I-75 Corridor Feasibility Study

Consideration of Multi-Modal Solutions

Task #3 - Technical Memorandum

November 2, 2010

Table of Contents

Appendices

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ADAM	Advanced Traffic Data Analysis and Management Software
AADT	Annual Average Daily Traffic
AL	Alabama
AV	Avenue
CARTA	Chattanooga Area Regional Transportation Authority
CBD	Central Business District
CBER	University of Tennessee Center for Business and Economic Research
CCTV	Closed-Circuit Television
CHCNGA	Chattanooga Hamilton County North Georgia
CMAQ	Congestion Mitigation and Air Quality
CMS	Congestion Management System
CTPP	Census Transportation Planning Package Data
CUAMPO	Cleveland Urban Area MPO
DMS	Dynamic Message Signs
DOD	Department of Defense
DOT	Department of Transportation
EPA	Environmental Protection Agency
ETHRA	East Tennessee Human Resources Agency
EVE	Evaluation of Roadway Efficiency System
FAA	Federal Aviation Administration
FDS	Fog Detection System
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GA	Georgia
GDOT	Georgia Department of Transportation
GIS	Geographic Information System
HAR	Highway Advisory Radio
HCM	Highway Capacity Manual
HCRT	Hamilton County Rural Transportation
HELP	Incident Management Program
HERS	Highway Economic Requirements System
HOV	High Occupancy Vehicle
HWY	Highway
ID	Identification
IDAS	ITS Deployment Analysis System
IJS	Interchange Justification Studies
IMS	Interchange Modification Studies
IRRIS	Intelligent Road / Rail Information Server
ITS	Intelligent Transportation System
JCT	Junction
KAT	Knoxville Area Transit
KY	Kentucky
LOS	Level of Service
LPG	Liquid Propane Gas
LRTP	Long Range Transportation Plan
MM	Mile Marker
MPC	Metropolitan Planning Commission

MPH	Miles per Hour
MPO	Metropolitan Planning Organization
MS	Mississippi
MTA	Metro Transit Authority
NC	North Carolina
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NHS	National Highway System
NOx	Nitrogen Oxides
NSRR	Norfolk Southern Railroad
PES	Project Evaluation System
PND	Ports for National Defense
RDS	Radio Data System
RND	Railroads for National Defense
RPA	Regional Planning Agency
RPO	Rural Planning Organization
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act
SIP	State Implementation Plan (for air quality)
SIP	Strategic Investment Program
SR	State Route
STIP	State Transportation Improvement Program
STP	Surface Transportation Program
STRACNET	Strategic Rail Corridor Network
STRAHNET	Strategic Highway Network
TAZ	Traffic Analysis Zone
TCRP	Transit Cooperative Research Program
TDM	Transportation Demand Management
TDOT	Tennessee Department of Transportation
THP	Tennessee Highway Patrol
TIP	Transportation Improvement Program
TMA	Transportation Management Association
TMC	Transportation Management Center
TN	Tennessee
TPO	Transportation Planning Organization
TPR	Transportation Planning Report
TRIMS	Tennessee Roadway Information Management System
TSIS	TDOT Smartway Information System
TSM	Transportation System Management
V/C	Volume to Capacity Ratio
VHT	Vehicles Hours Traveled
VMT	Vehicle Miles Traveled

1.0 INTRODUCTION

1.1 Project Background

PLAN Go, Tennessee's first 25-Year Long Range Transportation Plan (LRTP), was completed in 2005. The Plan was the result of an extensive public planning process throughout the State and consists of three principal elements:

- 25-Year Vision Plan, which broadly defined how Tennessee will respond to the trends and challenges facing the transportation system,

- 10-Year Strategic Investments Program (SIP), which identified critical investments that warrant accelerated funding or special attention over the next 10 years, and a

- 3-Year Project Evaluation System (PES), which will guide the selection of the 3-year program of projects, giving state and local leaders a broader view of projects under development.

Of these elements, the Strategic Investments Program (SIP) identifies proposed spending priorities and policy initiatives that will address many of Tennessee's transportation needs and help implement the LRTP over the next ten years. The SIP established three interrelated core investment initiatives: congestion relief, transportation choices, and key corridors.

The Interstate 75 Corridor from Chattanooga to the Kentucky State Line was identified through the LRTP planning effort in the SIP as a corridor that is significant to Tennessee's economic development, particularly with regard to freight movement. The purpose of the I-75 Corridor Feasibility Study is to obtain a more detailed understanding of the deficiencies of the corridor and then develop corridor level multi-modal solutions to address these deficiencies.

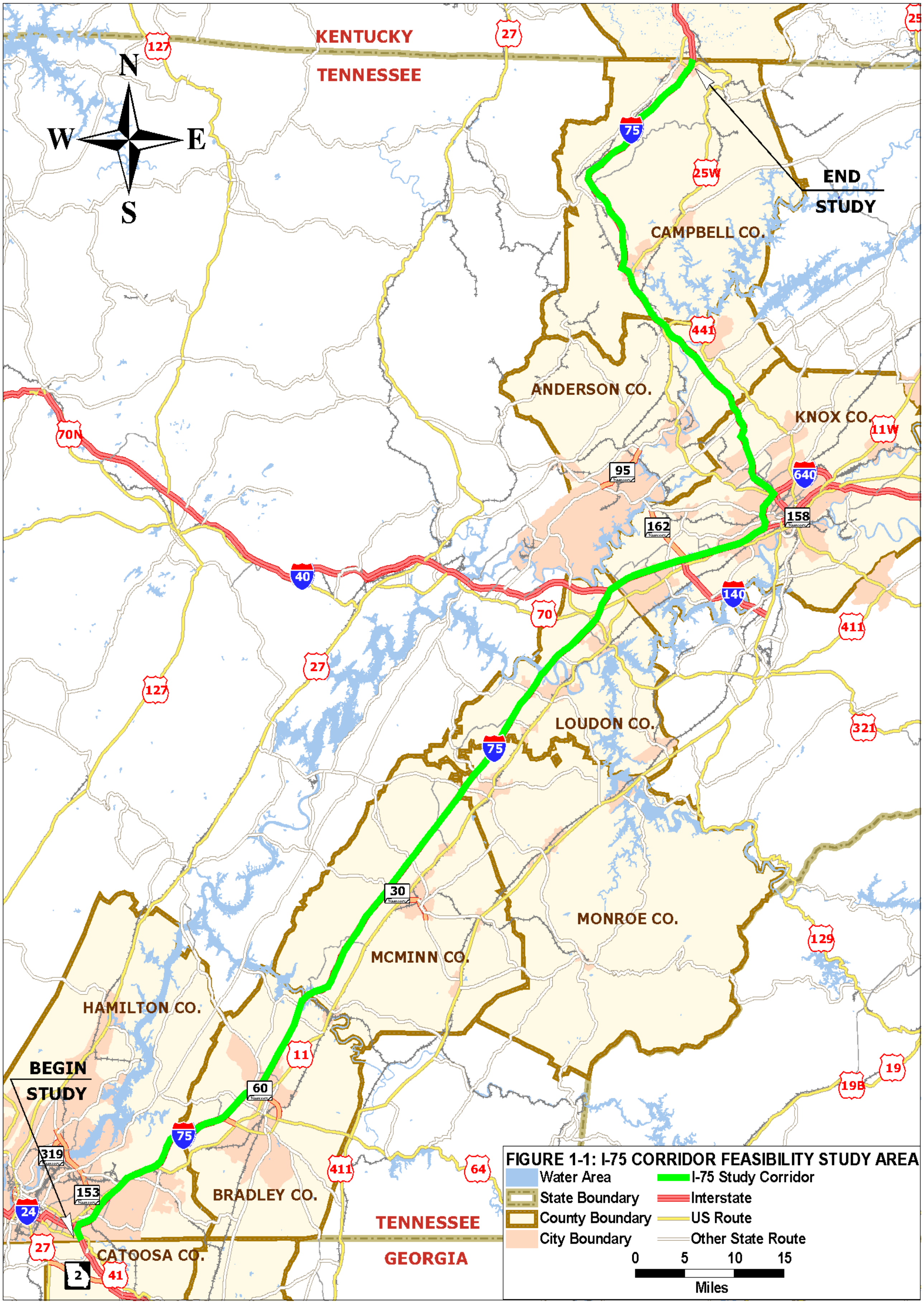
The study area for the I-75 Corridor Feasibility Study extends from the Georgia State Line in Chattanooga to the Kentucky State Line in Jellico (see **Figure 1-1**), a distance of approximately 162 miles. The corridor includes I-75, parallel Class I railroads, and parallel major arterial routes. The corridor traverses eight counties, three Rural Planning Organization (RPO) areas, and three Metropolitan Planning Organization (MPO) areas. Cities along the route, such as Chattanooga, Cleveland, Athens, and Knoxville, depend on this corridor for commerce, tourism, and daily commuting.

1.2 Purpose of the Report

The purpose of the report is to document all of the multi-modal solutions developed to address deficiencies along I-75 associated with:

- Capacity,
- Operations and Safety,
- Freight Movement/Diversion and Intermodal Facilities,
- Economic Access,
- No-Build Alternative, and
- TDOT staffing needs

The report describes the results of the screening analyses conducted on potential multi-modal solutions for the I-75 corridor. The Task 4 Technical Memorandum documents the project priorities in the Corridor Plan.


KENTUCKY
TENNESSEE
N
W
E
S
END
STUDY
CAMPBELL CO.
ANDERSON CO.
KNOX CO.
LOUDON CO.
MONROE CO.
MCMINN CO.
HAMILTON CO.
BEGIN
STUDY
BRADLEY CO.
CATOOSA CO.
TENNESSEE
GEORGIA
FIGURE 1-1: I-75 CORRIDOR FEASIBILITY STUDY AREA
Water Area
I-75 Study Corridor
State Boundary
Interstate
County Boundary
US Route
City Boundary
Other State Route
0
5
10
15
Miles

1.3 Organization and Content

Multi-modal solutions identified through this task are presented as follows:

- *Chapter 2 – Capacity*, describes two separate and independent solutions to address congestion along the I-75 study corridor:
  - Roadway Capacity – widening existing I-75 to accommodate current and projected traffic volumes, and
  - Corridor Capacity – widening parallel arterials and constructing roadway alternatives within the corridor to reduce congestion on I-75.
- *Chapter 3 – Operations and Safety*, identifies solutions to improve operations and safety at locations along I-75 where poor highway geometrics affect traffic flow and safety. These solutions include strategies such as interchange improvements and construction of truck climbing lanes. The chapter also lists recommended improvements to the intelligent transportation system (ITS) and incident management program, as well as the potential for creation of a managed lane solution.
- *Chapter 4 – Freight Movement/Diversion and Intermodal Facilities*, identifies opportunities for diverting freight movements in the I-75 corridor from truck to rail and impacts of improvements to the Chickamauga Lock. As part of improving the attractiveness of rail for corridor freight movements, the need for new or improved intermodal facilities is addressed.
- *Chapter 5 – Future Interchanges for Economic Access*, forecasts of population, housing, and employment growth to assess and prioritize community needs for future access to I-75 are used to determine potential interchange improvements or locations for new interchange access. TDOT's policy for interchange modification or justification is also used to identify roadways eligible for possible future interchanges.
- *Chapter 6 – Evaluation*, describes the methodology for and results from analyzing potential multi-modal solutions for the I-75 corridor.

2.0 CAPACITY

The congestion levels identified in the Assessment of Deficiencies Technical Memorandum were based on 2030 forecasted traffic volumes obtained from TDOT's Statewide Model and urban travel demand models located in the study area. These forecasted traffic volumes are based on projected population and employment changes within the respective model boundaries. The travel demand models also take into account the committed roadway improvements found in the Tennessee *State Transportation Improvement Pr*ogram (TIP) for Fiscal Years 2008-2011 and the committed projects from the current local TIP documents for the three urban areas along the study corridor.

To improve the capacity and reduce traffic congestion along the I-75 corridor, two sets of packages of solutions were examined. The first set of solutions investigates widening I-75 to accommodate the existing and future projected traffic volume. The second set of solutions examines widening parallel arterial routes or constructing new roadway alternatives within the I-75 corridor to effectively divert traffic from I-75.

2.1 Roadway Capacity

This set of potential improvements consists of widening segments of I-75 to accommodate the forecasted 2030 traffic volumes. Improvements made to these segments are intended to increase capacity and improve the level of service (LOS) along I-75 to a minimum of "D" in rural areas and "E" in urban areas based on results from TDOT's Statewide Model and the urban area models. All of these models were evaluated using the existing plus committed (E+C) highway network as the base line with the potential solutions added for evaluation of the effectiveness of the solutions. Committed projects are identified in the Assessment of Deficiencies Memorandum.

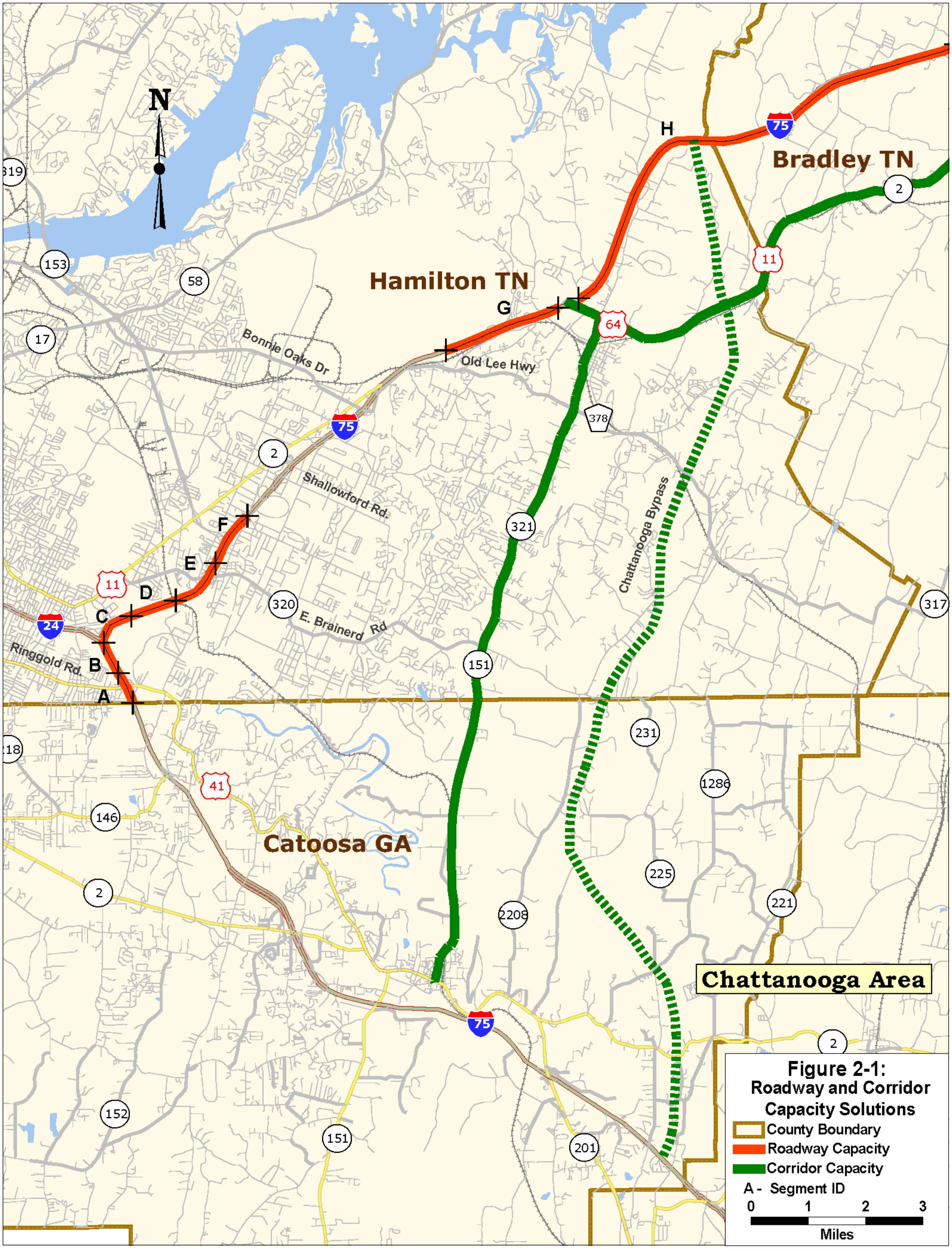
In conducting the analysis of potential alternatives, adjustments were made to the models to reflect programmed facility widening and future planned corridors were added or removed from the network as necessary. Adjustments were made to the external trip estimates on I-75 for the urban area models to achieve consistency with future year forecasts based on the Statewide Model. **Table 2-1** summarizes the segments of I-75 that are proposed to be potentially widened. **Figures 2-1** through **2-7** show the location of these capacity improvements.

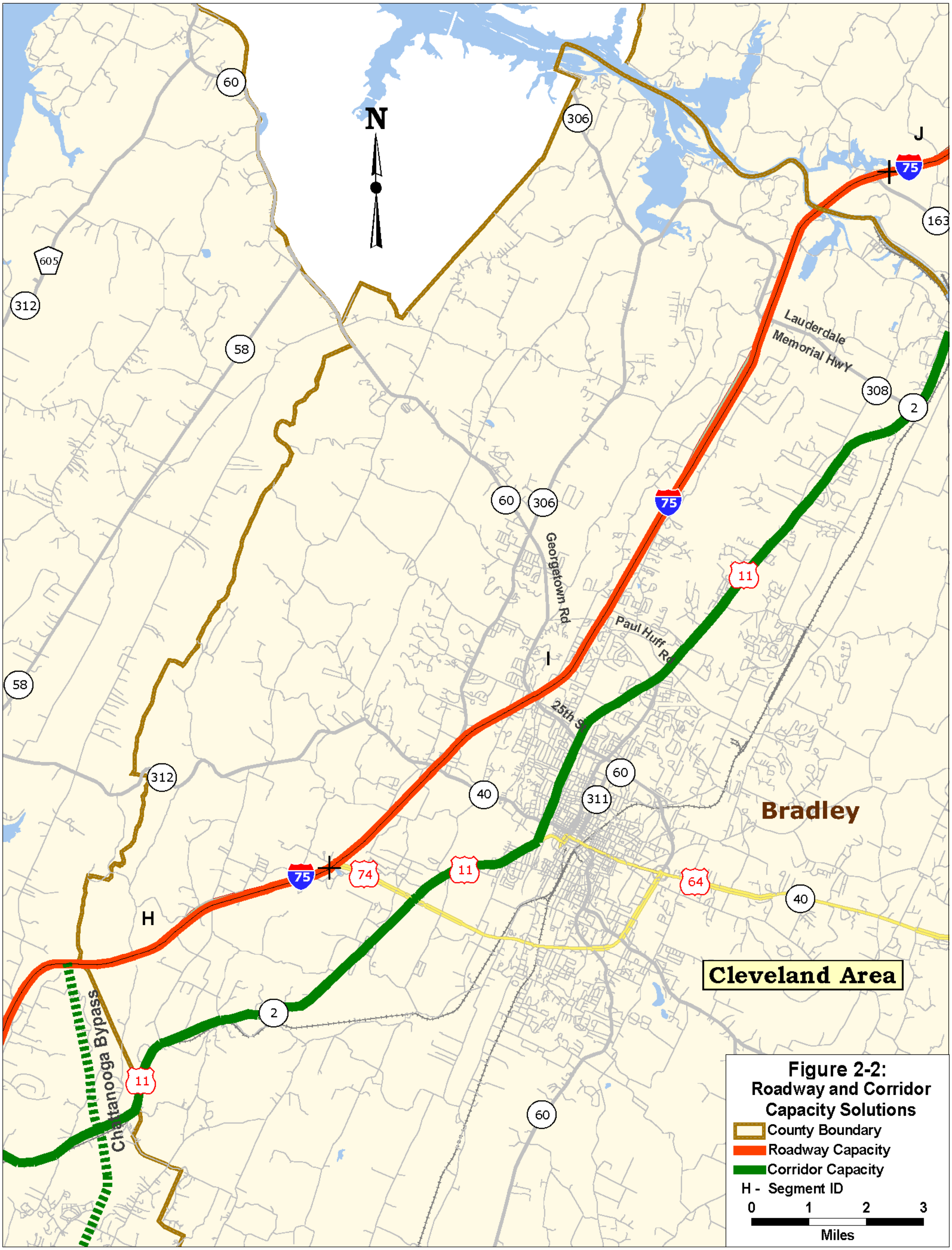
Table 2-1: Roadway Capacity "Package" of Solutions

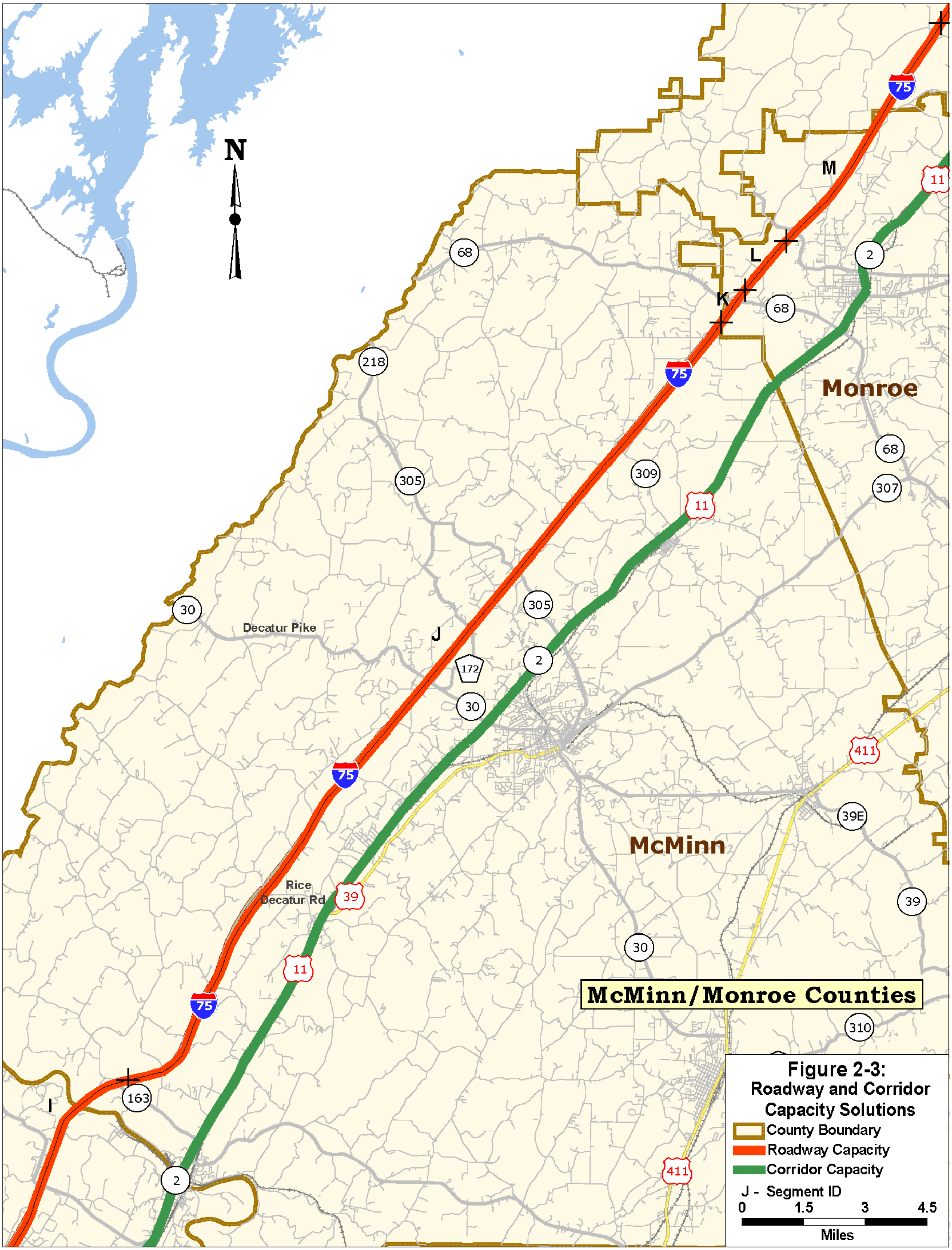
Region	Segment ID	Solution or Project
Hamilton County	A	Widen from 6 lanes to 8 lane from the Georgia State Line to Ringgold Road
	B	Widen from 8 lanes to 10 lanes from Ringgold Road to the I-24/I-75 Junction
	C	Improve the I-75/I-24 Interchange to provide three lanes for the I-75 movements through the interchange
	D, E	Widen from 8 lanes to 10 lanes from the I-24/I-75 junction to East Brainerd Road (SR 320)
	F	Widen southbound I-75 to 4 lanes from East Brainerd Road to SR 153

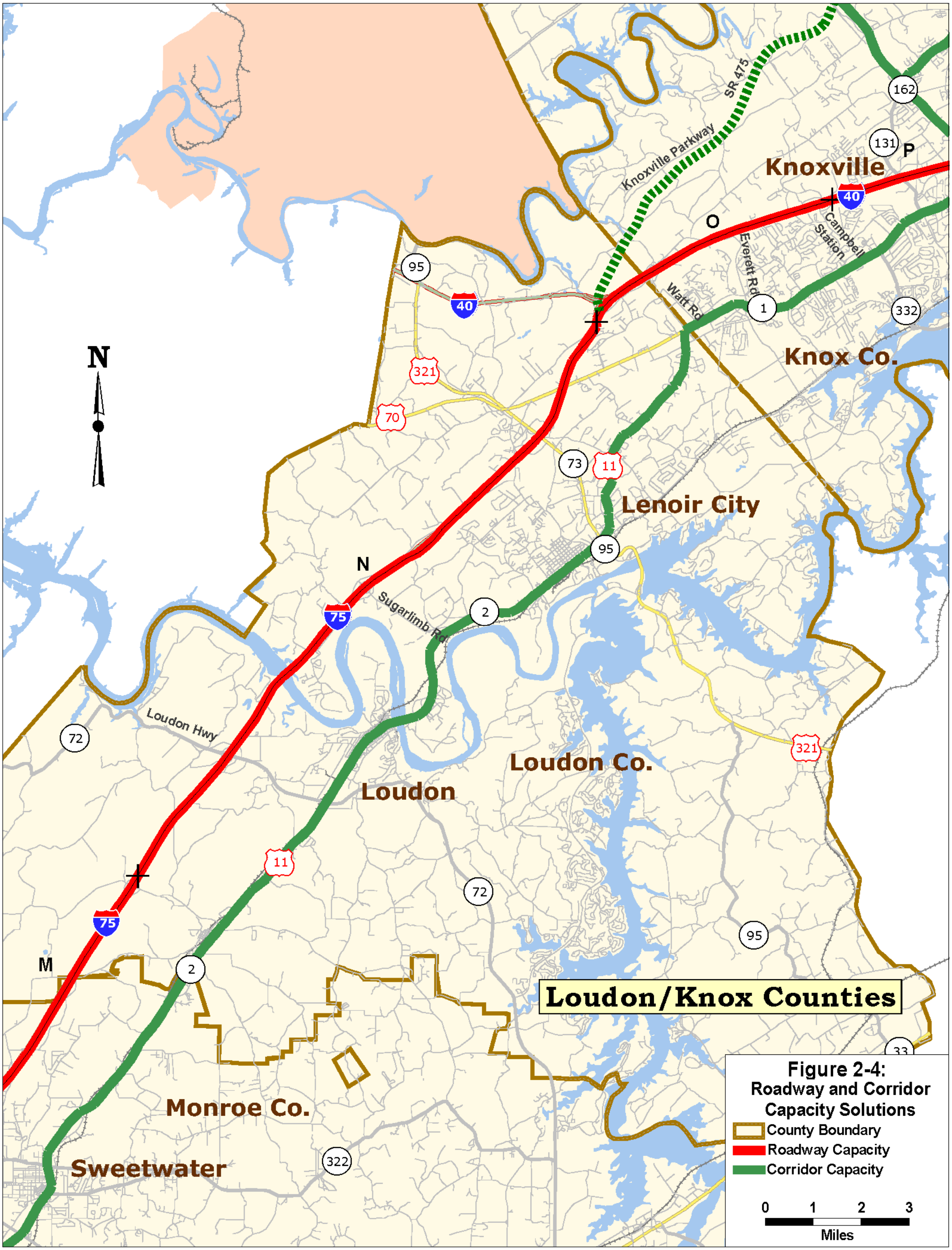
Table 2-1: Roadway Capacity "Package" of Solutions (cont.)

Region	Segment ID	Solution or Project
Hamilton County	G	Widen I-75 from 6 lanes to 8 lanes from Volunteer Ordnance Road to just south of US 64
Hamilton/ Bradley County	H	Widen I-75 from 4 lanes to 6 lanes from north of US 64 to US 74
Bradley County	I	Widen I-75 from 4 lanes to 6 lanes from US 74 to SR 163
McMinn County	J	Widen I-75 from 4 lanes to 6 lanes from SR 163 to SR 68
Monroe County	K, L, M	Widen I-75 from 4 lanes to 6 lanes from SR 68 to Pond Creek Road (SR 323)
Loudon County	N	Widen I-75 from 4 lanes to 6 lanes from Pond Creek Road (SR 323) to the I-40/I-75 Junction
Knox County	O	Improve Interchange to provide 3 through lanes for I-75
	O, P	Widen I-75 from 6 lanes to 10 lanes from the I-40/I-75 east to Pellissippi Parkway (SR 162)
	Q, R, S	Widen I-75 from 8 lanes to 10 lanes from Pellissippi Parkway (SR 162) to the I-40/I-75/I-640 Junction
	T	Improve the I-75/I-40 Interchange to provide three through lanes on I-75
	U	Improve the I-75/I-640/I-275 Interchange to provide 2 through lanes for I-75
	V	Widen I-75 from 6 lanes to 8 lanes from the I-75/I-640/I-275 Junction to Emory Road (SR 131)
	W	Widen I-75 from 4 lanes to 6 lanes from Emory Road (SR 131) to Raccoon Valley Road (SR 170)
Anderson County	X	Widen I-75 from 4 lanes to 6 lanes from Raccoon Valley Road (SR 170) to Andersonville Hwy (SR 61)
	Y	Widen I-75 from 4 lanes to 6 lanes from Andersonville Hwy (SR 61) to Cherry Bottom Road (SR 116)
Campbell County	Z, AA	Widen I-75 from 4 lanes to 6 lanes from Cherry Bottom Road (SR 116) to SR 63 (US 25W)

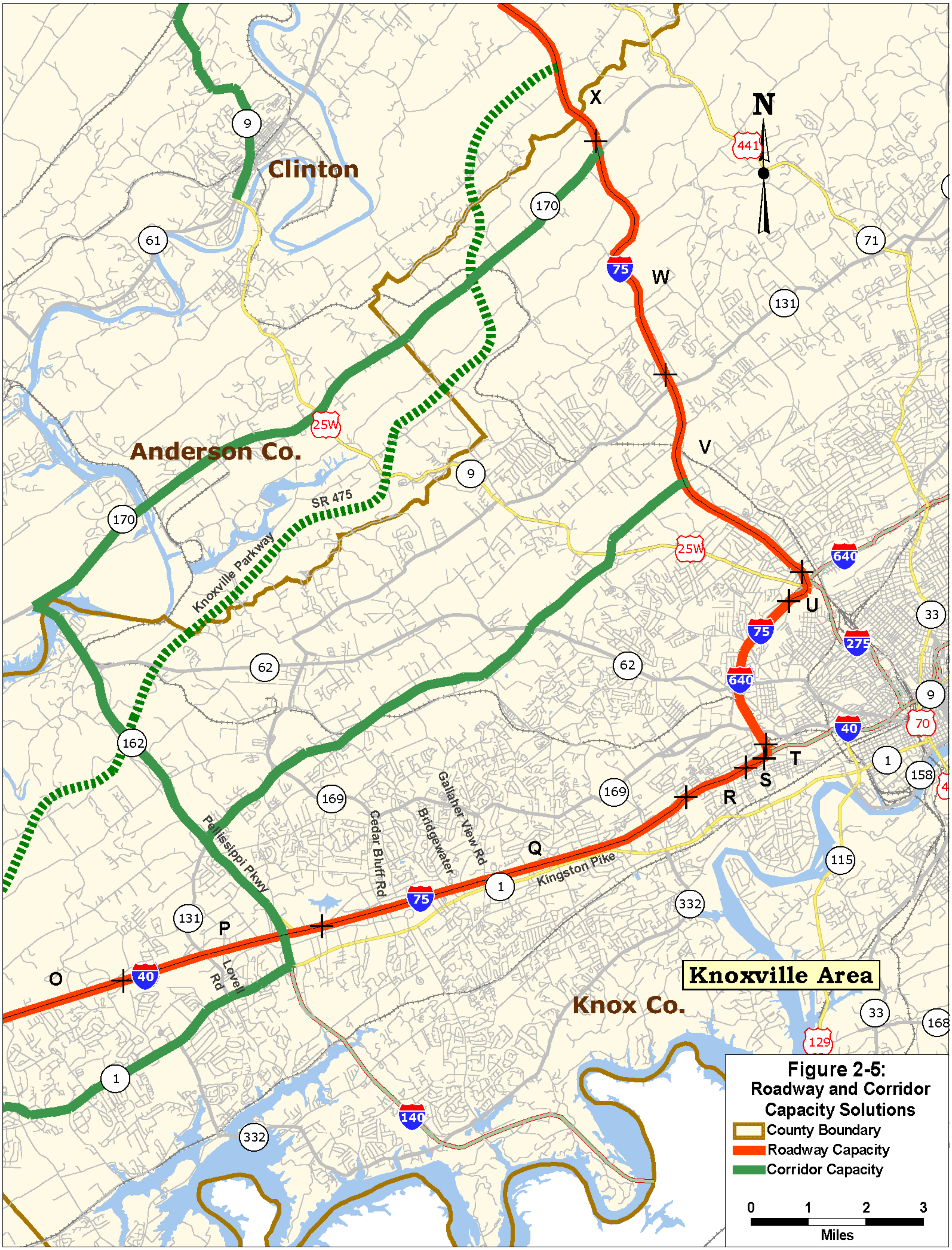

N
Hamilton TN
Bradley TN
Catoosa GA
Chattanooga Area
Bonnie Oaks Dr
Old Lee Hwy
Shallowford Rd.
E. Brainerd Rd
Ringgold Rd.
Chattanooga Bypass
A
B
C
D
E
F
G
H
Figure 2-1:
Roadway and Corridor
Capacity Solutions
County Boundary
Roadway Capacity
Corridor Capacity
A - Segment ID
0 1 2 3
Miles


N
J
H
I
Bradley
Cleveland Area
Lauderdale Memorial HwY
Georgetown Rd
Paul Huff Rd
25th St
Chattanooga Bypass
75
74
11
64
60
306
163
605
312
58
308
2
40
311
Figure 2-2:
Roadway and Corridor Capacity Solutions
County Boundary
Roadway Capacity
Corridor Capacity
H - Segment ID
0
1
2
3
Miles


N
M
L
K
J
I
Monroe
McMinn
Decatur Pike
Rice
Decatur Rd
McMinn/Monroe Counties
Figure 2-3:
Roadway and Corridor
Capacity Solutions
County Boundary
Roadway Capacity
Corridor Capacity
J - Segment ID
0 1.5 3 4.5
Miles



Knoxville
Knox Co.
Lenoir City
Loudon Co.
Loudon
Monroe Co.
Sweetwater
Loudon/Knox Counties
Knoxville Parkway
SR 475
Everett Rd
Campbell Station
Watt Rd
Sugarlimb Rd
Loudon Hwy
N
O
P
M
N
Figure 2-4:
Roadway and Corridor
Capacity Solutions
County Boundary
Roadway Capacity
Corridor Capacity
0 1 2 3
Miles


Clinton
Anderson Co.
Knox Co.
Knoxville Area
N
SR 475
Knoxville Parkway
Pellissippi Pkwy
Lovell Rd
Cedar Bluff Rd
Bridgewater
Gallaher View Rd
Kingston Pike
O
P
Q
R
S
T
U
V
W
X
Figure 2-5:
Roadway and Corridor
Capacity Solutions
County Boundary
Roadway Capacity
Corridor Capacity
0
1
2
3
Miles

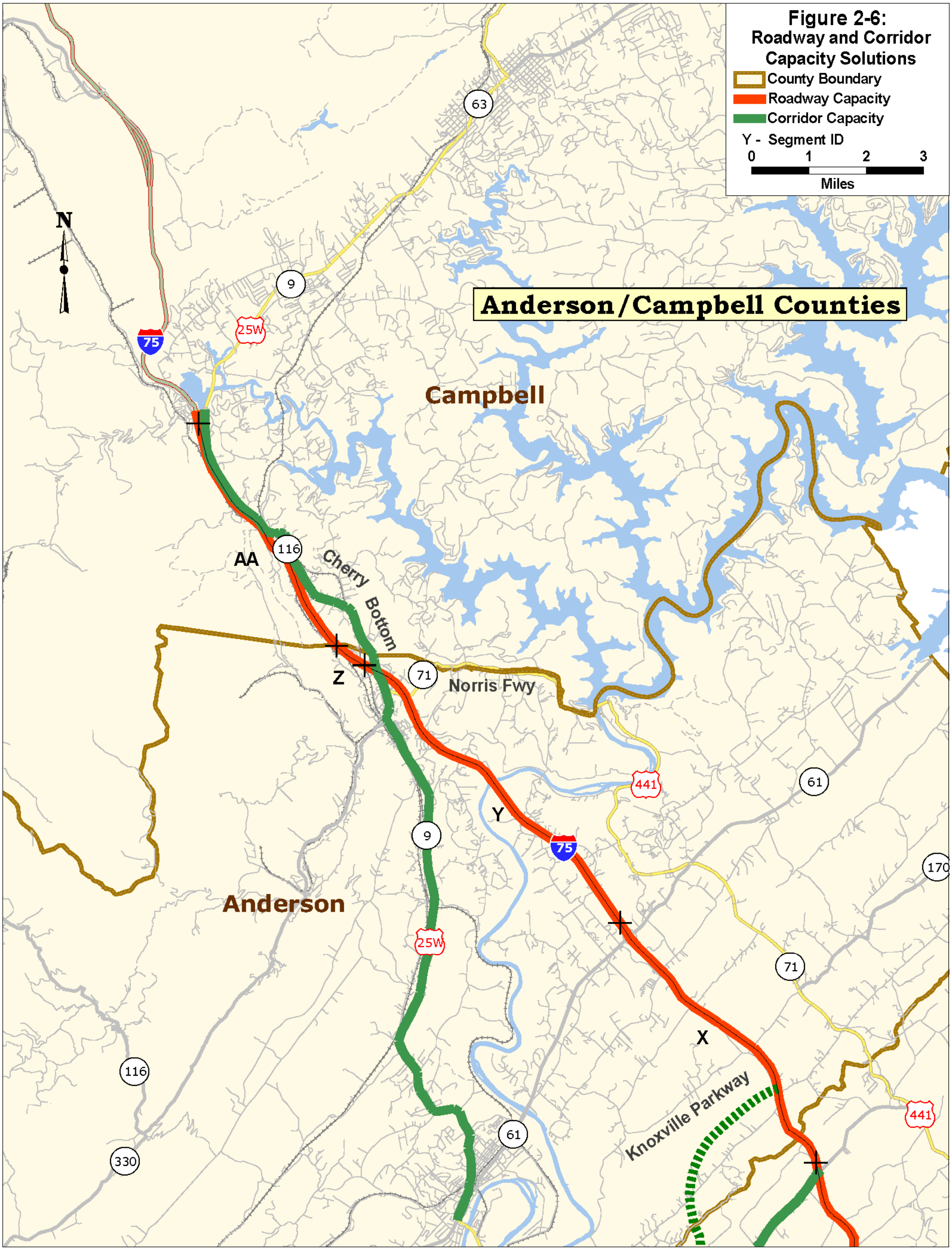
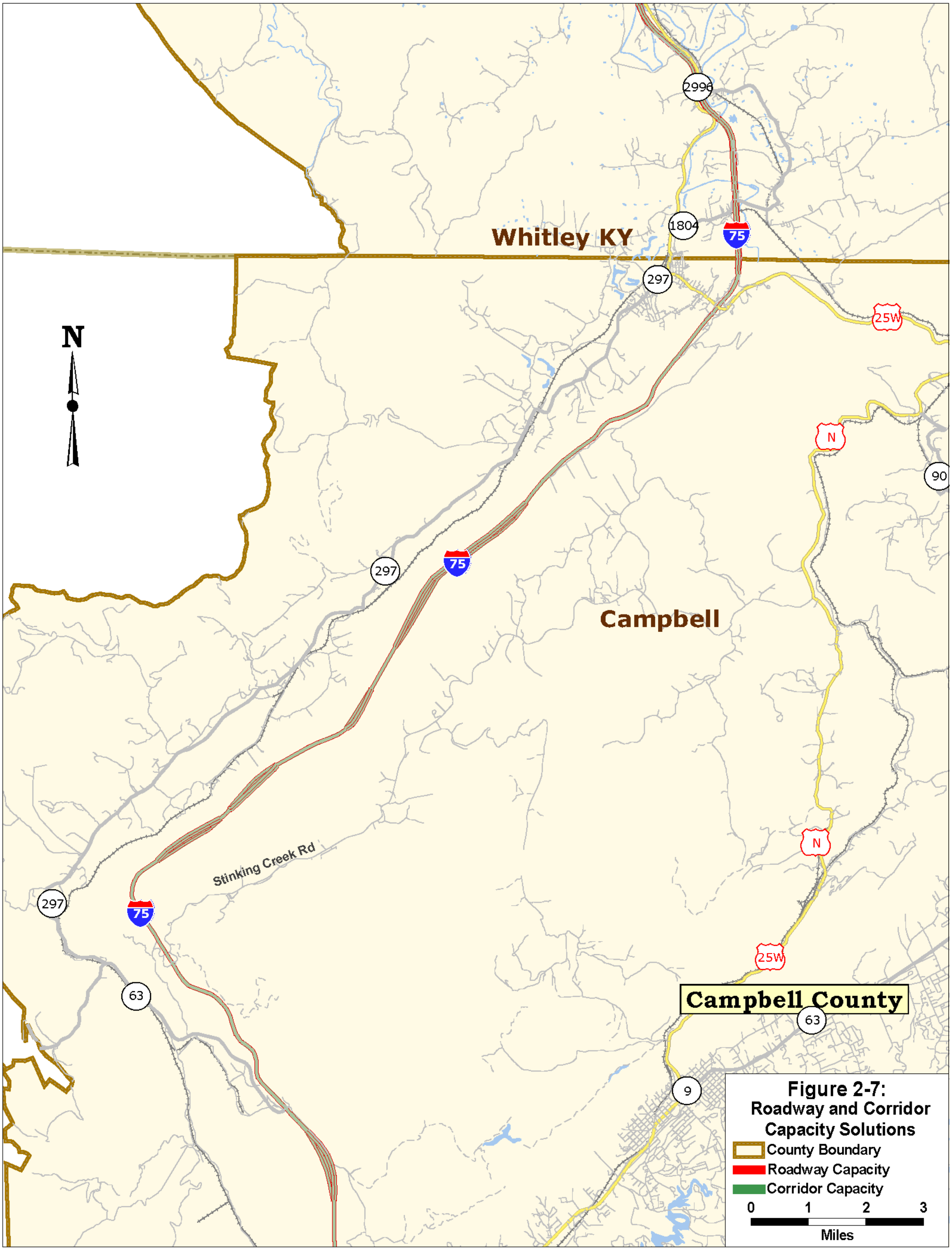


Figure 2-6:
Roadway and Corridor Capacity Solutions
County Boundary
Roadway Capacity
Corridor Capacity
Y - Segment ID
0
1
2
3
Miles
N
Anderson/Campbell Counties
Campbell
Anderson
AA
Z
Y
X
Cherry Bottom
Norris Fwy
Knoxville Parkway
75
25W
9
63
116
71
441
61
170
330


Whitley KY
Campbell
Campbell County
Stinking Creek Rd
N
2996
1804
297
75
25W
90
63
9
Figure 2-7:
Roadway and Corridor Capacity Solutions
County Boundary
Roadway Capacity
Corridor Capacity
0
1
2
3
Miles

2.1.1 Constructability

The widening of I-75 to accommodate future traffic volumes was reviewed to determine the feasibility of constructing additional lanes based on a visual assessment of the route and construction cost. The visual assessment was conducted using the Tennessee Roadway Information Management System (TRIMS) database. Segments of I-75 that may require extensive earthwork were identified by noting segments with steep side slopes and guardrail. Divided segments of I-75 were reviewed to determine potential constraints related to widening in the existing median. Locations with limited right of way or barrier separated segments were also noted.

The details of the constructability assessment are provided in **Appendix B**. The appendix includes images that were extracted from the TRIMS database and reflect the typical issues that are anticipated for widening the segment. The segments are noted by county log mile (LM) as used in the TRIMS database.

2.1.2 Construction Cost Estimates

Construction costs for additional lanes and operational improvements on I-75 were estimated using the cost data shown in **Table 2-2**. These unit costs are based on average costs for similar projects provided by the TDOT Long Range Planning Division and on experience with similar projects by the planning team. The base cost values shown in the table were adjusted for use on those segments of I-75 where proposed widening differs from the standard two lanes.

Table 2-2 – Roadway Capacity Improvement Cost Estimate Factors

Right of Way	**Base Per Mile Right of Way Cost**	**$850,000**
	Right of Way Factor	
	Area Type	Factor
	Central Business District, Urbanized	12.50
	Commercial	3.25
	Fringe (Mixed Residential/Commercial)	1.75
	Residential	1.75
	Rural	1.00
Construction	**Base Per Mile Construction Cost**	**$2,700,000**
	Terrain Factor	
	Area Type	Factor
	Flat	1.00
	Rolling	1.30
	Mountainous	2.30
	Major River Crossing	$16,500,000
	Bridges (Overpass, Underpass)	$4,000,000
	Interchanges	$8,000,000
	Major Interstate interchange	$12,000,000
	Constructability Cost	$10,000,000
Engineering	Preliminary Engineering Cost (% of Const. Cost)	10%

Because the costs of right-of-way acquisition and road construction vary with on adjacent land use and terrain, information from the TRIMS database was used to divide the proposed widening projects into segments with consistent adjacent land use and terrain conditions. Right-of-way costs were calculated for those portions of each segment where the presence of median barrier indicates that additional traffic lanes or shoulder width cannot be constructed within the existing median. The cost of right-of-way was estimated by multiplying the length of segment with median barrier by the per-mile base right-of-way cost and by a land use factor reflecting the cost premium of various adjacent land use types.

Construction costs for each segment were calculated by multiplying the per-mile base construction cost by the length of the segment and by a terrain factor to account for the additional costs of construction in rolling or mountainous terrain. The cost of each major structure and interchange modification on the segment was then added to the construction cost. An additional construction cost premium of $10 million per mile was applied to the segments with constructability constraints identified in Section 2.1.1. Preliminary engineering costs were estimated at 10% of the segment construction costs. The total estimated costs are provided in **Table 2-3**.

2.1.3 Environmental Review

An environmental review of the capacity improvements associated with widening on I-75 was conducted based upon available literature and databases. This environmental review is a high level “red flag” review that highlights potential environmental concerns. These environmental constraints included wetlands, schools, historic sites, churches, and air quality or noise issues that would be impacted by the widening of I-75. Identification of these issues was based upon current available databases.

The environmental constraints that were investigated for this review were those determined to be within a 500 foot buffer zone of I-75. A list of these locations can be found in **Appendix E**. This list was compared to the roadway capacity improvements to determine locations with a potential conflict.

The environmental review revealed a number of environmental issues that would need to be addressed for individual projects that are identified as part of this feasibility study. No environmental issues that may stop a project have been identified as part of this high level review. As federal funding will be used for any interstate widening project, an environmental impact assessment in conformance with the National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) will be required for I-75 widening projects pursued following this study.

2.2 Corridor Capacity

This set or package of potential solutions consist of the possibility of widening or constructing parallel routes to I-75 that would serve as an alternative to I-75, rather than widening existing I-75. Increased capacity of the parallel routes or providing new alternative corridors may serve to divert trips from I-75 and thereby reduce the congestion along the study corridor. The corridor capacity package of solutions has two distinct types of improvements; widening existing parallel arterials, and constructing parallel facilities on new alignment. The projects identified in the corridor capacity package of solutions are shown in **Figures 2-1** through **2-7**. **Table 2-4** lists each corridor capacity solution. The solid green lines shown in the figures represent improvements to existing routes, and the dashed green lines represent routes on new alignment.

Table 2-3: Estimated Construction Costs By Segment for Widening I-75

(All Costs are in Thousands of Current Year Dollars)

Figure	ID	Begin and End Log Mile		County	Length (mi.)	R.O.W. Cost	Road Const. Cost	Inter-changes	Major Structures	Constraints Cost	Preliminary Engineering Cost	Total Segment Cost
2-1	A	0.0	0.6	Hamilton	0.58	$1,600	$1,565	$8,000	$0	$1,160	$1,075	$13,400
2-1	B	0.6	1.2	Hamilton	0.58	$360	$1,565	$0	$0	$0	$155	$2,080
2-1	C	1.2	1.9	Hamilton	0.74	$385	$2,110	$12,000	$12,000	$960	$2,705	$30,165
2-1	D	1.9	2.7	Hamilton	0.82	$1,220	$2,880	$0	$20,500	$1,640	$2,500	$28,740
2-1	E	2.7	3.7	Hamilton	0.99	$2,735	$3,475	$8,000	$0	$1,980	$1,345	$17,535
2-1	F	3.7	4.7	Hamilton	1.00	$745	$1,755	$14,000	$16,000	$5,000	$3,675	$41,175
2-1	G	9.3	11.4	Hamilton	2.09	$1,775	$7,335	$0	$4,000	$5,225	$1,655	$19,995
2-1, 2-2	H	11.8	20.3	Hamilton/ Bradley	8.58	$3,485	$30,115	$8,000	$8,000	$25,740	$7,185	$82,525
2-2	I	20.3	36.4	Bradley/ McMinn	16.02	$0	$56,230	$40,000	$52,500	$16,020	$16,475	$181,225
2-3	J	36.4	60.0	McMinn	23.61	$0	$82,870	$32,000	$96,000	$11,805	$22,270	$244,945
2-3	K	60.0	61.0	Monroe	0.98	$0	$3,440	$8,000	$0	$0	$1,145	$12,585
2-3	L	61.0	62.5	Monroe	1.55	$0	$5,440	$0	$0	$0	$545	$5,985
2-3	M	62.5	69.0	Monroe/ Loudon	6.52	$0	$22,885	$16,000	$12,000	$0	$5,090	$55,975
2-4	N	69.0	84.4	Loudon	15.33	$0	$53,810	$24,000	$72,500	$7,665	$15,795	$173,770
2-4	O	84.4	90.0	Loudon/ Knox	5.66	$9,535	$39,560	$28,000	$8,000	$45,380	$12,095	$142,570
2-4, 2-5	P	90.0	93.6	Knox	3.57	$19,725	$25,060	$20,000	$4,000	$35,700	$8,475	$112,960
2-5	Q	93.6	100.3	Knox	6.74	$18,620	$23,655	$48,000	$32,000	$67,400	$17,105	$206,780
2-5	R	100.3	101.5	Knox	1.16	$1,725	$4,070	$0	$4,000	$11,600	$1,965	$23,365
2-5	S	101.5	101.8	Knox	0.36	$995	$1,265	$12,000	$4,000	$3,600	$2,085	$23,945
2-5	T	101.8	102.1	Knox	0.26	$0	$915	$12,000	$0	$2,600	$1,550	$17,065
2-5	U	105.0	105.7	Knox	0.70	$1,935	$2,455	$20,000	$20,000	$7,000	$4,945	$56,335
2-5	V	105.7	110.3	Knox	4.56	$12,595	$16,005	$24,000	$28,000	$36,480	$10,450	$127,530
2-5	W	110.3	115.0	Knox	4.69	$3,025	$16,460	$8,000	$20,000	$28,140	$7,260	$82,885
2-6	X	115.0	120.6	Knox/ Anderson	5.58	$880	$19,590	$8,000	$28,000	$5,580	$6,120	$68,160
2-6	Y	120.6	127.0	Anderson	6.48	$0	$22,745	$24,000	$48,500	$6,480	$10,170	$111,895
2-6	Z	127.0	127.6	Anderson	0.60	$0	$2,105	$0	$8,000	$0	$1,010	$11,115
2-6	AA	127.6	132.3	Campbell	4.62	$415	$32,760	$16,000	$28,000	$20,800	$9,755	$107,735
				Total	117.97	$81,755	$482,120	$390,000	$526,000	$347,955	$174,600	$2,002,440

Table 2-4: Corridor Capacity Package of Solutions

Region	Route	Project Limits and Description
Chattanooga	SR 321/ GA 240	Widen route from 2 lanes to four lanes from US 41/US 76 in Ringgold, Georgia to US 64 in Tennessee.
Chattanooga	Chattanooga Bypass	Construct new 4 lane fully access-controlled facility from I-75 in Georgia to I-75 at the Hamilton/Bradley County Line.
Chattanooga/ Cleveland	US 64/US 11	Widen from 4 to 6 lanes from Little Debbie Parkway to just east of SR 317. Widen from 2 to 4 lanes from east of SR 317 to US 74.
Cleveland	US 11	Widen from 5 to 7 lanes from US 74 to Pleasant Grove Road. Widen from 4 to 6 lanes from Pleasant Grove Place to Boyd Street. Widen from 5 to 7 lanes from Boyd Street to SR 40 (South Lee Highway). Widen from 4 to 6 lanes from SR 40 (Lee Highway) to Paul Huff Parkway. Widen from 5 to 7 lanes from Paul Huff Parkway to Anatole Lane. Widen from 2 to 4 lanes from Anatole Lane to SR 308 (Lauderdale Memorial Highway).
McMinn County	US 11	Widen route from 2 to 4 lanes from SR 308 to Market Street/Newport Street in Charleston. Widen from 3 to 5 lanes from Market/Newport Street to just north of the Hiwassee River. Widen from 2 to 4 lanes from the Hiwassee River to SR 39.
McMinn County	US 11	Widen route from 2 to 4 lanes from McMinn County Road 260 to SR 68.
Monroe County	US 11	Widen route from 3 to 5 lanes from SR 68 to SR 322. Widen from 2 to 4 lanes from SR 322 to SR 72.
Loudon County	US 11	Widen route from 2 to 4 lanes from SR 72 to N Street in Lenoir City. Widen from 2 to 4 lanes from Magnolia Street/Monument Street to US 70.
Knox County	US 70	Widen route from 5 to 7 lanes from US 11 to I-140.
Knoxville	SR 162 and SR 62	Widen from 4 lanes divided to 6 lanes and reconstruct intersections to provide full access control along SR 162 from Lovell Road to SR 62. Widen existing 4 lane divided on SR 62 to 6 lanes.
Knoxville	SR 131 to Ball Camp Pike to Schaad Road to Callahan Drive	Widen SR 131 from SR 162 to Middlebrook Pike and construct a new 800 foot connector route to Ball Camp Pike. Widen Ball Camp Pike from 2 to 4 lanes from Middlebrook Pike to Ball Road. Widen Ball Road from Ball Camp Pike to SR 62. Widen SR 62 from Ball Road to Schaad Road. Widen Schaad Road from SR 162 to Pleasant Ridge Road. Widen existing Callahan Drive from 4 lane divided/5 lanes to 6 lanes and 7 lanes from Pleasant Ridge Road to I-75.
Knox County	Knoxville Parkway	Construct new 4 lane access-controlled facility from the I-40/I-75 junction to I-75 in Anderson County.
Anderson County	SR 170	Widen route from 2 lanes to 4 lanes from SR 62 to I-75.
Anderson County	US 25W	Widen from 2 to 4 lanes from SR 61 to Landrum Road. Widen from 2 to 4 lanes from Old Cane Creek Road/Shaw Lane to Hill Street/Mason Avenue.
Campbell County	SR 116	Widen route from 2 to 4 lanes from I-75 to Howard Baker Road (US 25W/SR 63).

*Although evaluated as part of this study, the selected alternative from the Knoxville Parkway Environmental Impact Statement was the “No-Build” alternative, announced on June 25, 2010.

The construction costs for corridor capacity improvement projects were estimated using a method similar to that used for widening projects on I-75. Unit cost data used for corridor capacity improvements is shown in **Table 2-5**. These unit costs are based on average cost information provided by the TDOT Long Range Planning Division and on experience with similar projects by the planning team. The cost estimate for the Knoxville Parkway project was provided by the TDOT Construction Division.

Per-mile right-of-way and construction costs were developed assuming that new and widened arterials would have a center median. A constructability premium was added to the cost of some projects with difficult construction conditions such as heavy traffic conditions or remote location. Preliminary engineering costs were estimated at 10% of the segment construction costs. The total estimated costs are provided in **Table 2-5**.

Table 2-5: Corridor Capacity Improvement Cost Estimate Factors

Right of Way	**Base Per Mile Right of Way Cost**	
	Widen Arterial to provide 2 additional lanes	$650,000
	New Four Lane Limited-Access Freeway	$1,100,000
	Right of Way Factor	
	Area Type	Factor
	Central Business District, Urbanized	12.50
	Commercial	10.00
	Fringe (Mixed Residential/Commercial)	4.00
	Residential	1.75
	Rural	1.00
Construction	**Base Per Mile Construction Cost**	
	Widen Arterial to provide 2 additional lanes	$4,000,000
	New Four Lane Limited-Access Freeway	$6,000,000
	Terrain Factor	
	Area Type	Factor
	Flat	1.00
	Rolling	1.30
	Mountainous	2.30
	Major River Crossing	$16,500,000
	Bridges (Overpass, Underpass)	$4,000,000
	Interchange Widening	$15,000,000
	New Interchange	$30,000,000
	Intersection Reconstruction	$350,000
	Railroad Crossing Grade Separation	$5,000,000
	Constructability Cost (% of Construction)	Varies
Preliminary Engineering	Preliminary Engineering Cost (Percent of Construction Cost)	10%

Table 2-6: Estimated Construction Costs by Segment for Corridor Capacity Solutions
(All Costs are in Thousands of Current Year Dollars)

Figure	Route	Project Limits	R.O.W. Cost	Road Const. Cost	Intersections	Major Structures	Construct-ability Premium	Preliminary Engineering Cost	Total Project Cost
2-1	SR 321 / GA 151	US 41/US 76 in Ringgold, GA to US 64 in TN	$17,140	$55,890	$1,750	$8,000	$0	$6,565	$89,345
2-1	Chattanooga Bypass	I-75 in GA to I-75 at Hamilton/Bradley County Line	$35,555	$178,320	$105,000	$60,000	$0	$34,330	$413,210
2-1, 2-2	US 64 / US 11	I-75 Exit 11 to US 74 south of Cleveland	$18,990	$47,795	$700	$4,000	$0	$5,250	$76,735
2-1	SR 321	NS Railroad near Ooltewah	$1,820	$1,600	$0	$5,000	$0	$660	$9,080
2-2	US 11	US 74 to SR 308	$35,635	$59,845	$1,750	$8,000	$1,390	$7,100	$113,725
2-3	US 11	SR 308 to SR 30	$20,020	$41,905	$0	$0	$0	$5,840	$84,270
2-3	US 11	SR 30 to SR 68	$21,870	$41,720	$350	$0	$0	$4,205	$68,145
2-3, 2-4	US 11	SR 68 to SR 72	$22,535	$51,890	$1,400	$4,000	$0	$5,730	$85,550
2-4	US 11	SR 72 to US 70	$33,410	$55,570	$700	$0	$0	$7,275	$113,455
2-4, 2-5	US 70	US 11 to I-140	$31,140	$31,465	$1,400	$0	$0	$3,285	$67,290
2-5	SR 162 and SR 62	US 70 to SR 170	$30,360	$34,575	$105,000	$12,000	$0	$16,805	$215,240
2-5	SR 131/Ball Camp Pk./ Schaad Rd. /Callahan Dr.	SR 162 to I-75	$24,160	$47,175	$2,450	$8,000	$0	$5,765	$87,550
2-4, 2-5	Knoxville Parkway / SR 475	I-40/I-75 junction to I-75 in Anderson County	$54,050	N/A	N/A	N/A	N/A	$53,020	$637,290
2-5	SR 131 (Emory Rd)	NS Railroad near Powell	$1,545	$1,600	$0	$5,000	$660	$725	$9,535
2-4	SR 170	SR 62 to I-75	$25,885	$59,295	$700	$5,000	$1,630	$8,310	$117,320
2-4, 2-5	US 25W	SR 61 to SR 116	$25,685	$66,455	$700	$0	$1,345	$6,850	$101,035
2-5	US 25W	SR 116 to Howard Baker Road (SR 63)	$12,460	$41,975	$700	$4,000	$935	$4,760	$64,830
		Total	$412,260	$817,075	$222,600	$123,000	$5,960	$176,475	$2,353,605

Knoxville Parkway costs provided by TDOT Construction Division from February 2006 cost estimate.

3.0 OPERATIONS AND SAFETY

Improvements to I-75 related to operations and safety were developed based on the deficiencies analysis performed as part of this study. The operations and safety package of potential solutions is made up of roadway, bridge, interchange and ramp improvements; intelligent transportation systems and HELP program enhancements; truck climbing lanes; park and ride facilities; and managed lanes, such as high occupancy vehicle lanes. Of the five potential groups of packages of solutions, the operations and safety package has the widest range of solutions.

The operations and safety related improvements were developed for each solution based on the methodology described in each section of this chapter. Stakeholder interviews and the information obtained in the public meetings during the deficiencies analysis were critical in the development of the potential solutions. Stakeholder interviews or meetings were conducted with the following agencies or groups:

- Tennessee Department of Transportation – Regions 1 and 2
    - Operations and Maintenance
    - Incident Management
    - Construction
    - Safety
- Tennessee Department of Safety – Regions 1 and 2
    - Tennessee Highway Patrol
- Rural, Metropolitan and Transportation Planning Organizations (RPO, MPO and TPO)
    - Chattanooga MPO
    - Cleveland MPO
    - Knoxville TPO
    - East Tennessee North RPO
    - East Tennessee South RPO
- Transit Agencies
    - Chattanooga Area Transit Authority
    - Knoxville Transit Authority
- Army Corps of Engineers

3.1 Roadway, Interchange, and Ramp Improvements

The need for geometric improvements, as well as interchange and ramp improvements along I-75 were based on a review of the crash data, the Tennessee Roadway Information Management System (TRIMS) database, the TRIMS photolog, aerial photography along the route, visual alignment reviews, stakeholder interviews, and comments received from the public. Based on the need, initial solutions were developed to address operations and safety issues of selected roadway segments, interchanges, rest areas, and weigh station along I-75. A listing of the location, type of deficiency and, if applicable, the potential solutions are provided in **Table 3-1**. Conceptual designs for interchange improvements are provided in **Appendix C**.

Table 3-1: Operational Improvements for Roadway, Interchanges, Rest Areas, and Weigh Stations

Region/County	Location	Deficiency	Solution or Project
Chattanooga	I-75 from Ringgold Road to just north of the Tennessee Welcome Center	Inadequate inside shoulder width	Widen inside shoulder to 14'
Chattanooga	I-75 from Big Springs Creek just south of the I-75/I-24 Interchange	Bridge Condition - Structural	Monitor
Chattanooga	I-75 from Ringgold Road to I-24W	Insufficient weave distance/ramp spacing	NA
Chattanooga	I-75 at I-24 Interchange	Insufficient superelevation transitions along ramps and insufficient weaving length north of interchange	Reconstruct interchange
Chattanooga	I-75 just north of I-24 Interchange to north of Lee Hwy	Inadequate inside shoulder width	Widen inside shoulder to 14'
Hamilton Co.	I-75 north of Ooltewah Georgetown Road to north of the Hamilton/Bradley County Line	Inadequate inside shoulder width	Widen inside shoulder to 10'
Bradley Co.	Scenic Overlook at the Hamilton/Bradley County Line on southbound I-75	Inadequate deceleration and acceleration lanes	Lengthen acceleration and deceleration lanes
Bradley Co.	I-75 Northbound Exit Ramp at Georgetown Road (SR 60)	Inadequate deceleration lane for northbound I-75 exit ramp, and inadequate traffic control.	Lengthen NB exit ramp decel lane and install a traffic signal for the NB I-75 ramp terminals at SR 60
Loudon Co.	I-75 at the Tennessee River Bridge	Inadequate shoulder width	Widen inside shoulder to 10' and outside shoulder to 12'
Loudon Co.	I-75 just north of Hickory Creek Road	Inadequate distance for superelevation transition	NA
Loudon Co.	I-75 south of the Loudon/Knox County Line to the I-75/I-640/I-40 Interchange	Inadequate inside shoulder width	Widen inside shoulder to 14'
Knox Co.	Westbound I-40/I-75 between the I-40/I-75 Junction and Watt Road	Inadequate weaving distance	Widen WB I-40/I-75 from 3 -4 lanes
Knox Co.	I-75 from Gap Road to Emory Road	Inadequate inside shoulder width	Widen inside shoulder to 14'
Knox Co	I-40/I-75 Westbound from I-140 to Lovell Road	Inadequate capacity and weaving distance	Add full auxiliary lane westbound between interchanges
Knox Co	I-40/I-75 Weigh Stations	Inadequate on and off ramp length	Extend on and off ramps
Campbell Co.	I-75/US-441 to I-75/US-25W	Insufficient weave distance/ramp spacing	NA
Campbell Co.	I-75 at CSX underpass south of Vasper	Inadequate inside shoulder width	Widen inside shoulder to 10'
Campbell Co.	Butter and Eggs Road	Bridge Condition - Structural	Bridge Rehabilitation
Campbell Co.	SR 63	Bridge Condition - Structural	Bridge Replacement
Campbell Co.	Rarity Mountain Road to just south US-25W	Inadequate inside shoulder width	Widen inside shoulder to 10'
Jellico	I-75/US-25W Interchange in Jellico	Inadequate ramp radii for speeds and insufficient weaving distance for ramps	Reconstruct interchange

The construction costs for operational improvements to I-75, interchanges, rest areas, and weigh stations were estimated using a method similar to that used for widening projects on I-75. Unit cost data used for corridor capacity improvements is shown in **Table 3-2**. A constructability premium was added to the cost of some projects with difficult construction conditions such as heavy traffic conditions or remote location. Preliminary engineering costs were estimated at 10% of the segment construction costs. The total estimated costs are provided in **Table 3-3**.

Table 3-2: Operational Improvement Cost Estimate Factors

Right of Way	**Base Per Mile Right of Way Cost**	
	Widen Shoulder 4 feet or less	$280,000
	Widen Shoulder more than 4 feet	$850,000
	Right of Way Factor	
	Area Type	Factor
	Central Business District, Urbanized	12.50
	Commercial	10.00
	Fringe (Mixed Residential/Commercial)	4.00
	Residential	1.75
	Rural	1.00
Construction	**Base Per Mile Construction Cost**	
	Widen Shoulder 4 feet or less	$2,025,000
	Widen Shoulder more than 4 feet	$2,700,000
	Terrain Factor	
	Area Type	Factor
	Flat	1.00
	Rolling	1.30
	Mountainous	2.30
	Widen Major River Crossing	$16,500,000
	Modify Overpass/Underpass (per site)	$4,000,000
	Modify Interchanges	$15,000,000
	Modify Major Directional Interchanges	$30,000,000
	Rehabilitate/Replace Bridge (per structure)	$350,000
	Constructability Cost (% of Construction)	$10,000,000
Preliminary Engineering	Preliminary Engineering Cost (Percent of Construction Cost)	10%

Table 3-3: Estimated Construction Costs by Segment for I-75 Operational Improvements
(All Costs are in Thousands of Current Year Dollars)

Location	Project Description	R.O.W. Cost	Road Const. Cost	Inter-sections	Major Structures	Construct-ability Premium	Preliminary Engineering Cost	Total Project Cost
Ringgold Road to north of Tennessee Welcome Center	Widen inside shoulder to 14'	$1,930	$1,395	$0	$0	$690	$210	$4,225
Ringgold Road to East Brainerd Rd.	Reconstruct I-24/I-75 Interchange and weaving areas	$4,700	$10,030	$20,000	$32,500	$7,480	$7,000	$81,710
North of I-24 Interchange to north of Lee Highway	Widen inside shoulder to 14'	$4,955	$29,855	$60,000	$40,500	$11,340	$14,170	$160,820
Ooltewah Georgetown Rd to Bradley County Line	Widen inside shoulder to 10'	$2,345	$9,690	$0	$0	$2,760	$1,245	$16,040
Scenic overlook at Hamilton/Bradley County Line	Lengthen acceleration and deceleration lanes	$850	$3,510	$0	$0	$1,000	$450	$5,810
Northbound I-75 Exit Ramp at SR 60 (Georgetown Rd)	Ramp improvement & traffic signal	$50	$210	$0	$2,400	$0	$260	$2,920
At Tennessee River Bridge	Widen inside shoulder to 10' and outside shoulder to 12'	$280	$1,160	$0	$16,500	$330	$1,800	$20,070
South of Loudon/Knox County Line to I-40/I-75/I-640	Widen inside shoulder to 14'	$11,485	$42,515	$96,000	$28,000	$16,150	$18,265	$212,415
I-40/I-75 between the I-40/I-75 junction and Watt Road	Widen westbound I-40/I-75 from 3 to 4 lanes	$0	$1,240	$0	$0	$400	$165	$1,805
I-40/I-75 Weigh Stations - east of Watt Road	Extend the on and off ramps	$0	$630	$0	$0	$360	$100	$1,090
Gap Road to Emory Road	Widen inside shoulder to 14'	$13,735	$18,355	$52,000	$24,000	$5,230	$9,960	$123,280
At CSX underpass south of Vasper	Widen inside shoulder to 10'	$135	$2,280	$0	$4,000	$490	$675	$7,580
At Butter and Eggs Road	Bridge rehabilitation	$0	$0	$0	$8,000	$0	$800	$8,800
Northbound I-75 Exit Ramp at East Brainerd Rd	Relocate NB to EB ramp terminal 300' west.	$0	$450	$0	$0	$0	$45	$495
Westbound I-40/I-75 Exit Ramp at Lovell Rd	Additional ramp lane from I-140 to Lovell Rd	$0	$1,995	$0	$0	$0	$200	$2,195
Northbound I-75 Exit Ramp at Callahan Drive	Additional ramp lane	$0	$250	$0	$0	$0	$25	$275
	Total	$40,465	$123,565	$228,000	$155,900	$46,230	$55,370	$649,530

Some projects have overlapping limits. These will be adjusted when individual solutions are combined to form alternative solution sets.

3.1.1 Tennessee Ramp Queue Program

TDOT's Project Planning Division identified locations where queuing problems were prevalent as part of the state's Ramp Queue Program. Ramp locations were identified based on the following provisions:

1. Safety improvements would be proactive and would include widening ramps at intersections to provide additional storage; traffic signal upgrades; signing; additional Intelligent Transportation Systems; ramp metering; and relocating signal heads;
2. Each location will have a road safety audit which will be used to determine the depth of the safety issue;
3. Each location will receive the appropriate traffic analysis to determine congestion mitigation issues and solutions;
4. All projects will be within existing right of way which should result in categorical exclusions;
5. The Department will implement a cap of $2 million.

The following ramp locations within the I-75 study corridor were identified by the Project Planning Division for the Ramp Queue Program.

I-75, Exit 374-C at Lovell Road, Knox County (Region 1)
The westbound off ramp at Lovell Road is a single lane exit that widens to a three lane section at the ramp termini at Lovell Road. Increased westbound traffic volumes at the exit ramp to Lovell Road have resulted in extensive queue lengths along the ramp. The problem is made worse along westbound I-75 by the weaving volume between Pellississippi Parkway (I-140) and Lovell Road. As part of the Ramp Queue program, TDOT recommends construction of an "Exit Only" lane on I-40/I-75 from I-140 that ties into the off ramp to Lovell Road with widening of the off ramp to two lanes.

I-75, Exit 110A at Callahan Drive, Knox County (Region 1)
Existing conditions for this off-ramp at the intersection include one left turn lane and one right turn lane. Due to the heavy right turns during the peak hour and the inadequate capacity for storage, queuing will consistently back up onto I-75. TDOT recommends that the ramp be widened to accommodate dual left turn lanes and lengthen the right turn lane.

I-75, Exit 3 at East Brainerd Road, Hamilton County (Region 2)
This ramp becomes a right turn only lane for a signalized intersection, which is a short distance away to the east of the off-ramp. The majority of traffic from I-75 must merge into East Brainerd Road, conflicting with traffic trying to make a right turn at the signalized intersection. This heavy weave maneuver results in a high number of reported crashes at this ramp location. This ramp location has been reviewed as part of the Ramp Queue program / Road Safety Audit Review. As part of this Review, TDOT recommends realigning the ramp termini at East Brainerd Road, construction of a traffic signal, and widening the ramp to two lanes.

3.2 ITS and HELP Program Enhancements

Intelligent transportation system (ITS) is a term used to describe the use of advanced information technologies and management practices to improve the safety and operation of highways and other transportation modes. These technologies are usually delivered to regional transportation management centers (TMC) through combinations of fiber optic cables, digital transmission, high-level communication networks, remote and central processors, the Internet, leased communication circuitry, geographic information systems (GIS), and global positioning systems (GPS). This information is available to travelers through many other means, including roadside dynamic message signs (DMS), highway advisory radio (HAR), in-vehicle navigation, personal digital assistants (PDA's) and cellular telephones. Recommended expansion of ITS applications through the I-75 corridor study area falls into six (6) general categories of projects. These categories include the following:

Extension of SmartWay ITS instrumentation through the balance of Knoxville urban areas – TDOT currently has completed or has construction underway to provide SmartWay ITS throughout most of the urban areas within the I-75 corridor study area. However, two significant gaps in TDOT SmartWay urban coverage still exist in the Knoxville urban area. The southern segment of I-75/40 is missing from the ITS coverage from the Lovell Road (SR 131) interchange to the critical I-75/40 split. Additionally, another critical section is missing from north of Merchant Road to the northern Knoxville urban boundary at Emory Road (SR 131).

Deployment of a fog detection system on Jellico Mountain – Multiple stakeholders from both TDOT and the Tennessee Highway Patrol (THP) emphasized the need for a fog detection system on I-75 through Jellico Mountain. This system would be similar to the system TDOT recently upgraded in the southern section of study corridor near the Hiawassee River in Bradley and McMinn Counties. Jellico Mountain, like the area around the Hiawassee River, is prone to significant fog events that dramatically reduce visibility within the approaching segments to the north and south. This problem is compounded by impacts of the roadway geometry restrictions created by the surrounding mountainous terrain. This section is also prone to significant snowfall due to its elevation. With limited options for alternative routes, due to the mountainous terrain, advance warning is needed before entering this area. All of these inherent problems would benefit from the deployment of a fog detection system.

Strategic ITS instrumentation between the Chattanooga SmartWay Urban deployment and the I-75 Fog Detection System – Typically, over half of the expense in an ITS deployment is associated with the communication infrastructure needed to support the associated applications. The ongoing ITS project in the Chattanooga urban area is extending the fiber optic communication backbone northward to permit the I-75 fog detection system in Bradley and McMinn Counties to be managed from the Chattanooga Regional TMC which is presently under construction. In this area between the northern limits of the Chattanooga urban area and the southern limits of the I-75 fog detection system, significant investment to support ITS deployment has already been made but no ITS applications have been programmed to date. ITS instrumentation could be implemented in this area at a much lower unit cost than in areas where the supporting communication infrastructure must be constructed from scratch. This segment goes from approximately mile marker 14 to mile marker 25 and it includes a critical section of I-75 that crosses White Oak Mountain between Chattanooga and Cleveland.

High-capacity alternate route diversion corridor ITS deployment – In the event of significant long term freeway closure events it becomes necessary to divert traffic from the affected route. Due to the significant traffic volumes carried by freeway facilities, diversion to other high-capacity facilities are the only effective options without overwhelming the surrounding transportation thoroughfare network. One segment of the I-75 corridor through the Knoxville urban area combines the traffic of both I-75 and I-40 for approximately 17 miles. The only alternative high-capacity corridor for this critical segment is a combination of I-140 and US 129 (SR 115). While portions of this critical diversion corridor have been instrumented with ITS technology, most of it has not. Strategic expansion of ITS elements on the presently un-instrumented sections is necessary to properly manage major I-75/40 diversions.

Other locations along I-75 that experience a high crash rate and may benefit from installation camera and dynamic message signs were identified. Those locations are:

- SR 68 (Sweetwater), Exit 60 in Monroe County,
- US 321 (Lenoir City), Exit 81 in Loudon County,
- SR 131 (Emory Road), Exit 112 in Knox County,
- SR 170 (Raccoon Valley Road), Exit 117 in Knox County,
- SR 61 (Andersonville Highway), Exit 122 in Anderson County,
- US 25W (SR 116), Exit 129 in Anderson County, and
- SR 63 (Howard Baker Road), Exit 141 in Campbell County.

Lower-capacity alternate route diversion corridor ITS deployments – In areas where no high-capacity diversion alternatives exist, lower-capacity surface street arterials must be used by necessity. These facilities will become overwhelmed by the magnitude of diversion volumes but some elements of ITS can still benefit these relief corridors. In these areas the corridors will require, as a minimum, basic traffic signal coordination capability, special diversion timing patterns prepared in advance and ability of the local jurisdiction to implement the special timing patterns upon notification, and some form of center-to-center communication between TDOT and the local jurisdictions with traffic signal operational responsibility. There are multiple segments that are representative of this condition and under different jurisdictions throughout the study corridor. These include various segments of US 11 within the Cities of Chattanooga, Cleveland, Athens, and Knoxville as well as segments of US 25 within the Cities of Jacksboro and Lafollette.

Rural ITS capability expansion – TDOT has begun expanding ITS technology applications into some portions of the rural segments of the I-75 study corridor. These limited rural ITS deployments have focused upon deployment of traveler information elements in advance of critical route decision points. However little, or no, capability for surveillance or monitoring of vehicular flow has been provided in these areas. The investment into these initial rural ITS applications would greatly benefit from the addition of surveillance and traffic flow monitoring. Deployment configurations associated with these applications will not be similar to the concentrated investments that have been made in the urban areas for similar applications. Some of the greatest potential for expansion of surveillance and vehicular flow monitoring in the corridor rural areas may come from public/private partnerships such as probe vehicle flow monitoring by private sector traveler information entities and fiber optic sharing opportunities with other regional entities such as the Tennessee Valley Authority. All rural segments of the I-75 study corridor could benefit from such partnerships.

Table 3-4 summarizes the proposed enhancements to the TDOT ITS and HELP programs along the study corridor and their associated costs.

Table 3-4: ITS and HELP Program Enhancements

Region	Solution or Project	Total Project Cost
Hamilton and Bradley County	Expand ITS instrumentation on I-75 from Oolteway-Georgetown Pike to SR 60 which includes segment over White Oak Mountain	$2,016,000
Monroe County	Install ITS instrumentation and communications on I-75 at SR 68 (Sweetwater)	$250,000
Loudon County	Install ITS instrumentation and communications on I-75 at US 321 (Lenoir City)	$250,000
Knoxville	Expand arterial ITS communication and instrumentation on I-140 and US 129 for high-capacity route diversion	$3,631,902
Knoxville	Expand TDOT SmartWay urban coverage to include I-75/I-40 from Lovell Rd to I-40/I-75 Interchange	$2,664,861
	Expand TDOT SmartWay urban coverage to include I-75 from north of Merchant Rd to the northern Knoxville urban boundary at Emory Rd	$1,332,430
Knox County	Install ITS instrumentation and communications on I-75 at SR 170 (Raccoon Valley Rd)	$250,000
Anderson County	Install ITS instrumentation and communications on I-75 at SR 61 (Andersonville Hwy)	$250,000
Anderson County	Install ITS instrumentation and communications on I-75 at US 25W (SR 116)	$250,000
Campbell County	Install ITS instrumentation and communications on I-75 at SR 63 (Howard Baker Rd)	$250,000
Campbell County	Implement a fog and severe weather detection system on I-75 over Jellico Mountain	$8,886,416
Rural Segments along Entire Corridor	ITS deployment for route diversion along lower capacity routes to include signal coordination, special diversion timing plans, and center to center communications for US 11 and US 25	$550,000

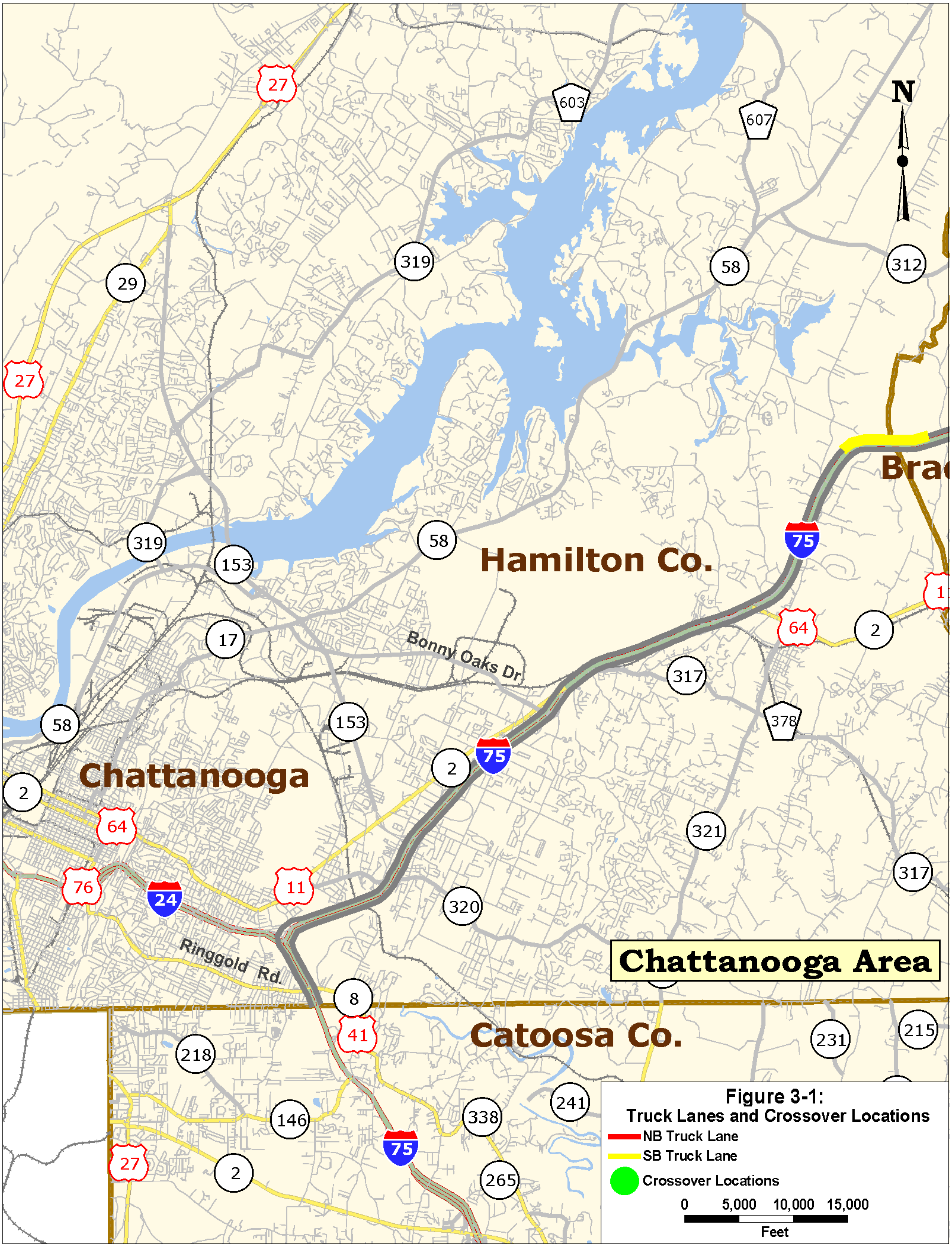
3.3 Truck Climbing Lanes and Interstate Crossover Locations

Four lane sections of I-75 along the study corridor were reviewed to identify long steep segments. Due to the weight and operating characteristics of heavy trucks, these long steep sections cause trucks to slow and may result in reduction in capacity on the roadway and safety problems. Using the Tennessee Roadway Information Management System (TRIMS) database and the *I-75 Lane Widening and Truck Lane Analysis* completed by TDOT in January 2008, a complete list of deficient segments were identified using criteria specified in *A Policy on Geometric Design of Highways and Streets* published by AASHTO. This total list of deficient segments was refined and the most significant locations were identified. A listing of the potential truck climbing lane locations is provided in **Table 3-5** and shown in **Figure 3-1** through **3-3**. Estimates of cost to construct the truck lanes and crossovers were developed using the methodology described in Section 2.1.1 and are provided in **Table 3-6 and Table 3-7**.

Table 3-5: Truck Climbing Lanes

Beginning Log Mile	Project Length (ft)	County	Grade	Direction	Annual Average Daily Traffic	% Trucks
1.06	5,250	Bradley	3.8	Southbound	56,800	21
9.74	9,715	Knox	3.1	Southbound	46,120	18
1.38	5,966	Campbell	3.8	Northbound	42,120	26
3.71	4,805	Campbell	3.9	Southbound	42,120	26
5.78	14,784	Campbell	3.9	Northbound	35,540	30
15.11	5,386	Campbell	3.7	Northbound	29,510	35
26.08	4,066	Campbell	3.9	Southbound	29,510	35
26.85	1,584	Campbell	3.9	Southbound	29,510	35
27.37	13,253	Campbell	3.9	Southbound	29,510	35
30.31	1,690	Campbell	4.5	Southbound	29,510	35

As I-75 traverses through mountainous terrain, maintenance issues related to rock slides and rock fall are of concern. TDOT has conducted an assessment and has identified sites that have a moderate or high risk for rock fall. Although there may be other sites that pose a slight risk along the corridor, the primary problem areas are in Knox and Campbell County. To aid in maintenance following a rock slide or fall event, it is recommended that median crossovers be constructed in these areas. Median crossovers are used on divided interstate routes to temporarily allow diversion of traffic from one side of the interstate to the other during construction or following an incident such as a crash or rock fall. **Figure 3-2** and **3-3** show the recommended crossover locations along I-75.


N
Hamilton Co.
Chattanooga
Catoosa Co.
Brad
Bonny Oaks Dr
Ringgold Rd.
Chattanooga Area
Figure 3-1:
Truck Lanes and Crossover Locations
NB Truck Lane
SB Truck Lane
Crossover Locations
0 5,000 10,000 15,000
Feet
27
603
607
319
58
312
29
75
153
17
64
2
317
378
24
76
11
320
321
8
41
218
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215
146
338
241
265

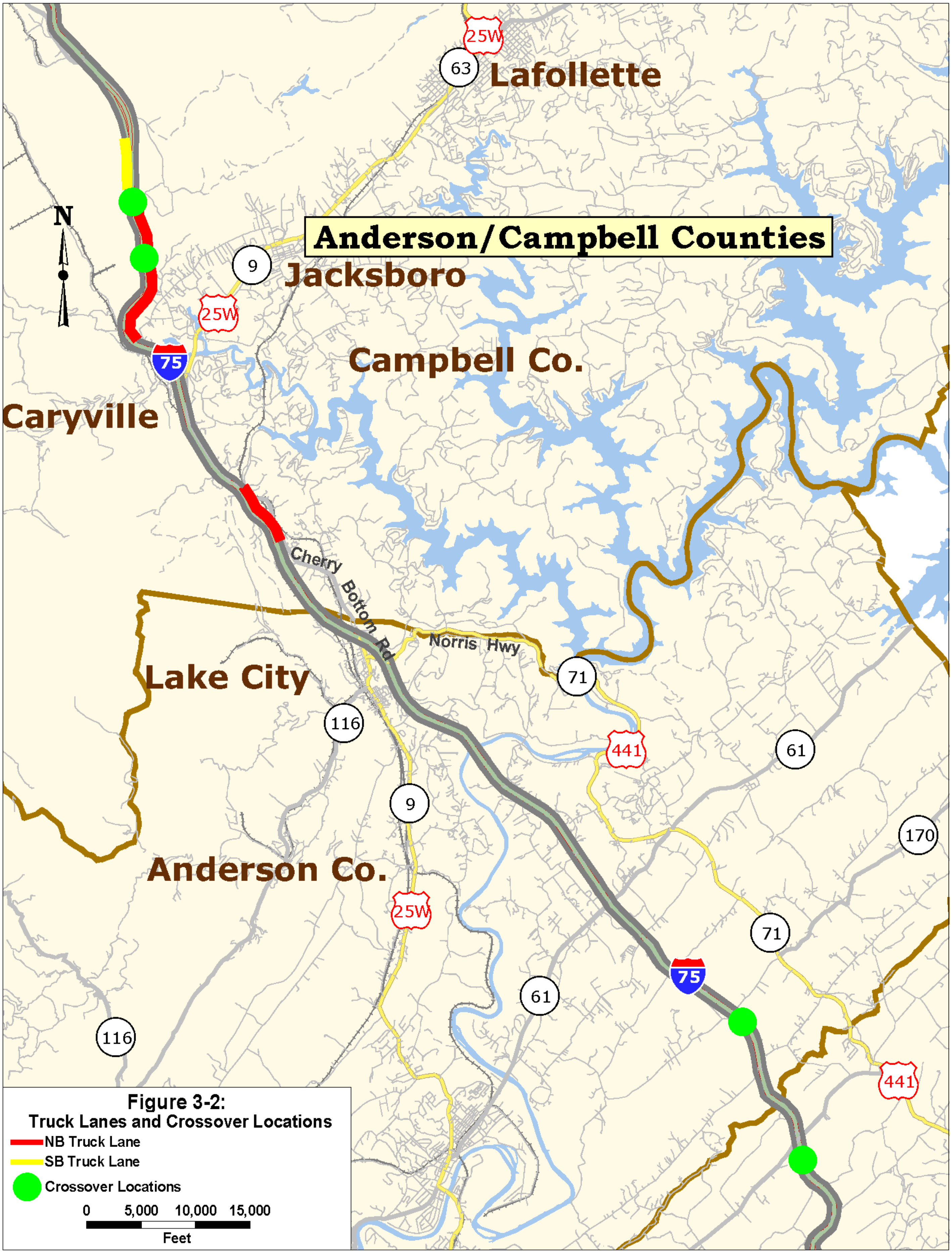

Figure 3-2:
Truck Lanes and Crossover Locations

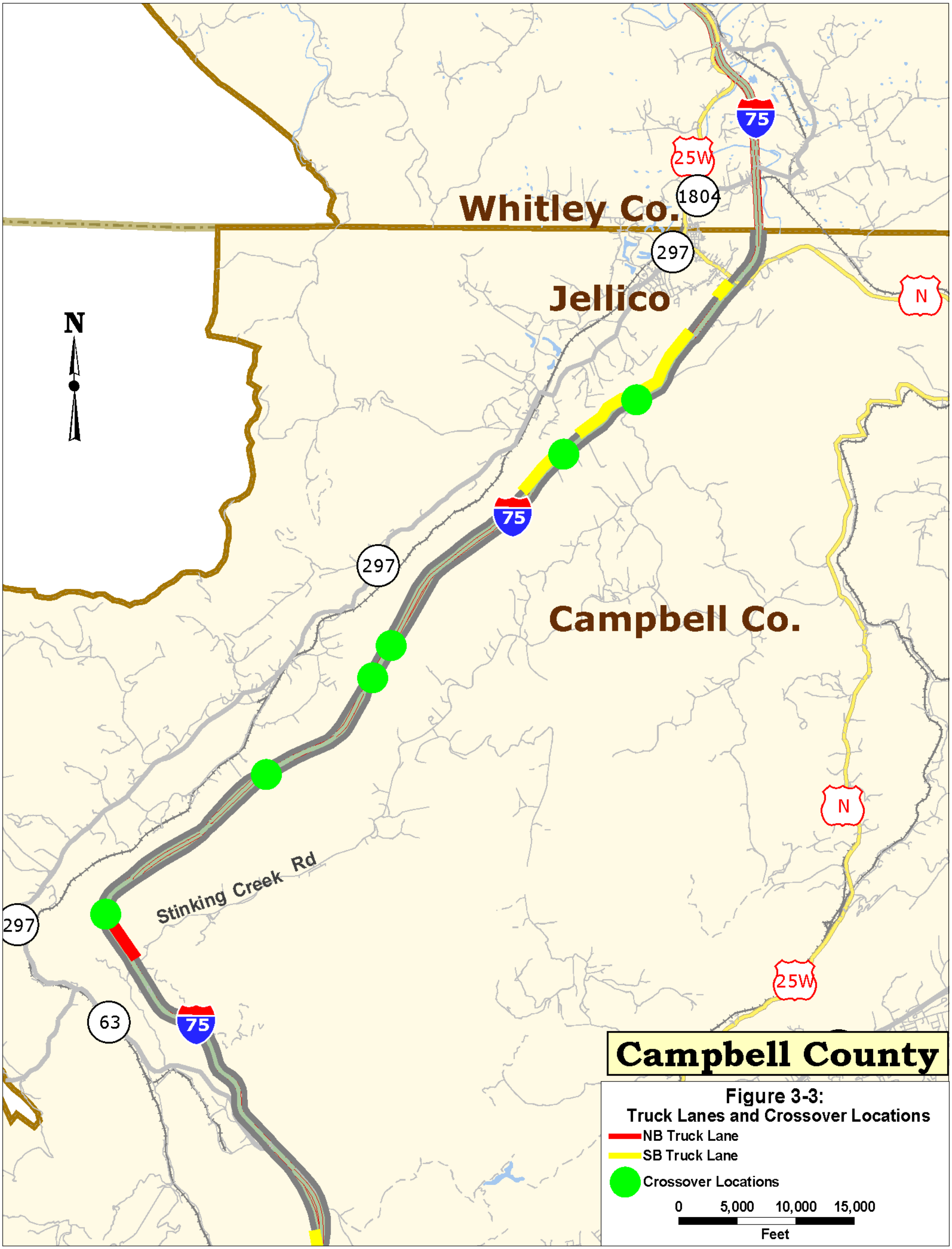
Whitley Co.
Jellico
Campbell Co.
Campbell County
Stinking Creek Rd
75
25W
1804
297
N
63
Figure 3-3:
Truck Lanes and Crossover Locations
NB Truck Lane
SB Truck Lane
Crossover Locations
0
5,000
10,000
15,000
Feet

Table 3-6: Estimated Construction Costs By Segment for Truck Climbing Lanes I-75
(All Costs are in Thousands of Current Year Dollars)

Begin Log Mile County	Begin Log Mile	End Log Mile	Length (mi.)	Right of Way Cost	Road Construction Cost	Major Structures	Constraints Cost	Preliminary Engineering Cost	Total Segment Cost
Bradley	1.06	2.05	0.99	$425	$3,085	$8,000	$995	$1,210	$13,715
Knox	9.74	11.58	1.84	$2,540	$3,230	$20,000	$1,840	$2,505	$30,115
Campbell	1.38	2.51	1.13	$210	$3,510	$8,000	$1,130	$1,265	$14,115
Campbell	3.71	4.62	0.91	$0	$2,825	$0	$910	$375	$4,110
Campbell	5.78	8.58	2.80	$0	$8,695	$0	$2,800	$1,150	$12,645
Campbell	15.11	16.13	1.02	$0	$3,165	$0	$1,020	$420	$4,605
Campbell	26.08	26.85	0.77	$125	$2,390	$4,000	$770	$715	$8,000
Campbell	26.85	27.15	0.30	$130	$930	$0	$300	$125	$1,485
Campbell	27.37	29.88	2.51	$1,065	$7,795	$0	$2,510	$1,030	$12,400
Campbell	30.31	30.63	0.32	$45	$995	$0	$320	$130	$1,490
		Total	11.60	$4,540	$36,620	$40,000	$12,595	$8,925	$102,680

Table 3-7: Estimated Construction Costs By Segment for Crossover Lanes I-75
(All Costs are in Thousands of Current Year Dollars)

Crossover Group	Crossover Number	Log Mile County	Location (Log Mile)	Construction Cost	Preliminary Engineering Cost	Total Segment Cost
A	1	Knox	12.56	$2,645	$265	$2,910
	2	Anderson	1.49	$2,645	$265	$2,910
B	3	Campbell	7.57	$1,840	$185	$2,025
	4	Campbell	8.57	$1,840	$185	$2,025
C	5	Campbell	15.97	$1,840	$185	$2,025
	6	Campbell	19.37	$1,840	$185	$2,025
D	7	Campbell	21.87	$1,840	$185	$2,025
	8	Campbell	22.57	$1,840	$185	$2,025
E	9	Campbell	26.97	$1,840	$185	$2,025
	10	Campbell	28.17	$1,840	$185	$2,025
			Total	$20,010	$2,010	$22,020

3.4 Managed Lanes Feasibility

This section investigates the potential for managed lanes to improve travel within the study area. 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."[1] These operational strategies can include any combination of:

- Pricing, including flat-rate tolls or tolls that vary by time of day or congestion level
- Vehicle eligibility restrictions that allow entry only to vehicles that meet specific criteria (e.g., buses, trucks, emergency vehicles or high-occupancy vehicles)
- Access control restrictions to limit where vehicles can enter or exit the facility

Managed lanes often provide an increase in the roadway capacity by providing a lane designated for and thereby limited to the use by specific group of vehicles.

In 2009, the Tennessee General Assembly enacted legislation that, in part, requires TDOT to evaluate the potential use of managed lanes on Interstates and other controlled access highways.

3.4.1 Background on HOV and HOT Lanes

This study evaluated the potential for two types of managed lane solutions in the I-75 corridor—high occupancy vehicle (HOV) lanes and high occupancy toll (HOT) lanes. HOV lanes are travel lanes that are reserved for the use of transit and emergency vehicles and automobiles that meet minimum vehicle occupancy requirements. Two persons per vehicle is the most frequently used minimum occupancy requirement. HOV lanes can provide congestion relief for adjacent general purpose lanes, as well as a travel time savings for transit users and carpoolers that encourage people to use these modes. HOV lanes can be implemented in a concurrent freeway lane with no separation from adjacent general purpose lanes, separated from general purpose lanes using a non-traversable barrier, or accommodated on an entirely separate facility. HOV restrictions can be enforced 24-hours a day or only during peak travel times.

HOT lanes are lanes that are reserved for transit and emergency vehicles, automobiles that meet minimum vehicle occupancy requirements, and otherwise ineligible vehicles that choose to pay a toll. These lanes are sometimes built as new facilities within existing or newly acquired right of way. However, HOT lanes have also been created by converting existing HOV lanes. HOT lanes address inefficiencies in HOV lanes that experience "empty lane syndrome," where unused capacity can lead to public opposition to the facility. By allowing priced vehicles access, the lanes can be managed to achieve maximum throughput conditions, with speeds of approximately 45 miles per hour during congested periods. When HOV lanes experience congestion in peak periods, a HOT lane treatment could be used in tandem with increased occupancy restrictions (e.g. 2+ to 3+) to efficiently manage the lane, guaranteeing mobility benefits regardless of conditions in the general purpose lanes. Like HOV lanes, HOT lanes can be separated from general lanes by buffers or barriers, and the eligibility/pricing restrictions can be enforced all day or just in peak travel times.

TDOT supports the development of HOV lanes in order to maximize the people-moving capacity of a highway while mitigating transportation-related pollution. TDOT defines a successful HOV facility as a lane that carries at least the same number of persons in fewer vehicles than the adjacent non-HOV lanes. It has established a target hourly volume for an HOV facility of 800 vehicles transporting 1,600 persons, which requires at least two persons per vehicle. The

[1] *Managed Lanes: A Primer*, Federal Highway Administration, August 2008.

department considers 1,600 persons per hour to be the number of passengers carried in a non-HOV lane at capacity (level-of-service E).[2]

Currently, there are no managed lane facilities in the I-75 corridor. However, TDOT operates HOV facilities on I-24, I-40 and I-65 in the Nashville metropolitan area and on I-40 and I-55 in the Memphis metropolitan area. A review of HOV usage data conducted as part of the I-40/I-81 Corridor Study indicates that these facilities are experiencing relatively high violation rates and may not provide meaningful travel time savings to HOVs due to lack of congestion in the adjacent general purpose lanes. The study suggests that retaining managed lanes on these facilities may be warranted due to projected traffic volumes and limited ability to add capacity, and that conversion of the existing HOV lanes to HOT lanes should be considered.[3]

3.4.2 Definition of 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."[4] These operational strategies can include any combination of:

- Pricing, including flat-rate tolls or tolls that vary by time of day or congestion level;
- Vehicle eligibility restrictions that allow entry only to vehicles that meet specific criteria (e.g., buses, trucks, emergency vehicles or high-occupancy vehicles); and
- Access control restrictions to limit where vehicles can enter or exit the facility.

3.4.3 Application of Managed Lanes Evaluation

HOV and HOT facilities are typically used to improve the person throughput in heavily congested urban corridors, and these managed lane solutions were therefore only considered for application on I-75 within the urban areas of Chattanooga, Knoxville and Cleveland. Experience compiled from applications in many U.S. cities suggests that there are a series of indicators of HOV facility success, most of which should be met for reasonable assurance that a facility will provide the intended benefits[5]. These indicators, as shown below, were the primary factors considered in identifying candidate locations for potential implementation of managed lane solutions.

- The urban area population is at least 1.5 million.
- The HOV facility services a major employment center, typically the city center, with preferably more than 100,000 jobs.
- Geographic barriers concentrate development and constrict travel.
- Severe congestion exists in the general purpose lanes that parallel the facility, with speeds regularly dropping below 35 mph.
- Vehicles using the HOV facility can experience travel time savings of at least 0.5 minutes per mile or 5 minutes total and preferably 1 minute per mile or 7.5 minutes total.
- There is a realistic potential for at least 25 or more buses to use the facility in the peak hour.

Traffic forecasts from urban travel demand models were first used to identify segments of I-75 that are anticipated to experience recurring congestion. Projected peak period volume-to-

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[2] *Proposed Procedures for Monitoring and Evaluating High Occupancy Vehicle (HOV) Lanes*, Tennessee Department of Transportation, Undated.
[3] *I-40/I-81 Corridor Feasibility Study, Task 4.0 Technical Memorandum: Project Priorities – A Corridor Plan,* Tennessee Department of Transportation, July 2008.
[4] *Managed Lanes: A Primer*, Federal Highway Administration, August 2008.
[5] *Traveler Response to Transportation System Changes, Chapter 2--HOV Facilities*, Transit Cooperative Research Program Report 95, Transportation Research Board, 2006.

capacity (V/C) ratios of at least 0.9 or peak hour volumes of at least 1,700 vehicles per lane over an extended length of freeway indicate congested segments where an HOV facility might provide significant travel time savings to its users. Once these areas of forecasted recurring congestion were identified, a review of other indicators of HOV success was performed to assess the potential for successful application of managed lanes.

Potential for Managed Lanes in Chattanooga

Figures 3-4 and **3-5** show the projected 2030 AM and PM peak hour per lane volumes on Chattanooga area freeways, as identified by the Chattanooga MPO travel demand model. This information, along with projected peak hour V/C ratio, shows that the primary areas of recurring freeway congestion in 2030 are anticipated to be on I-75 from Cloud Springs Road (in Georgia) to I-24 and on I-24 from I-75 to Downtown Chattanooga. The peak hour per-lane volumes indicate that a managed lane facility could potentially provide appropriate benefits if implemented along the entire 9.5-mile segment of I-75 and I-24 from the Cloud Springs Road interchange to downtown Chattanooga. The segment of I-75 north of the I-24 interchange is not expected to experience sufficient peak period congestion to warrant managed lanes.

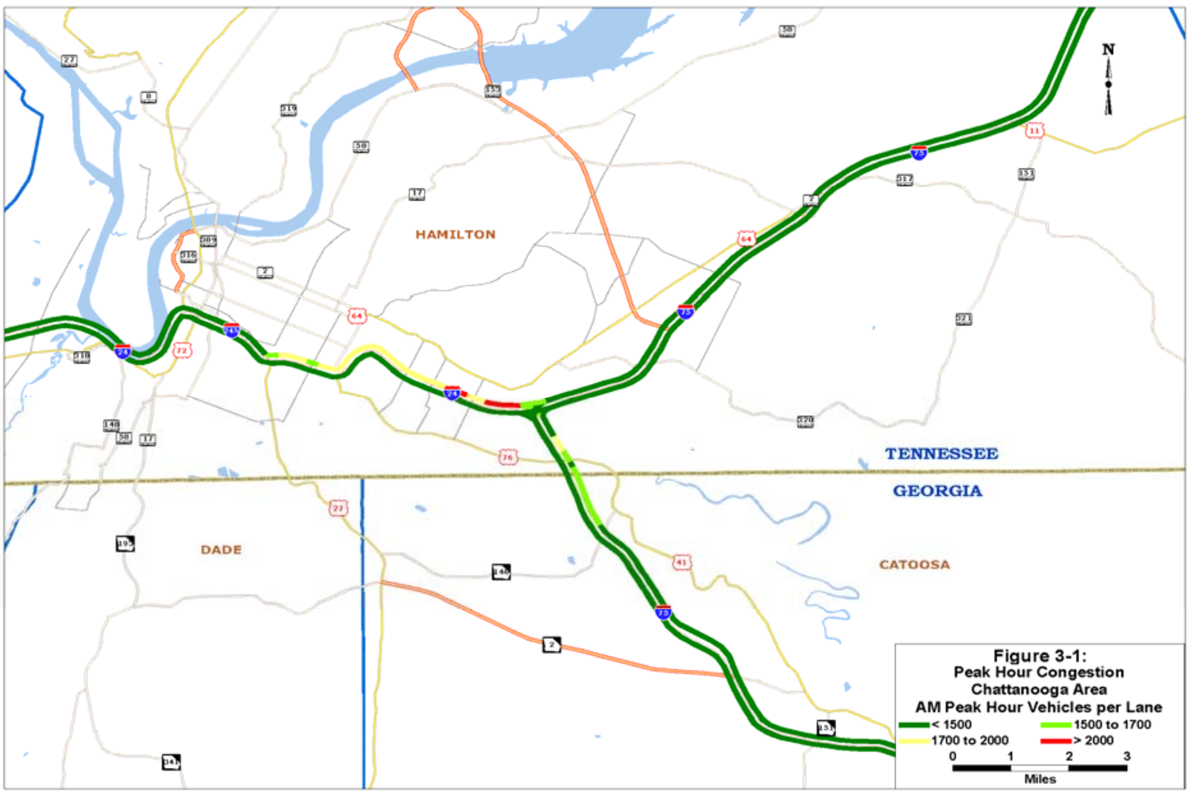

Figure 3-4: Peak Hour Congestion Chattanooga Area (AM)

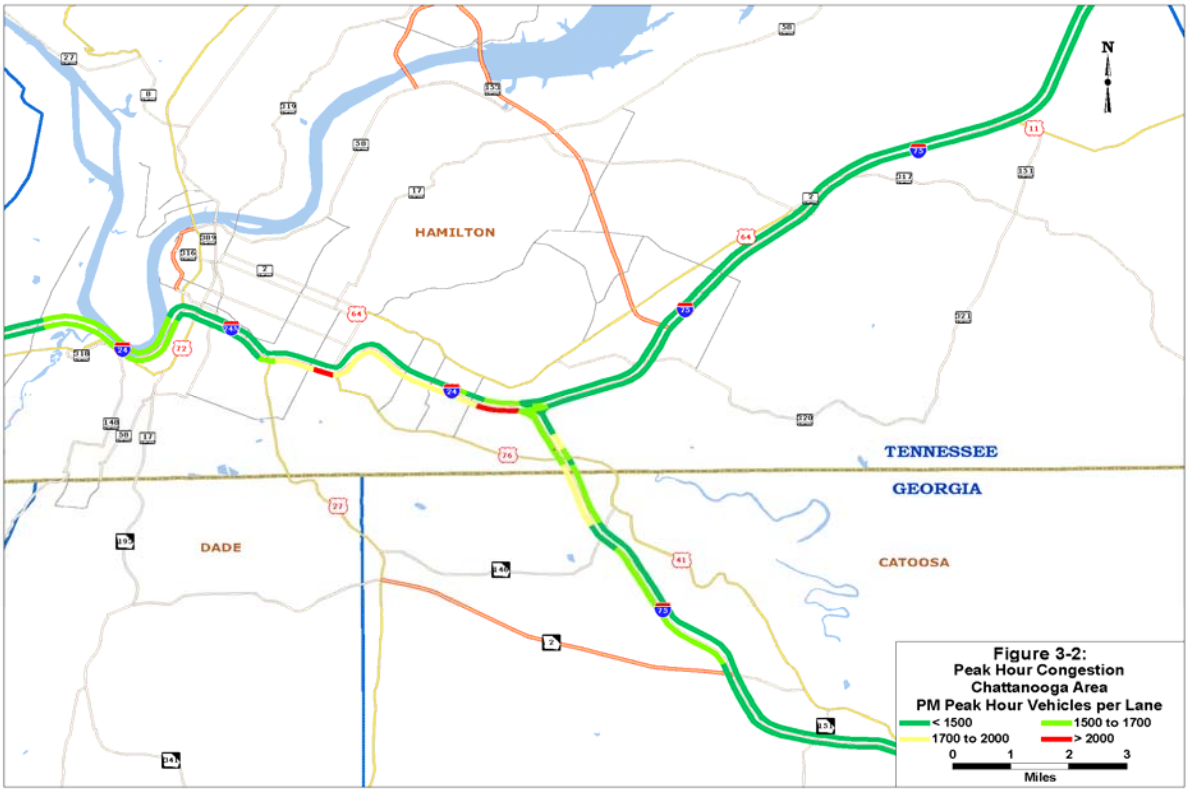

Figure 3-5: Peak Hour Congestion Chattanooga Area (PM)

Much of the freeway segment from I-75 at Cloud Springs Road to I-24 in Downtown Chattanooga is currently three lanes in each direction. Converting existing general purpose lanes to managed lanes is not advisable, as public opposition has limited the success of this strategy elsewhere. However, widening I-24 between I-75 and downtown Chattanooga to provide adequate width for new managed lanes and enforcement area could be challenging and expensive due to the terrain and adjacent development. The terrain in this area has also limited alternative routes into downtown Chattanooga, contributing to congestion on I-24 and the potential success of managed lanes. US 27 and Ringgold Road are two alternative routes that could experience increased traffic volumes with the implementation of managed lanes on I-24.

Indicators of success from other urban areas suggest that the projected population and employment in Chattanooga may be inadequate to support full utilization of freeway HOV lanes. The 2000 Census population of the Chattanooga urbanized area was 343,509, and the Long Range Transportation Plan forecasts the population for the four counties that contain the urbanized area to grow 20% (from 438,197 to 524,669) between 2000 and 2020. The Chattanooga MPO travel demand model shows employment within the Central Business District to be 56,989 in 2000 and 70,361 in 2030.

Current bus service in the I-75 and I-24 corridors does not indicate that sufficient transit demand exists at this time to support successful implementation of an HOV facility into downtown Chattanooga. The Chattanooga Area Regional Transportation Authority (CARTA) currently operates one route between Hamilton Place (near I-75 and Shallowford Road) and downtown. Two inbound AM peak express buses and two outbound PM peak express buses are offered as part of this route. Implementation of a managed lane facility would need to be supported by improved express bus service to downtown, including service from areas within Catoosa County.

Because the 2030 forecasts from the Chattanooga MPO travel demand model showed congestion levels that could potentially support a managed lane facility from Cloud Springs Road to downtown Chattanooga, the model was used to evaluate the peak hour performance of this potential facility in more detail. An HOV facility was modeled along this segment of I-75 and I-24 with one HOV lane and three general purpose lanes in each direction. 2030 peak period volume forecasts on the facility are shown in **Table 3-7**. While the model demonstrated good use of the HOV lanes, travel time savings for users of the facility are expected to be minimal due to relatively uncongested conditions in the adjacent general purpose lanes. The travel demand model shows that 25% to 35% of peak hour traffic on these freeways are HOVs under the Existing plus Committed forecast, which based on experience in other cities is higher than expected. Due to the high HOV lane volumes with respect to the general purpose lanes, the model showed an estimated travel time savings of less than 5 minutes for HOVs traveling the entire length of the facility. This savings was corroborated through independent estimates using the forecast volumes and the POET-ML sketch planning tool developed for the evaluation of managed lanes policies.[6]

Table 3-8: 2030 Forecast Peak Hour Volumes on I-24/I-75 HOV Facility

AM Peak Period Volumes				PM Peak Period Volumes			
WB/SB Lanes		NB/EB Lanes		WB/SB Lanes		NB/EB Lanes	
General Purpose	HOV	HOV	General Purpose	General Purpose	HOV	HOV	General Purpose
I-75 @ Cloud Springs Rd.				**I-75 @ Cloud Springs Rd.**			
2,087	706	755	3,797	3,785	1,276	837	3,516
I-75 @ Ringgold Rd.				**I-75 @ Ringgold Rd.**			
2,712	862	1,040	5,027	4,991	1,588	988	4,392
I-24/I-75				**I-24/I-75**			
2,307	621	1,531	5,164	4,905	1,517	1,192	3,555
I-24 @ Moore Rd.				**I-24 @ Moore Rd.**			
2,142	436	1,178	5,066	4,802	1,113	980	3,491
I-24 @ Germantown Rd				**I-24 @ Germantown Rd**			
2,584	479	1,300	5,183	4,635	1,264	1,072	3,405
I-24 @ Westside Dr.				**I-24 @ Westside Dr.**			
2,748	479	1,300	4,984	5,176	1,264	1,072	3,385
I-24 @ 4th Ave				**I-24 @ 4th Ave**			
2,414	479	1,300	4,462	4,693	1,264	1,072	3,272
I-24 @ Rossville Blvd.				**I-24 @ Rossville Blvd.**			
2,425	479	1,300	3,825	4,670	1,264	1,072	3,355
I-24 @ Market St.				**I-24 @ Market St.**			

[6] *Policy Options Evaluation Tool for Managed Lanes (POET-ML) Methodology White Paper*, Booz-Allen-Hamilton and HNTB, Submitted under FHWA Contract DTFH61-D-00006, January 2009.

The HOV lanes are projected to have sufficient capacity to accept priced vehicles in the off-peak direction. However, HOV lane volumes in the peak direction approach 1,600 vehicles per hour at some locations, thus limiting the number of priced vehicles that could be accommodated while still maintaining acceptable travel speeds. More importantly, however, the number of priced vehicles that would choose to use a HOT lane facility is limited by the low volumes and relatively high speeds in the adjacent general purpose lanes.

Despite the forecasted congestion on parts of I-75 and I-24 in Chattanooga, detailed modeling and comparison with the indicators of success from other cities suggests that conditions will not support successful implementation of managed lanes. Population, employment, bus service and travel time savings thresholds that would indicate a successful HOV facility do not appear to be met. Although current forecasts and this analysis do not indicate that managed lanes would be successful, they should continue to be considered as an alternative to future widening for additional general purpose lanes. The 2030 Long Range Transportation Plan for Chattanooga calls for widening to accommodate new HOV lanes on I-24 from US 27 to I-75 and on I-75 from the Georgia border to the north end of the MPO area. These HOV lanes are shown as a long-term need and are not currently part of the cost feasible plan.[7]

Potential for Managed Lanes in Cleveland

Projected population, employment and commuter traffic volumes do not indicate a need for managed lane solutions on I-75 in the Cleveland urbanized area. The Census 2000 population for the Cleveland urbanized area was 58,192, and the Long Range Transportation Plan shows a 2030 population forecast of 138,607 for all of Bradley County (which includes the Cleveland urbanized area). Employment for all of Bradley County was 42,469 in 2000 and is forecast to be approximately 65,000 by 2030. Most of the population and employment growth is anticipated to occur in areas along I-75, outside of Cleveland.[8]

Potential for Managed Lanes in Knoxville

Future congested segments along I-75 were identified from the 3-hour AM and PM peak period forecasts developed with the Transportation Planning Organization's travel demand model. V/C ratios for the forecast year of 2030 indicate that I-75 is anticipated to have sufficient capacity to serve the 3-hour peak period demands throughout the Knoxville area.

2030 peak hour lane volumes were forecast by assuming that 40% of the peak period volume would occur during the peak hour. These volumes are shown in **Figures 3-6** and **3-7**. PM peak hour lane volumes are forecast to exceed 1,700 vehicles per lane for much of I-75 and I-40/I-75 from the Loudon County line to I-640, but AM peak hour lane volumes are forecast to exceed 1,700 vehicles per lane only on a few portions of this segment. This difference is likely due to additional PM peak traffic generated by the large amount of commercial land use that exists along the I-40/I-75 corridor between Campbell Station Road and I-640. The greatest potential for peak hour congestion on I-75 in the Knoxville area is in the I-40/I-75 segment south of the Pellissippi Parkway interchange, where growing traffic demand will strain the existing 6-lane section.

[7] *Chattanooga Hamilton County North Georgia 2030 Long Range Transportation Plan*, Chattanooga Hamilton County North Georgia Transportation Planning Organization, June 2005.
[8] *2030 Long Range Transportation Plan*, Cleveland Urban Area MPO, undated

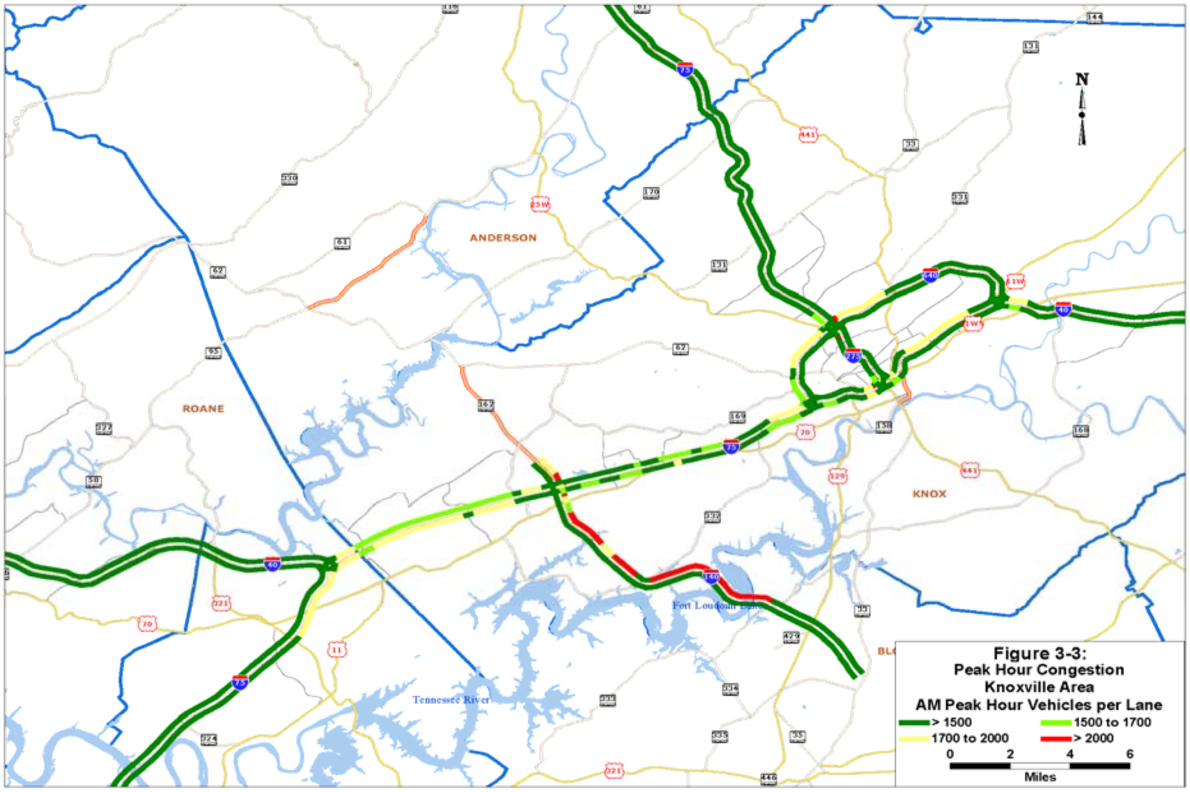

Figure 3-6: Peak Hour Congestion Knoxville Area (AM)

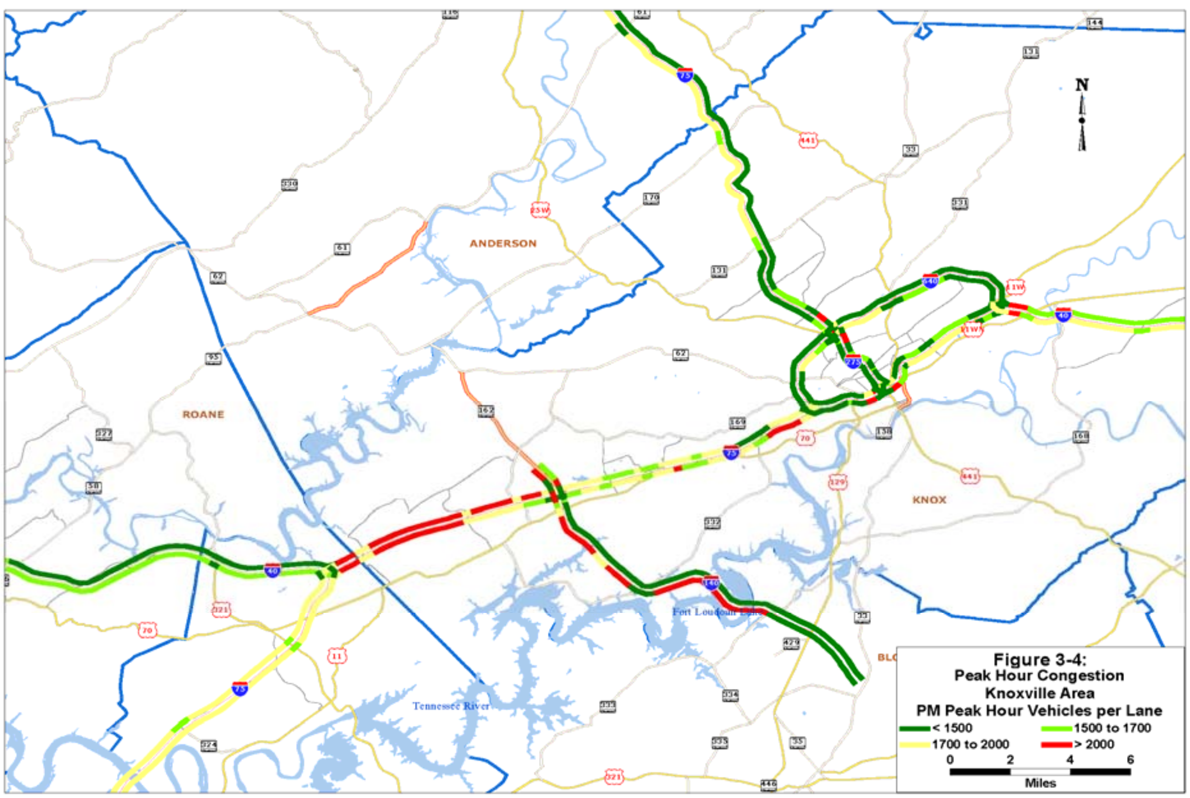

Figure 3-7: Peak Hour Congestion Knoxville Area (PM)

Like Chattanooga, the forecast population and employment in the Knoxville urban area may be too small to support successful HOV implementation. The 2000 Census population of the Knoxville urbanized area was 419,830, and the Long Range Transportation Plan estimates that the entire 7-county region that contains the urban area will grow by 38% (1,055,522) between 2002 and 2025.[9] Although Knoxville's population is larger than Chattanooga's, employment is less concentrated in the downtown area. CBD employment shown in the Transportation Planning Organization's travel demand models is 49,059 in 2000 and 65,290 in 2030, well below the 100,000 that is a desirable indicator of a successful HOV facility. A significant amount of employment outside of the downtown area is located in the I-40/I-75 corridor southwest of downtown. Employment in this corridor contributes to the congested conditions experienced on this freeway segment, but is not dense enough to be considered an employment center destination that supports high occupancy lane treatments.

Physical constraints on freeway widening limit the ability to implement any managed lane treatment on the segment of I-40/I-75 south of I-640. Much of the freeway from Winston Drive to Papermill Drive is separated from adjacent development with retaining walls or steep embankments, making further widening very expensive. Additionally, conversion of an existing general purpose lane to a managed lane is not advisable on this freeway segment.

Managed lanes on I-40/I-75 south of downtown would likely increase traffic on Kingston Pike and Parkside Drive, which run parallel to the freeway and serve many commercial destinations in the corridor.

Existing bus service in the Knoxville area does not indicate sufficient transit demand to support successful implementation of managed lane solutions on I-75. Two express bus routes currently operate on I-40/I-75 between downtown Knoxville and the Campbell Station Road and Cedar Bluff Road interchanges. Approximately 10 AM peak and 14 PM peak buses per day are provided on these routes. Experience from other U.S. urban areas would suggest that a successful HOV facility is supported by at least 3 times as much bus service.

HOV or HOT facilities do not appear to be appropriate solutions for I-75 in the Knoxville urban area under forecast conditions. Travel forecasts do not indicate the necessary extent or duration of peak period congested conditions to support successful implementation of managed lane solutions. Some congestion is anticipated between the I-40/I-75 junction and I-640, especially during afternoon peak periods. However, the lack of extensive morning peak period congestion, restrictions on freeway widening, and the dispersion of travel destinations along the corridor, indicate that this segment should not be considered for implementation of managed lanes.

3.5 Park and Ride Facilities

Purpose of Park and Ride Facilities

Park and ride facilities provide a convenient location for travelers to change from low-occupancy modes, primarily single-passenger automobiles, to high-occupancy modes such as rail, bus or carpool. They are intended to support the use of these high-occupancy modes in low-density areas that are traditionally dominated by automobile travel.

Those that use park and ride lots choose to do so instead of continuing to their destinations in their private vehicles. They must therefore have some incentive to change modes. For most, this means that the travel time or travel cost benefits must outweigh the time spent in changing modes and the loss of access to a vehicle during the day. Park and ride lots are unlikely to have significant usage or impact on traffic congestion unless downtown parking costs, HOV

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[9] *2005-2030 Knoxville Regional Long Range Transportation Plan*, Knoxville Regional Transportation Planning Organization, September 2007.

preference, convenient transit service or other travel time/travel cost incentives generate sufficient demand for high-occupancy modes.

The focus of this analysis was on suburban park and ride facilities rather than remote carpool lots in rural areas, as the suburban facilities offer the most potential to reduce traffic congestion. Suburban park and ride facilities tend to be located relatively near the home origins of trips, with trip destinations typically concentrated in one or more central employment areas. A review by the Transportation Research Board identified several location factors that tend to increase the usage of a suburban park and ride lot.[10]

- A location at least 5 miles, and preferably 10 miles from the destination activity center.
- Location in an area of relatively dense land use.
- High visibility and easy access to the lot.
- Separation from adjacent lots such that they do not compete for the same market share.
- A significant length of congestion on the travel route serving the lot, preferably with a travel time savings for the HOV.
- Frequent transit service between the lot and the destination activity center.

Existing Park and Ride Facilities in the I-75 Corridor

In Chattanooga, the Chattanooga Area Regional Transportation Authority (CARTA) operates one route from Hamilton Place and Eastgate Town Center to downtown that utilizes park and ride lots in the I-75 corridor. Park and ride lot capacity is provided at Hamilton Place, Bi-Lo (Brainerd Road and Jenkins Road), Concord Baptist Church (Brainerd Road near I-75), and Eastgate Town Center. These are all leased space in private lots. Capacity at Hamilton Place is reported to be 100 spaces, with occupancy of 22 recently observed. Capacity at Eastgate Town Center is reported to be 275 spaces, with occupancy of 183 recently observed. No information is available on the other lots.

Cleveland Urban Area Transit System (CUATS) currently operates 5 bus routes in the Cleveland area. Service is hourly between 6 AM and 6 PM. One of the routes serves a 24-space park and ride lot on Georgetown Road adjacent to the I-75 interchange. Occupancy counts of 7 to 15 vehicles were observed from recent aerial photographs and site visits.

Knoxville Area Transit (KAT) currently provides express bus service from three existing park and ride lots to downtown and the University of Tennessee. Two of these routes use I-40/I-75. The Cedar Bluff Express (Route 101X) runs between Downtown Knoxville and the park and ride lot at the I-40/I-75 Cedar Bluff Road interchange. The Farragut Express (Route 102X) runs between downtown Knoxville and a park and ride lot at the I-40/I-75 Campbell Lakes Road interchange. These two routes combine to provide approximately 10 AM peak and 14 PM peak buses per day on I-40/I-75. The Cedar Bluff Road park and ride consists of 20 designated spaces in a shopping center parking lot. Recent observation showed all spaces to be occupied. The Campbell Station Road park and ride lot has a capacity of 55 spaces, with recent occupancy counts of 32 to 34.

Evaluation of Park and Ride Expansion Opportunities

Analyses of regional travel demand models in Knoxville and Chattanooga were used to identify locations along I-75 that are expected to best serve demand for new park and ride capacity. This was done by comparing the potential number of transit or HOV trips to downtown that could take advantage of a park and ride lot located at candidate interchanges.

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[10] *Traveler Response to Transportation System Changes, Chapter 3—Park-and-Ride/Pool*, Transit Cooperative Research Program Report 95, Transportation Research Board, 2004.

Based on study results from different urban areas summarized in the Transit Cooperative Research Program (TCRP) 95, Chapter 310, it was estimated that approximately 50% of the users of any particular park and ride lot would originate within a 5-mile diameter circle centered on the lot location. These 5-mile diameter "50% market sheds" were drawn around the candidate interchanges, and the travel demand models were used to estimate the number of home-based work trips produced within these sheds and destined to the Central Business District. These estimates were then doubled to develop the 100% market shed estimate and multiplied by 18% to represent the proportion of home-based work trips that might use transit or carpool modes if good service were provided. The 18% mode split estimate was based on Census 2000 Journey to Work information summarized by the Federal Highway Administration.[11]

The results of this analysis for the Chattanooga and Knoxville urban areas are shown in **Tables 3-8** and **3-9**. These tables provide an estimate of the total number of home-based work trips that will originate within the market shed for a park and ride lot at each candidate interchange and thus could potentially use the lot to access high-occupancy (transit or carpool) modes with the right incentives. Although it does not provide a direct prediction of how many people would actually use a park and ride facility at each candidate interchange, this analysis method does identify which lot locations have the most potential to generate ridership. Actual lot usage would depend on a variety of factors that impact the cost and time savings associated with transit or carpool usage. These factors include actual levels of congestion in the corridor, preferential treatment of HOV modes, availability of alternate routes, the quality of transit service provided, fuel prices, and the availability and price of downtown parking.

Table 3-9: Potential Home-Based Work HOV Trips to Downtown Chattanooga from Interchange Market Shed Areas

I-75 Interchange	Potential Daily HOV Trips to Downtown		Distance to Downtown (mi)
	2011	2030	
South			
Ringgold Road	702	897	7.9
Cloud Springs Road	440	668	9.6
Battlefield Parkway	192	348	13.2
GA SR 151	162	298	15.3
North			
Brainerd Road	607	747	9.1
SR 153	579	712	9.8
Shallowford Road	522	691	11.3
Bonny Oaks Drive	388	553	13.1
Enterprise Parkway	125	159	14.6
Lee Highway	197	306	17.2

[11] *Journey to Work in the United States and its Major Metropolitan Areas 1960-2000*, FHWA-EP03-058, Federal Highway Administration, 2003.

Table 3-10: Potential Home-Based Work HOV Trips to Downtown Knoxville from Interchange Market Shed Areas

I-75 Interchange	Potential Daily HOV Trips to Downtown		Distance to Downtown (mi)
	2009	2030	
North			
Merchants Drive	2,044	2,234	4.8
Dante Road	1,153	1,208	6.5
Emory Road	762	716	8.3
Raccoon Valley Road	75	122	13.1
South			
Gallaher View Road	1,010	926	9.1
Cedar Bluff Road	514	459	10.9
Pellissippi Parkway	211	188	12.7
Campbell Station Road	103	95	15.8
Watt Road	36	36	19.6
US 321	26	30	24.0
Sugar Limb Road	6	6	28.7

The numbers shown in Tables 3-8 and 3-9 were evaluated along with two important considerations concerning park and ride location and spacing. First, if a candidate lot is closer than 10-miles from the Central Business District, it is likely that a significant portion of potential trips identified in the table will travel directly to the CBD instead of using a park and ride lot. Thus, the number of potential trips shown will overestimate the park and ride potential for interchanges that are close to the CBD. Second, the park and ride service areas for many of the candidate interchanges overlap each other, sometimes extensively. This means that the full usage potential of a park and ride lot would not be realized if an adjacent lot were also implemented with an overlapping service area. It also means that the trips shown in the table cannot be summed to identify the total demand for home-based work trips to the CBD from all of the market sheds, as trips in overlapping market sheds would be double-counted. The market shed trip estimates can only be used as a relative comparison of park and ride location potential among the candidate interchange locations.

In general, the need for additional park and ride capacity in the I-75 corridor will be driven by the provision of new or improved transit service, or by travel time or cost incentives that encourage the use of high occupancy modes. Park and ride facilities without significant transit service and/or HOV cost/travel time savings incentives are not expected to provide substantial operational improvements on I-75.

Recommendations for Chattanooga

Priority locations for new park and ride capacity along I-75 in the Chattanooga area are shown in **Figure 3-8**. If managed lanes are implemented on I-75 and I-24 between Cloud Springs Road and downtown Chattanooga, supporting transit service improvements and park and ride lots will be necessary. Park and ride lots at the Cloud Springs Road and the Georgia SR 151 interchanges would be best located to serve the demand. While the Ringgold Road interchange shows more potential demand in Table 3-6, it is less desirable than Cloud Springs Road because of its proximity to downtown, its location past the beginning of the congested conditions, and its location on an alternate arterial route to downtown.

North of I-24, the existing Hamilton Place park and ride lot is well-situated to serve demand for downtown work trips using the I-75 corridor. Priority should be given to expanding the use of this lot and potentially adding a lot near the Lee Highway interchange as HOV demand and transit service increase. The need for this additional capacity will be much more critical if managed solutions are implemented on I-24.

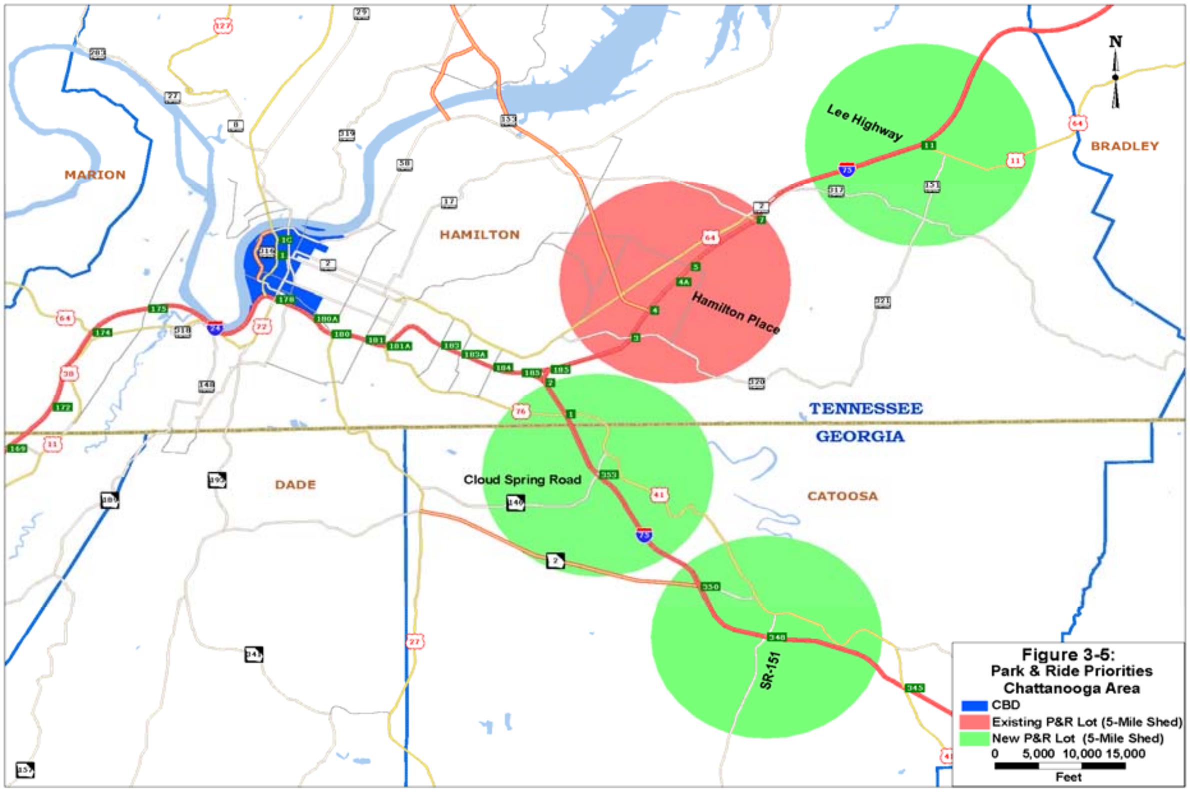

Figure 3-8: Park and Ride Priorities Chattanooga Area

Recommendations for Cleveland

Additional park and ride capacity on I-75 in the Cleveland area is not expected to be necessary to satisfy anticipated travel demand within the Cleveland area. Park and ride capacity may be beneficial to carpools or vanpools that travel to Chattanooga from Cleveland, but is not expected to have any significant impact on I-75 travel conditions.

Recommendations for Knoxville

Priority locations for new park and ride capacity along I-75 in the Knoxville area are shown in **Figure 3-9**. The first priority for park and ride implementation on I-75 north of Knoxville should be at the Emory Road interchange. Although both Merchants Drive and Dante Road interchanges show more potential trips in the market shed, park and ride lots at either of these locations would likely draw a much smaller portion of their potential due to proximity to downtown Knoxville.

As demand increases in the I-40/I-75 corridor south of downtown Knoxville, the first consideration for park and ride capacity expansion should be given to the existing lots at Cedar Bluff Road and Campbell Station Road. Although a park and ride lot at Gallaher View Road exhibits greater market shed potential, the portion of this market shed that does not overlap with

Cedar Bluff Road, is less than 9-miles from the CBD, and may not backtrack to a lot at Gallaher View. A new lot at the SR 321 interchange should be considered as a long-term possibility, when significant congestion occurs regularly south of the Pellissippi Parkway and transit service can be provided.

Analysis of the travel demand model indicated that the total number of home-based work trips from the candidate interchange areas to all destinations throughout the Knoxville area is forecast to increase from 2009 to 2030, However, Table 3-7 shows that only the Merchants Drive and Dante Road interchange areas are expected to experience significant growth in work trips to the CBD. This trend reflects the shift in employment away from the Knoxville CBD to outlying locations.

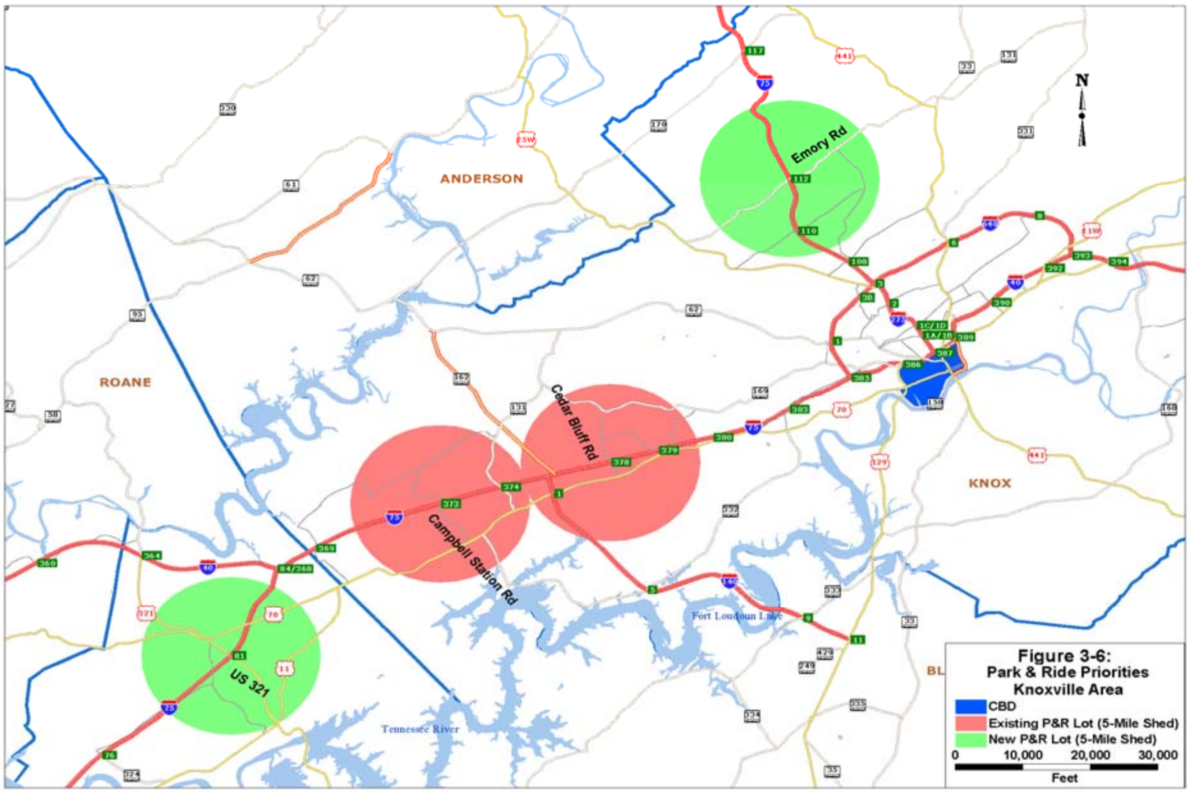

Figure 3-9: Park and Ride Priorities Knoxville Area

4.0 FREIGHT MOVEMENT/DIVERSION AND INTERMODAL FACILITIES

Opportunities for freight diversion from truck to rail were investigated as part of the development of potential multimodal solutions for the I-75 corridor. The planning team first identified the universe of divertible freight, with consideration given to commodity type, distance travelled, and general operating costs. The team then outlined opportunities for TDOT involvement that could impact freight diversion. These opportunities were drawn from peer agency experience and a recently released NCHRP Report. Report 586: Rail Freight Solutions to Roadway Congestion- Final Report and Guidebook provides a number of broad recommendations for the public sector to consider to improve rail service and help relieve roadway network demand. Some of these solutions lent themselves to further quantitative analysis, and were studied using a combination of TDOT's Freight and Statewide Travel Demand Models.

4.1 Divertible Commodities

The planning team studied Tennessee's freight movements to determine the commodities that could be eligible for diversion from truck to rail. The Reebie Associates TRANSEARCH2001 commodity flow database includes freight flows for over 700 different commodity groups defined by Standard Transportation Commodity Codes. As part of the development of TDOT's statewide freight model in 2005, these 700 groups were aggregated into 11 broad categories that capture the key differences among commodity types while providing for efficiency in model development and application. **Table 4-1** outlines these commodities and includes annual flows (in tons) within, into, and through Tennessee for the year 2001.

Table 4-1: Freight Model Commodity Groups

Group	Statewide Freight Model Commodity Group	Commodity Flow (Annual Tons in 2001)
1	Petroleum and minerals	511,600,000
2	Food products	107,100,000
3	Chemicals	123,300,000
4	Timber and lumber	49,100,000
5	Agriculture	158,000,000
6	Machinery	49,300,000
7	Paper products	43,100,000
8	Primary metal	78,900,000
9	Waste materials	20,600,000
10	Manufactured household and other	34,000,000
11	Miscellaneous and container	104,500,000
All Commodity Groups		**1,279,500,000**

Source: TDOT Freight Model Documentation, 2005

Data from the TRANSEARCH2001 database was used to establish relative truck and rail mode splits for these 11 commodities. This data was further segregated to include only those freight flows eligible for diversion to rail, which is comprised of freight flows through Tennessee (external-external) or with just an origin or a destination within Tennessee (internal-external or external-internal). Flows that begin and end within the state (internal-internal) were ignored because the potential for diversion to rail is limited for these movements. Total eligible truck freight was 584 million tons in 2001 and total eligible rail freight was 234 million tons. The breakdown of freight distribution eligible for diversion by commodity is presented in **Table 4-2**[12].

Table 4-2: Freight Commodity Distribution by Mode

Commodity	Truck % by Weight	Rail % by Weight
Petroleum and minerals	19	57
Food products	12	6
Chemicals	13	10
Timber and lumber	7	3
Agriculture	12	10
Machinery	7	4
Paper products	5	5
Primary metal	5	3
Waste materials	0	1
Manufactured household and other	6	0
Miscellaneous and container	14	1
TOTAL	**100%**	**100%**

Source: TRANSEARCH2001 and Planning Team Calculations

Tonnage flows for the eligible movements were coupled with the commodity distributions for both modes of transport to calculate the total tons moved for each commodity for both truck and rail. From those totals, the relative mode splits between truck and rail were calculated for each commodity. The results are presented in **Table 4-3**.

[12]Tonnage and commodity distribution values are from statewide data. It was assumed that these general statewide freight flow relationships could be reasonably extrapolated to the I-75 corridor study area.

Table 4-3: Commodity-Specific Mode Splits

Commodity	Truck Tons (2001)	Rail Tons (2001)	Truck Mode Split	Rail Mode Split
Petroleum and minerals	112,265,000	132,860,000	46%	54%
Food products	68,595,000	14,875,000	82%	18%
Chemicals	75,650,000	24,080,000	76%	24%
Timber and lumber	42,460,000	5,950,000	88%	12%
Agriculture	70,140,000	24,535,000	74%	26%
Machinery	39,370,000	8,750,000	82%	18%
Paper products	29,225,000	11,725,000	71%	29%
Primary metal	31,980,000	7,035,000	82%	18%
Waste materials	-	2,975,000	0%	100%
Manufactured household and other	33,525,000	-	100%	0%
Miscellaneous and container	81,290,000	1,715,000	98%	2%
TOTAL	**584,500,000**	**234,500,000**		

Source: TRANSEARCH2001 and Planning Team Calculations

Table 4-3 shows that truck and rail are competitive modes for most of these commodities. However, it is apparent that 3 of the 11 materials are essentially "captive" to one particular mode and would therefore not be suitable for consideration in the universe of divertible freight. Waste materials are carried exclusively by rail, and manufactured household and other goods are carried exclusively by truck. In addition, rail has just a 2% relative market share of miscellaneous and container shipments. It is unlikely that improvements to rail service would have measureable impacts on the mode choice for shippers of any of these 3 commodities. So these commodity flows were removed from subsequent analysis of divertible freight.

4.2 Origin-Destination Analysis

Flows for the 8 divertible commodities were studied in further detail to understand trip lengths for trucks that use I-75 in Tennessee. TDOT's Statewide Travel Demand Model was used to run select link analysis in order to produce commodity-specific trip length frequency distributions. Two paths were selected for the select link analysis: I-75 from Chattanooga to I-75 at the Kentucky state line and I-75 from Chattanooga through Knoxville and continuing along I-40 and I-81 to the Virginia state line. The vast majority of I-75 truck traffic travels along one of these two paths through the state of Tennessee. **Figures 4-1** and **4-2** highlight the paths that were studied as part of the origin-destination analysis.

Figure 4-1: Path 1 from Chattanooga to KY State Line along I-75

Figure 4-2: Path 2 from Chattanooga to VA State Line along I-75

Internal-external and external-internal trucks trips along I-75 were removed from consideration because the select link analysis showed that these trips make up just a small proportion of travel along much of I-75 and these trips are shorter, as a whole, than external-external trips, and therefore weaker candidates for truck to rail diversion. Reebie Associates TRANSEARCH2001 data indicates that 62% of all freight traveling in Tennessee is external-external (TDOT freight model documentation, 2005). Select link analysis showed that over 80% of truck freight on much of I-75 is external to external, leading to the focused effort on these trips.

TDOT's Statewide Travel Demand Model, which was used to perform the select link analysis, includes TAZs throughout the lower 48 states and 4 external stations providing linkage to Canada and Mexico. States not immediately adjacent to Tennessee have just one TAZ centroid to represent travel from and into that state. Select link analysis produces a new origin destination matrix for the subset of trips that use the links that the user specifies. Using this matrix, the planning team was able to determine an approximate distance of through trips along the two previously defined I-75 paths. **Figure 4-3** and **4-4** show trip length distribution information for the Chattanooga to Kentucky path and the Chattanooga to Virginia path, respectively.

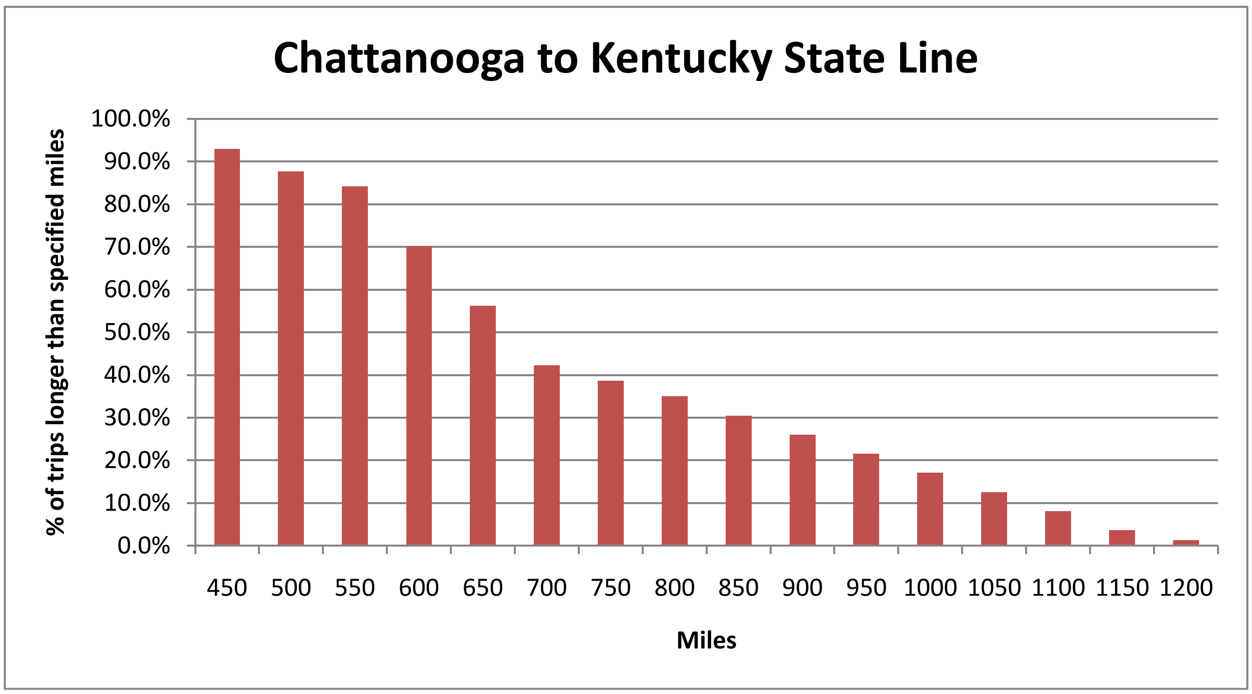

Figure 4-3: Trip Length Distribution for I-75 Trucks (Chattanooga to KY State Line)

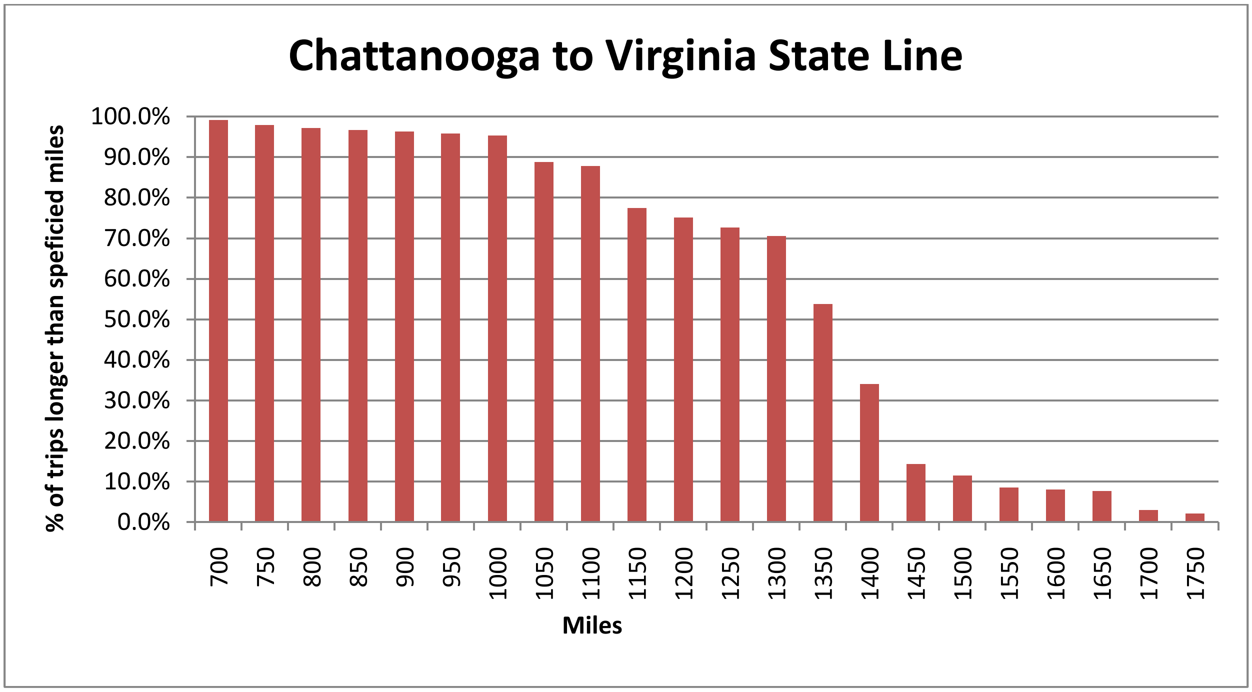

Figure 4-4: Trip Length Distribution for I-75 Trucks (Chattanooga to VA State Line)

Both of these figures show that the vast majority of through trips along I-75 are over 500 miles, which is a commonly accepted distance for divertible freight. In fact, 17% of trips in **Figure 4-3** are over 1000 miles and 11% of trips in **Figure 4-4** are over 1500 miles. The most common movements identified on the Chattanooga to Kentucky path were Ohio to Georgia and Michigan to Florida. The most common movements identified on the Chattanooga to Virginia path were Louisiana to New York and Louisiana to New Jersey. Assuming that longer trips have a greater potential for diversion, a lookup table can be developed from the combined data derived from these two path analyses. Market analysis suggests that the most optimistic diversion assumptions would be around 25%, assuming significant improvements to rail service and reasonable cost (Tennessee Rail System Plan, 2003). More likely scenarios put potential diversion at 10 percent or less due to the inertia inherent in changing the behavior of shippers (The Potential for Shifting Virginia's Highway Traffic to Railroads, 2001). With that information as a guide, **Table 4-4** was developed as a tiered approach to help calculate the universe of divertible freight along I-75.

Table 4-4: Distance-Based Freight Diversion Lookup Table

Distance between Origin and Destination	% of Freight that could be Diverted
500-750 miles	10
750-1000 miles	15
1000-1250 miles	20
1250+ miles	25

The values from **Table 4-4** were combined with trip length data from **Figures 4-3** and **4-4** to calculate an approximate number of divertible trucks. Parts of Table 7-1 from Technical Memorandum #2 that show existing truck volumes in the I-75 corridor are reproduced in **Table 4-5**, along with revised values for truck volumes if full diversion from truck to rail were realized (specifically diversion based on commodities and shipping distances). Overall, the new values represent a diversion potential of approximately 14% of the existing total truck traffic on I-75.

Table 4-5: Existing Truck Volumes Before and After Rail Diversion

Route and General Location	Truck Volumes (vehicles/day)	
	2008 (Before Diversion)	2008 (After Diversion)
I-75 - North of Shallowford Road, Hamilton County	14,600	12,700
I-75 - Bradley County, just east of Hamilton County	13,400	11,500
I-75 - North of SR 1, Loudon County	14,300	12,400
I-75/I-40 - East of Everett Road, Knox County	14,900	12,900
I-75 - North of I-640, Knox County	10,500	9,100
I-75 - North of SR 61, Anderson County	11,500	10,100
I-75 - East of Jellico, Campbell County	10,300	8,900
I-75 - Near Kentucky State Line, Campbell County	13,200	11,800

The results of this freight diversion study will be used as a baseline for comparison against the technical analysis described in section 4.4 of this report. The technical analysis looks at the impacts of rail infrastructure improvements using both TDOT's statewide rail and highway travel demand models. These models will provide insight into truck to rail diversion as a result of specific efforts to increase the competitiveness of rail.

4.3 TDOT's Freight Diversion Levers

TDOT has a number of options available to promote increased rail and waterway competitiveness in order to encourage freight diversion from trucks. Through targeted public investment and coordination efforts, the State can affect positive change and provide lasting transportation benefits to those traveling within and through Tennessee. Additional benefits to the State from strategic rail and waterway improvements include highway maintenance cost savings, improved safety, and improved air quality. Following are descriptions of several potential options available to TDOT to facilitate freight diversion. Some of these ideas are described in National Cooperative Highway Research Program (NCHRP) Report 586: Rail Freight Solutions to Roadway Congestion – Final Report and Guidebook, published in 2007. This document serves as an invaluable resource for state departments of transportation seeking to relieve highway congestion through rail investment.

Crescent Corridor Program - Currently, the most significant railroad initiative that will directly impact I-75 in Tennessee is Norfolk Southern's Crescent Corridor program. Specific projects related to the Crescent Corridor include track improvements, the addition of sidings and double tracking, certain signaling projects, and other capacity improvement projects including additional rolling stock and intermodal facility construction (as well as a new intermodal terminal in East Tennessee). This initiative is forecast to divert between 1 and 1.2 million truck trips annually from major north-south highways in the improvement area, which stretches from New Jersey to Memphis and New Orleans. Already, the state of Virginia has committed $40 million to this program, in partnership with the railroad, recognizing the public benefits that will be realized from these investments. The federal government and several other states in the corridor have also agreed to fund a portion of the estimated $2 billion cost.

Ongoing coordination with Norfolk Southern and other impacted states regarding the Crescent Corridor initiative is important for TDOT. Increased coordination with the Class I railroads (Norfolk Southern and CSX), short line railroads (Chattanooga and Chickamauga, East Chattanooga Belt Railway, Tennessee Valley Railroad Museum, and Knoxville and Holston

River Railroad), waterway port and airport facilities, the operators of truck transfer and intermodal facilities, and local shippers is one of the most important steps TDOT, and its Multimodal Transportation Resources Division, can take to ensure the competitiveness of alternative freight transportation modes. A continuous dialogue, including frequent meetings, is necessary to assess issues and opportunities related to freight movement.

Market the Benefits of Rail Diversion - Ongoing coordination with Norfolk Southern Railroad and adjacent impacted states regarding the Crescent Corridor initiative is imperative for TDOT. Increased coordination with the Class I railroads (Norfolk Southern and CSX), short line railroads (Chattanooga and Chickamauga, East Chattanooga Belt Railway, Tennessee Valley Railroad Museum, and Knoxville and Holston River Railroad), waterway port and airport facilities, the operators of truck transfer and intermodal facilities, and local shippers is one of the most important steps TDOT, and its Multimodal Transportation Resources Division, can take to ensure the competitiveness of alternative freight transportation modes.

In addition, the staff could spearhead marketing programs in partnership with the entities responsible for both rail and waterway infrastructure. The intent of the programs would be to broadcast the benefits of these modes to the community of shippers and producers through various media and outreach efforts in order to attract new commerce and trade and increased economic development. Finally, the office staff should pursue the formation of a freight advisory council to include representatives from both the rail and waterway industries. These councils have become more common in state and urban jurisdictions, and even at the federal level. “They offer a proven and available method for making realistic assessments of the public planning options and for opening doors to other stakeholders who can contribute requisite data and participate in project opportunities” (NCHRP 586, pg. 108). The Council would serve to advise TDOT, the General Assembly, and the Governor’s Office on actions that would facilitate the maintenance and growth of rail and waterway freight transportation.

Maximize Existing Incentives - TDOT could maximize existing opportunities to improve freight transportation. The Office of Freight and Rail currently administers a short line railroad rehabilitation program that provides grants for infrastructure maintenance (track and bridge rehab) to Short Line Railroad Authorities that have applied for and been accepted into the program. Included in the Tennessee Rail System Plan from 2003 is the Short Line Program Review and Recommendations which outline the program’s organization, funding history, and future challenges, while providing recommendations on optimizing funding outlays. The report notes that as Class I railroads continue to abandon trackage, short lines are afforded the opportunity to increase their business, but must meet the challenges associated with heavier axle loads and double-stacked cars. TDOT’s 2005 short line railroad track assessment identified needs for the State’s short lines, including the four lines within the I-75 corridor study area. TDOT should provide support, up to and including funds from their Rehabilitation Program, where appropriate, to sustain viable short line railroads. However, caution is warranted, as noted in the NCHRP Report 586. Based on nationwide experience, the report warns state governments that “investing public money in rail facilities does not necessarily create a competitive advantage for rail, nor does it mean that the rail system will be used” (NCHRP 586, pg. 14). Rail investment must be based on rigorous analysis of the future potential of the line, not solely based on a history of past performance.

Minimize Rail – Highway Conflicts - Other strategies to maximize rail freight movement include grade separation or signalization improvements to at-grade rail/road crossings. In order to minimize conflicts between trains and other vehicles that cause train accidents and delays, TDOT should consider updates to those crossings shown to be most problematic. A discussion of at-grade crossings along state highways that run parallel to I-75 is included in the discussion of recommended improvements to parallel roadway facilities. Projects that improve these crossings will benefit both trains and other vehicles in the study area, and could lead to freight diversion from truck to rail.

4.4 Freight Diversion Technical Analysis

Rail network improvements, such as those related to the Crescent Corridor initiative, will result in travel time savings for both carload and intermodal freight. This time savings increases the competitiveness of rail relative to trucks, and can lead to diversion of freight from I-75 to the nearby rail network. The objective of this technical analysis is to quantify the potential freight diversion resulting from investments outlined as part of the Crescent Corridor. The key output of this effort will be a revised forecast for future year truck volumes along I-75.

Following are the steps used to estimate freight diversion from truck to rail. These steps are described in more detail in the discussion that follows.

- Develop an interzonal impedance matrix for the no-build scenario
- Develop the build scenario rail network
- Develop an interzonal impedance matrix for the newly created build scenario
- Apply cost/distance equations to both matrices to determine scenario costs
- Calculate the percent change in cost for every origin-destination pair between the no-build and build scenarios
- Apply the cross elasticity factors for each commodity to produce commodity-specific matrices to use as multipliers
- Generate a TAZ equivalency file for the rail and truck models
- Apply the multiplier matrices to the original commodity matrices to generate new truck trip tables
- Use these new trip tables to rerun the TDOT Statewide Travel Demand Model to examine the impact on I-75 truck demand

TDOT's Statewide Travel Demand Model was used in tandem with TDOT's Statewide Rail Model to forecast freight diversion due to rail network improvements. The planning team used TransCAD to calculate a shortest path impedance matrix for the statewide rail freight network. A build network was then created by updating the primary impedance field for the rail network links: NEWLENGTH. The team identified over 1,000 links in the rail network as Crescent Corridor links (see **Figure 4-5** for a map of the rail network with the Crescent Corridor highlighted). For each of these links, new fields were added and populated with values that were smaller than the original NEWLENGTH value. Forecasts for travel time savings between specific origin-destination pairs vary along the Crescent Corridor. For this reason, the team calculated three separate values for the revised NEWLENGTH fields, namely 10%, 25%, and 50% reductions from the original value. This allowed for sensitivity testing to determine the impact to freight diversion resulting from various levels of travel time improvement.

Figure 4-5: National Rail Network and Crescent Corridor

New shortest path impedance matrices were then created for each of the three levels of NEWLENGTH reduction. The change in cost resulting from this change in distance was then estimated using the cost/distance equations that were applied in TDOT's I-40/I-81 Corridor Feasibility Study. Those equations are:

For carload rail, cost/ton = $14.55 + $0.025 * miles

For intermodal rail, cost/ton = $20.84 + $0.028 * miles

With costs calculated for all no-build and build origin-destination pairs, the team was able to calculate the percentage changes in cost for the 10%, 25%, and 50% impedance reduction scenarios relative to the no-build scenario. Percent change in cost is directly related to freight diversion potential. The next step in this analysis was to apply commodity-specific cross-elasticities to these percentage changes in cost. To remain consistent with the assumptions from TDOT's I-40/I-81 Study, the team applied the commodity bridge table outlined in Technical Memorandum 2 from that study. Key sections of that table are reproduced in **Table 4-6**. The cross elasticity of petroleum and minerals, for example, should be interpreted as a 0.96 percent diversion from truck to rail as a result in a 1 percent reduction in the cost of shipping via rail.

Table 4-6: Commodity Cross Elasticities

TDOT Commodity Code	TDOT Commodity Name	Cross Elasticity
1	Petroleum and minerals	0.96
2	Food Products	0.67

3	Chemicals	0.96
4	Timber and lumber	0.77
5	Agriculture	0.62
6	Machinery	0.86
7	Paper products	1.05
8	Primary metal	1.11
9	Waste Materials	1.11
10	Manufactured household and other	1.05
11	Miscellaneous and container	0.62

The commodity bridge table allowed the team to generate new matrices to apply to the original truck trip tables. A TAZ equivalency file was constructed to relate the rail and truck zones, and then the multiplier matrices were applied to the original truck tables. The new matrices that resulted from this effort were then run through TDOT's Statewide Travel Demand Model to determine the impact to I-75 truck volumes from the 10%, 25%, and 50% improvement to rail travel times along the crescent corridor. **Table 4-5** was updated to include the additional information from this analysis and the results are presented in **Table 4-7** and in **Figure 4-6**.

Table 4-7: I-75 Truck Volumes

Route and General Location	Truck Volumes (vehicles/day)				
	2008 Counts	2008 (After Full Potential Diversion)	10% Reduction in Travel Time	25% Reduction in Travel Time	50% Reduction in Travel Time
I-75 - North of Shallowford Road, Hamilton County	14,600	12,700	14,300	13,900	13,000
I-75 - Bradley County, just east of Hamilton County	13,400	11,500	13,200	12,700	11,900
I-75 - North of SR 1, Loudon County	14,300	12,400	14,000	13,600	12,700
I-75/I-40 - East of Everett Road, Knox County	14,900	12,900	14,600	14,100	13,200
I-75 - North of I-640, Knox County	10,500	9,100	10,500	10,400	10,300
I-75 - North of SR 61, Anderson County	11,500	10,100	11,500	11,400	11,300
I-75 - East of Jellico, Campbell County	10,300	8,900	10,300	10,300	10,100
I-75 - Near Kentucky State Line, Campbell County	13,200	11,800	13,200	13,100	13,000

Table 4-7 includes the 2008 truck traffic counts and the projected truck volumes from the full potential diversion analysis in Section 4-2. The columns on the right side of the table show the results for the three Crescent Corridor travel time reduction scenarios. According to these results, if the Crescent Corridor improvements lead to an average 10% reduction in travel times for freight movements, truck volumes on I-75 would fall from 14,600 to 13,900 just north of Shallowford Road in Hamilton County. If the improvements achieved a 50% reduction in travel times, volumes would fall to 13,000 trucks per day. These reductions reflect the increased competitiveness of rail as a result of time savings that causes freight diversion from the truck mode.

The overall impact of the Crescent Corridor on I-75 ranges from negligible to over 11% of daily truck traffic, depending on the location along the corridor and the travel time reduction scenario assumed. The Crescent Corridor appears to have less of an impact north of Knoxville where truck traffic reductions range from just 0.1% for the 10% travel time reduction scenario to nearly 2% for the 50% travel time reduction scenario. However, between Chattanooga and Knoxville, the rail improvements have a much greater impact. In fact, at a few points along the corridor, the 50% travel time reduction scenario leads to volumes that approach the overall diversion potential values shown in the previous column. Clearly, the improvements to the rail network as part of the Crescent Corridor initiative will have a significant impact on truck volumes on I-75. This will improve overall operational efficiency and safety along this route and will help decrease lifecycle maintenance costs (e.g. pavement, etc.) on the facility.

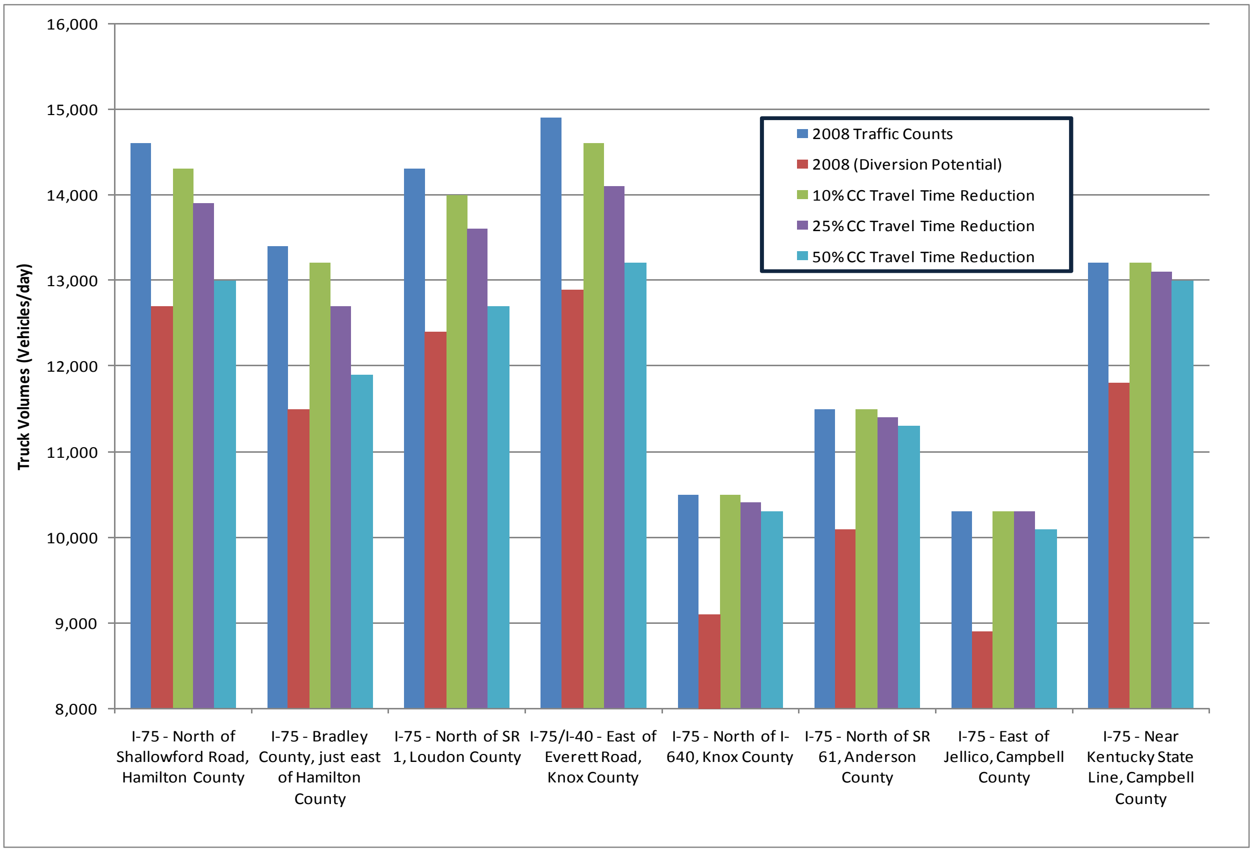

Figure 4-6: 2008 Truck Volume Comparisons

4.5 Chickamauga Lock Status

Work is continuing on the construction of the new Chickamauga Lock. The existing lock with a chamber of 360 ft. by 60 ft. was built in 1938. It has been experiencing a series of severe problems associated with concrete expansion. Yearly maintenance requires closure of the lock for two weeks at a time. In 1995, the lock was unexpectedly closed for repair. A new replacement lock, 600 ft by 110 ft., has been authorized by Congress. To date road and bridge replacements have been completed and a cofferdam has been built. Construction of the actual lock is scheduled to begin next year if funds are available.

Tables 4-8 and **4-9** indicate the tonnage and value of commodities through Chickamauga Lock in 2007.

Table 4-8: 2007 Barge Tonnage Shipped from States

Chickamauga Lock 2007 Barge Tonnage Shipped from States (values in millions of dollars)			
Shipments By	**Tons**	**Value**	**Top Commodity**
Louisiana	433,919	$33	Ores/Minerals
Tennessee	203,435	$107	Chemicals
Kentucky	183,618	$13	Petroleum
Illinois	115,284	$34	Petroleum
Indiana	30,877	$17	Chemicals
Source: U.S. Army Corps of Engineers Waterborne Commerce Statistics			

Table 4-9: 2007 Barge Tonnage Shipped to States

Chickamauga Lock 2007 Barge Tonnage Shipped to States (values in millions of dollars)			
Receipts By	**Tons**	**Value**	**Top Commodity**
Tennessee	852,820	$151	Ores/Minerals
Texas	47,574	$19	Chemicals
Alabama	43,323	$35	Iron/Steel
Louisiana	28,659	$5	Grain
Illinois	9,704	$11	Iron/Steel
Source: U.S. Army Corps of Engineers Waterborne Commerce Statistics			

Figure 4-7 shows the historical trend in commodity flows at the lock.

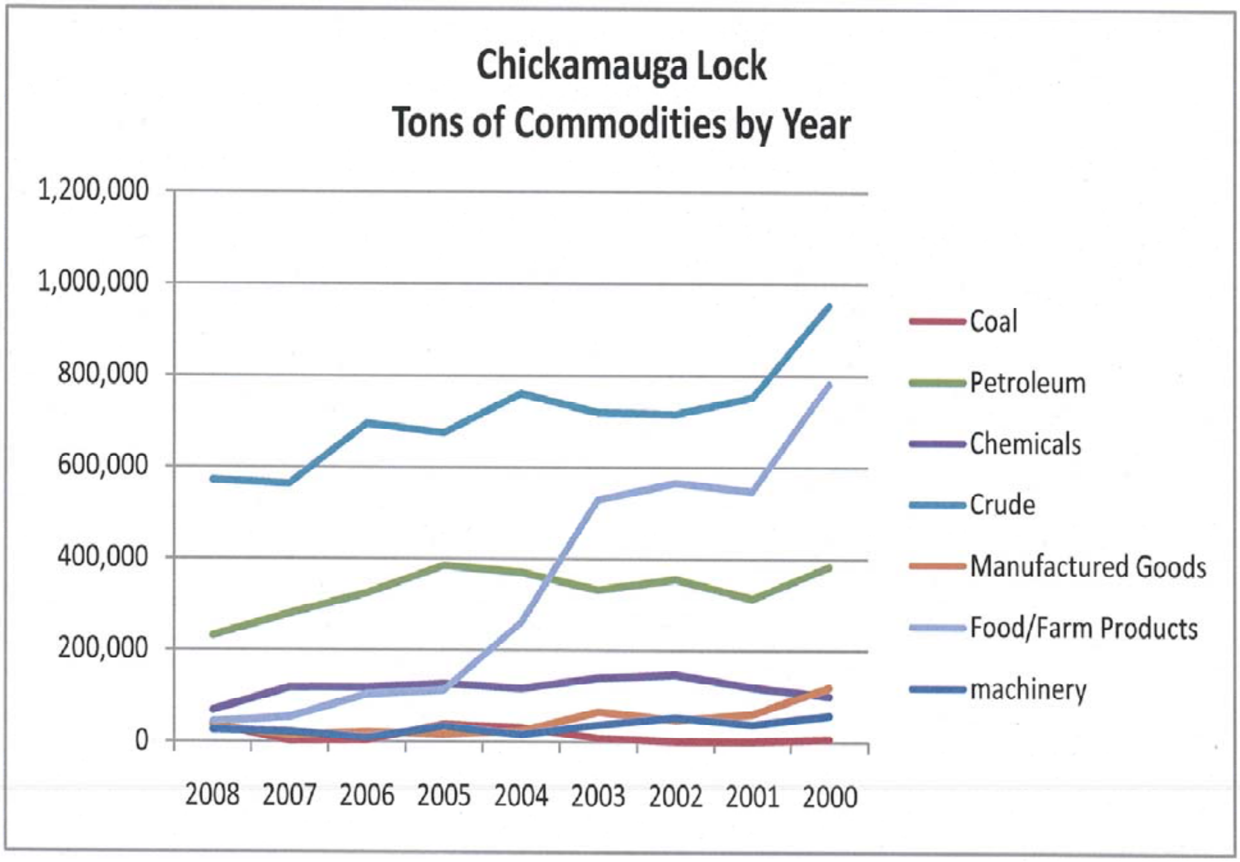

Figure 4-7: Chickamauga Lock Tons of Commodities by Year

All indications are that the Chickamauga Lock will not be closed and that the new lock will be constructed. If funds are not available, additional expenditures will be needed to keep the lock open – this could be as much as $30 million in operating and maintenance costs to prevent further concrete deterioration.

As is indicated, bulk commodities make up the majority of shipments through the lock. The potential for diversion from the highway system is minimal.

5.0 FUTURE INTERCHANGES FOR ECONOMIC ACCESS

5.1 Assessment of Interchange Access

As part of the data collection effort, the Long Range Transportation Plans (LRTP) from the urban areas and from the state, as well as interchange modification and justification studies prepared by TDOT staff, were reviewed to identify potential locations for new interchange access or locations where existing interchanges could be improved. This information was presented to key stakeholders and the public at a series of meetings describing the project and the corridor's deficiencies.

The Tennessee Department of Economic and Community Development (TDECD) database was used to identify Tennessee Valley Authority (TVA) certified megasites and other large industrial sites and mega sites along the corridor that are being marketed for economic development. **Table 5-1** lists the new interchanges and interchange improvement projects identified through the data collection and stakeholder involvement process. The locations of the potential new interchanges and locations of the potential industrial sites are provided in Figures 8-1 through 8-2 in *Technical Memorandum 2*.

Table 5-1: New Interchanges or Interchange Improvement for Economic Access

Project Limits	Improvement	Source	Year
I-75 at Ringgold Road Interchange and Welcome Center, Hamilton County	Interchange reconstruction	Chattanooga LRTP	2006-2008
I-75 at SR 2 (US 11/Lee Highway), Hamilton County	Interchange reconstruction	Under Construction	2009
I-75 at US-64, SR-311(APD) adjacent to I-75 Exit 20, Bradley County	Interchange reconstruction and roadway improvements	Cleveland TIP, LRTP, and TDOT IMS	2006-2016
I-75 at Hooper Gap Rd, Bradley County	New interchange	Cleveland LRTP	Beyond 2030
I-75 between Rocky Mount Union Chapel Road and Coile Road, McMinn County	Construct new interchange at proposed Athens Bypass	TDOT Interchange Justification Study	-
Knoxville Regional Parkway - I-40/I75 in Loudon County to I-75 in Anderson County	Construct new 4 lane access controlled highway	Knoxville TIP and LRTP	2025-2034
Interchange with SR 131 (Emory Road), Knox County	Interchange reconstruction	Knoxville LRTP and TDOT Interchange Modification Study	2015-2024
I-640/I-275/I-75 Interchange, Knox County	Add through lanes on I-75 north and southbound ramps	Knoxville LRTP	2015-2024
I-75 at Watt Road, Knox County	Interchange reconstruction	Knoxville LRTP	2015-2024
I-75 at Merchant Drive, Knox County	Interchange reconstruction	Knoxville LRTP	2015-2024
I-75 at Callahan Drive, Knox County	Interchange reconstruction	Knoxville LRTP	2015-2024
I-75 at Raccoon Valley Rd, Knox Co.	Interchange reconstruction	Knoxville LRTP	2025-2034

5.2 Approach and Methodology

An economic needs assessment was conducted for the I-75 corridor to identify the high growth areas with needs for access to the interstate route. Major routes that do not have existing interstate access were identified. From this list, candidate sites that were separated by at least one mile in an urban area or two miles in a suburban/rural area were identified. Qualified candidate roadways were prioritized based on their roadway functional class, whether they are state routes, and whether they are located in a high growth area.

5.3 Relative Growth in Population

5.3.1 Population Growth Rate

Based on the annual population estimates of the U.S. Census Bureau, population growth rates for Tennessee counties along the I-75 corridor during the period of 2000 to 2008 range from 0.33 percent average annual growth rate for Campbell County to 2.14 percent for Loudon County. Among the 8 Tennessee counties along the I-75 corridor, Bradley, Monroe, Loudon, and Knox counties are the fastest population growth counties. The spatial distribution along the I-75 corridor of the counties with their average annual growth rate in population is shown in **Figure 5-1**.

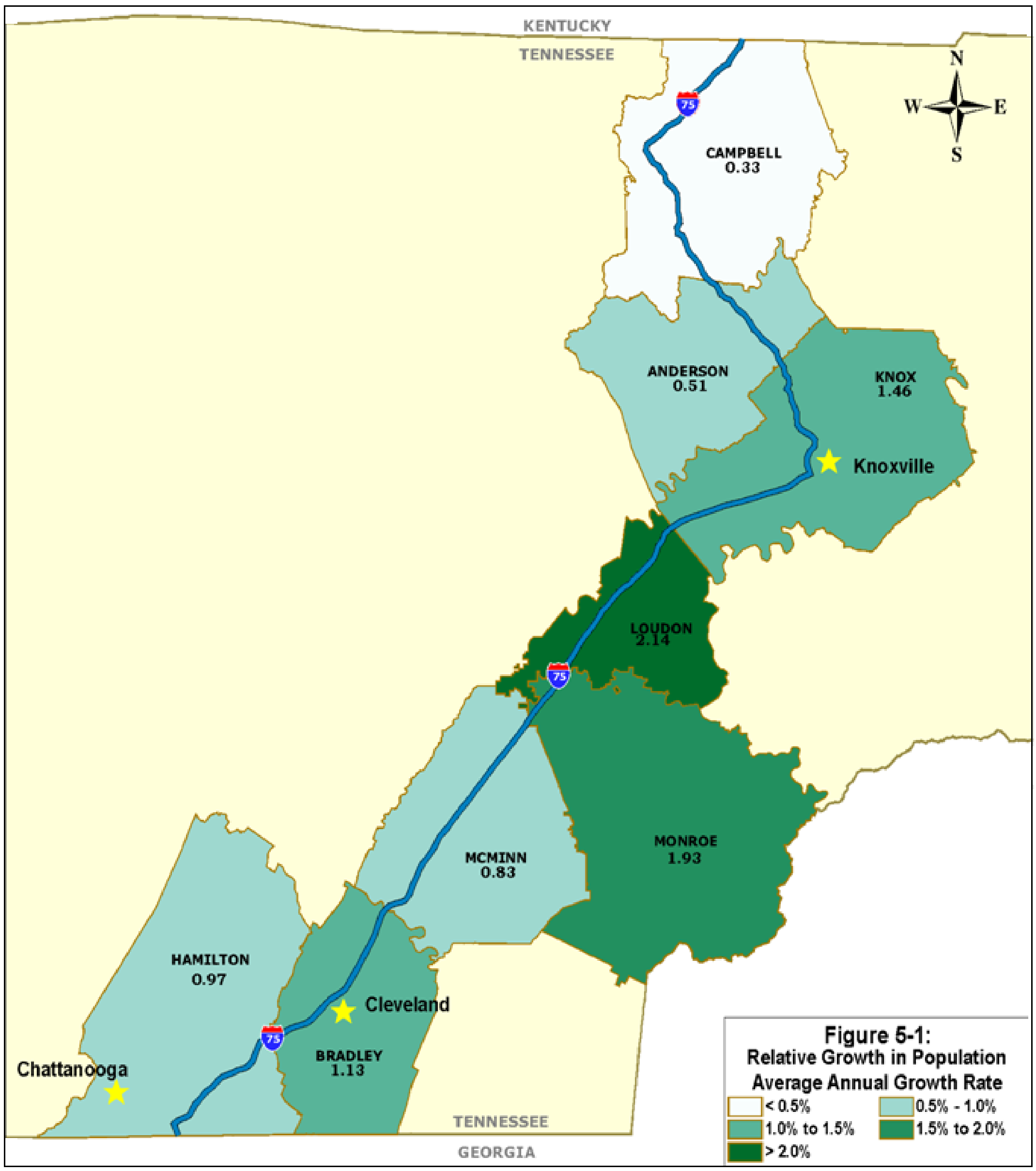

Figure 5-1:
Relative Growth in Population
Average Annual Growth Rate

5.3.2 Housing Units Growth Rate

Based on the estimated total housing units in Tennessee counties by the U.S. Census Bureau, average annual growth rates for total housing units in Tennessee counties along the I-75 corridor between 2000 and 2007 ranged from 0.42 percent for Campbell County to 1.92 percent for Loudon County. Loudon and Knox counties are in the top quartile with the fastest growth rates for total housing units. The spatial distribution of the counties and their housing growth rates are displayed in **Figure 5-2**.

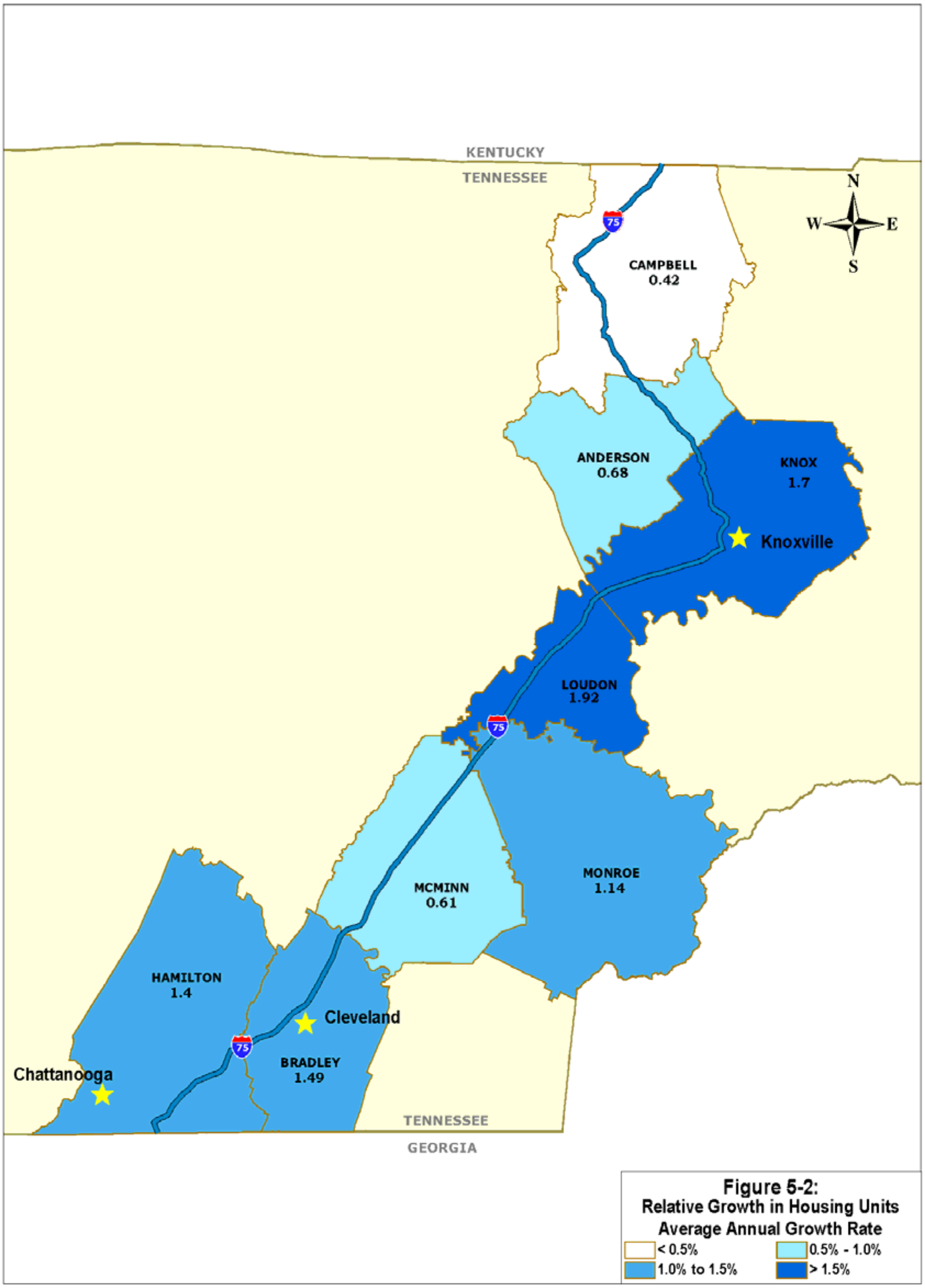

Figure 5-2:
Relative Growth in Housing Units

5.3.3 Employment Growth Rate

Based on the estimates of total employment in Tennessee counties by the U.S. Bureau of Economic Analysis, average annual growth rates for employment in Tennessee counties along the I-75 corridor between 2000 and 2007 ranged from 0.54% percent for Anderson County to 3.27% for Loudon County. **Figure 5-3** shows the average annual growth rates in employment in the counties along the I-75 corridor.

In July 2008, the Volkswagen Group of America, Inc. announced that it would build an auto production facility at the Enterprise South Industrial Park in Chattanooga. Based on information provided by the Chattanooga Chamber of Commerce, the new Volkswagen manufacturing plant will create 2,000 new jobs in the region associated with the plant and nearby suppliers. The U.S. Department of Labor's Bureau of Labor Statistics (BLS) shows a total employment in the Chattanooga Metropolitan Area at approximately 230,800 jobs in March 2010. Access to the I-75 corridor from the Enterprise South Industrial Park is provided by a recently constructed interchange just north of Bonny Oaks Drive (US 11/US 64).

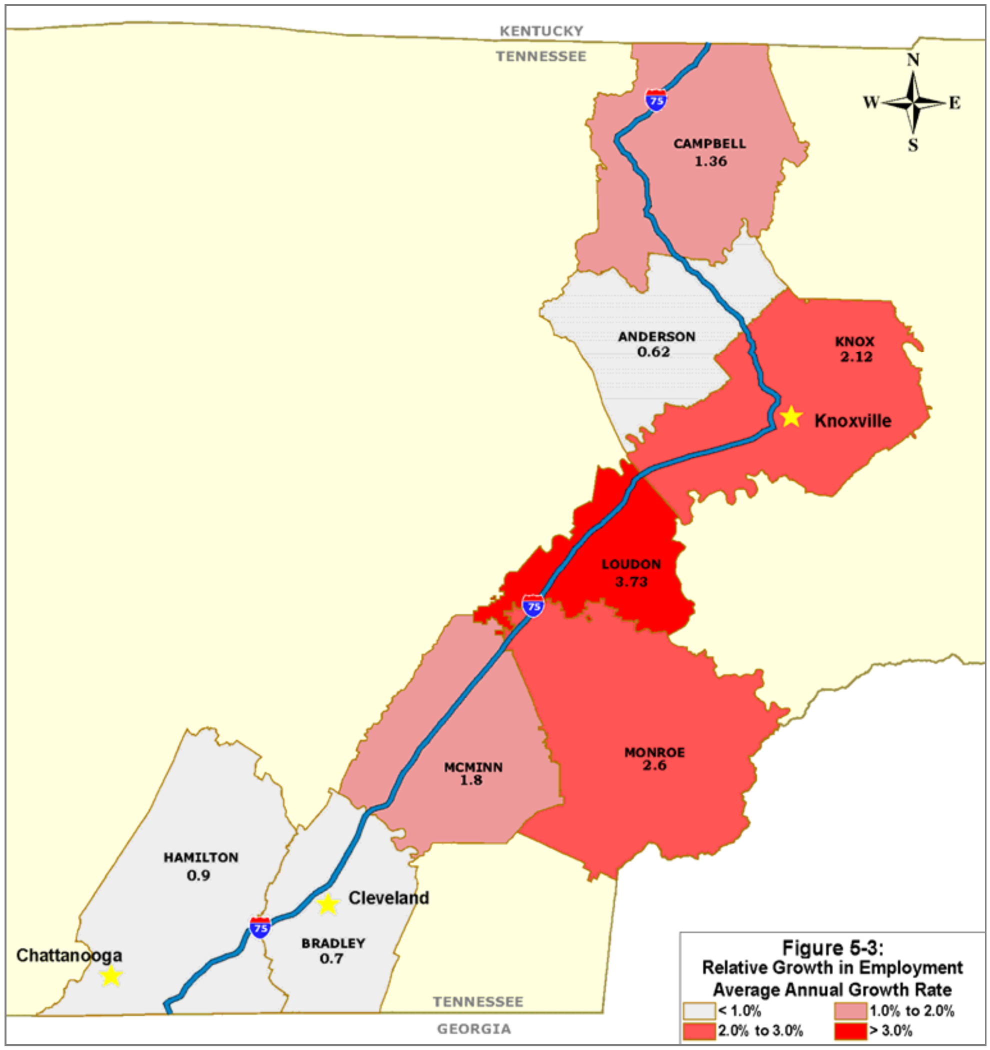

Figure 5-3:
Relative Growth in Employment
Average Annual Growth Rate

In early 2009, Wacker Chemie AG Company announced plans to construct a production facility in Bradley County to produce material that is a key component in photovoltaics used in solar energy production and semiconductors. Based on information provided by the company, construction of the plant will result in 500 new jobs for the region. The BLS estimated total employment in Bradley County was approximately 33,800 in March 2009. The facility will be located adjacent to the Hiwassee River Industrial Park in the northern part of the county and will be served by a new industrial access road constructed with assistance from the Tennessee Department of Transportation and the Tennessee Department of Economic and Community Development. Access to the I-75 corridor from the Hiwassee River Industrial Park is provided by an existing interchange at Lauderdale Memorial Highway (SR 308).

In addition to the socio-economic forecasts provided in the regional travel demand models, new employment for both of these facilities were added to the regional travel demand models prior to estimating travel forecasts for the deficiencies analysis and development of the multimodal solutions.

5.4 Categories of Economic Development along the Study Corridor

Based on the growth and associated growth characteristics, communities were grouped into four categories of economic growth and development as shown in **Table 5-2** and **Figure 5-4**.

Table 5-2: Economic Development and Associated Growth Characteristics

Growth Category	Growth Characteristics
Economic Expansion	High rate of employment growth leading to high rate of population and/or housing growth
Moderate Economic Growth	Moderate rate of job growth leading to moderate rate of population and/or housing growth
Slow Economic Growth	Low rate of job growth in harmony with low rate of population and housing growth
Population In-Migration	Significantly higher rates of population and housing growth than the rate of job growth

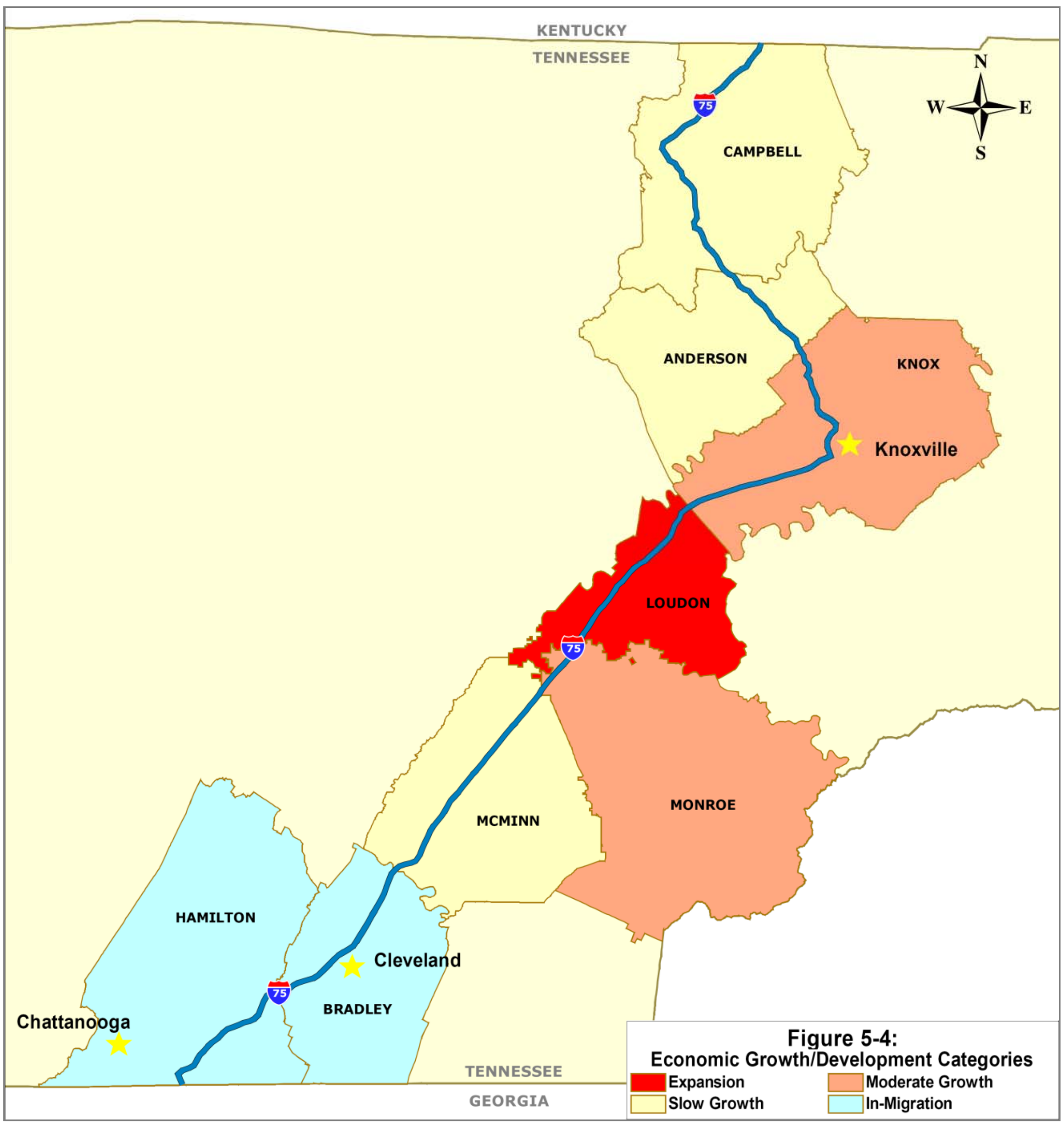

Figure 5-4:
Economic Growth/Development Categories

5.5 Growth Category and Growth Impact Scoring

Population growth, housing unit growth, and employment/job growth in Tennessee counties along the I-75 corridor were ranked according to their absolute number of net growth and to their rate of relative growth. The four categories shown in **Table 5-2** were used to group counties with comparable numbers of net growth and similar rates of relative growth. Each category was assigned an impact score to be used for the growth impact ranking. **Table 5-3** shows the description of the growth category and the impact ranking criteria.

Table 5-3: Growth Impact Categories and Impact Scoring

Growth Category	Impact Scores	Impact Ranking
Super High	8	Super High
Very High	7	High
High	6	Medium High
Moderate High	5	Low High
Low High	4	Medium
Moderate	3	High Low
Low	2	Medium Low
Loss/Very Low	1	Low

The overall growth impact scores and ranking were derived from the total net growth and total relative growth impact scores based on an equal weighting. The overall growth impact scores were then converted to overall growth impact ranking based according to the following:

- Ranking is from high to low, Ranking #1 is the highest ranked. Highest ranked has the largest number of scores (Growth impact score 21, 20, and 19 equals Ranking #1).
- For every ranking number (1, 2, 3, 4, 5, 6, and 7), there are three corresponding score numbers that are in consecutive order (score number 18, 17, and 16 are corresponding to Ranking #2).

The results of the growth ranking are provided in **Table 5-4** and **Figure 5-5**.

Table 5-4: Overall Growth Impact Scores for Counties along the I-75 Corridor

Sequence (North to South)	Tennessee Counties	Growth Impact Scores - Equal Weight Scenario			Overall Growth Impact Ranking
		Net Growth	Relative Growth	Overall Growth	
1	Hamilton	15	10	13	3
2	Bradley	10	10	10	4
3	McMinn	7	8	8	5
4	Monroe	8	13	11	4
5	Loudon	10	17	14	3
6	Knox	20	13	17	2
7	Anderson	7	4	6	6
8	Campbell	5	6	6	6

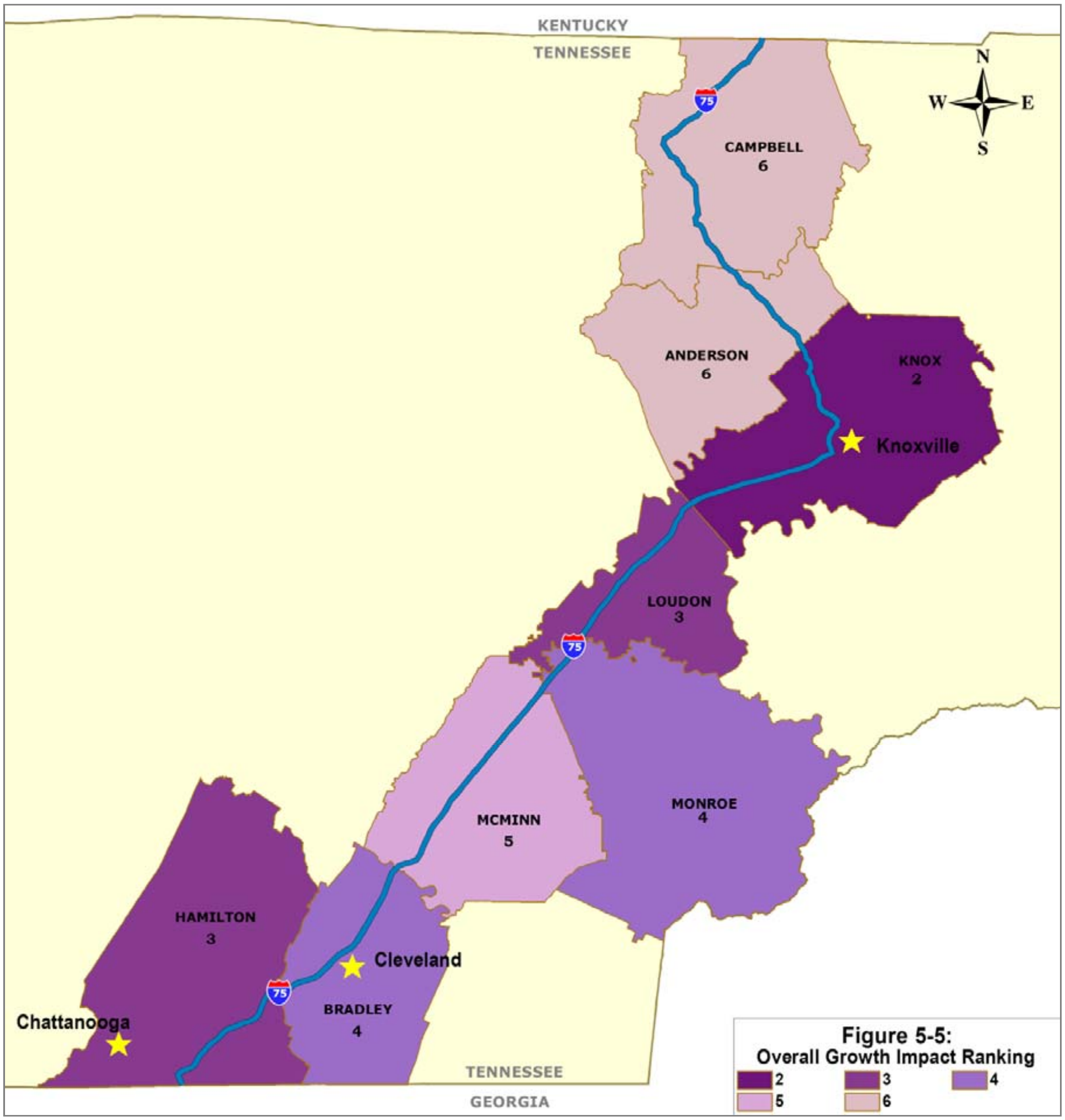

Figure 5-5:
Overall Growth Impact Ranking

5.6 Routes for Future Interchanges

Candidate roadways for new interchange access were identified based on information from the Tennessee Roadway Information Management System (TRIMS) database. There were 27 routes along the I-75 corridor that met the following criteria:

- No existing interchange access,
- At least one mile separation from an existing interchange in an urban area, and
- At least two mile separation from an existing interchange in a rural area.

The routes were ranked based on their residing county's growth impact scores and their functional classification. **Table 5-5** is a listing of ranked interchanges by county from south to north along the I-75 corridor.

Table 5-3: Roadways Identified for Future Interchanges

Location	Route
Hamilton County	Ooltewah-Georgetown Pike
Bradley County	Harrison Pike and SR 312
	Bancroft Road
	Harris Creek Road
	Hooper Gap Road
McMinn County	Hillsview-Sanford Road
	Rocky Mount / Union Chapel Road
	Rocky Mount-Union Chapel Road
	Coile Road
	Doc Womac Road
	Lanetown Road
	Hoover Rock Crusher Road
Monroe County	Raby Road
	County Line Road
Loudon County	Kingston Pike (US 70/SR 1)
	Hotchkiss Valley Road
Knox County	Brushy Valley Road
	Evertt Road
	Copeland Road
Anderson County	Wolf Valley Road
	Brushy Valley Road
	Pumpkin Hollow Road
	Hillvale Road
	Peach Orchard Lane
	Savage Garden Lane
Campbell County	Old Mill Road
	HW Coal Road

The list of interchanges and the ranking process conducted as part of this study are a guide to assist in further developments. The need for additional interchanges along I-75 at these locations will be based on the needs of the individual communities and will need to be coordinated with local land use plans and plans for future growth. Further study, such as an Interchange Justification Study or other environmental assessments, will be required for any of these projects to move forward. Routes for future interchanges were not included in the multi-modal solutions ranking or Project Priorities Technical Memorandum.

6.0 EVALUATION

6.1 Methodology

The following packages of solutions were evaluated as part of this task:

- Baseline "Do Nothing" Alternative
- Roadway Capacity – provide additional capacity to I-75 by improving the existing interstate
- Corridor Capacity – provide additional capacity to parallel routes by improving existing arterial routes or constructing parallel routes on new alignment
- Freight Diversion – impact of diverting truck traffic from I-75 to other modes
- Operational Solutions – Intelligent Transportation Systems and HELP program expansion, managed lane solutions, truck climbing lanes, interchange improvements, and park and ride expansion

The Tennessee Statewide Travel Demand Model and the urban area travel demand models from Chattanooga, Cleveland, and Knoxville were used to analyze the Roadway and Corridor capacity packages of solutions. The proposed solutions were coded into the appropriate model network and the output statistics of each model run were tabulated separately across each of the following geographic regions:

- Chattanooga MPO Area,
- Cleveland MPO Area,
- Cleveland to Knoxville,
- Knoxville TPO Area, and
- Knoxville to the Kentucky State Line.

The truck and rail component of the Tennessee Statewide Travel Demand Model was used to estimate the diversion of truck trips to rail due to improvements associated with the Norfolk Southern Railroad Crescent Corridor improvements.

Crash rates were estimated based on average crash rates from the Tennessee Roadway Information Management System (TRIMS) database by road functional classification, projected volume, and volume to capacity ratios. These rates were then applied to each package of solutions to estimate the change in crashes with each scenario.

Following the evaluation of the impacts of each of the packages of solutions, the benefits of each specific project were estimated. Using the estimated construction costs, a benefit cost ratio was developed for each project. The benefit cost ratio, as well as other metrics, will be used to prioritize projects in the I-75 Corridor Plan.

6.2 Evaluation Results

Each package of solutions was evaluated using various measures of effectiveness, identified in **Table 6-1** as "evaluation criteria." This table provides a comparison of each package to the existing-plus committed (E+C) highway networks for planning years 2011 and 2030. Full results of the evaluation are shown for each package and each geographic region in **Appendix D**. The 2030 Roadway Capacity package provided the greatest level of improvement for the corridor.

Table 6-1 provides the 2030 projected values for the unit of measure for each of the evaluation criteria and for each package of solutions. The results provided represent the implementation of each package separately and are not cumulative. For instance, the 2030 Roadway Capacity package provides the most potential delay reduction. It is projected to reduce recurring auto delay from approximately 57,600 hours per year in the 2030 E+C Scenario to below 30,600 hours annually. It is also projected to reduce recurring truck delay from roughly 28,500 hours per year to roughly 11,800 hours annually. The 2030 Corridor Capacity package and 2030 Rail package were projected to provide about equal delay reduction. The projected combination of truck and auto delay for both of these packages is 80,000 hours per year. The 2030 Operational Solutions package is projected to provide only marginal delay reduction when compared to the 2030 E+C Scenario. The projected time to travel the entire corridor in 2030 is shortest under the 2030 Roadway Capacity package and longest under the 2030 Operational Solutions package.

Table 6-1: Evaluation Results for Solution Packages

Evaluation Criteria	Unit	Baseline		Packages			
		2011 Existing + Committed Network	2030 Existing + Committed Network	2030 Roadway Package	2030 Corridor Package	2030 Rail Package	2030 Operations Package
Vehicle Hours Traveled - AUTO	Hour	128,624	179,377	168,991	176,988	178,298	178,754
Recurring Travel Delay - AUTO	Hour	23,232	57,626	30,649	53,394	55,026	57,510
Vehicle Miles Traveled - AUTO	Mile	7,194,645	8,315,597	9,457,465	8,464,574	8,419,233	8,288,630
Vehicle Hours Traveled - TRUCK	Hour	56,437	97,604	84,355	91,646	90,146	97,603
Recurring Travel Delay - TRUCK	Hour	8,401	28,460	11,759	25,679	25,727	28,210
Vehicle Miles Traveled - TRUCK	Mile	3,289,532	4,735,726	4,973,015	4,535,887	4,407,230	4,720,737
Time to Travel Across Entire Corridor	Minute	166	210	166	204	206	208
Travel Delay to Across Entire Corridor	Minute	28	72	28	66	68	70

6.2.1 Highlighted Evaluation Results for Roadway Capacity Package

The Roadway Capacity package is projected to provide delay relief throughout the entire corridor compared to the existing plus committed roadway network. In the rural areas, it could significantly reduce travel congestion and delay. For the rural segment between Cleveland and Knoxville the auto delay is projected to be reduced by 67 percent. On the rural segment of I-75 from Knoxville to Kentucky, auto delay is projected to be reduced by 25 percent. Overall, the percent reduction in delay is projected to be 47 percent for autos and 59 percent for trucks. The reduction in delay in terms of seconds per vehicle mile traveled was also determined for each major segment of the route. The reduction in auto delay ranged from 1 second per vehicle mile north of Knoxville, to 24 seconds per mile in the Knoxville urban area.

The Roadway Capacity package is projected to reduce the percentage of the route that will operate at level of service (LOS) D, E or F. The percent of the total corridor length that is projected to operate at LOS D, E, or F is 86 percent with the existing and committed network and 54 percent with the Roadway Capacity package. Summarized roadway capacity results for each of the main segments of the corridor are provided in **Table 6-2.**

Table 6-2: Evaluation Results for Roadway Capacity Package of Solutions

Evaluation Criteria	Region					Total
	Chattanooga	Cleveland	Cleveland to Knoxville	Knoxville	Knoxville to State Line	
Percent Reduction in Auto Delay Relative to 2030 E+C	7	29	67	60	25	47
Percent Reduction in Truck Delay Relative to 2030 E+C	8	27	72	65	16	59
Percentage of Corridor at LOS D-F (2030 Roadway Capacity Package)	97	25	0	95	23	54
Percentage of Corridor at LOS D-F (2030 E+C)	96	100	100	99	35	86
Percent Reduction in Travel Time Relative to 2030 E+C	5	4	5	36	1	21

6.2.2 Highlighted Evaluation Results for the Corridor Capacity Package

The Corridor Capacity package of solutions consists of improvements to existing routes or construction of new facilities parallel to I-75 to provide reductions in delay. The analyses indicate that while the new facilities constructed parallel to I-75 will be attractive in the urban areas, the net effect will be a slight reduction in congestion on I-75 in the urban areas and an increase in congestion on the rural segments of I-75. The unintended consequence of construction of or improvement to the parallel facilities in the Chattanooga and Knoxville areas is that as traffic moves to the new or improved parallel facilities, there is a latent regional traffic demand that is presently using the other highways and roads in these urbanized areas that will shift to I-75. The models indicate that this shifted traffic is more likely to remain on I-75 into the rural areas. Therefore, while the net effect in the urban areas may be less traffic on I-75, there will be a net increase in traffic, congestion, and travel times on the rural segments of I-75.

The implication of this analysis is that all of the potential solutions in the Chattanooga, Cleveland, and Knoxville areas included in the Corridor Capacity package should be analyzed separately in the project prioritization task to develop project-specific benefit/cost ratios which can be used to further refine alternatives for the I-75 Corridor Feasibility Study. The summarized corridor capacity results for each main segment of the corridor are provided in **Table 6-3**.

Table 6-3: Evaluation Results for Corridor Capacity Package of Solutions

Evaluation Criteria	Region					Total
	Chattanooga	Cleveland	Cleveland to Knoxville	Knoxville	Knoxville to State Line	
Percent Reduction in Auto Delay Relative to 2030 E+C	14	-20	-48	10	-71	7
Percent Reduction in Truck Delay Relative to 2030 E+C	12	-20	-37	14	-49	10
Percentage of Corridor at LOS D-F (Roadway Capacity)	88	100	100	98	38	86
Percentage of Corridor at LOS D-F (2030 E+C)	96	100	100	99	35	86
Percent Reduction in Travel Time Relative to 2030 E+C	0	-2	-3	7	-2	3

6.2.3 Evaluation Results from the Freight Diversion Package of Solutions

The Freight Diversion package of solutions has a positive impact by reducing auto and truck delay. However, there is not a significant reduction in the number of links that will operate at LOS D-F with this package of solutions. A summary of the evaluation results of the Freight Diversion package are provide in **Table 6-4**.

Table 6-4: Evaluation Results for the Freight Diversion Package of Solutions

Evaluation Criteria	Region					Total
	Chattanooga	Cleveland	Cleveland to Knoxville	Knoxville	Knoxville to State Line	
Percent Reduction in Auto Delay Relative to 2030 E+C	2.5	9.1	9.7	4.9	-2.4	4.5
Percent Reduction in Truck Delay Relative to 2030 E+C	2.2	8.9	30.5	9.5	13.8	9.6
Percentage of Corridor at LOS D-F (Freight Diversion)	95	100	100	99	15	86
Percentage of Corridor at LOS D-F (2030 E+C)	96	100	100	99	35	86
Percent Reduction in Travel Time Relative to 2030 E+C	0.5%	0.7%	1.1%	2.5%	0.3%	1.6%

6.2.4 Evaluation results for the Operational Package of Solutions

The Operational package described in Chapter 3 exhibits the least benefit of all of the packages in terms of the various measures of effectiveness. Most of the benefits are found in the reliability and safety categories as shown in **Appendix D**. These solutions are likely to have the lowest cost, can be implemented in the shortest period of time, and will minimize disruption of existing traffic conditions. These projects have the greatest potential to provide some short-term improvements in vehicular flow along the corridor, but are not expected to provide significant long term benefits.

6.3 Benefit / Cost Ratio Estimation Methodology

A benefit cost (B/C) ratio was estimated for each multi-modal solution. The B/C ratio is a measure to compare or assess the relative value of projects. The benefits used in the B/C cost ratio calculation refer only to those along I-75 itself. There are broader system-wide impacts on regional travel, including impacts to other roadways, but those were not included as part of this study. It should also be noted that the B/C ratio is not the sole determinate of a solution's value. The B/C ratios were calculated based on four specific performance metrics:

- Recurrent Congestion,
- Non-Recurrent Congestion,
- Safety, and
- Air Quality

Recurrent congestion is the congestion experienced on a daily basis due to traffic volume that approaches or exceeds the capacity of the roadway. The amount of recurrent delay for each solution was estimated using regional and statewide travel demand models. The models were used to evaluate the existing plus committed roadway network, as well as the multi-modal solutions for the base, interim, and horizon years.

Non-recurrent congestion is caused by incidents such as crashes, debris in the roadway, or inclement weather. Non-recurrent delay may be improved by select Intelligent Transportation Systems (ITS) solutions, such as weather management systems, dynamic message signs, and incident response teams (HELP). These solutions are focused on reducing the number of these delays, the amount of delay associated with each incident, and the time to provide emergency assistance to impacted motorists.

The benefits of the solutions for safety were estimated using the change in number of crashes, and the change in the number of fatalities. These performance measures were estimated based on crash and fatality rates summarized in the Tennessee Roadway Information Management System (TRIMS). The estimate changes in crashes and fatalities were determined based on a change in the vehicle miles traveled (VMT) and volume to capacity (V/C) ratio due to the improvements.

The impact to air quality of the multi-modal solutions was estimated using the Federal Highway Administration's (FHWA) Highway Economic Requirement System (HERS), 2002 analysis. Air pollution costs per mile traveled were estimated separately for automobiles and trucks.

To estimate the benefit to be used in the B/C ratio for each multi-modal solution, the monetary value of each performance measure shown in **Table 6-5** was used. For consistency in evaluating alternatives for multiple corridors, these values are also those used in the I-40/I-81 Corridor Feasibility Study Completed in 2008.

Table 6-5: Monetary Value of I-75 Performance Metrics

Performance Metric	Monetary Value
Recurrent Congestion for Autos	$19.82/hour of delay
Recurrent Congestion for Trucks	$36.05/hour of delay
Non-recurrent Congestion for Autos	$39.64/hour of delay
Non-recurrent Congestion for Trucks	$72.10/hour of delay
Crashes	$8,500/crash
Fatalities	$4,300,000 per fatality
Auto Air Pollution Costs	$0.011 per VMT
Truck Air Pollution Costs	$0.039 per VMT

6.3.1 Evaluation of Roadway Capacity Package of Solutions

The Roadway Capacity package of solutions provides for the widening of I-75 to achieve an acceptable level of service for the horizon year of 2030. For the purpose of this study, an acceptable LOS for urban and rural conditions corresponds to a LOS E and LOS D, respectively. The cost to construct, the cumulative benefits, and the B/C ratios of the roadway capacity package of solutions are shown in **Table 6-6** for 2015, 2020, and 2030.

6.3.2 Evaluation of Corridor Capacity Package of Solutions

The corridor capacity package of solutions provides for improving alternative parallel corridors adjacent to I-75. **Table 6-7** lists the cumulative net benefit, costs to construct, and the benefit cost ratios for 2015, 2020, and 2030.

Although the SR 475 Knoxville Parkway project was evaluated and is show in Table 6-7, it was decided based on the findings of a Supplemental Environmental Impact Statement that the project would not be constructed. The decision to select the “No-Build” alternative as opposed to the “Orange Route” was announced to the public on June 25, 2010.

6.3.3 Evaluation of Operations and Maintenance Package of Solutions

The Operations and Maintenance package of solutions provides for improvements to I-75 not associated with the additional capacity provided by constructing general purpose lanes on I-75 or by improving parallel routes. Solutions provided in this package include safety and operations improvements to I-75, Intelligent Transportation Systems (ITS), constructing truck climbing lanes, and constructing interstate crossovers. The cost to construct, the cumulative benefits, and the B/C ratios of the operations and safety improvements, ITS, and truck climbing lanes are shown in **Tables 6-8** through **6-10**, respectively for 2015, 2020, and 2030.

Table 6-6: Benefit / Cost Ratio for Roadway Capacity Solutions
(All Costs are in Thousands of Dollars)

Project ID	County	Project Description	Length (mi.)	Total Cost	Cumulative Net Benefits			B/C Ratio		
					2015	2020	2030	2015	2020	2030
A	Hamilton	Widen from 6 lanes to 8 lane from the Georgia State Line to Ringgold Road	0.6	$13,400	$1,125	$7,432	$23,462	0.08	0.55	1.75
B	Hamilton	Widen from 8 lanes to 10 lanes from Ringgold Road to the I-24/I-75 Junction	0.6	$5,270	$1,394	$9,125	$28,391	0.26	1.73	5.39
C	Hamilton	Improve the I-75/I-24 Interchange to provide three lanes for the I-75 movements through the interchange	0.7	$30,160	$687	$4,715	$15,735	0.02	0.16	0.52
D, E	Hamilton	Widen from 8 lanes to 10 lanes from the I-24/I-75 junction to East Brainerd Road (SR 320)	1.8	$46,275	$1,122	$7,545	$24,464	0.02	0.16	0.53
F	Hamilton	Widen southbound I-75 to 4 lanes from East Brainerd Road to SR 153	1.0	$41,175	-$81	-$654	-$2,646	0.00	-0.02	-0.06
G	Hamilton	Widen I-75 from 6 lanes to 8 lanes from Volunteer Ordnance Road to just south of US 64	2.1	$19,990	$799	$5,129	$15,458	0.04	0.26	0.77
H	Hamilton/ Bradley	Widen I-75 from 4 lanes to 6 lanes from north of US 64 to US 74	8.6	$82,525	$5,877	$37,604	$112,763	0.07	0.46	1.37
I	Bradley/ McMinn	Widen I-75 from 4 lanes to 6 lanes from US 74 to SR 163	16.0	$181,225	$8,763	$53,443	$147,129	0.05	0.29	0.81
J	McMinn	Widen I-75 from 4 lanes to 6 lanes from SR 163 to Monroe County	23.6	$244,945	$3,786	$25,329	$81,487	0.02	0.10	0.33
K	Monroe	Widen I-75 from 4 to 6 lanes from McMinn County to SR 68	1.0	$12,585	$239	$1,645	$5,514	0.02	0.13	0.44
L	Monroe	Widen I-75 from 4 lanes to 6 lanes from SR 68 to Oakland Road (SR 322)	1.6	$5,985	$819	$5,237	$15,691	0.14	0.88	2.62
M	Monroe/ Loudon	Widen I-75 from 4 to 6 lanes from SR 322 to Pond Creek Road (SR 323)	6.5	$55,975	$1,345	$8,746	$26,924	0.02	0.16	0.48
N	Loudon	Widen I-75 from 4 to 6 lanes from Pond Creek Road (SR 323) to the I-40/I-75 Junction	15.3	$173,770	$36,344	$269,934	$996,455	0.21	1.55	5.73
O, P	Loudon/ Knox	Widen I-75 from 6 to 10 lanes from the I-40/I-75 east to Pellissippi Pkwy (SR 162)	9.2	$255,530	$64,544	$485,617	$1,819,514	0.25	1.90	7.12

Table 6-6: Benefit / Cost Ratio for Roadway Capacity Solutions (cont.)

Project ID	County	Project Description	Length (mi.)	Total Cost	Cumulative Net Benefits			B/C Ratio		
					2015	2020	2030	2015	2020	2030
Q, R, S	Knox	Widen I-75 from 8 to 10 lanes from Pellissippi Pkwy (SR 162) to the I-40/I-75/I-640 Junction	8.3	$254,085	$29,335	$203,309	$687,742	0.12	0.80	2.71
T	Knox	Improve the I-75/I-40 Interchange to provide three through lanes on I-75	0.3	$17,065	$281	$1,928	$6,419	0.02	0.11	0.38
U	Knox	Improve the I-75/I-640/I-275 Interchange to provide 2 through lanes for I-75	0.7	$56,335	$126	$623	$960	0.00	0.01	0.02
V	Knox	Widen I-75 from 6 lanes to 8 lanes from the I-75/I-640/I-275 Junction to Emory Road (SR 131)	4.6	$127,530	$3,492	$24,260	$82,333	0.03	0.19	0.65
W	Knox	Widen I-75 from 4 lanes to 6 lanes from Emory Road (SR 131) to Raccoon Valley Road (SR 170)	4.7	$82,885	$6,221	$46,803	$175,363	0.08	0.56	2.12
X	Knox/ Anderson	Widen I-75 from 4 to 6 lanes from Raccoon Valley Road (SR 170) to Andersonville Hwy (SR 61)	5.6	$68,170	$5,500	$42,018	$160,138	0.08	0.62	2.35
Y	Anderson	Widen I-75 from Andersonville Highway to Cherry Bottom Road (SR 116)	6.5	$111,900	$8,780	$64,035	$231,332	0.08	0.57	2.07
Z	Anderson	Widen I-75 from 4 to 6 lanes from Cherry Bottom Road (SR 116 to Campbell County	0.6	$11,115	$754	$5,569	$20,413	0.07	0.50	1.84
AA	Campbell	Widen I-75 from 4 to 6 lanes from Anderson County to SR 63 (US 25W)	4.6	$74,300	$5,438	$34,903	$105,212	0.07	0.47	1.42

Table 6-7: Benefit / Cost Ratio for Corridor Capacity Solutions
(All Costs are in Thousands of Dollars)

Region	Route	Project Limits and Description	Total Cost	Cumulative Net Benefits			B/C Ratio		
				2015	2020	2030	2015	2020	2030
Chattanooga	SR 321/ GA 240	Widen route from 2 lanes to four lanes from US 41/US 76 in Ringgold, Georgia to US 64 in Tennessee.	$89,345	$596	$5,330	$23,577	0.01	0.06	0.26
Chattanooga	Chattanooga Bypass	Construct new 4 lane fully access-controlled facility from I-75 in Georgia to I-75 at the Hamilton/Bradley County Line.	$413,205	$26,639	$159,016	$419,677	0.06	0.38	1.02
Chattanooga/ Cleveland	US 64/US 11	Widen from 4 to 6 lanes from Little Debbie Parkway to just east of SR 317. Widen from 2 to 4 lanes from east of SR 317 to US 74.	$76,735	$785	$7,298	$33,275	0.01	0.10	0.43
Cleveland	US 11	Widen from 5 to 7 lanes from US 74 to Pleasant Grove Road. Widen from 4 to 6 lanes from Pleasant Grove Place to Boyd Street. Widen from 5 to 7 lanes from Boyd Street to SR 40 (South Lee Highway). Widen from 4 to 6 lanes from SR 40 (Lee Highway) to Paul Huff Parkway. Widen from 5 to 7 lanes from Paul Huff Parkway to Anatole Lane. Widen from 2 to 4 lanes from Anatole Lane to SR 308 (Lauderdale Memorial Highway).	$113,720	$315	$2,559	$10,396	0.00	0.02	0.09
McMinn County	US 11	Widen route from 2 to 4 lanes from SR 308 to Market Street/Newport Street in Charleston. Widen from 3 to 5 lanes from Market/Newport Street to just north of the Hiwassee River. Widen from 2 to 4 lanes from the Hiwassee River to SR 39.	$84,265	$111	$581	$1,087	0.00	0.01	0.01
McMinn County	US 11	Widen route from 2 to 4 lanes from McMinn County Road 260 to SR 68.	$68,145	$264	$2,114	$8,460	0.00	0.03	0.12
Monroe County	US 11	Widen route from 3 to 5 lanes from SR 68 to SR 322. Widen from 2 to 4 lanes from SR 322 to SR 72.	$85,550	$191	$1,275	$4,077	0.00	0.01	0.05

Table 6-7: Benefit / Cost Ratio for Corridor Capacity Solutions (cont.)

(All Costs are in Thousands of Dollars)

Region	Route	Project Limits and Description	Total Cost	Cumulative Net Benefits			B/C Ratio		
				2015	2020	2030	2015	2020	2030
Loudon County	US 11	Widen route from 2 to 4 lanes from SR 72 to N Street in Lenoir City. Widen from 2 to 4 lanes from Magnolia Street/Monument Street to US 70.	$113,455	$1,788	$15,281	$65,034	0.02	0.13	0.57
Knox County	US 70	Widen route from 5 to 7 lanes from US 11 to I-140.	$67,290	$1,993	$13,691	$45,765	0.03	0.20	0.68
Knoxville	SR 162 and SR 62	Widen from 4 lanes divided to 6 lanes and reconstruct intersections to provide full access control along SR 162 from Lovell Road to SR 62. Widen existing 4 lane divided on SR 62 to 6 lanes.	$215,245	$5,644	$38,415	$126,720	0.03	0.18	0.59
Anderson County	SR 170	Widen route from 2 lanes to 4 lanes from SR 62 to I-75.							
Knoxville	SR 131 to Ball Camp Pk to Schaad Rd to Callahan Dr	Widen SR 131 from SR 162 to Middlebrook Pike and construct a new 800 foot connector route to Ball Camp Pike. Widen Ball Camp Pike from 2 to 4 lanes from Middlebrook Pike to Ball Road. Widen Ball Road from Ball Camp Pike to SR 62. Widen SR 62 from Ball Road to Schaad Road. Widen Schaad Road from SR 162 to Pleasant Ridge Road. Widen existing Callahan Drive from 4 lane divided/5 lanes to 6 lanes and 7 lanes from Pleasant Ridge Road to I-75.	$87,550	$5,093	$34,491	$112,960	0.06	0.39	1.29
Knox County	Knoxville Parkway	Construct new 4 lane access-controlled facility from the I-40/I-75 junction to I-75 in Anderson County.	$637,290	$92,802	$664,591	$2,347,069	0.15	1.04	3.68
Anderson County	US 25W	Widen from 2 to 4 lanes from SR 61 to Landrum Road. Widen from 2 to 4 lanes from Old Cane Creek Road/Shaw Lane to Hill Street/Mason Avenue.	$101,035	$2,155	$17,374	$70,021	0.02	0.17	0.69
Campbell County	SR 116	Widen route from 2 to 4 lanes from I-75 to Howard Baker Road (US 25W/SR 63).	$64,830	-$446	-$3,270	-$11,900	-0.01	-0.05	-0.18

Table 6-8: Benefit / Cost Ratio for Operational Improvements

(All Costs are in Thousands of Dollars)

Project ID	Solution	Region	Total Cost	Cumulative Net Benefits			B/C Ratio		
				2015	2020	2030	2015	2020	2030
1	I-75, Exit 3 at East Brainerd Road - Ramp Queue Project	Hamilton County	$839	$311	$2,573	$10,621	0.37	3.07	12.66
2	I-75, Weigh Station ramp modification - Ramp Queue Project	Knox County	$1,090	$89	$542	$1,482	0.08	0.50	1.36
3	I-75, Westbound off-ramp to Lovell Road - Ramp Queue Project	Knox County	$2,194	$1,022	$6,186	$16,776	0.47	2.82	7.65
4	I-75, Northbound off-ramp to Callahan Drive - Ramp Queue Project	Knox County	$275	$111	$666	$1,783	0.40	2.42	6.49

Table 6-9: Benefit / Cost Ratio for ITS Solutions
(All Costs are in Thousands of Dollars)

Project ID	Solution	Region	Total Cost	Cumulative Net Benefits			B/C Ratio		
				2015	2020	2030	2015	2020	2030
1	Expand ITS instrumentation on I-75 from Oolteway-Georgetown Pike to SR 60 which includes segment over White Oak Mountain	Hamilton and Bradley County	$2,016	$891	$6,008	$19,540	0.44	2.98	9.69
2	Install ITS instrumentation and communications on I-75 at SR 68 (Sweetwater)	Monroe County	$250	$76	$525	$1,761	0.30	2.10	7.04
3	Install ITS instrumentation and communications on I-75 at US 321 (Lenoir City)	Loudon County	$250	$165	$1,197	$4,288	0.66	4.79	17.15
4	Expand arterial ITS communication and instrumentation on I-140 and US 129 for high-capacity route diversion	Knoxville	$3,632	$1,628	$12,292	$46,238	0.45	3.38	12.73
5	Expand TDOT SmartWay urban coverage to include I-75/I-40 from Lovell Rd to I-40/I-75 Interchange	Knoxville	$2,665	$3,233	$22,613	$77,465	1.21	8.49	29.07
6	Expand TDOT SmartWay urban coverage to include I-75 from north of Merchant Rd to the northern Knoxville urban boundary at Emory Rd	Knoxville	$1,332	$487	$3,784	$14,701	0.37	2.84	11.03
7	Install ITS instrumentation and communications on I-75 at SR 170 (Raccoon Valley Rd)	Knox County	$250	$240	$1,824	$6,916	0.96	7.30	27.67
8	Install ITS instrumentation and communications on I-75 at SR 61 (Andersonville Hwy)	Anderson County	$250	$136	$993	$3,581	0.55	3.97	14.32
9	Install ITS instrumentation and communications on I-75 at US 25W (SR 116)	Anderson County	$250	$100	$687	$2,294	0.40	2.75	9.17
10	Install ITS instrumentation and communications on I-75 at SR 63 (Howard Baker Rd)	Campbell County	$250	$129	$843	$2,632	0.51	3.37	10.53
11	Implement a fog and severe weather detection system on I-75 over Jellico Mountain	Campbell County	$8,886	$603	$3,799	$11,087	0.07	0.43	1.25
12	ITS deployment for route diversion along lower capacity routes to include signal coordination, special diversion timing plans, and center to center communications for US 11 and US 25	Rural Segments along Entire Corridor	$550	-	-	-	-	-	-

Table 6-10: Benefit / Cost Ratio for Truck Climbing Lanes
(All Costs are in Thousands of Dollars)

Project ID	Beginning Log Mile	Project Length (ft)	Region	Total Cost	Cumulative Net Benefits			B/C Ratio		
					2015	2020	2030	2015	2020	2030
1	1.06	5,250	Bradley County	$2,910	$891	$6,008	$19,540	0.44	2.98	9.69
2	9.74	9,715	Knox County	$2,910	$792	$4,955	$14,301	0.27	1.70	4.91
3	1.38	5,966	Campbell County	$2,910	$16,428	$102,797	$296,673	5.65	35.33	101.95
4	3.71	4,805	Campbell County	$2,025	$13,429	$84,030	$242,512	6.63	41.50	119.76
5	5.78	14,784	Campbell County	$2,025	$10,375	$64,921	$187,362	5.12	32.06	92.52
6	15.11	5,386	Campbell County	$2,025	$12,649	$79,149	$228,425	6.25	39.09	112.80
7	26.08	4,066	Campbell County	$2,025	$3,603	$22,546	$65,068	1.78	11.13	32.13
8	26.85	1,584	Campbell County	$2,025	$482	$3,017	$8,706	0.24	1.49	4.30
9	27.37	13,253	Campbell County	$2,025	$2,017	$12,623	$36,429	1.00	6.23	17.99
10	30.31	1,690	Campbell County	$2,025	$2,315	$14,485	$41,805	1.14	7.15	20.64

6.3.4 Evaluation of Freight Focused Package of Solutions

The benefits and costs of the Norfolk Southern Crescent Corridor improvements were evaluated as part of this study, and that information was used to generate a benefit-cost (B/C) ratio for this package of rail improvements. In addition, B/C ratios were calculated for two highway/rail grade separation projects located along corridors near I-75. B/C ratios were not calculated for the other freight-related improvements described in section 4.3 of this memorandum. While these other recommendations would help encourage freight diversion from trucks to other modes, their direct impact on the transportation network cannot be precisely determined. Therefore a detailed benefit calculation was not conducted.

The approach for determining the B/C ratio for the Crescent Corridor was different than the approach used for other project types considered in this study. Costs included in this calculation were based on the Norfolk Southern estimate for the entire Crescent Corridor program, which includes improvements both within Tennessee and outside of the state, on an alignment stretching from New Jersey to Memphis and New Orleans (**Figure 6-1** shows the primary route improvement areas along this corridor). However, benefits were calculated only for the 162-mile section of I-75 in Tennessee from the Georgia state line north to the Kentucky state line. The monetary values of metrics shown in **Table 6-5** were used to calculate the benefits of the freight focused solutions.

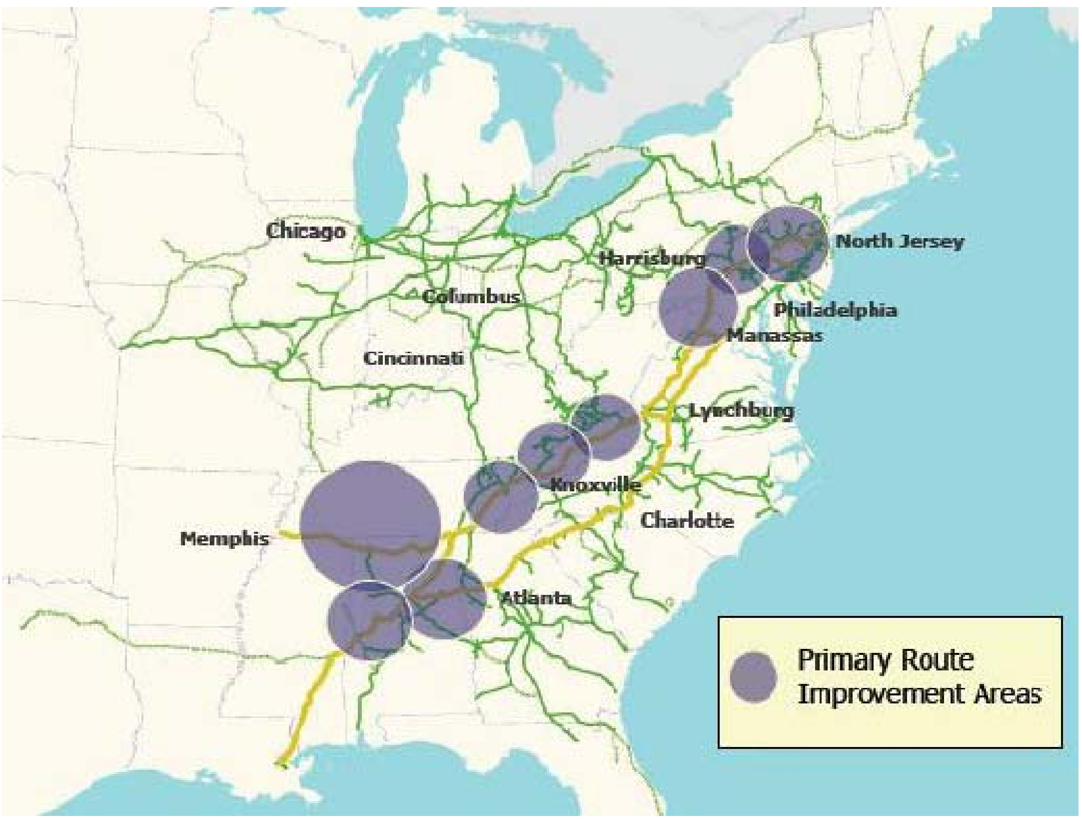

Figure 6-1: Norfolk Southern Crescent Corridor and Proposed Rail Improvements

Based on the cumulative benefits accruing along the I-75 corridor through year 2030, and a total estimated cost of $2 Billion, the B/C ratio estimated for the Crescent Corridor is 1.4. Of course, the total benefit to the state of Tennessee from this package of rail projects is much higher than that used to calculate this B/C ratio. The B/C ratio calculated for the Crescent Corridor along I-40/I-81 in the I-40/I-81 Corridor Feasibility Study, 2008, was 5.0. There would certainly be benefits to Tennessee's other interstate highways and major roadways beyond those included in these two analyses that are not accounted for in these two studies.

Improvements to the rail network, and any subsequent increase in rail traffic, could have impacts on at-grade crossings in terms of safety and vehicle delay. Two at-grade crossings on roadways in the I-75 study area were identified that may be impacted by increased rail movements along the corridor; Ringgold Road in Hamilton County (Crossing No. 719675S), and Emory Road (SR 131) in Knox County (Crossing No. 730822B). The benefit cost methodology used to evaluate grade separation projects for these two crossings was derived from FHWA's Railroad Highway Grade Crossing Handbook. This handbook provides guidance on calculating the B/C ratio associated with projects that improve at-grade crossings. Benefits from these projects typically include reduction in vehicle delay and increased safety. The primary factors related to vehicle delay are the number of trains per day, average train length, train passing time, and the average daily traffic of vehicles. Safety-related benefits are derived from the projected number of crashes avoided after the improvement is implemented.

Using this methodology, the B/C ratio for the Hamilton County rail crossing grade separation is 0.044, and the ratio for the Knox County crossing is 0.048. The high capital costs for these grade separations ($7.4M and $7.7M, respectively), coupled with resulting minimal delay and safety-related benefits led to the relatively low B/C ratios for these projects. In fact, even if train traffic and vehicle traffic were both doubled, the B/C ratios for these projects would still be far less than 1.0. **Table 6-11** summarizes the benefits and costs used in this calculation.

Table 6-11: Benefit / Cost Ratio for Rail Grade Crossings

Rail Crossing Location and Number	Cumulative Net Benefits		Present Value of Capital Cost	B/C Ratio
	Delay	Safety		
Ringgold Road, Chattanooga, Crossing No. 719675S	$253,300	$67,900	$7,359,000	0.044
Emory Road (SR 131), Knoxville, Crossing No. 730822B	$292,800	$78,500	$7,726,000	0.048

6.4 Conclusions

The costs and benefits associated with each of the four packages of solutions were estimated and a cost benefit (B/C) ratio was developed for each project. The benefits associated with the packages of solutions were for I-75 itself, although other benefits along parallel routes could result. Based in part upon the B/C ratio, a Corridor Plan will be developed that prioritizes projects from the multi-modal solutions.