, many low-income households own a single car or no car at all. Because regional transit, TDM, walking, and bicycling facilities and services are limited in the I-65 corridor, traditionally underserved populations and communities face barriers to economic and physical well-being. Providing high quality multimodal transportation choices, including transit that is fast, frequent, and dependable and walking and bicycling facilities that are safe, comfortable, and convenient, can help reduce barriers for traditionally underserved individuals and communities to realize important transportation cost savings.

Safety

While all types of people and communities walk and bicycle, traditionally underserved populations can be particularly vulnerable in urban neighborhoods near major arterials or interstates. Individuals and households lacking private automobiles depend on walking and bicycling to access key destinations or transit service. Bicycle and pedestrian safety hotspots in Davidson County include areas near Trinity Lane (Exit 87); Jefferson Street; Charlotte Avenue, Church Street, and Broadway Avenue (Exit 209); and 4th Avenue and Lafayette Street (Exit 210).

10.2 Rural Equity

The primary equity issues facing minority and low-income communities within rural areas of the corridor are access to employment centers and transportation choice.

Access to Employment Centers

Population is projected to grow between now and 2040 in all counties within the study analysis area. However, many areas will experience employment decline, particularly the most rural portions of Giles, Lincoln, and Marshall Counties. The combination of modest population growth and employment decline in rural communities will result in some residents needing to find employment in other parts of the corridor, most likely in town centers or larger urban activity centers closer to Nashville. These commuters will need quality transportation connections to county seats and town centers, as well as facilities and services for longer distance commuting. Additionally, US and state routes with geometric deficiencies will need to be identified to ensure safe operations on major facilities.

Transportation Choice

Transportation choices in rural areas within the corridor are limited. On-demand public transportation is offered by both the Mid-Cumberland Human Resource Agency and the South Central Tennessee Development District, though these services are often not convenient for unscheduled transportation needs. Additional transportation choices that serve commuting needs of rural residents should be examined, including express bus transit, expanded on-demand service, and ridesharing.

11. Public and Stakeholder Outreach

11.1 Public Workshops

As part of the existing and futures deficiencies phase of the I-65 Multimodal Corridor Study, TDOT held three public workshops throughout the analysis area to present an overview of the project, discuss preliminary findings, and solicit feedback on corridor vision, priorities, and specific areas of concern. The three meetings held were:

- **October 18, 2016 –** Nashville Main Public Library – 11:30 AM – 1:00 PM
- **October 25, 2016 –** Portland High School – 5:30 PM – 7:00 PM
- **November 15, 2016 –** Williamson County Public Library - 5:30 PM – 7:00 PM

Approximately 120 individuals attended the public workshops. The sections below explain the various methods of providing feedback and summarize the public feedback that was received.

Dot Board – Corridor Priorities

In the Corridor Priorities activity, attendees were asked to vote on their top priorities using a dot board. Attendees were given three dots and could distribute them however they pleased, whether voting for three priorities or voting three times for a single priority. The priorities reflected seven overarching themes: Safety, Congestion, Access and Connectivity, Operations and Maintenance, Livability and Beautification, Fiscal Responsibility, and Economic Development. A total of 167 votes were received. Figure 11-1 summarizes the results of the activity.

Establishing a Corridor Vision Statement – "Three Words or Phrases"

Meeting attendees were also asked to list words or phrases to describe their vision for the I-65 corridor. Figure 11-2, a "Wordle" word cloud, highlights key words and phrases based on the number of times they were mentioned. The words and phrases will be used in the coming months to guide the development of the draft vision statement for the corridor and the study's recommendations. While there was some regional variation in the words or phrases identified by the attendees, the graphic below represents all the feedback received.

Mapping Exercise – Issues and Opportunities

Meeting attendees were provided with a series of maps depicting the entire corridor and asked to identify specific issues or opportunities along the corridor. The following bullet points summarize, by county or counties, highlights of the input received:

- Robertson/Sumner Counties
  - Widen I-65 to Tennessee/Kentucky state line
  - Need direct access to SR 386 from SB I-65 and from SR 386 to NB I-65
  - Need additional lanes at SR 386 and Conference Drive
  - Improve Exit 98 interchange (US 41)
  - Restrict trucks to right lane
  - Complete SR 109 improvements
  - Incorporate transit into I-65 and SR 386 corridors
- Davidson County
  - Improve Trinity Lane interchange area
  - Need solutions to peak hour congestion in downtown Nashville loop
  - Enlarge Fern Avenue overpass
  - Provide better interchange access to I-65 from 4th Avenue South
  - Expand and widen exits at Armory Drive interchange (Exit 78)
  - Explore strategies that can reduce traffic volume on I-65
- Williamson County
  - Improve I-65/SR 254 (Old Hickory Blvd.) interchange
  - Enforce HOV lane restrictions
  - Integrate high-capacity transit service between Nashville and Franklin
  - Improve interchanges in the Franklin/Cool Springs area

Figure 11-1. Summary of Priority Preferences

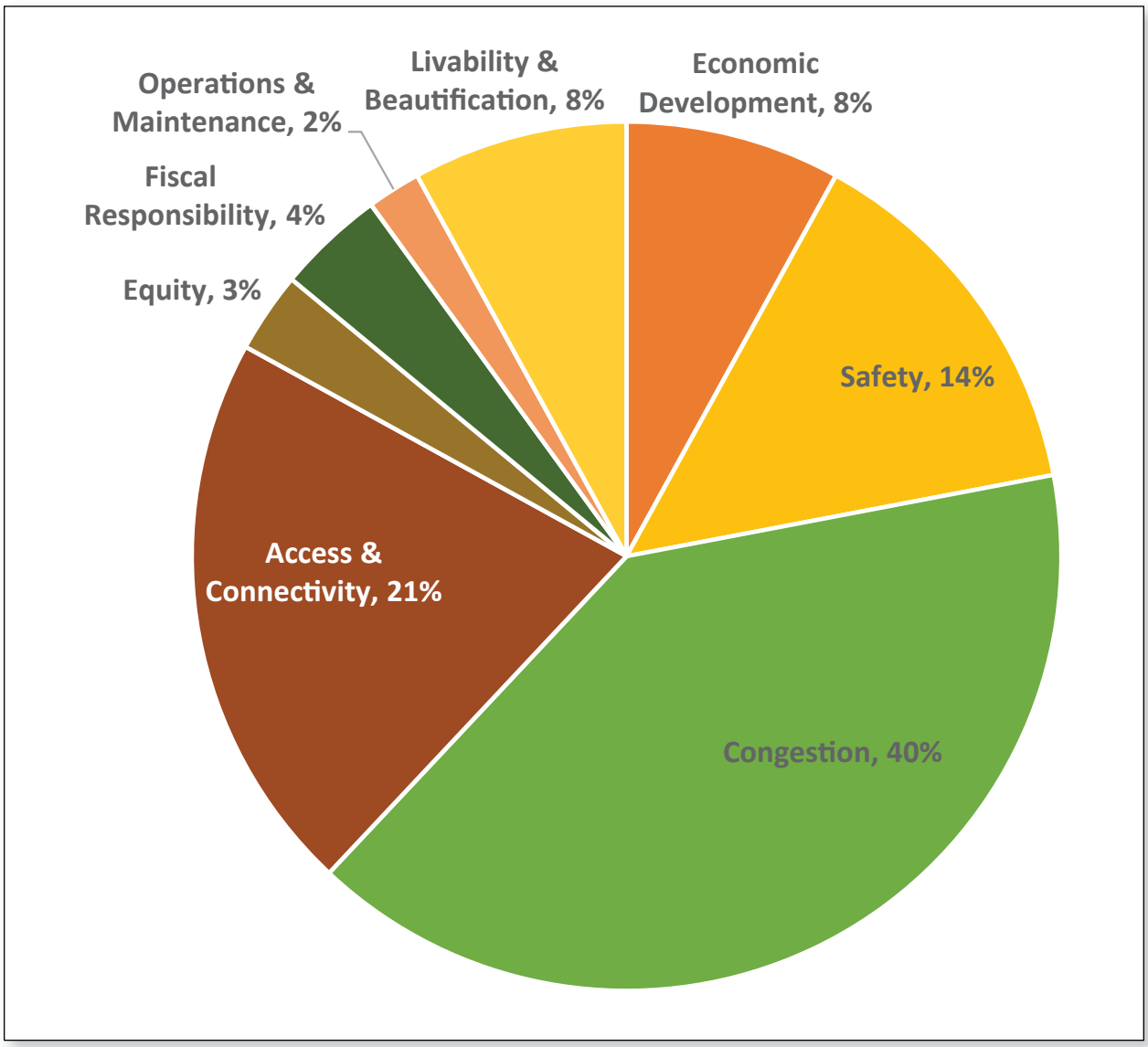


Figure 11-2. Word Cloud – Corridor Vision

  - Address safety issues at the I-65/I-840 interchange area
  - Coordinate growth and transportation improvements on key arterials
- Maury County
  - Connect Saturn Parkway to Lewisburg
  - Review safety concerns on Saturn Parkway interchange (Exit 53)
  - Address spillover congestion on major arterials
- Giles/Lincoln/Marshall Counties
  - Add truck climbing lanes in hilly areas
  - Provide transportation options for residents in small towns and rural areas

11.2 Online Public Comment

Online Survey

Two outlets for public comment have been continually offered on the project website. A survey hosted on a Survey Monkey platform has been available for public input since February 2016. To date, more than two thousand responses have been received. Following is a summary of the survey feedback received to date.

Respondents were first asked to rate, on a scale of one to five, the importance of three transportation needs along I-65: less congestion, safer travel, and better/more efficient interchanges. Table 11-1 shows a breakdown of the responses. Congestion was clearly rated as the most important concern. Safer travel and interchange concerns were both rated highly by at least half of the respondents. These findings are consistent with the feedback received at the public workshops.

The next series of questions were open-ended in nature. The following list shows the questions and includes a high-level summary of the themes expressed by respondents:

- **Question:** What specific problems/concerns do you have about the corridor?
  - Bottlenecks, particularly during peak hour
  - Interchange safety and congestion
  - Need for additional public transportation options
  - HOV lanes: increased enforcement or discontinuation
  - Increased law enforcement along corridor/ unsafe driver behavior
- **Question:** What ideas or suggestions do you have that could improve/correct your I-65 Corridor problems/concerns?
  - Additional lanes/widening
  - Improved public transit
  - Better legislation/enforcement
  - Improved operations and maintenance (e.g., additional HELP trucks, better lighting, improved signage, and pothole repair)
- **Question:** What are other transportation improvements along the stretch of I-65 in your area would you like to see TDOT research or consider?
  - Improved public transit
  - Additional lanes/widening
  - Interchange improvements and new interchanges
  - Improved operations and maintenance (e.g., additional HELP trucks, better lighting, improved signage, and pothole repair)

Table 11-1. Transportation Needs Responses

	Least Important		Neither Most nor Least Important		Most Important	
	Number	Percent	Number	Percent	Number	Percent
Less congestion	6	0.5%	276	21.9%	977	77.6%
Safer travel	28	2.2%	490	38.9%	741	58.9%
Better/more efficient interchanges	24	1.9%	603	47.9%	632	50.2%

Additional questions determined the average respondent's experience with the I-65 corridor, with over 50 percent of respondents using I-65 as a regular commuter route and an additional 30 percent using the route for personal or leisure travel. Additionally, 80 percent of respondents indicated they travel I-65 frequently.

Finally, respondents were asked to choose other transportation options they would consider using along I-65. Figure 11-3 represents the breakdown by mode for all responses received. Passenger and high-speed rail were the most preferred options, accounting for over 70 percent of responses. More conventional transportation options within the region, such as bus routes and carpools, accounted for a much smaller percentage of the responses.

Interactive Mapping Tool

An interactive mapping tool, similar to the one offered to attendees at the public workshops, is also available on the project website. The tool, hosted on a Wikimaps platform, asks participants to identify specific areas of concern along the corridor. While participants often included detailed comments associated with the areas they identified, the responses were analyzed at a higher level by both general topic area and geographic location. Figure 11-4 summarizes the categorical breakdown of the more than one hundred comments received to date. Figure 11-5 includes a heat map showing the geographic distribution of the comments.

Figure 11-3. Alternative Mode Preferences

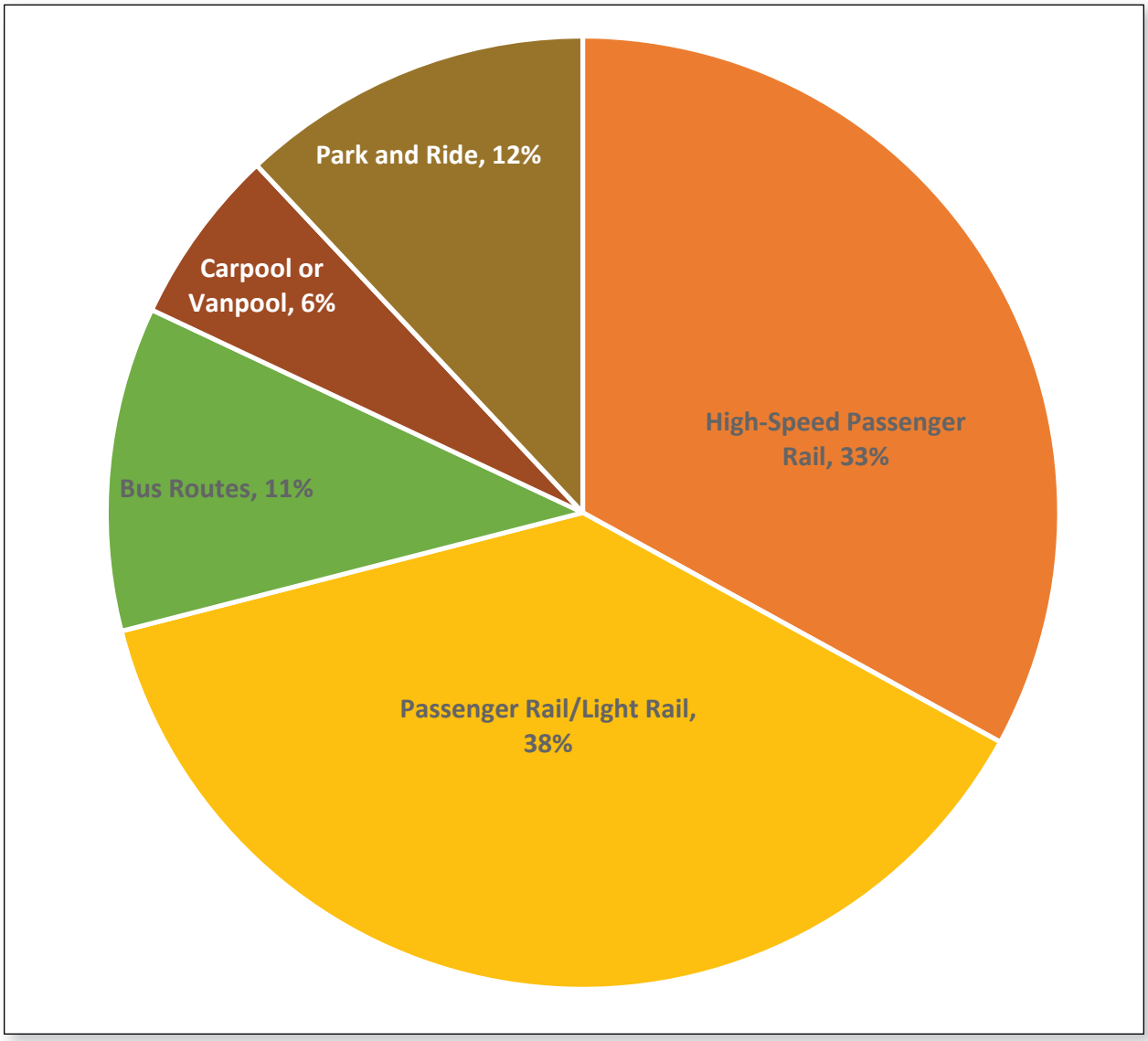
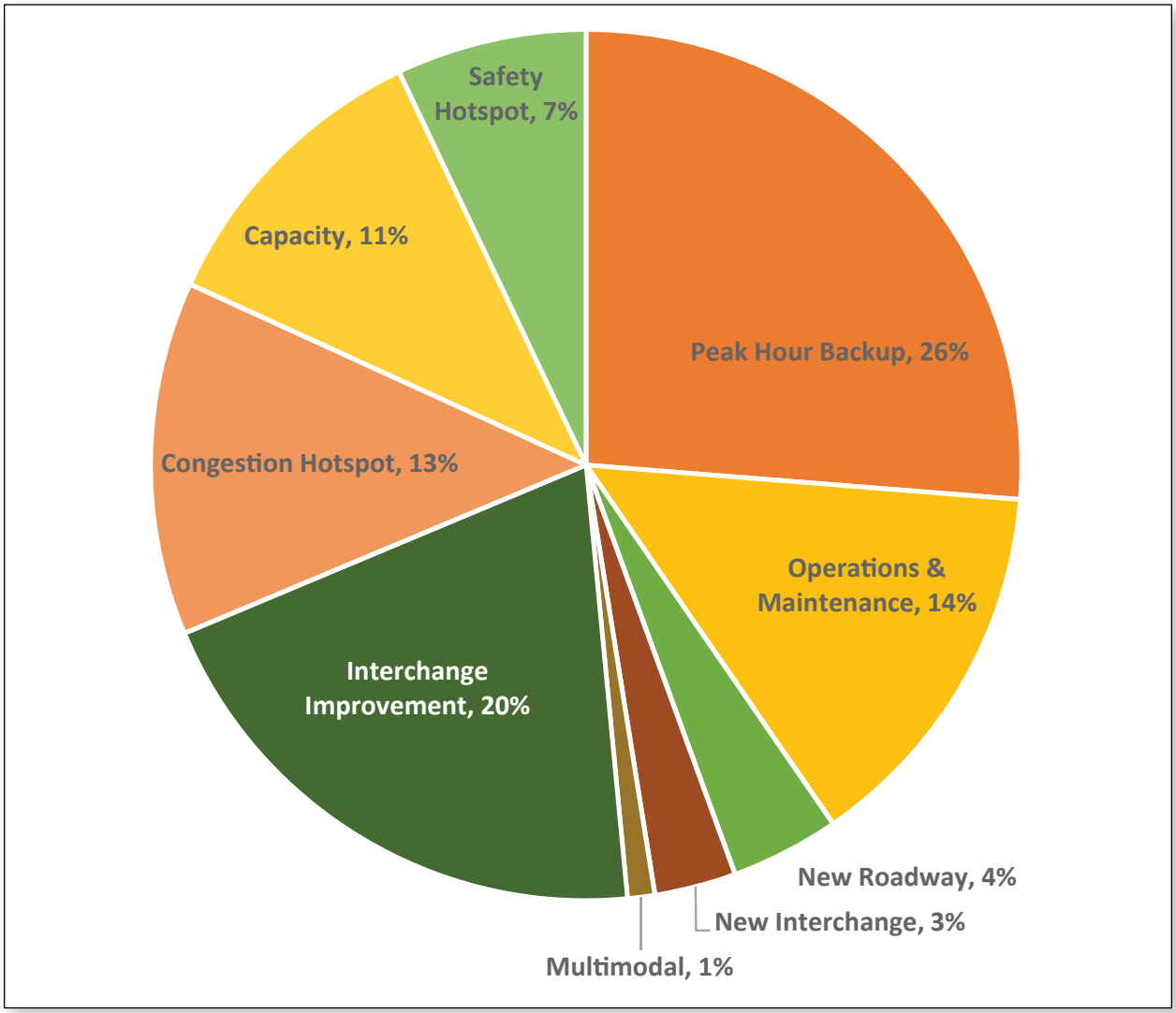


Figure 11-4. Wikimaps Comments – Breakdown by Category



Comments on the interactive map focused primarily on peak hour congestion hotspots and operational problems at key interchanges. Given that people generally focus on problem areas they encounter daily, the feedback paints a clear picture of specific problem areas from a user's point of view. The areas that were the subject of the most comments, from north to south along the corridor, were:

- I-65/I-24 interchange north of downtown Nashville;
- I-65/I-40 interchange south of downtown Nashville;
- Old Hickory Boulevard interchange area in Brentwood;
- Cool Springs Boulevard interchange area in Franklin;
- I-65/I-840 interchange area; and
- I-65/SR 396 (Saturn Parkway) interchange area in Spring Hill.

11.3 Additional Public and Stakeholder Outreach

In addition to the outreach activities listed here, the TDOT Office of Community Transportation (OCT) is coordinating small group presentations to key stakeholder, civic, and citizen groups on an as requested basis. These outreach activities are ongoing.

Figure 11-5. Geographic Distribution of Wikimaps Comments