Atlanta Regional

MANAGED LANES Implementation Plan

FINAL REPORT

December 2015

Prepared for

GDOT
Georgia Department of Transportation

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1 INTRODUCTION

1.1 STUDY OVERVIEW

In November 2012, the Georgia Department of Transportation (GDOT) Division of Planning began two coordinated study efforts:

1. The Metro Atlanta Operational Planning Study (OPS), which identified low-cost operational strategies that can be quickly implemented to alleviate bottlenecks
2. The Atlanta Regional Managed Lanes Implementation Plan (MLIP), which updated the 2010 Managed Lanes System Plan (MLSP) with potentially lower-cost and easier to implement managed lane projects to address major capacity issues

This final report documents the MLIP. However, given the coordinated efforts between the two studies, a high level overview of each study is provided here. The OPS final report is in a separate document, entitled *Metro Atlanta Operational Planning Study Final Report, December 2014*.

1.1.1 Managed Lanes Implementation Plan (MLIP)

GDOT's award-winning Atlanta Regional MLSP completed in 2010 was the first system-wide evaluation of priced managed lanes in the United States – an innovative approach to urban area mobility. The plan met the following goals:

- Protected mobility
- Maximized person/vehicle throughput
- Minimized environmental impacts
- Provided a financially feasible system (using a blend of traditional, federal and state funds, and public-private partnerships)
- Designed and maintained a flexible infrastructure for varying lane management

Atlanta Regional MANAGED LANES Implementation Plan

The Atlanta Regional Managed Lane Implementation Plan (MLIP) reflects the funding constraints and knowledge gained by GDOT from managed lane projects recently implemented around the country since the Atlanta Regional Managed Lane System Plan (MLSP) was adopted in 2009. The funding constraints were based on the uncertainty of federal authorizations along with the 2012 failure at the local level to pass the regional sales tax referendum for transportation allowed for in the Transportation Investment Act of 2010. The constraints were applied prior to the passage of Georgia's Transportation Funding Act of 2015. The intent is to have a cost-conscience focused, prioritized list of managed lane projects that avoid the need to rely on long-term private financing agreements. Lower-cost solutions that maximize the delivery of travel-time reliability across the region and that could be more quickly and efficiently implemented were considered.

1.1.2 Operational Planning Study (OPS)

Metro Atlanta has a well-established network of interstates and limited-access facilities. However, many of these facilities experience traffic congestion during peak travel periods. In some instances, this congestion is due to recurring bottlenecks; other times, congestion is incident-related. Given limited federal funding availability, the GDOT is looking to improve the existing transportation system.

Metro Atlanta OPS OPERATIONAL PLANNING STUDY

The OPS provided an operational assessment of the interstate and limited-access system in the metro Atlanta region. Specifically, the OPS:

- Identified bottleneck areas along the limited-access facilities in the metro Atlanta region
- Identified and evaluated potential low-cost improvements that maximized capacity
- Documented a prioritized list of operational project recommendations

1.2 STUDY AREA

There are a total of 20 corridors that were evaluated for potential managed lanes and operational strategies as part of the MLIP and OPS. I-75 north of I-285 and I-575 were not part of the study area due to the recent letting of the reversible managed lanes known as the Norwest Corridor project. I-285 North from I-75 North to I-85 North was not part of the study because of the current Environmental Impact Statement (EIS) underway along the corridor. The MLIP study area is illustrated in **Figure 1.1**.

The candidate corridors included:

1. I-75 South from I-285 to SR 16
2. I-85 North from I-285 North to SR 211
3. I-85 South from I-285 South to US 29
4. I-20 West from I-285 West to Post Road
5. I-20 East from I-285 East to SR 138
6. I-285 South from I-75 South to I-20 East
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10. SR 400 from I-285 to SR 20
11. I-75 Inside I-285
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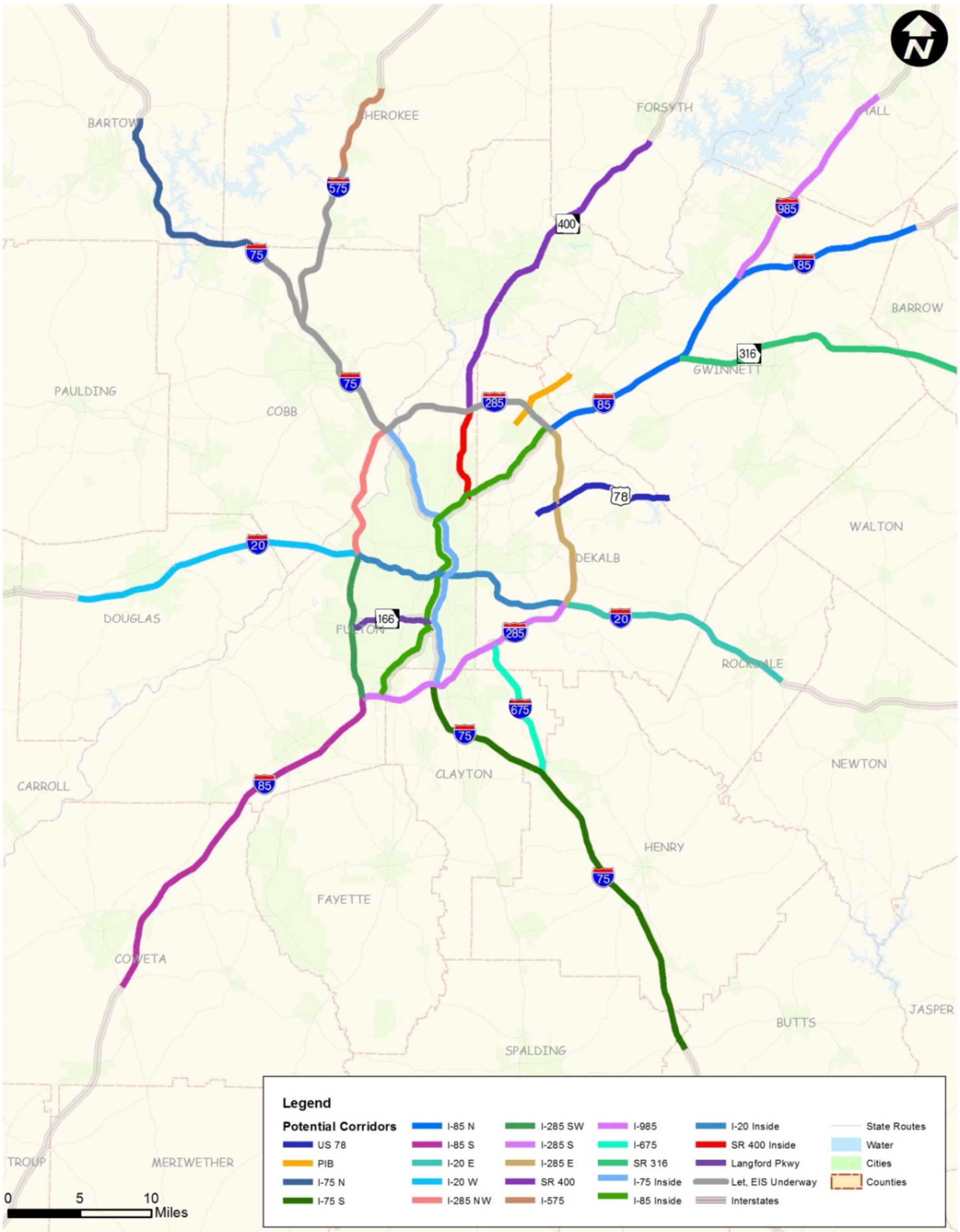
14. SR 400 Inside I-285
15. SR 166 / Langford Parkway
16. I-675 from I-75 to I-285
17. I-985 from I-85 to SR 13
18. SR 316 from I-85 to SR 81
19. US 78 from N. Druid Hills Road to Rockbridge Road
20. Peachtree Industrial Boulevard

Figure 1.1: Study Corridors[1]



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[1] *I-75 North and I-285 North were removed from the MLIP study area as both corridors are currently let or have an EIS underway for managed lanes projects.*

1.3 PURPOSE OF THIS REPORT

The scope of the MLIP included the following tasks:

- Data Collection
- Stakeholder Coordination and Outreach
- Corridor Screening
- Needs Assessment
- Development of Managed Lane Strategies
- Evaluation of Managed Lane Strategies
- Financial Assessment
- Findings

This final report provides an overview of the methodology used to identify corridor needs, including the collection and compilation of various transportation data for the study area corridors, as well as how potential managed lane solutions were developed, evaluated, and prioritized. As part of this process, extensive coordination and outreach took place between GDOT and its stakeholders to assist with what would ultimately be the list of potential managed lane projects.

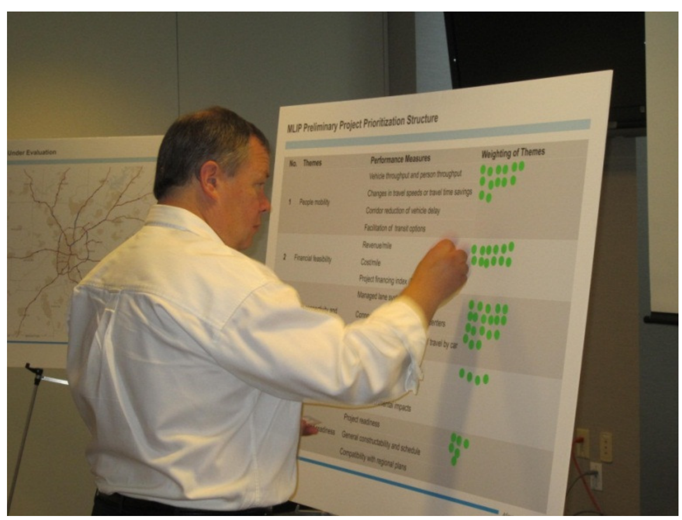
1.4 FINDINGS

The MLIP found that managed lanes were an appropriate solution along I-20 East and West, I-285 East and Northwest, I-85 North, SR 316, SR 400 North, and I-75 South. All of these corridors were deemed feasible for new lanes. A subset of these corridors was also deemed feasible for further engineering for the potential use of dynamic flex lanes, including I-20 East and West, I-285 Northwest, and I-75 South. How the managed lane will be delivered (new lane versus dynamic flex lane) will be determined during the project development process as part of an independent study or preliminary engineering, as well as the planning process, as part of the Atlanta MPO's Regional Transportation Plan.

Various evaluation criteria, including project financeability index (PFI), were used to determine the feasibility of each priced managed lane treatment. Detailed analysis on the evaluation of all potential managed lanes is located in **Chapter 7**, beginning on page 101. A summary of MLIP findings is located in **Chapter 9**, beginning on page 120. **Table 9.1** (New Lanes) and **Table 9.2** (Dynamic Flex Lanes) provide a summary of the financial criteria, including the 30-year revenue, capital costs, and 30-year operation and maintenance costs for each of the managed lane strategies that could move forward for further analysis and consideration.

2 STAKEHOLDER COORDINATION AND OUTREACH

Several stakeholders and agency groups were involved in the development of the MLIP. Two committees were formed for the purpose of both the OPS and MLIP studies: 1) Stakeholder Committee comprised of transportation agencies in the Atlanta region; and 2) Community Improvement District (CID) Committee comprised of all the CIDs in the region at the time of the study. In addition, GDOT met with several industry partners to gain meaningful input into the MLIP, as well as presented at multiple industry functions and conferences to assist with additional outreach.



2.1 STAKEHOLDER AND CID COMMITTEES

The Stakeholder Committee established for both the OPS and MLIP studies included representatives from the following:

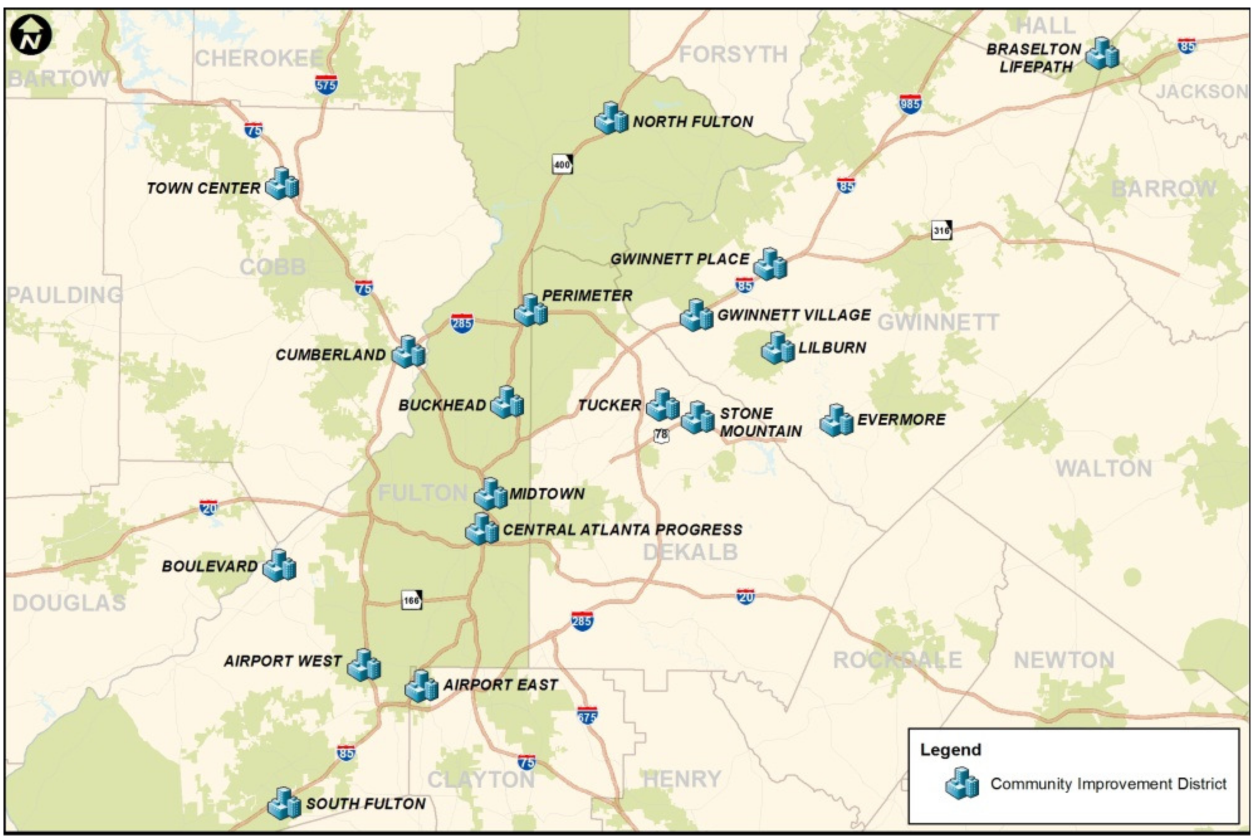
- GDOT
  - Deputy Commissioner
  - Division of Engineering
  - Division of Planning
  - Office of Traffic Operations
  - Office of Innovative Delivery
  - District 7
  - Traffic Management Center (TMC)

- Governor Nathan Deal's Office
- Georgia State Road and Toll Authority (SRTA)
- Georgia Regional Transit Authority (GRTA)
- Atlanta Metropolitan Planning Organization (MPO)
- Metropolitan Atlanta Rapid Transit Authority (MARTA)
- Federal Highway Administration (FHWA)

Stakeholder Committee meetings were held on the following dates covering the milestones noted:

1. January 24, 2013 – Overview of study
2. March 25, 2013 – Existing needs, corridor screening, and preliminary projects for evaluation
3. September 9, 2013 – Preliminary project prioritization structure and interactive exercise
4. June 3, 2014 – Findings

Figure 2.1: CID Locations



The CID Committee established for both the OPS and MLIP studies included representatives from the following 18 CIDs:

- Boulevard CID
- Lilburn CID
- Gwinnett Place CID
- Gwinnett Village CID
- Cumberland CID
- Buckhead CID
- Evermore CID
- Midtown CID
- Stone Mountain CID
- Atlanta Downtown Improvement District
- Braselton Lifepath CID
- Tucker CID
- North Fulton CID
- Perimeter CID
- South Fulton CID
- Town Center CID
- Airport West CID
- Airport East CID

CID Committee meetings were held on the following dates:

1. May 2, 2013 - Overview of study, existing needs, corridor screening, and preliminary projects for evaluation
2. September 16, 2013 – Preliminary project prioritization structure and interactive exercise

Each committee meeting was leveraged to engage the stakeholders and CIDs in order to gain meaningful input throughout each step of the process, including the development and testing of a variety of operational projects across metro Atlanta.

Techniques utilized at each meeting varied from PowerPoint presentations to interactive exercises, as well as roundtable discussions and break-out groups. For instance, the Stakeholder and CID Committees both participated in an exercise in which they weighted what they valued most as it related to project prioritization criteria and performance measures. The results were then used to assist with the development of weighting scenarios to apply to the project prioritization criteria in order to tier and prioritize projects.

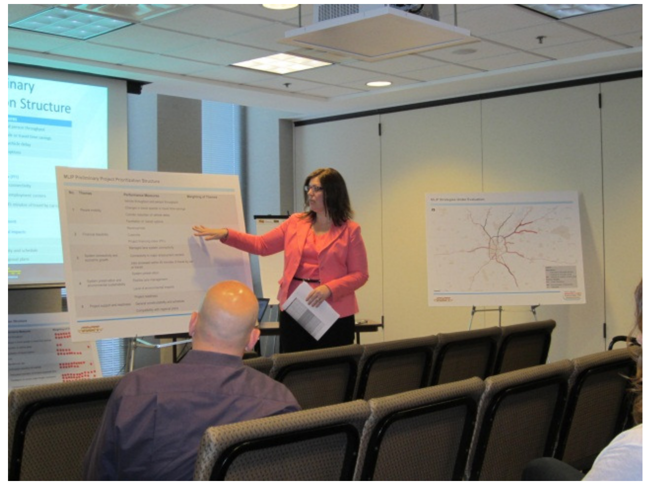
A summary of both the Stakeholder and CID Committee meeting minutes, as well as copies of the PowerPoint presentations, is provided in **Appendix A.**

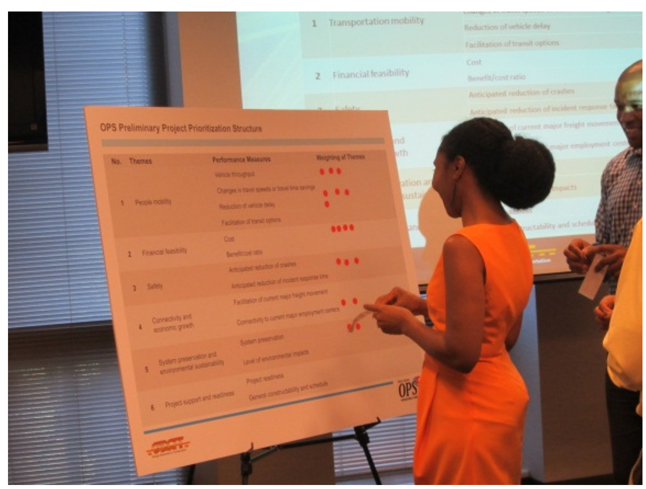
2.2 ADDITIONAL AGENCY COORDINATION

In addition to the Stakeholder and CID Committee meetings, the MLIP project team conducted several additional meetings with GDOT, SRTA, GRTA and Atlanta MPO employees including:

- GDOT Commissioner (August 2013)
- GDOT Upper Management meeting (January 2014, May 2014, December 2014)
- FHWA (March 2014)
- GRTA Board members and staff (April 2013)
- GRTA staff (November 2014)
- SRTA staff (April 2013, January 2014, December 2014)
- Atlanta MPO staff (December 2012, March, May, July, September 2013; January 2014)
- Atlanta MPO Technical Coordinating Committee (TCC) (May 2013)
- Atlanta MPO Managed Lanes Subcommittee (March and June 2013)
- Atlanta MPO Transportation and Air Quality Subcommittee (May 2013)

Coordination efforts with these groups helped the MLIP in evaluating and determining capacity and managed lane needs on metro Atlanta interstates and limited-access facilities, as well as considerations for different managed lane treatments.





2.3 INDUSTRY ENGAGEMENT

In addition to engaging stakeholders that will be directly influenced by priced managed lane projects in the Atlanta region, it is also important to engage a wider audience of stakeholders from across the state and nation. The MLIP engaged a wider audience by presenting the project process, updates, and preliminary results at several conferences throughout the state and the U.S.

The MLIP engaged stakeholders from outside the immediate Atlanta region through several conference presentations including:

- Transportation Research Board (TRB) Freeway and Managed Lanes Operation Meeting and Conference (June 2013)
- Georgia Chapter – American Planning Association (GPC) Conference (October 2013)
- Ohio Transportation Engineering Conference (OTEC) (October 2013)
- American Council of Engineering Companies (ACEC) of Georgia/GDOT Transportation Summit (November 2013)
- Southern District of the Institute of Traffic Engineers (SDITE) Annual Meeting (April 2014)
- American Planning Association (APA) National Planning Conference (April 2014, April 2015)
- Georgia Partnership for Transportation Quality (GPTQ) (December 2014)
- TRB Annual Meeting (January 2015)

3 DATA COLLECTION

As part of the MLIP, GDOT compiled existing available data, as well as purchased new data when deemed appropriate, to assist with identifying managed lane needs along limited access facilities in the study area. GDOT also reviewed previous studies, in addition to planned and programmed projects, to assist with needs identification and to determine if managed lane projects were already underway or planned for the location. Furthermore, a video log windshield survey was conducted on all limited access facilities in the region as part of the MLIP that was used to assist with determining physical constraints and problem areas. **Table 3.1** illustrates the data and user inputs used for the MLIP.

Table 3.1: MLIP Data Sources

Data Inputs	User Inputs
Speeds & Counts NAVIGATOR	GRTA Bus Drivers GRTA
Aerial Congestion Survey Skycomp	HERO Unit Operators GDOT Georgia Department of Transportation HERO
GPS Speeds & Duration of Congestion TOMTOM	 GDOT TMC Staff
Atlanta MPO Model ATLANTA REGION PLAN 2040	Stakeholders 

3.1 SUMMARY OF PREVIOUS STUDIES

There have been a variety of studies in the Atlanta region over the years evaluating congestion solutions along the interstate system and surrounding transportation system. Most of them are presented as a part of long-range planning efforts or corridor studies. Overall, these studies have varied from high-level, system-wide (regional) assessments all the way down to more detailed analyses at the corridor level. **Figure 3.1** lists all of the recently completed relevant studies and indicates whether it included managed lane and/or operational strategies for consideration.

In many cases where managed lane projects were identified in previous studies, such as the GA 400 Variable Pricing Feasibility Study (SRTA, 2010), these projects were further evaluated to determine if they should be included in the MLIP recommendations and/or, if a project modification would be deemed appropriate given more recent traffic conditions.

Figure 3.1: Review Findings of Relevant Studies

STUDY NAME	STUDY RECOMMENDATIONS: Managed Lane Strategies	STUDY RECOMMENDATIONS: Operational Strategies
2007		
• Buford Highway Multimodal Corridor Study (ARC)		✓
• Tara Blvd/US 19/41 Multimodal Corridor Study (ARC)		✓
• Southern Regional Accessibility Study (ARC)	✓	✓
2008		
• SR 6 Corridor Study (ARC)		✓
2010		
• GA 400 Variable Pricing Feasibility Study (SRTA)	✓	
• Statewide Strategic Transportation Plan 2010-2030 (IT3) (GRTA)	✓	✓
• Atlanta Radial Freeway Strategic Plan (GDOT)		✓
2011		
• Connect Atlanta (City of Atlanta)		✓
• Atlanta Strategic Regional Thoroughfare Plan (ARC)		✓
• Update on Congestion Snapshots (ARC)		✓
• I-285/I-20 West Interchange Reconstruct Feasibility Report (GDOT)	✓	✓
• I-85 North Express Managed Lane Alternatives: Moveable Barrier Wall System (GDOT)	✓	
• Misc. TIGER Grant Applications	✓	✓
2012		
• US 78 Moveable Barrier Reversible Lanes (Georgia Tech)		✓
2013		
• Feasibility of Implementing Reversible Movable Zipper Barrier Lanes I-20 East between Columbia Dr. and Panola Rd. (GDOT)		✓
On-going		
• Revive285 (GDOT)	✓	✓
• GA 400 Managed Lane Study (GDOT)	✓	✓
• I-85 HOT Lane Extension (GDOT)	✓	
• I-75 South Express Lanes (GDOT)	✓	
• I-20 East Managed Lane Study (GDOT)	✓	✓
• I-75 N Atlanta to Chattanooga Corridor Study (GDOT)	✓	✓
• I-75 Master Plan (GDOT)	✓	✓

3.2 SUMMARY OF PLANNED OR PROGRAMMED PROJECTS

Managed lane projects that are currently planned or programmed in the Atlanta MPO's *Plan2040* Transportation Improvement Program (TIP), as well as GDOT's State Transportation Improvement Program (STIP), were obtained early in the study process. **Table 3.2** lists the programmed managed lane projects for the study area. **Figure 3.2** illustrates the phasing of managed lane projects that are either currently programmed, let, or undergoing environmental review.

Table 3.2: *Plan2040* Programmed Managed Lane Projects

Status	GDOT PI #	Description
DEIS has been submitted to FHWA	0001758	I-285 managed lanes/Revive285 (from I-75 to I-85)
CE approved (2014)	110600-	I-85 North managed lanes (from SR 317/Old Peachtree Rd to SR 324/Gravel Springs Rd)
Let with opening in 2017	0009157	I-75 South managed lanes (from SR 138 to Eagles Landing Pkwy)
Let with opening in 2017	0009156	I-75 South managed lanes (from Eagles Landing Pkwy to SR 155)
Let with opening in 2018	0008256	Northwest Corridor managed lanes (Akers Mill Rd to Hickory Grove Rd on I-75, I-75 to Sixes Rd on I-575)
Long Range	0001757	SR 400 managed lanes from I-285 to SR 20
Long Range	0001759	I-75 South managed lanes from CW Grant Pkwy to SR 138

Note: DEIS = Draft Environmental Impact Statement, CE = Categorical Exclusion.

Figure 3.2: Programmed Projects Map

3.3 TRAFFIC DATA

A major objective of the data collection activities for the MLIP included locating and consolidating existing and new traffic data from several sources. The various data sources and a brief summary of each are discussed in the following sections.

3.3.1 Existing Data

Existing data sources were utilized as much as possible to maximize consistency with previous GDOT planning efforts. Existing data that was collected for the MLIP included model results, traffic counts and speeds, crash data to inform traffic safety, transit routes and park and ride locations, demographic data, and geographic data. The existing data sources are illustrated in **Table 3.3**.

Table 3.3: Existing Data Collected for the OPS

Description	Purpose	Source
SkyComp Aerial Congestion Surveys (2010)	Identification of congestion and bottleneck locations	GDOT
NaviGAtor Traffic Counts and Speeds by Lane (2012)	Identification of congestion and bottleneck locations	GDOT TMC (NaviGAtor)
GDOT's Annual Traffic Counts (2011)	Identification of congestion and bottleneck locations	GDOT
Crash Data (2007-2009)	Identification of high crash locations, especially trucks	CARE

GDOT's NaviGAtor collects traffic volume and speed data every 15 minutes and distributes traffic information to the public through websites or 511 telephone services. SkyComp data is collected through aerial surveys that monitor traffic flow along metro Atlanta freeways. These data sources, along with 2011 traffic count and Crash Analysis Reporting Environment (CARE) data, will be discussed in more detail in **Chapter 4** of this report.

3.3.2 New Traffic Count Data Collected

In addition to the existing data available, new data was collected for the MLIP and is summarized in the following paragraphs.

3.3.2.1 Speed Data

Collecting accurate speed data along limited access facilities was essential to effectively determine the most congested locations and what time of day that congestion was happening at those locations throughout the study area. A variety of sources were considered, including the following:

- GDOT Traffic Management Center (TMC) - NaviGAtor
- INRIX

- TomTom GPS
- AirSage

Table 3.4 illustrates the differences between the various data sources that were considered for the MLIP, as well as the pros and cons of each. After careful consideration, it was determined that in addition to speed data from the GDOT TMC's NaviGAtor system, TomTom GPS data would be purchased to supplement the NaviGAtor speed data. This allowed GDOT to maintain the project schedule while at the same time providing an accurate and reliable sample size. The NaviGAtor speed data was obtained for October of 2012, while the TomTom GPS speed data was obtained for October of 2010.

Table 3.4: Speed Data Sources

Source	GDOT TMC (NaviGAtor)	INRIX	TomTom GPS	AirSage
Type	Cameras and Loop Detectors	Probe	GPS	Cell phone
Time Intervals	5 min.	15 min.	1 hour	Varies
Pros	Speed by lane 24 hours per day, 7 days per week	Larger sample size; Provides all 24 hours of the day for the entire year	Although not as large of a sample size as INRIX, it is a sufficient sample size on limited access facilities Maintain schedule	Potential for lower cost
Cons	Point locations, not segments	Potential for schedule delays Third party licensing restrictions prevent sharing of GIS shape file with other agencies	Limited to 6 hours of data per run and queries certain days of the month (mid-week)	Potential for picking up speeds erroneously on parallel facilities

The speed data for both NaviGAtor and TomTom GPS were compared to determine if additional speed data or travel time runs may be necessary to clarify any areas of concern within the region. It was found that both data sources complemented each other and illustrated similar congested areas. Therefore, no additional speed data was necessary above and beyond the purchase of the TomTom GPS data. Details on the findings of the congested speed data analysis are included in **Chapter 4** of this report.

3.3.3 Windshield Survey

In order to assist with evaluating the feasibility of different managed lane strategies, in particular, the use of dynamic flex lanes using the outside shoulder and contraflow lanes using moveable barriers, a windshield survey was conducted by roadway engineers as part of the MLIP on all limited access facilities within the Atlanta region. The goal was to determine how the existing pavement could be used even more efficiently without converting currently operating general purpose (GP) and existing managed (High Occupancy Vehicle (HOV)) lanes in the peak direction into toll lanes.

Using a high definition video camera mounted on top of a car, a wide shot was taken to cover the shoulder(s) as well as nearby lanes. When the roadway was wider than three lanes the area had to be driven twice to properly document both the inside and outside shoulder widths. This video was then used to take screen captures at bridges or other potential narrow points, as well as to confirm any field data collected. While driving the corridors, a team member in the passenger seat would take notes on the following visible conditions, later to be compared with the video for accuracy:

- Number of managed/HOV lanes
- Number of general purpose lanes
- Inside shoulder width
- Outside shoulder width
- Managed/HOV lane width
- General purpose lane width
- Travel lane material (such as concrete or asphalt and partial v. full depth)
- Shoulder material (such as concrete or asphalt and partial v. full depth)
- Median width
- Auxiliary lane additions
- Light pole locations
- Miscellaneous unique items of interest

Bridges were often the “issue point(s)” along corridors and could both potentially increase the cost and delay the immediate implementation of a specific corridor. In some cases, the volume of traffic crossing the existing bridge may even prevent a simple, cost effective replacement. Bridges are also often surrounded by ramps with geometric complications at gores, elevations/grade differences requiring retaining walls, unique drainage patterns, etc., all of which would potentially need to be modified. The following specific information was observed at each bridge and interchange:

- Shoulder narrowing at the bridge
- Name of cross street
- Over or under pass
- Severe ramp/gore cross slope

The most common issue noted were narrow shoulders under long standing bridges. These vary in size and volume of traffic carried, requiring that each location be individually evaluated for a preferred solution. Where the problematic bridge crosses over the existing expressway the only apparent solution is full bridge replacement. Bridges supporting expressway traffic would simply require widening. In some locations, the bridge replacement could prove to be a fatal flaw since the road being carried is very congested with limited right-of-way at each abutment to allow an easy alignment shift for replacement.

Options to use contraflow lanes were also studied as part of the MLIP. Accomplishing this goal requires that traffic pass through the existing median barrier at ingress/egress points. It was assumed that overhead signs could be relocated and drainage inlets could be modified to carry traffic loading at these points. This leaves three items of importance that were noted during the field inspection:

- Bridge columns
- Street lighting
- Elevations differences between the two sides of the expressway

The final item of importance was pavement type and quality. While notes were taken concerning the existing roadbed, the focus was on the shoulders, as this was the location that would be carrying non-typical loading with some of the strategies developed as part of this study. Asphalt shoulders were assumed to be partial depth and require full replacement. Concrete shoulders were assumed to be full depth pavement, requiring only restriping and/or widening as required.

Some miscellaneous items of noted importance were also documented. These included:

- Locations where ramps could be shortened to eliminate a narrowing of the shoulder under an existing bridge
- Auxiliary lanes that could be changed to through lanes with merge ramps
- Median widths where a center median of substantial width still exists

The windshield survey logs are included in **Appendix B** and the identification physical constraints are documented in **Chapter 4** of this report.

4 NEEDS ASSESSMENT

This chapter documents the needs assessment that was conducted based on the existing and future conditions analysis, including travel demand or congestion, as well as the identification of current physical constraints along the corridors.

4.1 EXISTING CONDITIONS

The existing and future conditions analysis builds upon the data inputs outlined in **Chapter 3** of this report. Three key factors were considered in the congestion analysis: congestion duration, congested speed and congested distance. To document the existing congestion of the study area for this analysis, the following data sources were used: GDOT's NaviGAtor data, SkyComp aerial congestion surveys, and TomTom GPS data. The speed data and total daily congested hours for all three data sources were compared to each other.

The three data sources complement each other and illustrate similar congested areas and needs. Therefore, all three data sources were used to help evaluate current corridor performance and recognize future needs, thereby identifying congestion areas and capacity needs where the study team could develop potential managed lane improvement projects.

4.1.1 Existing Congestion Data

4.1.1.1 GDOT NaviGAtor Data

GDOT NaviGAtor is the traffic management system used to collect and distribute traffic information to the public via websites or 511 telephone services. NaviGAtor provides traffic volume and average speed data by lane every 15 minutes for over 2,400 locations along 17 limited-access facilities in the metro Atlanta region, with the exception of I-20 East and West outside of the I-285 perimeter, which were not included in the coverage area for NaviGAtor data at the time of this analysis.

Figure 4.1 and **Figure 4.2** highlight the speeds for those TMC stations during the AM peak hour (7 a.m. to 8 a.m.) and PM peak hour (6:00 p.m. to 7:00 p.m.), as defined using NaviGAtor data. **Figure 4.3** shows the total congested hours based on a speed threshold of 35 mph. The 35 mph threshold was chosen to illustrate peak period speeds that signified congested operating conditions. Based on NaviGAtor data illustrated in **Figures 4.1** through **4.2**, the following observations were made:

- The most common congested locations during the AM peak hour (7:00 a.m. – 8:00 a.m.) include:
    1. I-75/I-85 (Downtown Connector) (northbound and southbound)
    2. I-75 from Wade Green Road to I-575 (southbound)
    3. I-575 from I-75 to Bells Ferry Road (southbound)
    4. I-285 near Northside Drive and I-85 (eastbound)
    5. SR 400 from SR 120 to I-85 (southbound)
    6. I-85 from Pleasant Hill Road to I-285 North (southbound)
    7. I-285 East at US 78 (northbound)

8. I-285 near Paces Ferry Road and Atlanta Road (northbound)
9. I-20 from Downtown Connector to Glenwood Avenue (westbound)

- The most common congested locations during the PM peak hour (6:00 p.m. – 7:00 p.m.) include:
    1. I-75/I-85 (Downtown Connector) (northbound and southbound)
    2. I-85 from Downtown Connector to Cheshire Bridge Road (southbound)
    3. I-285 at Northside Drive (westbound) and the I-285/SR 400 interchange
    4. SR 400 from I-285 to SR 140 (northbound)
    5. I-285 West from US 278 to I-20 (northbound and southbound)

Figure 4.1: NaviGAtor AM Peak Hour Speeds (7:00 a.m. to 8:00 a.m.)

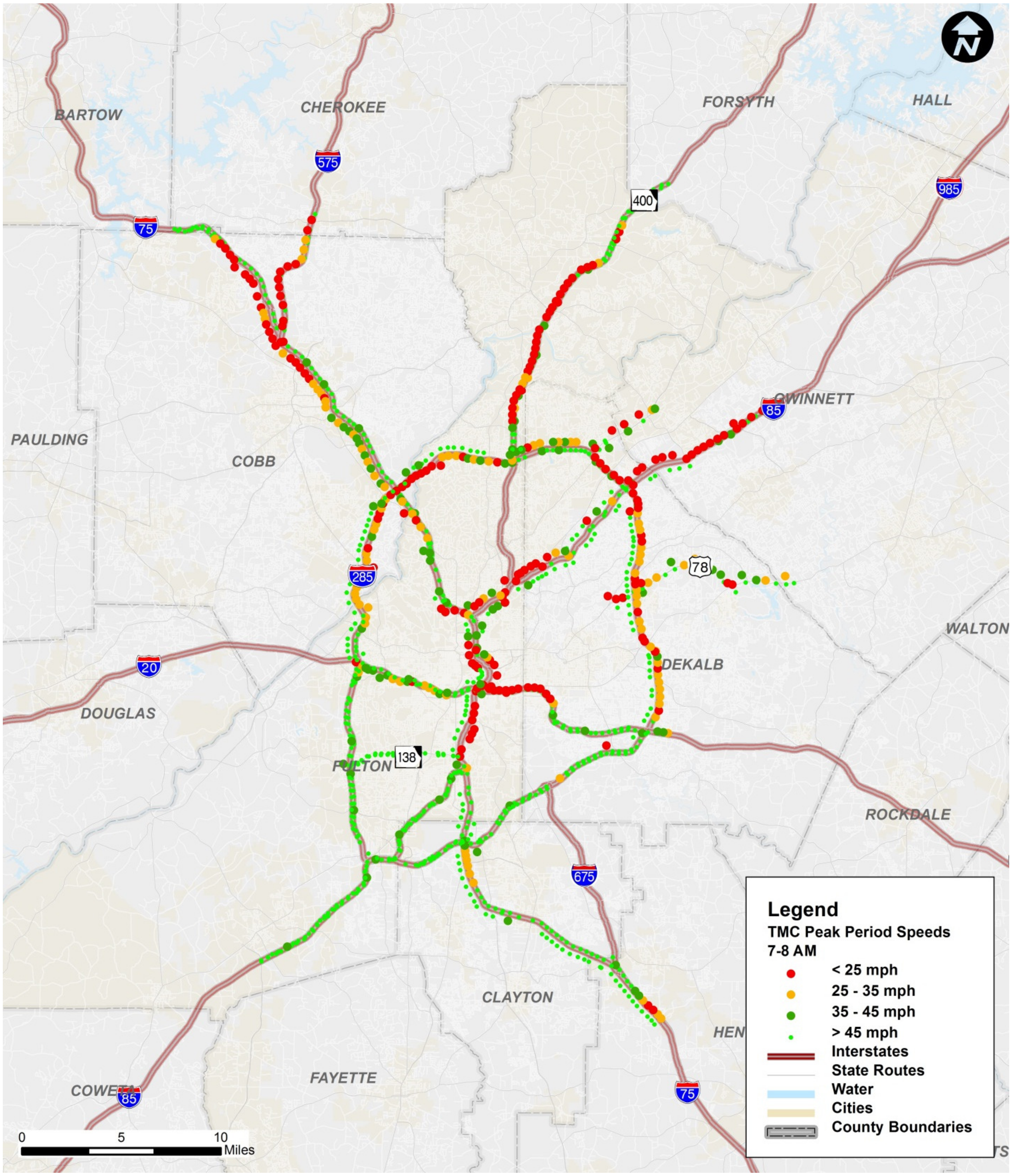


Figure 4.2: NaviGAtor PM Peak Hour Speeds (6:00 p.m. to 7:00 p.m.)

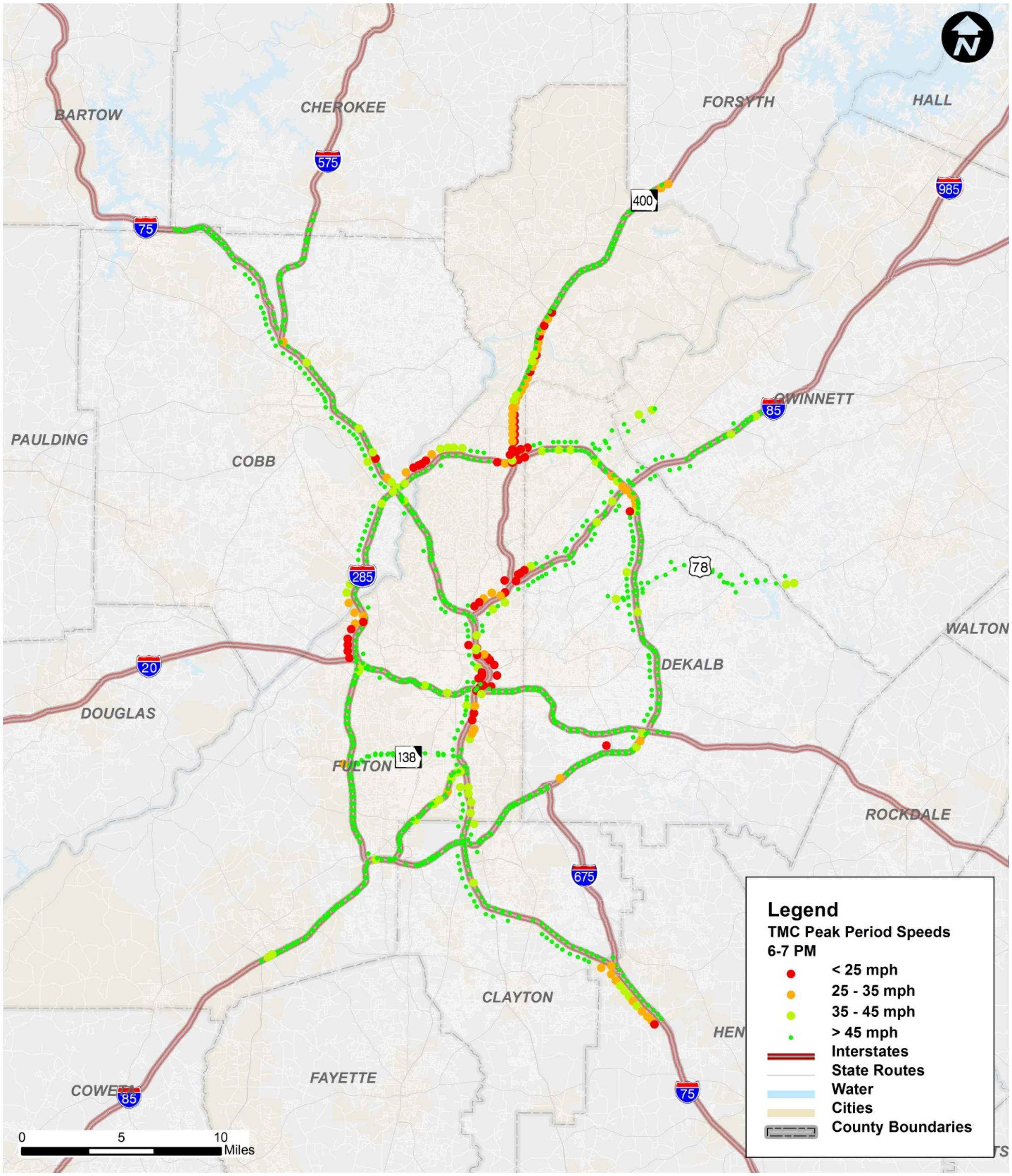
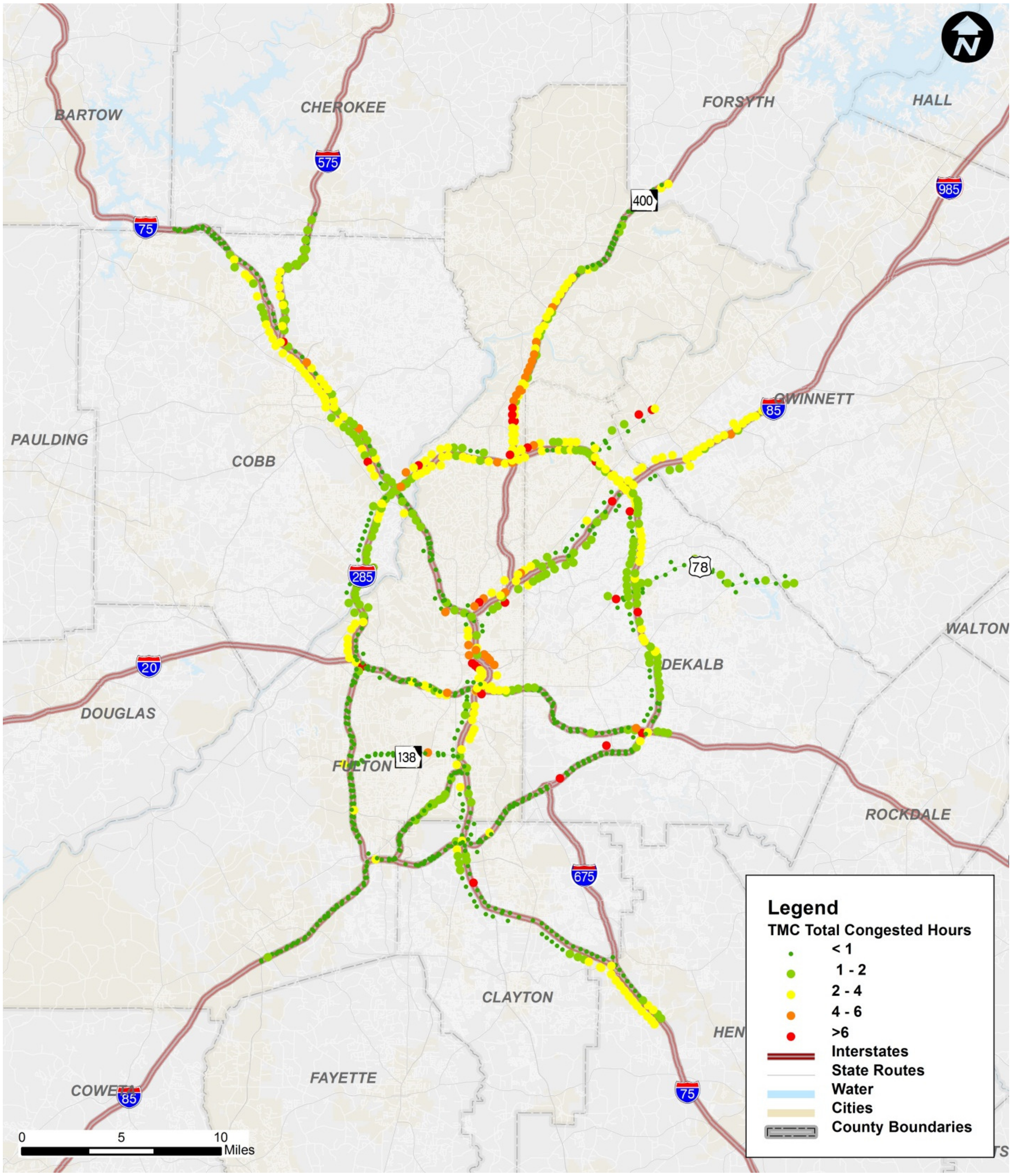


Figure 4.3: NaviGAtor Total Daily Congested Hours



4.1.1.2 Skycomp Aerial Congestion Surveys

In 1998, GDOT initiated an aerial survey program to monitor the quality of highway traffic flow across the 22-county Atlanta urbanized state highway network, through the use of time-lapse photography acquired from aircraft. These aerial photographs reveal insights about the underlying causes of congested bottlenecks, provide useful information for analysis, and help decision-makers better understand the congestion issues and technical recommendations.

The aerial survey data covers peak morning (6:30 a.m. to 9:30 a.m.) and evening (4:00 p.m. to 7:00 p.m.) commute periods in the spring and fall seasons. The average density of traffic flow is calculated for all surveyed links (by flight, by direction and by time period) and aggregated by hour and by link. It is then converted to level-of-service (LOS) performance ratings "A" through "F," based on ranges defined in the *2010 Highway Capacity Manual* (a widely-used planning guide produced by the Transportation Research Board of the National Academy of Sciences). An example of what each LOS looks like is shown in **Figure 4.4**. It is important to note that SkyComp has excluded the effects of confirmed or suspected incidents in their traffic flow and density analysis.

Figure 4.4: Level of Service Example

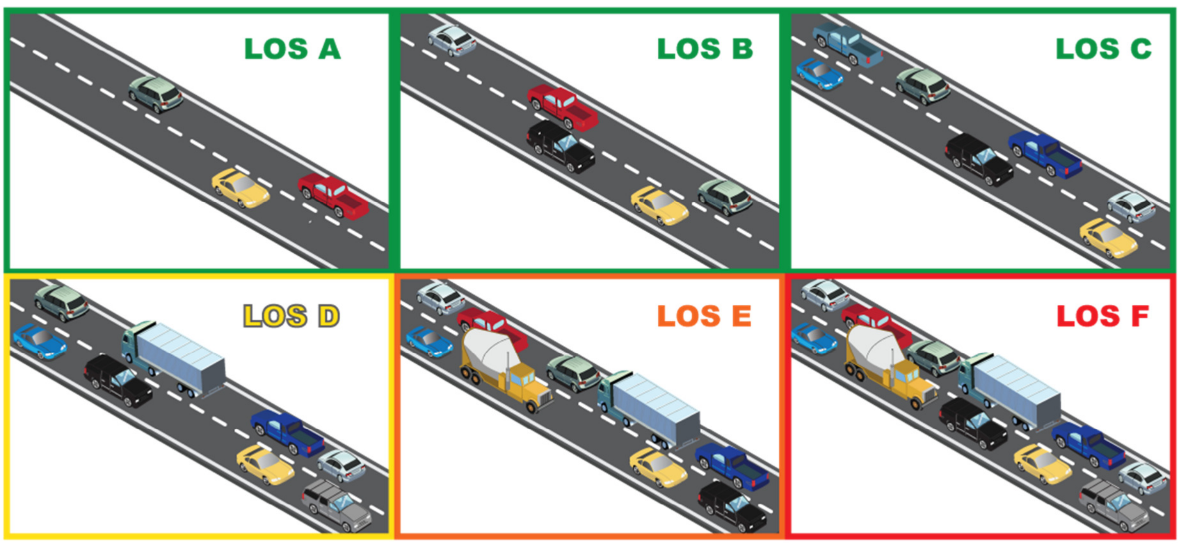


Figure 4.5 and **Figure 4.6** highlight LOS performance ratings during the AM peak hour (7:30 a.m. to 8:30 a.m.) and PM peak hour (6:00 p.m. to 7:00 p.m.) based on the average density of traffic flow from the SkyComp aerial survey data. Peak travel hours were selected based on the data. **Figure 4.7** illustrates the total congested hours based on an LOS threshold of "E" or worse.

Based on the SkyComp data illustrated in **Figure 4.5** through **4.7**, the following observations were made:

- The locations with a low LOS (E or worse) during the AM peak hour (7:30 a.m. to 8:30 a.m.) include:
    1. I-75/I-85 (Downtown Connector) (northbound and southbound)

2. I-75 Inside from I-285 to Downtown Connector (northbound and southbound)
3. I-285 North from I-85 North to Peachtree Industrial Boulevard (westbound)
4. SR 400 from I-85 to SR 20 (southbound)
5. I-285 East from I-20 East to I-85 North (northbound)
6. I-285 West from I-75 to S. Cobb Drive (southbound)
7. I-75 North from I-285 to I-575 (northbound and southbound)
8. I-575 from Sixes Road to I-75 (southbound)
9. I-85 North from I-285 North to SR 316 (northbound and southbound)
10. I-20 West from I-285 to Thornton Road (eastbound)
11. Peachtree Industrial Boulevard (northbound and southbound)

- The locations with a low LOS (E or worse) during the PM peak hour (6:00 p.m. – 7:00 p.m.) include:
    1. I-75/I-85 (Downtown Connector) (northbound and southbound)
    2. I-285 North from at I-75 and I-85 (eastbound and westbound)
    3. SR 400 from I-85 to SR 20 (northbound)
    4. I-285 East from I-85 to US 78 (southbound)
    5. I-75 North at I-575 (northbound)
    6. I-575 from I-75 to Sixes Road (northbound)

Figure 4.5: Skycomp AM Level of Service (7:30 a.m. to 8:30 a.m.)

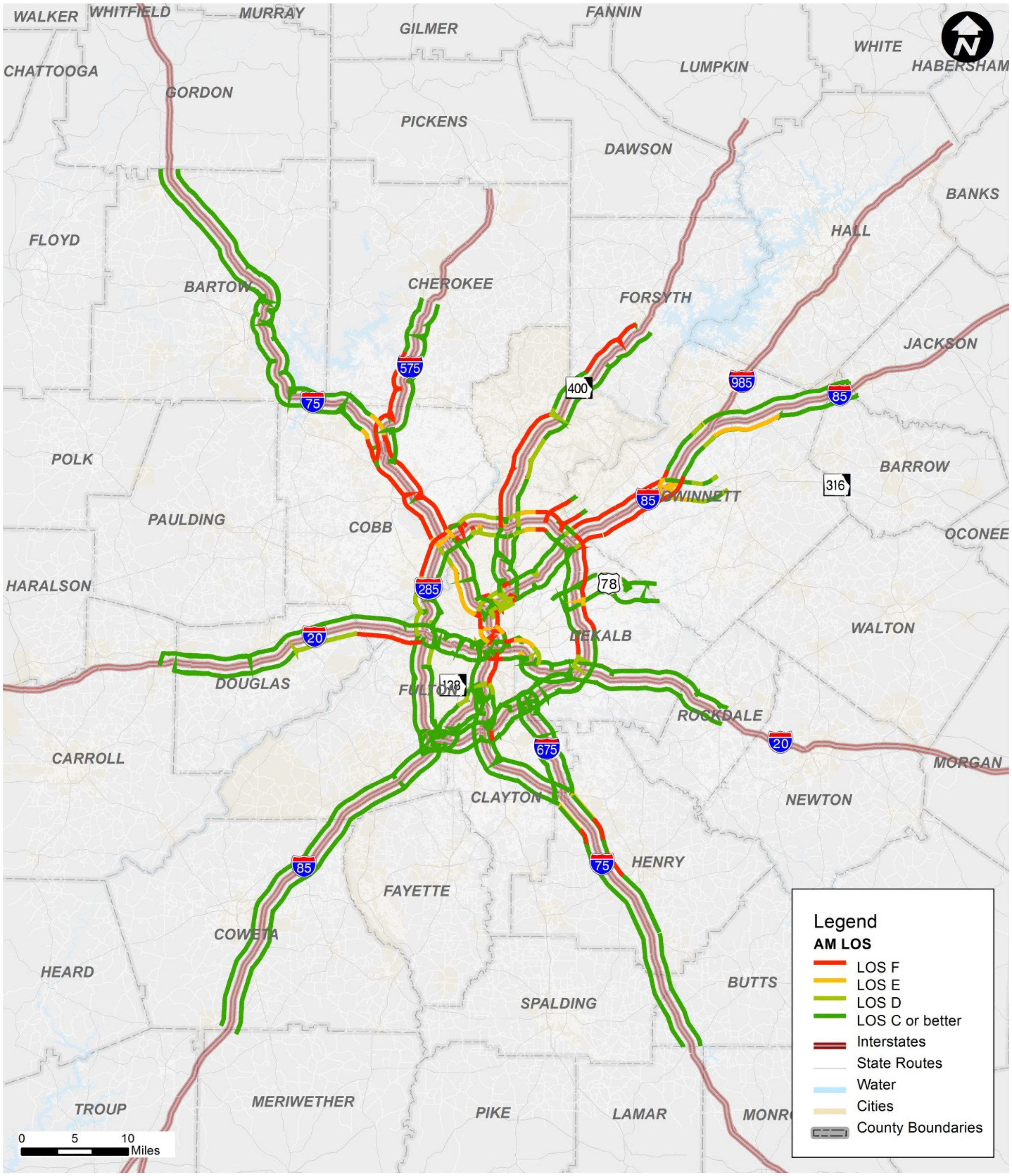


Figure 4.6: Skycomp PM Level of Service (6:00 p.m. to 7:00 p.m.)

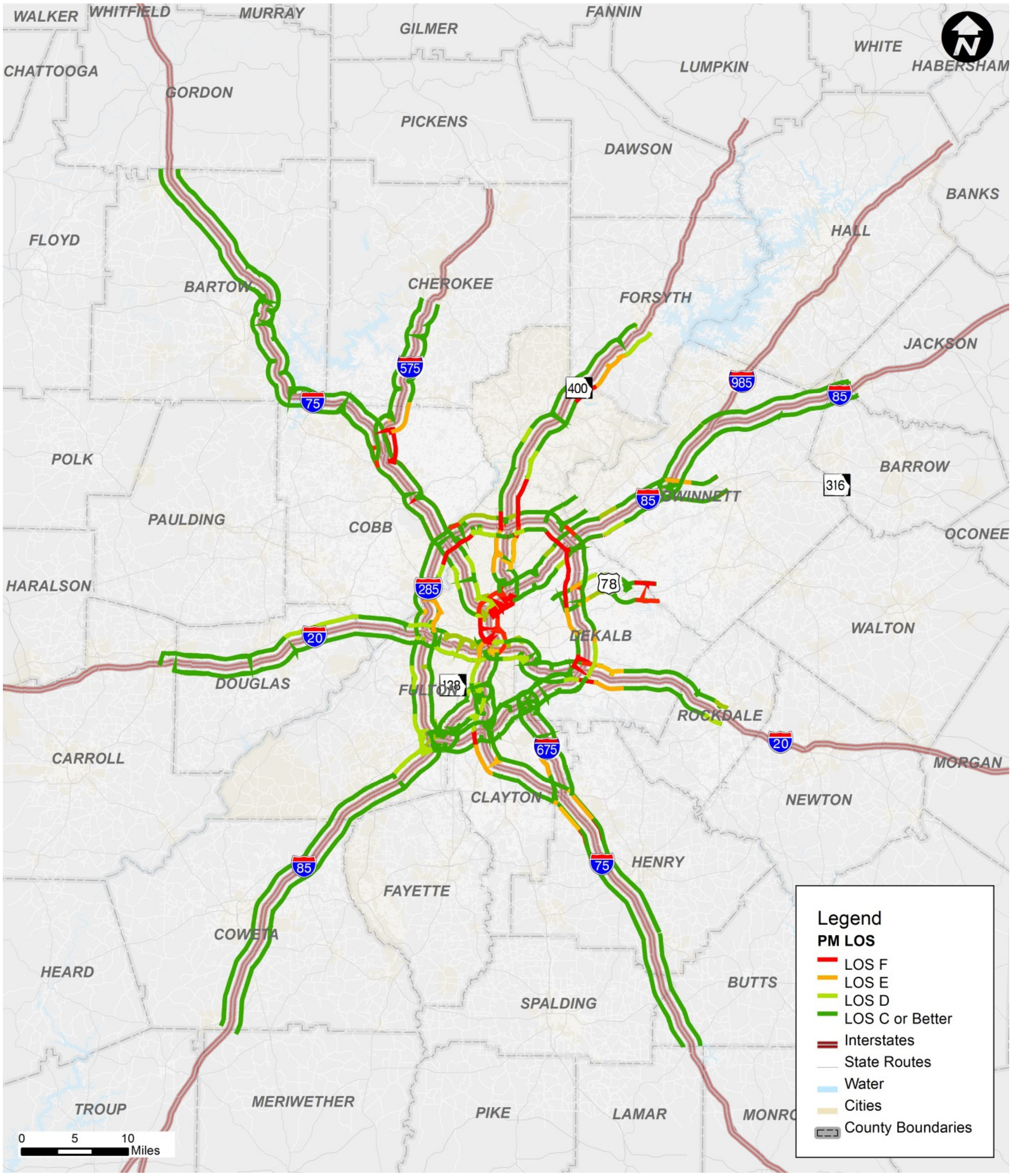
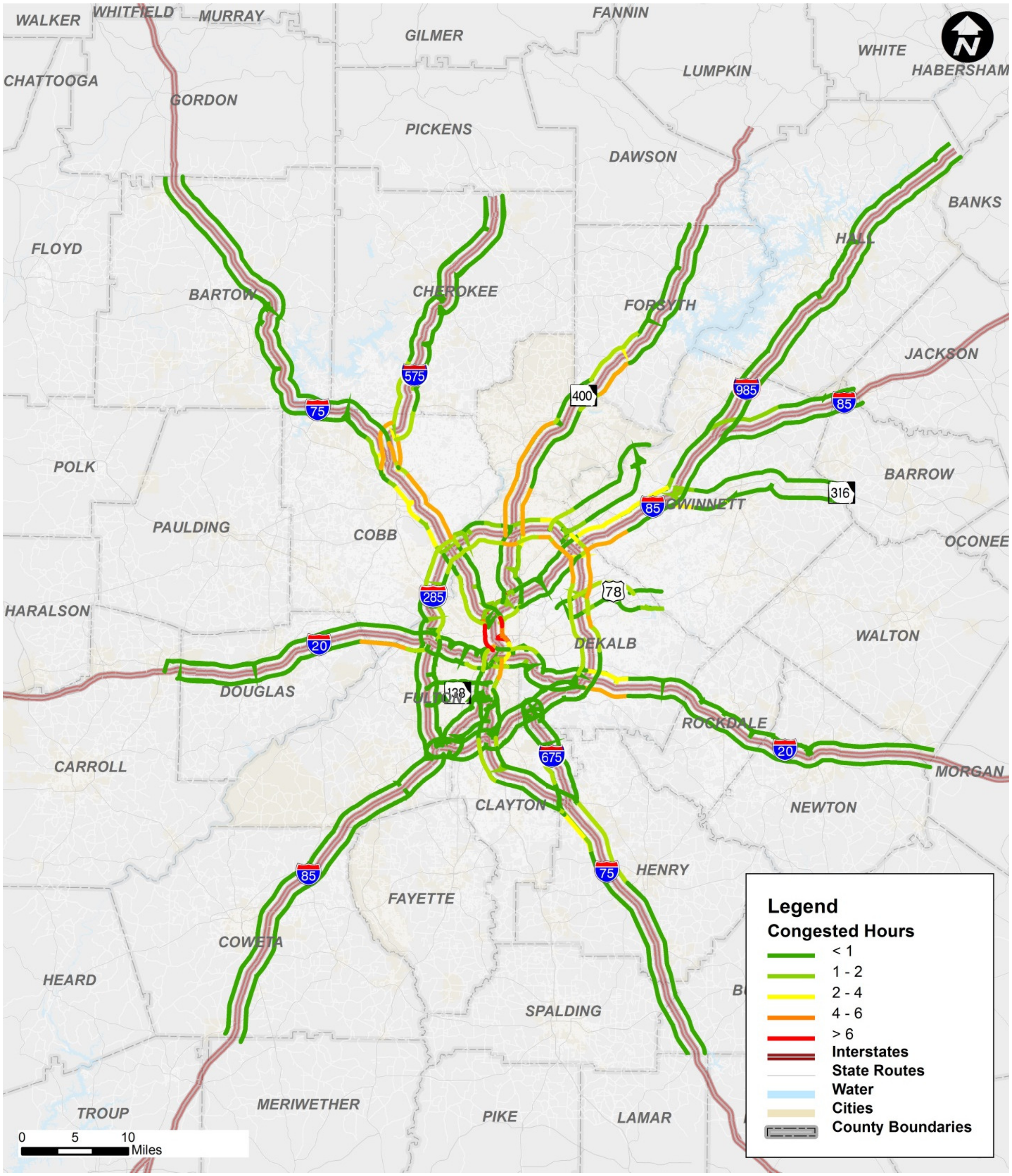


Figure 4.7: Skycomp Total Daily Congested Hours



4.1.1.3 TomTom Speed Data

TomTom speed data is comprised of historic and realistic average roadway speeds for specific times of day and week by aggregating billions of GPS measurements. TomTom GPS Speed data was purchased to supplement the NaviGAtor speed data and Skycomp data for Tuesdays, Wednesdays and Thursdays in October 2010 for all of the study corridors.

For each corridor, the following statistics were available, by hour, during the AM peak period (6:00 a.m. to 9:00 a.m.) and PM peak period (3:00 p.m. to 7:00 p.m.):

- Sample size (average per segment)
- Average travel time
- Median travel time
- Average speed (mph)
- Travel time ratios (peak travel time divided by off-peak travel time)
- Percentile travel time (for example: 90th percentile travel time means that for any particular route, 90 percent of the measured trips take less than this time)

Figure 4.8 and **Figure 4.9** highlight the speed during the AM peak hour (7:30 a.m. – 8:30 a.m.) and PM peak hour (6:00 p.m. – 7:00 p.m.) based on TomTom GPS speed data. **Figure 4.10** shows the total congested hours based on a speed threshold of 35 mph.

Based on the TomTom GPS data illustrated in **Figures 4.8** through **4.10**, the following observations were made:

- The locations with congested speeds during the AM peak hour (6:00 a.m. – 7:00 a.m.) include:
  1. I-75/I-85 (Downtown Connector) (northbound and southbound)
  2. I-75 North from I-575 to SR 120 (southbound)
  3. I-575 from Sixes Road to I-75 (southbound)
  4. SR 400 from McGinnis Ferry Road to SR 140 (southbound)
  5. I-85 North from SR 316 to Beaver Ruin Road (southbound)
  6. I-285 East at US 78 (northbound)
  7. I-20 Inside from Downtown Connector to Glenwood Avenue (westbound)
  8. I-20 West from Thornton Road to I-285 (eastbound)
  9. I-20 East from Panola Road to I-285 (westbound)
  10. I-75 South from SR 155 to US 23 (northbound)
  11. Peachtree Industrial Boulevard from SR 140 to I-285 (southbound)
- The locations with congested speeds during the PM peak hour (6:00 p.m. to 7:00 p.m.) include:
  1. I-75/I-85 (Downtown Connector) (northbound and southbound)
  2. SR 400 at I-285 (northbound and southbound)

3. I-285 East at I-85 (eastbound)
4. I-75 South SR 155 to US 23 (northbound)
5. US 78 at I-285 (eastbound)
6. Peachtree Industrial Boulevard (southbound)

Figure 4.8: TomTom GPS AM Peak Hour Speeds (6:00 a.m. to 7:00 a.m.)

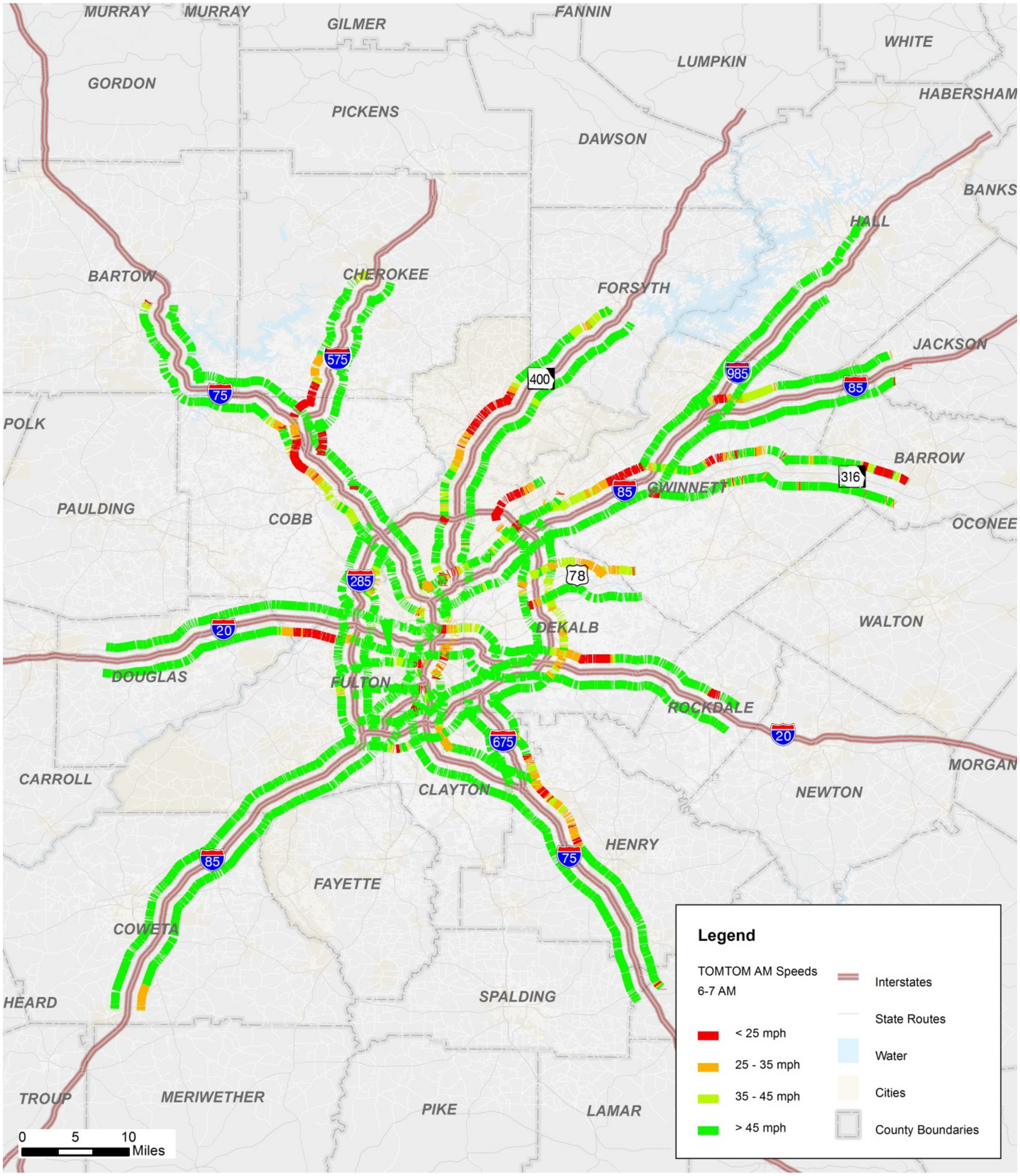


Figure 4.9: TomTom GPS PM Peak Hour Speeds (6:00 p.m. to 7:00 p.m.)

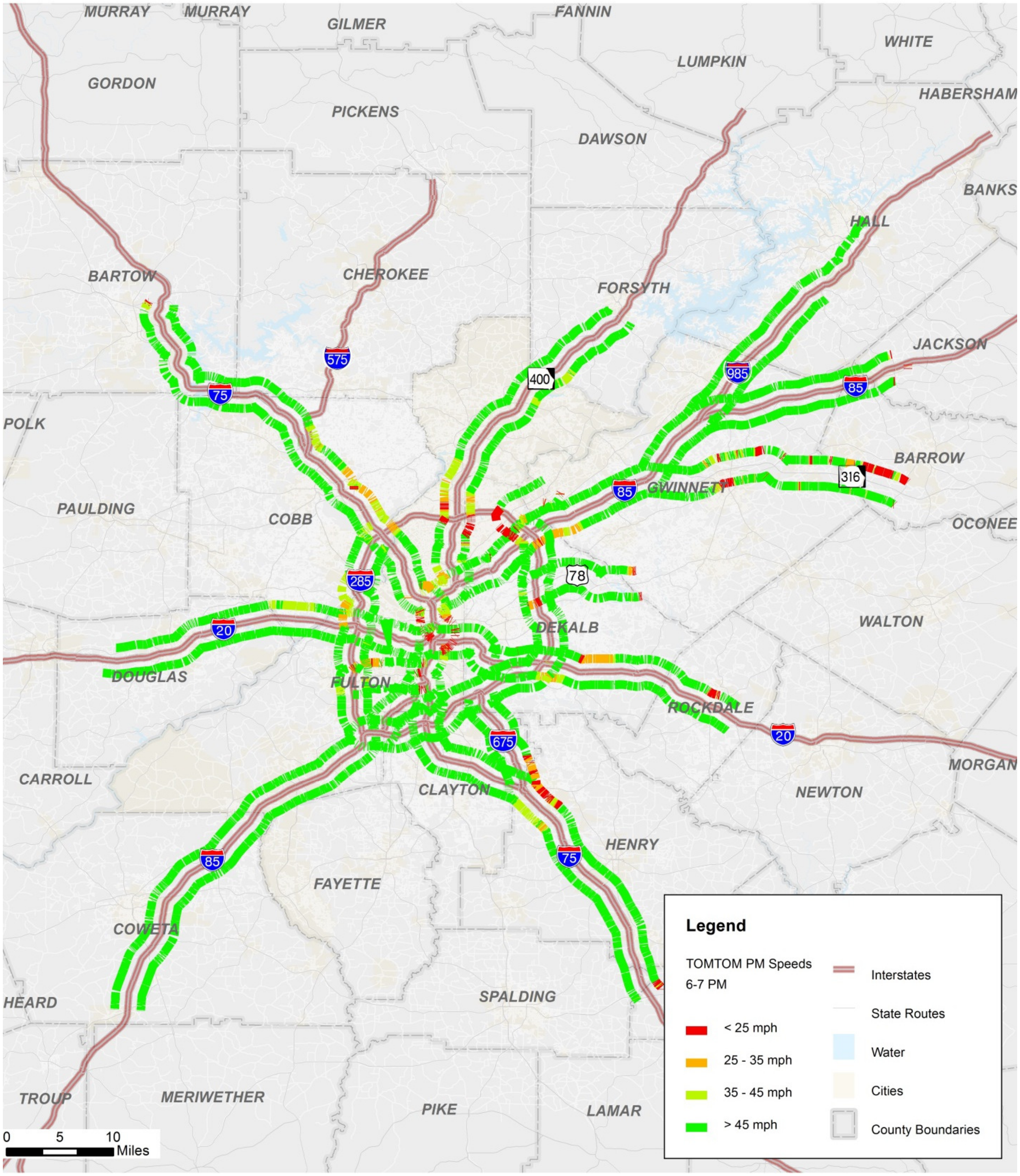
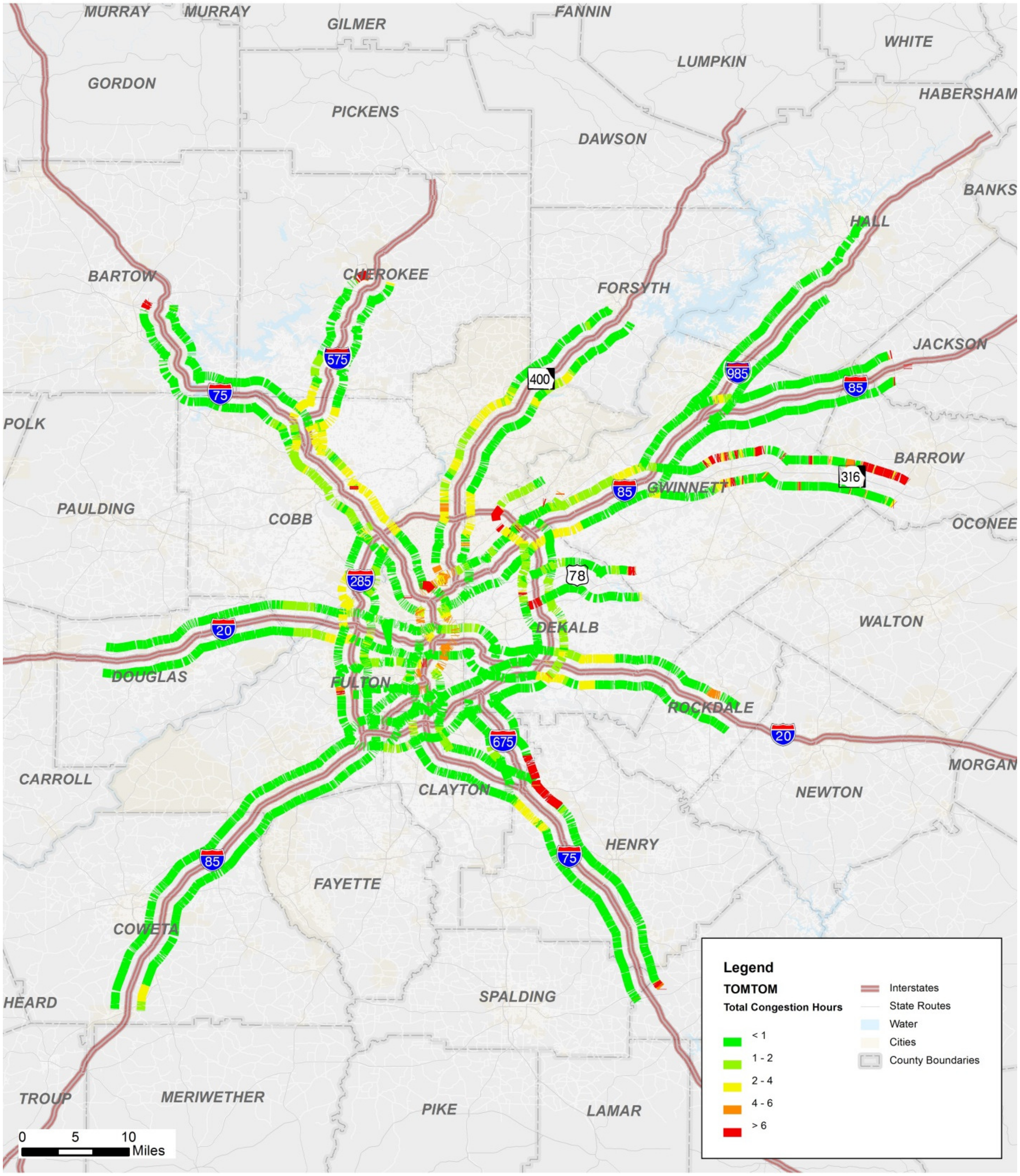


Figure 4.10: TomTom GPS Total Daily Congested Hours



4.1.2 Existing Physical Constraints

A survey was performed on all limited access routes in metro Atlanta to evaluate managed lane feasibility. The goal was to determine how the existing infrastructure could be used more efficiently to create managed lanes.

Using a Go-Pro 3 camera mounted on top of a car, the following was documented and confirmed against field notes:

- Pavement type/quality (mainly shoulders)
- Number of managed/general purpose lanes
- Inside/outside shoulder widths
- Lane widths
- Median width
- Auxiliary lane additions
- Bridge conflict points
- Severe ramp/gore cross slope
- Elevations differences between the two sides of the expressway

Inside shoulders were already minimized in most locations. The few areas that appeared wider were along tight horizontal curves where stopping sight distance around the barrier controlled the required width of the inside shoulder. Lane widths have been minimized to 11 feet or less in most locations along the interstates in metro Atlanta. At a few locations toward the outside limits of the study area (suburban Atlanta), lane widths of 12 feet still exist and could be reduced to 11 feet if warranted. Frequently, the outside shoulder was the only available location to expand without involving a major construction project (increased expense and right-of-way needs).

Evaluating bridge spans and widths was critical because bridges are common constraints along corridors and could both increase the cost and delay the immediate implementation of managed lanes on a specific corridor. Bridges are also often surrounded by ramps with geometric complications at gores, elevations/grade differences requiring retaining walls, unique drainage patterns, etc.; all of which would potentially need to be modified if managed lanes were implemented.

The most common constraint noted were narrow shoulders under long standing bridges. These vary in size and volume of traffic carried, requiring that each location be individually evaluated. Where a problematic bridge crosses over an existing expressway, the only apparent solution is full bridge replacement. Bridges supporting expressway traffic would simply require widening. In some locations, the bridge replacement could prove to be the fatal flaw since the road being carried is typically very congested with limited right-of-way at each abutment to allow an easy alignment shift for replacement.

Options to use off-peak lanes were also studied as part of the MLIP. Accomplishing this goal required that traffic pass through the existing median barrier at ingress/egress points. It was assumed that overhead signs could be relocated and drainage inlets could be modified to carry traffic loading at these points. The remaining three items of importance noted during the field survey were bridge columns, street lighting, and elevation differences.

Lastly, pavement type and quality was observed. Asphalt shoulders were assumed to be partial depth and require full replacement. Concrete shoulders were assumed to be full depth pavement, requiring only restriping and/or widening as required. Details on the physical constraint survey can be found in the Windshield Field Survey in **Appendix B**.

In total, 144 physical constraint locations were identified from the data analysis and various stakeholders. They are located at the following locations:

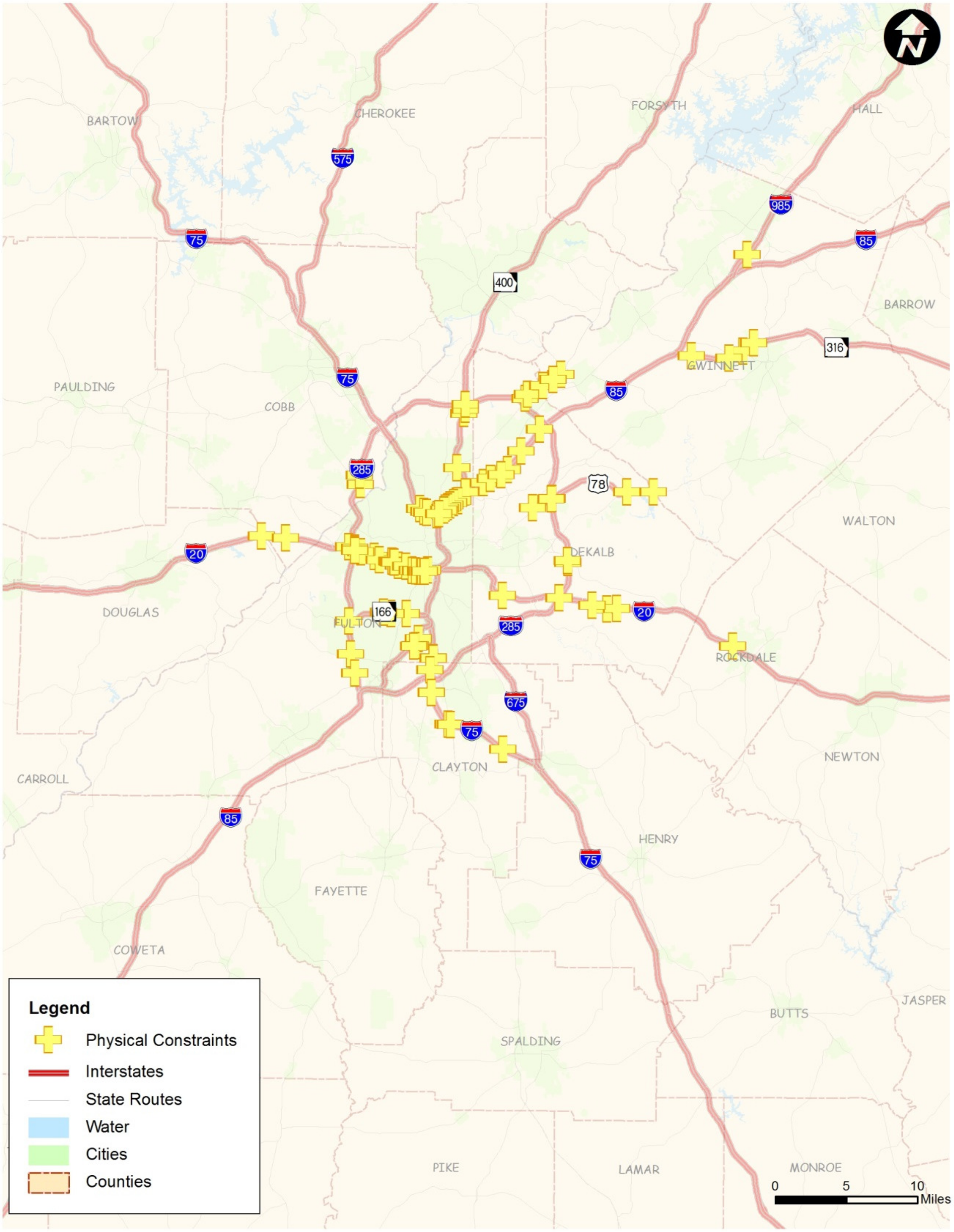
- I-20 East at:
    - I-285 (WB)
    - Miller Road (EB & WB)
    - Panola Road (EB & WB)
    - Snapfinger Creek (WB)
    - West Avenue (EB & WB)
- I-20 Inside at:
    - Anderson Avenue (EB & WB)
    - Fairfield Place (WB)
    - Gresham Road (EB & WB)
    - Hamilton E Holmes Drive (WB)
    - Joseph E Lowery Boulevard (EB & WB)
    - Langhorn Street (EB & WB)
    - Lawton Street (WB)
    - Lee Street (EB & WB)
    - Linkwood Road (EB)
    - Lucille Avenue (EB & WB)
    - McDaniel Street (EB & WB)
    - MLK Jr. Drive(EB & WB)
    - Murphy Avenue (EB & WB)
    - Northside Drive (EB & WB)
    - RR Crossing (EB & WB)
    - RR Crossing (EB & WB)
    - W. Lake Avenue (WB & WB)
    - Westview Drive (WB & WB)
    - Whitehall Street (EB & WB)
- I-20 West at:
    - Factory Shoals Road (WB)
    - Fairburn Road (WB)
    - Thornton Road (WB)
- I-285 East at:
    - Covington Highway (NB)
    - Redwing Circle (NB)
- I-285 North at:
    - Chattahoochee River to Riverside Drive
    - Chamblee-Dunwoody Road to Peachtree Industrial Boulevard
- I-285 Northwest at:
    - Church Road (NB)
    - RR Crossing (NB & WB)
- I-285 Southwest at:
    - Camp Creek Bridge (NB)
    - Washington Road (SB)
    - I-20 W – Bridge 1 (NB)
    - I-20 W – Bridge 2 (NB)
    - I-20 W – Bridge 3 (NB)
    - I-20 W – Bridge 4 (NB)

- I-75 Inside at:
    - Charles W Grant Parkway (NB)
    - Howell Mill Road (NB & SB)
    - N. Central Avenue/Crown Road (NB & SB)
    - Northside Drive (NB & SB)
    - Old Dixie Highway (NB & SB)
    - RR Crossing (NB & SB)
    - RR Crossing (NB)
- I-75 South at:
    - Forest Parkway Ramp (SB)
    - Forest Parkway (NB & SB)
    - Mt. Zion Road (SB)
    - Old Dixie Highway (NB & SB)
    - Upper Riverdale Ramp (NB & SB)
- I-85 Inside at:
    - Buford Highway (NB & SB)
    - Armour Drive (NB & SB)
    - Buford Highway (NB & SB)
    - Chamblee Tucker Road (NB & SB)
    - Clairmont Road (SB)
    - Cofield Drive (SB)
    - Frontage Road Crossover (NB & SB)
    - N. Druid Hills Road (NB & SB)
    - NS Railroad (SB)
    - Peachtree Creek (NB)
    - Piedmont Road (NB & SB)
    - RR Crossing (NB & SB)
    - RR Crossing (NB & SB)
    - RR Crossing (NB)
    - Shallowford Road (NB & SB)
    - Sylvan Road (SB)
    - Unknown Creek (NB & SB)
- SR 400 at:
    - Glenridge Connector (SB)
    - I-285 (NB & SB)
    - Johnson Ferry Road (SB)
    - Peachtree Road (SB)
- US 78 at:
    - Jefferson Davis Drive (EB & WB)
    - Silver Hill Road (EB & WB)
    - I-285 E – Bridge 1 (EB & WB)
    - I-285 E – Bridge 2 (EB & WB)
    - I-285 E – Bridge 3 (EB & WB)
- SR 316 at:
    - Duluth Highway (EB)
    - Herrington Road (EB & WB)
    - Bridge (EB & WB)
- SR 166 at:
    - Delowe Drive (EB & WB)
    - I-285 W (EB)
    - Main Street (EB)
    - RR Crossing (EB)
    - Stanton Road (EB & WB)

- Peachtree Industrial Boulevard at:
  - Jimmy Carter Boulevard (NB & SB)
  - N. Carver Circle Con. (NB & SB)
  - Peachtree Corners Circle (NB & SB)
  - Tilly Mill Road (NB & SB)
  - Winters Chapel Road (NB & SB)
- I-985 at:
  - Ivy Creek (NB & SB)

Figure 4.11 illustrates all of the physical constraints identified as part of the MLIP.

Figure 4.11: Physical Constraint Locations



4.2 FUTURE CONDITIONS

The Atlanta Regional Commission (ARC), in coordination with GDOT, is responsible for conducting transportation planning for the 18-county Atlanta MPO region. The product of these planning efforts is the 2040 Regional Transportation Plan (RTP), titled *Plan2040*, and the associated six-year Transportation Improvement Program (TIP).

The ARC regional travel demand model, which includes major capacity-adding projects reflected in the adopted TIP and RTP, was used to assess future congestion along the study corridors. Currently, there are several planned and programmed managed lane projects along the study corridors, as previously documented in **Figure 3.2**. The section below documents changes to the ARC travel demand model and how it was used to assess the future conditions.

4.2.1 Comparison of Future Needs Based on ARC *Envision6* and *Plan2040* Models

In order to capitalize on previous efforts, the MLIP incorporated the travel demand model analysis from the previous MLSP to use as a starting point. However, since some of the matrices and characteristics used in the MLSP screening process are based on the 2030 ARC *Envision6* travel demand model results, it was important for this study to compare the results from the recently adopted ARC *Plan2040* to the previous MLSP to determine if any of the needs have changed and to ensure the identified needs are still valid and relevant.

The AM and PM peak period travel speeds from the *Envision6* 2030 travel demand model are presented in **Figure 4.12** and **Figure 4.13** respectively. The *Envision6* total daily congested hours (identified based on the speed threshold of 35 mph or less) is presented in **Figure 4.14.** The AM and PM peak period travel speed from the *Plan2040* travel demand model are presented in **Figure 4.15** and **Figure 4.16**, respectively. The *Plan2040* total daily congested hours (identified based on the speed threshold of 35 mph or less) is presented in **Figure 4.17**.

Figure 4.12: 2030 AM Peak Period Speed (6:00 a.m. – 10:00 a.m.) – *Envision6* Model

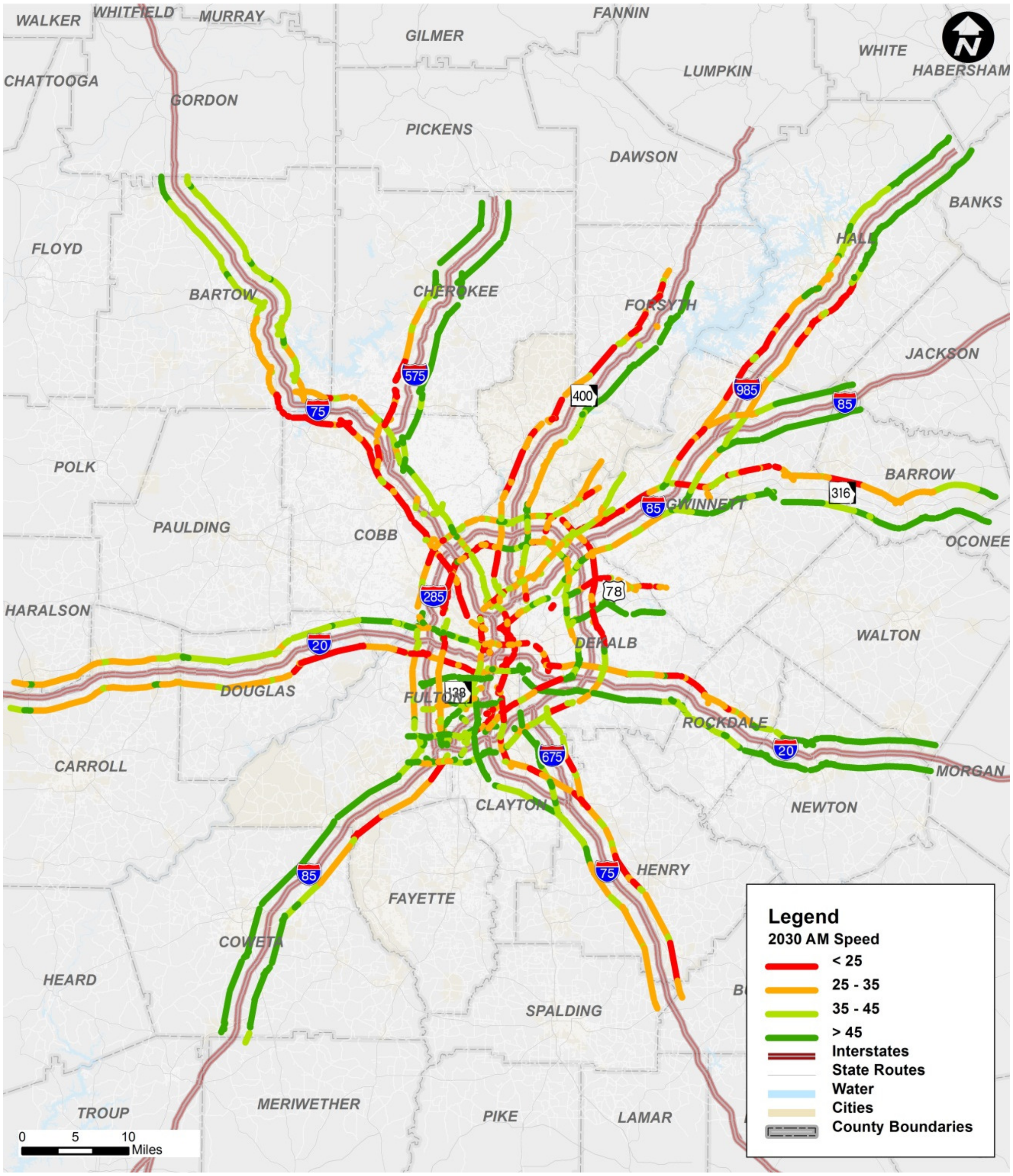


Figure 4.13: 2030 PM Peak Period Speed (3:00 p.m. – 7:00 p.m.) – *Envision6* Model

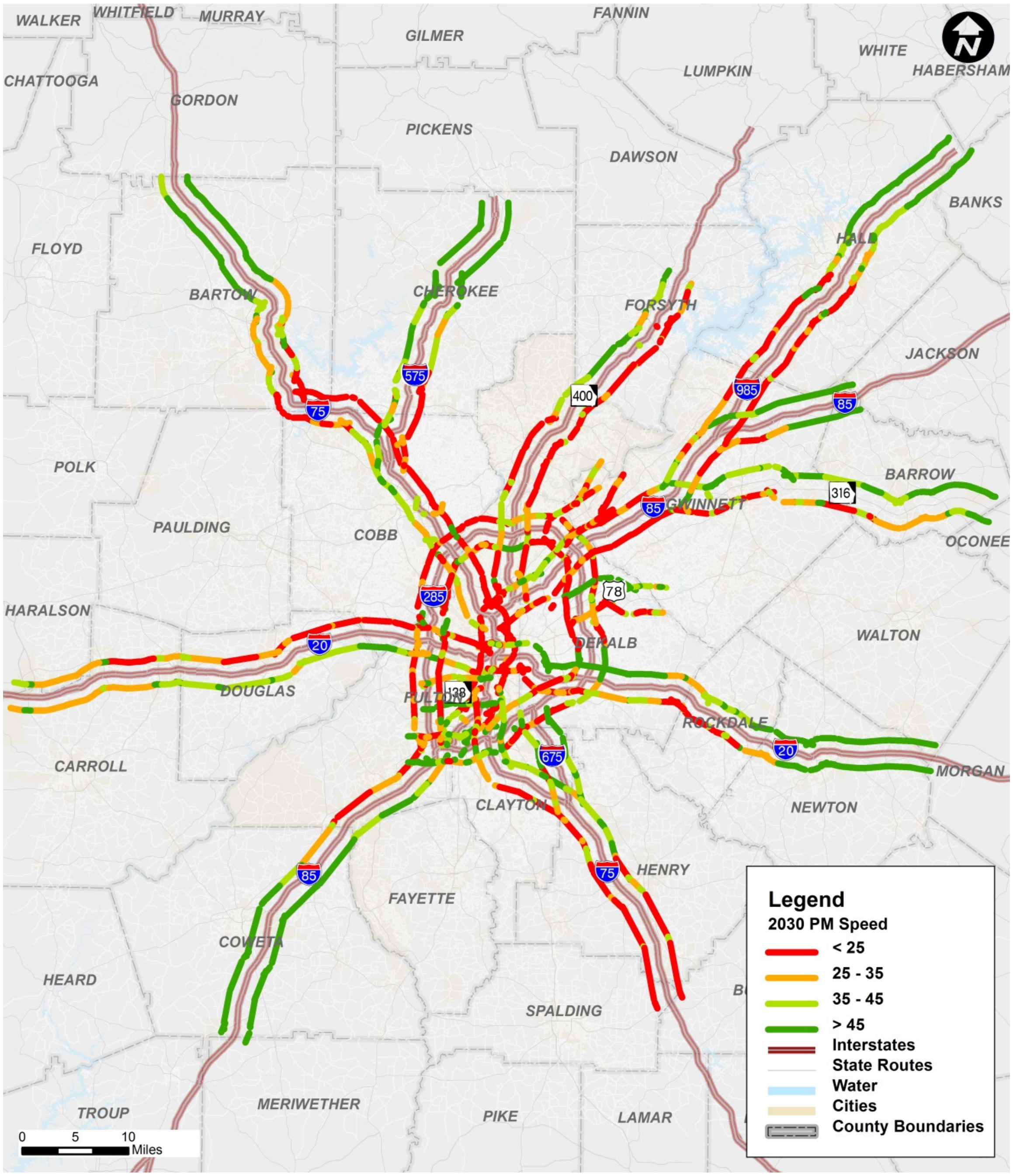


Figure 4.14: 2030 Total Daily Congested Hours – *Envision6* Model

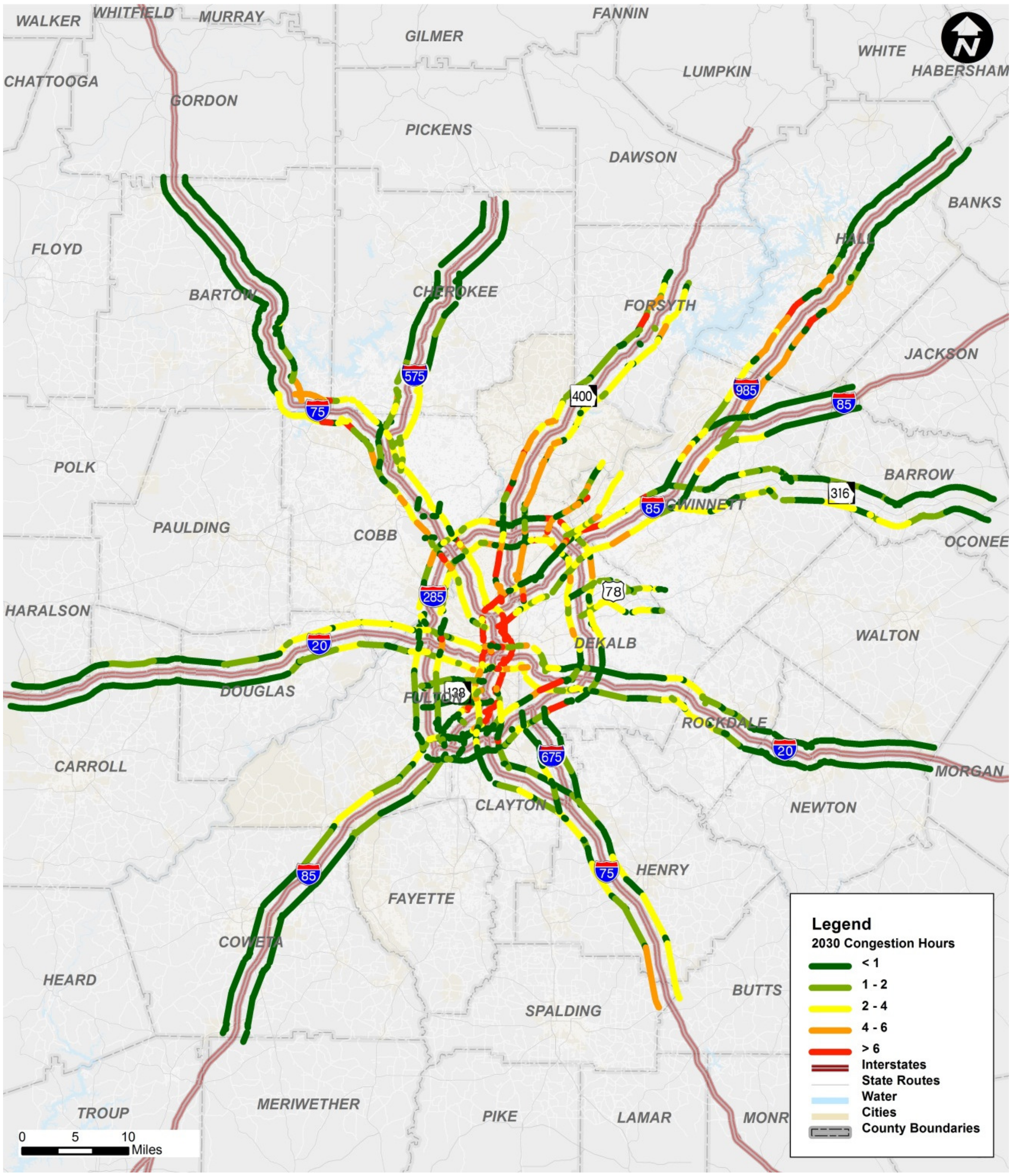


Figure 4.15: 2030 AM Peak Period Speed (6:00 a.m. – 10:00 a.m.) – *Plan2040*

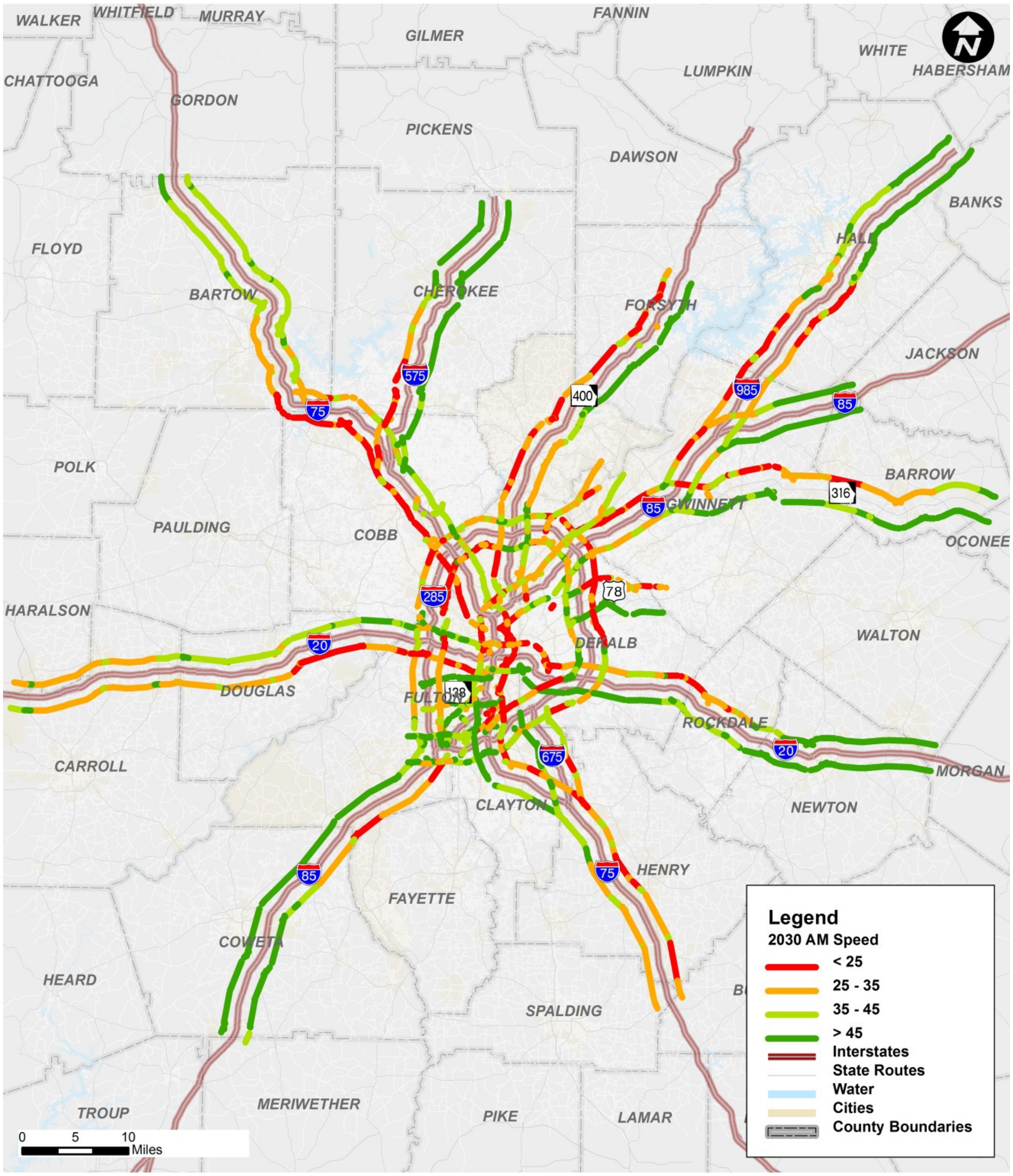


Figure 4.16: 2030 PM Peak Period Speed (3:00 p.m. – 7:00 p.m.) – *Plan2040*

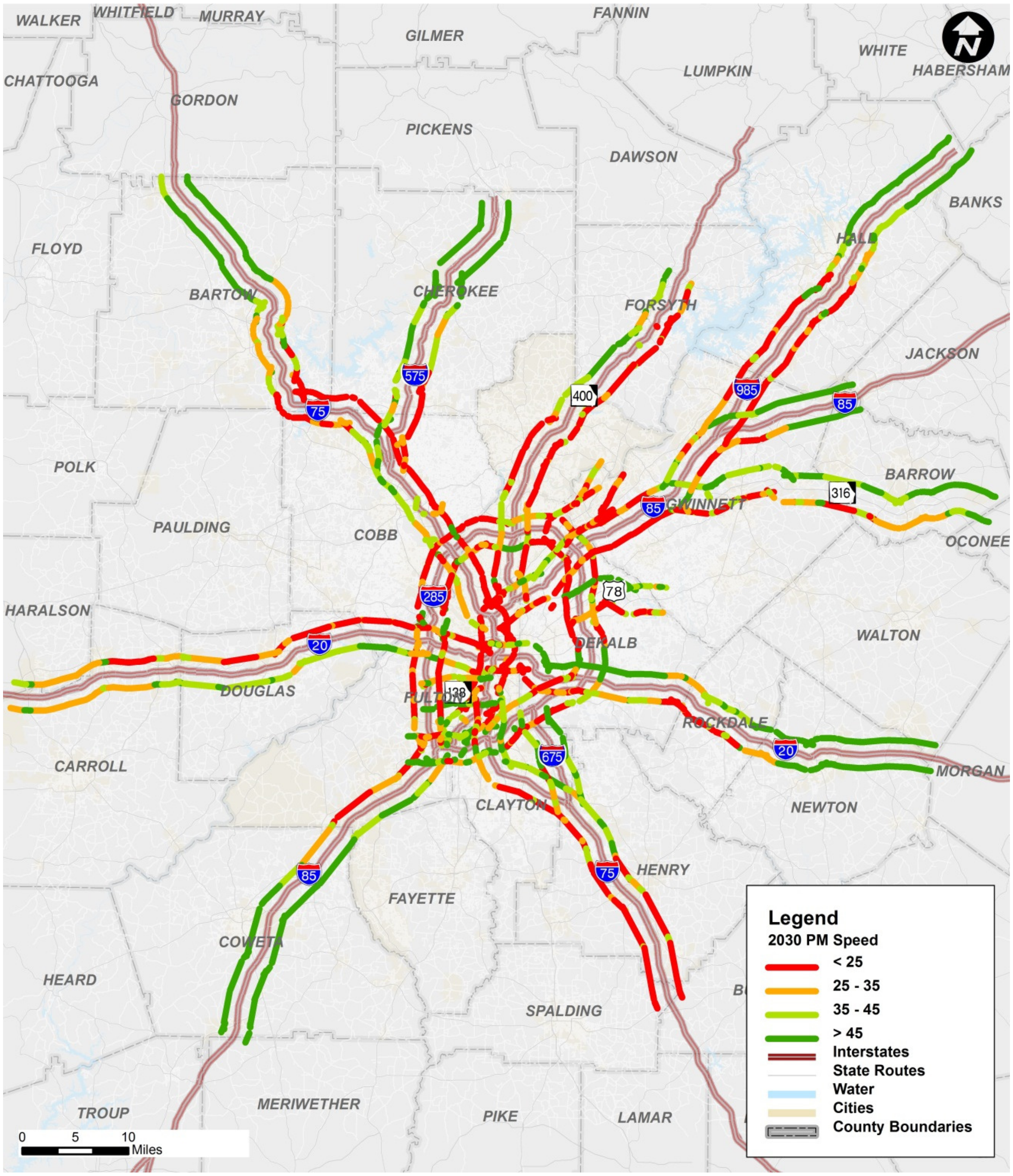
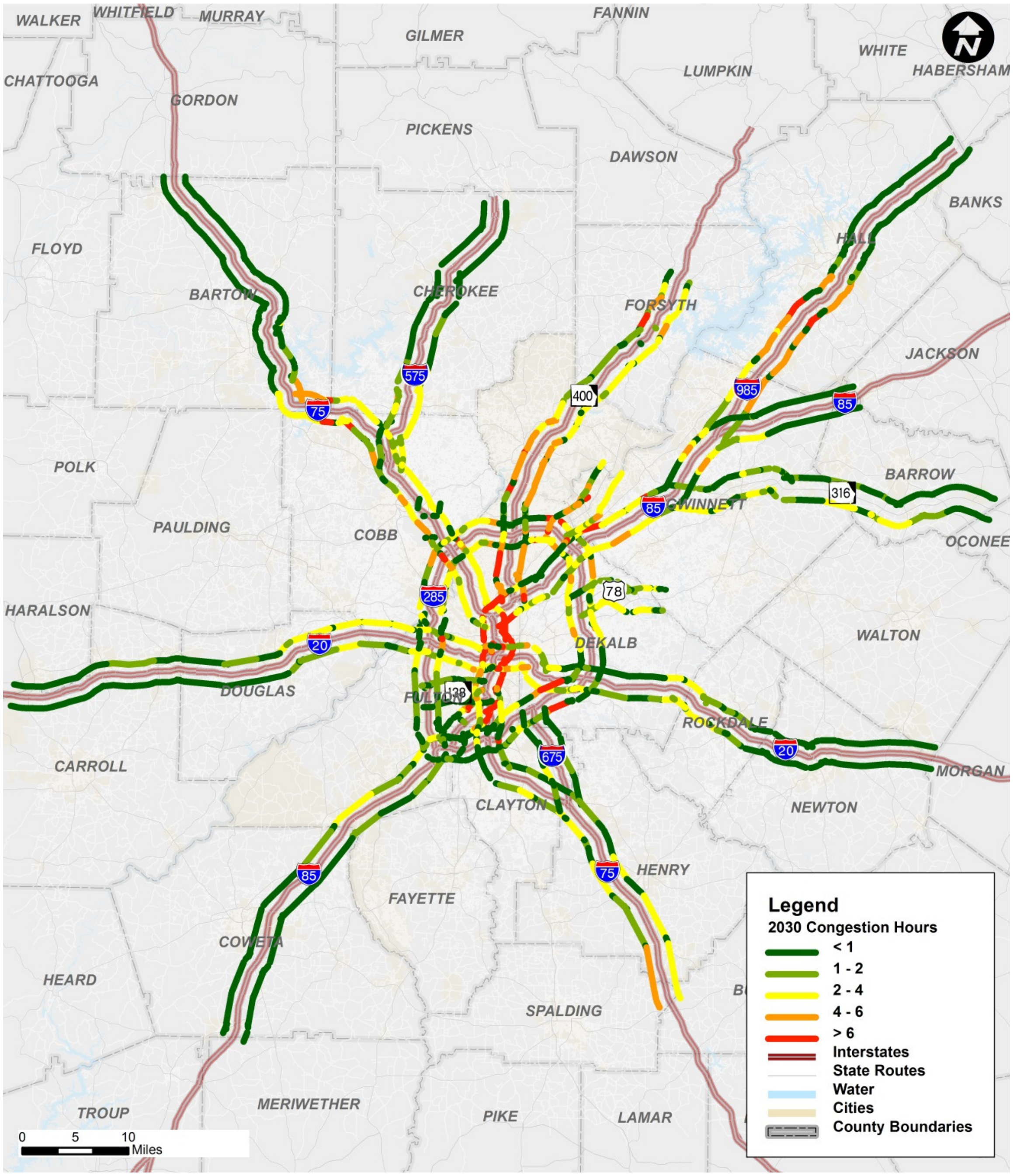


Figure 4.17: 2030 Total Daily Congested Hours – *Plan2040*



Based on these results, the following observations were made:

- The corridors with the worst congested speed during the 2030 AM and PM periods and the highest congestion hours, based on both the *Envision6* and *Plan2040* models, are:
    - I-75/I-85 (Downtown Connector)
    - I-285 North from I-85 North to I-75 North
    - SR 400 from I-85 to SR 20 (inside and outside the perimeter)
    - I-285 East from I-20 East to I-85 North
    - I-75 North from I-285 North to I-575
    - I-85 North from I-285 North to Hamilton Mill Road

  This is consistent with the highest priority corridors identified during the initial candidate corridor screening as part of the previous MLSP.
- During both the AM and PM peak periods, slightly fewer limited access facilities were observed to have operating speeds lower than 35 mph with the transition from the *Envision6* model to the *Plan2040* model. These facilities are primarily located outside the perimeter, including:
    - I-75 South from I-675 to SR 16
    - I-85 South from SR138/Jonesboro Road to US 29
    - I-20 West from I-285 to Post Road
    - SR 316 from Patrick Mill Road to SR 81
- With the transition from the *Envision6* model to the *Plan2040* model, those facilities located outside I-285 have slightly fewer total congested hours in 2030.
- However, other freeway segments inside or close to the perimeter were observed having slightly longer congested hours. Those segments include:
    - I-20 East from I-285 to Panola Road
    - I-575 from I-75 to SR 92
    - I-285 North from I-85 North to I-75 North

Overall, 2030 congestion levels appeared to remain very similar for a majority of the limited access facilities in the Atlanta region with the transition from the *Envision6* model to the *Plan2040* model. The limited access facilities identified with improved operating speeds outside of the perimeter in the *Plan2040* model are thought to be the result of changes to the socio-economic data and transportation projects between *Envision6* and *Plan2040*. In the *Plan2040* model, the overall future employment forecasts were reduced when compared to the *Envision6* model to reflect the recent economic recession. Furthermore, the employment growth is more concentrated on areas where development has already occurred instead of counties further from the region's core. The model comparison results revealed that the ranking of candidate corridors as developed in the MLSP still reflect the right needs and priorities in the region's future.

4.2.2 ARC *Plan2040* Model Needs

Once it was confirmed that the ARC *Plan2040* model was consistent with year 2030 needs identified during the previous MLSP, year 2040 needs were evaluated utilizing the *Plan2040* model going forward. **Figure 4.18** and **Figure 4.19** illustrate congestion during the year 2040 based on AM and PM peak period volume-to-capacity ratios, respectively. **Figure 4.20** illustrates total congested hours in 2040.

The corridors with the worst congested speeds during the 2040 AM and PM periods and the highest congestion hours, based on the Plan2040 model, are:

- I-75/I-85 (Downtown Connector)
- I-285 North from I-85 North to I-75 North
- SR 400 from I-85 to SR 20 (inside and outside the perimeter)
- I-285 East from I-20 East to I-85 North
- I-75 North from I-285 North to SR 92
- I-85 North from I-285 North to Hamilton Mill Road
- I-285 Northwest from I-20 West to I-75 North
- I-20 East from I-285 East to Salem Road
- I-20 West from I-285 to Chapel Hill Road
- I-575 from Towne Lake Parkway to I-75 North

Overall, 2040 congestion levels appeared to slightly worsen when compared to 2030 congestion for a majority of the limited access facilities in the Atlanta region. The model comparison results revealed that the region will experience more congestion in the future, and presents a need for future managed lane solutions.

Figure 4.18: 2040 AM Peak Period Speed (6:00 a.m. – 10:00 a.m.) – *Plan2040* Model

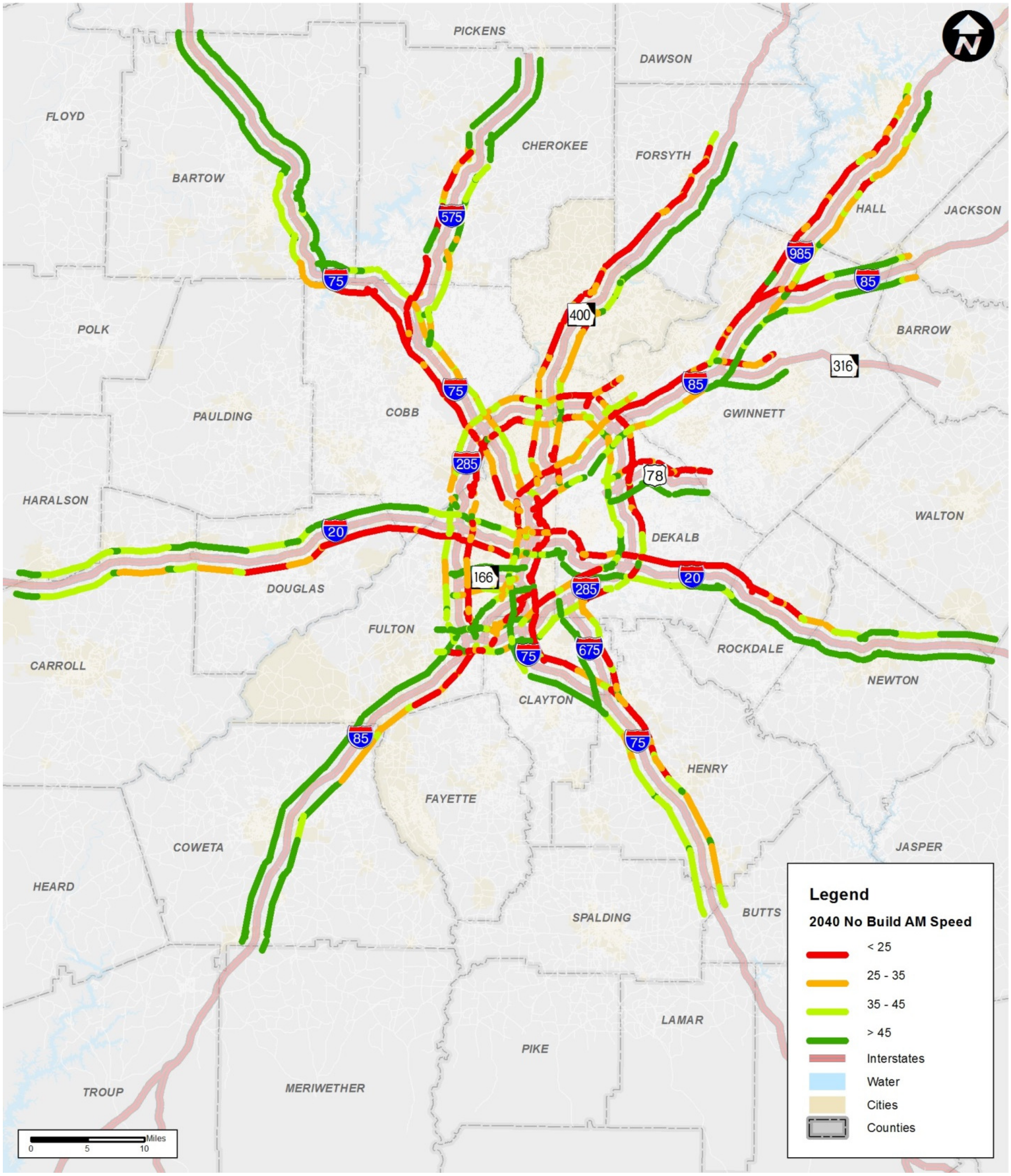


Figure 4.19: 2040 PM Peak Period Speed (3:00 p.m. – 7:00 p.m.) – *Plan2040* Model

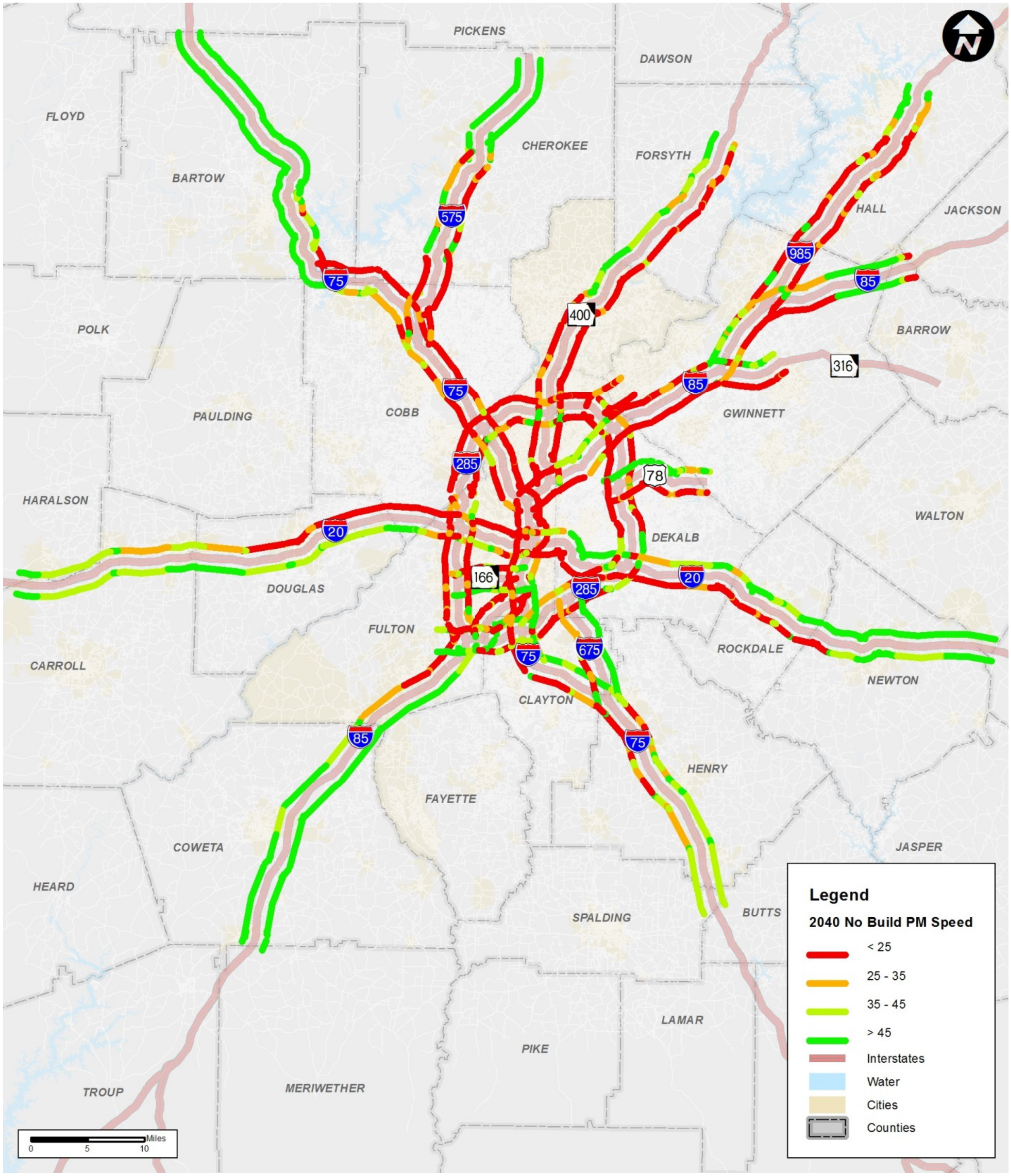
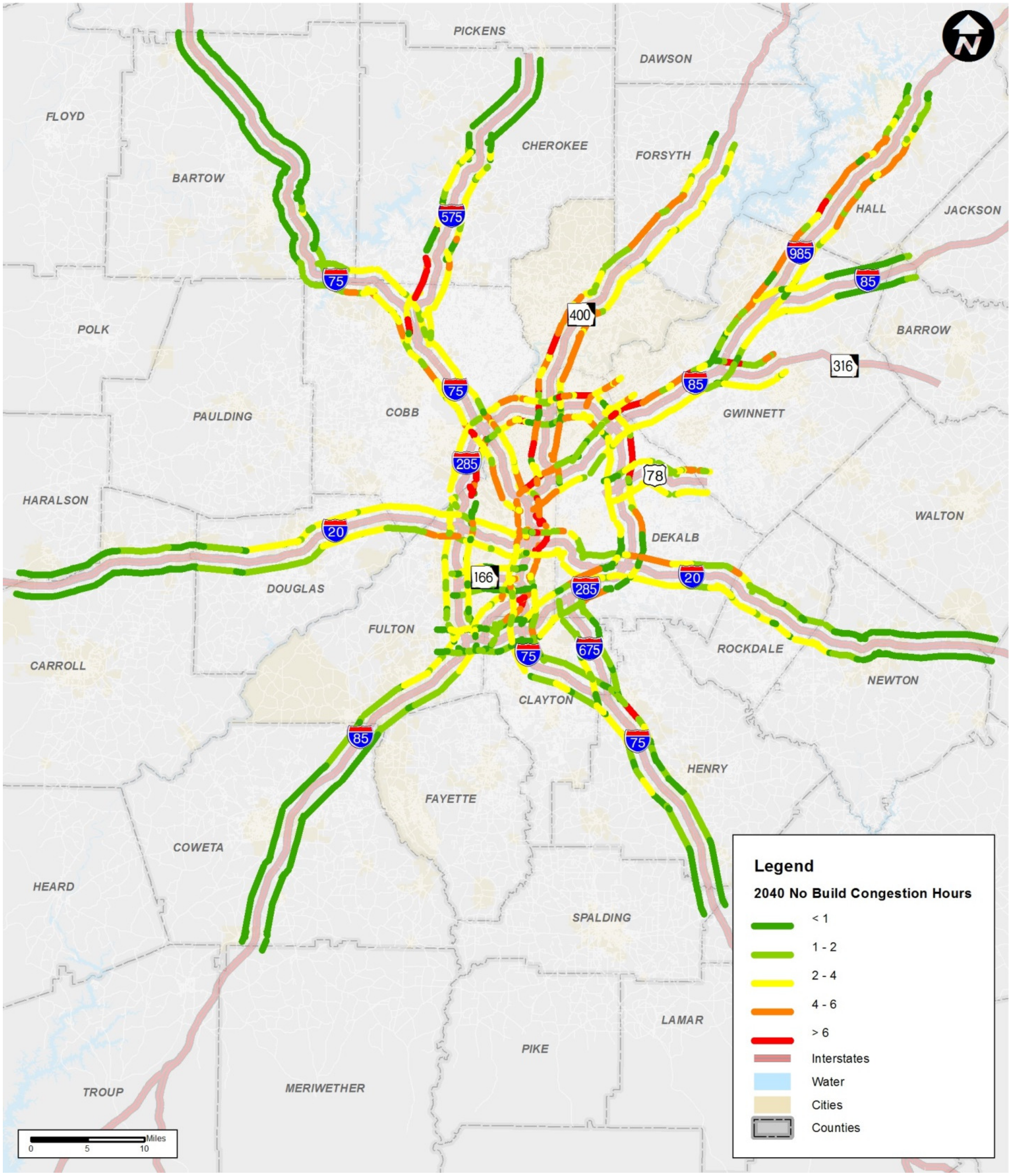


Figure 4.20: 2040 Total Congested Hours – *Plan2040* Model



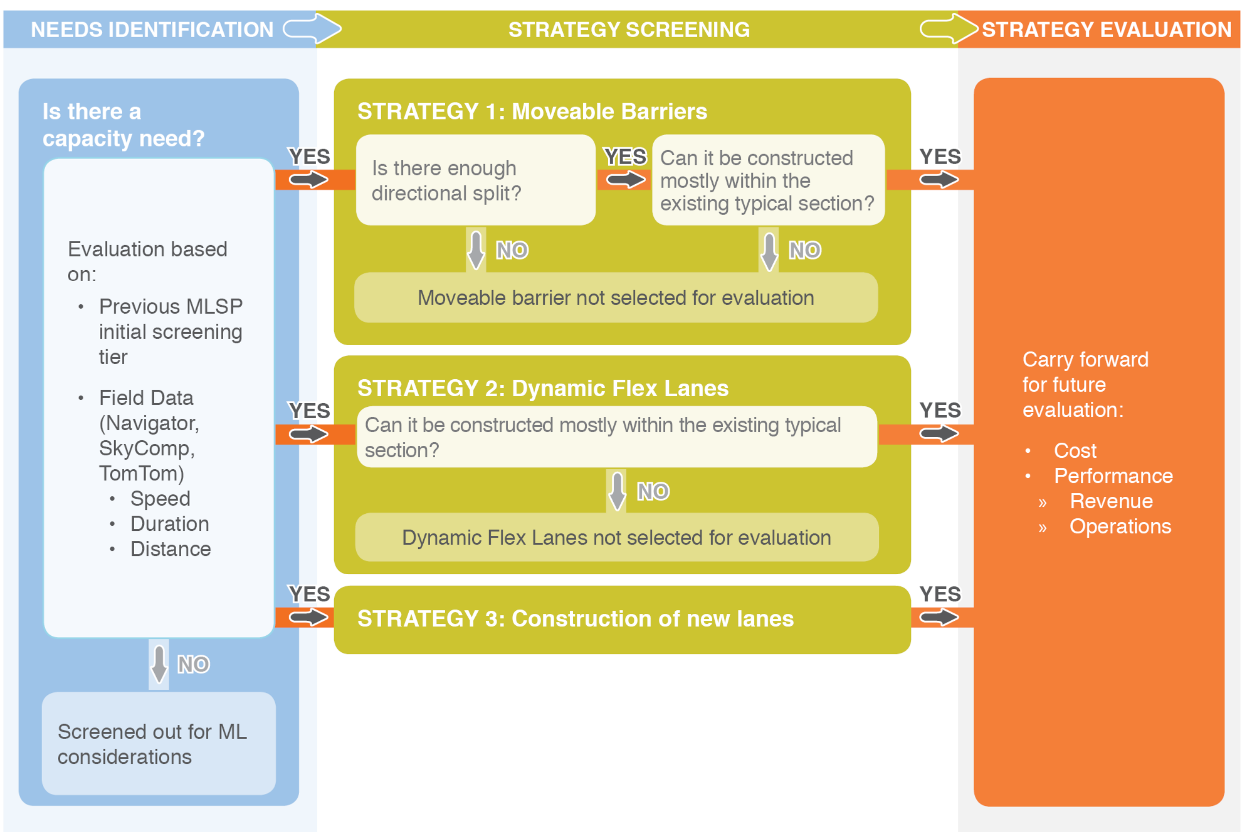
5 DEVELOPMENT OF MANAGED LANE STRATEGIES

There are a range of potential managed lane strategies that are applicable for improving limited-access freeways in metro Atlanta. The following sections discuss which corridors are appropriate for managed lanes, as well as the managed lane strategies that were developed to mitigate physical constraints by summarizing the concepts considered, their key benefits and potential applications of each strategy. More detailed technical reports discussing these managed lane strategies is located in **Appendix C**.

5.1 MLIP SCREENING FRAMEWORK

As part of the MLIP, a framework was developed that built upon the previous MLSP framework and confirmed the candidate corridors for MLIP consideration. The framework first screens candidate corridors for managed lane consideration (i.e., needs identification), followed by a screening of potential managed lane strategies and the evaluation of those strategies. The analysis involves utilizing various screening criteria, computing scores for each corridor, applying weighting factors and ranking corridor performance for additional managed lanes consideration and evaluation. **Figure 5.1** displays the MLIP screening framework.

Figure 5.1: Managed Lane Screening Framework



The following sections present the individual screening criteria and characteristics that were used for the needs identification and strategy screening process.

5.2 MANAGED LANE CORRIDOR SCREENING

As part of the managed lane corridor screening, the previous MLSP corridor screening process was revisited, as well as existing congestion based on updated observed field data, to determine if the corridors identified during the MLSP as appropriate for managed lanes were still the same going forward in the MLIP. Further detail is provided below.

5.2.1 Previous MLSP Corridor Screening

A lane can be managed by eligibility (vehicle occupancy and/or type), access (striping or barrier), and/or price. The previous MLSP established 26 characteristics under the three major categories: eligibility, access, and system connectivity to screen the study corridors and determine the needs and best candidate corridors for priced managed lane strategies. **Table 5.1** highlights the matrices and characteristics used in the MLSP initial candidate corridor screening process.

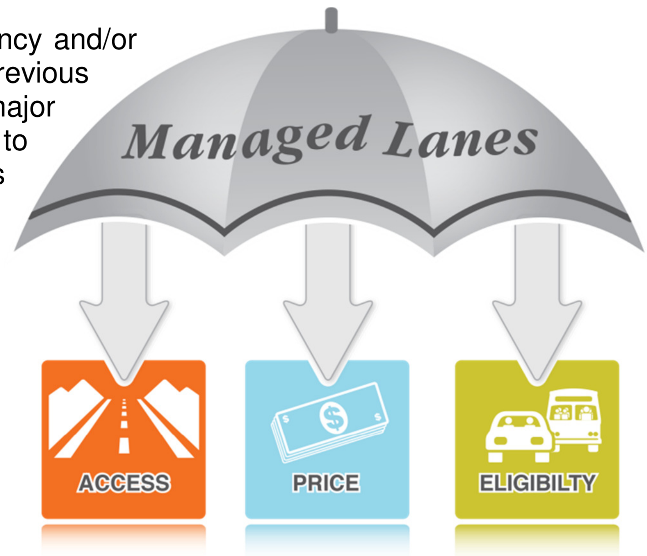


Table 5.1: MLSP Candidate Corridor Screening Criteria

Factor	Metrics	Characteristics
Eligibility	Functional Classification	Functional classification as defined in the Highway Performance Monitoring System (HPMS)
	Existing Managed Lanes	Presence of existing managed lanes
	Trip Length	Trips Length > 10 miles
	Vehicle Occupancy	Percent of vehicles with 2 or more occupants
	Demand	Total Vehicles
		Total Trucks
		Total High Occupancy Vehicles (HOVs)
	Level of Congestion	V/C Ratio
		Duration of Congestion (# of Hours)
		Travel Time Index

Factor	Metrics	Characteristics
Access	Population Served	% Persons residing within 5 miles of corridor (2005) % Persons residing within 5 miles of corridor (2030)
	Jobs Served	% Jobs located within 5 miles of corridor (2005) % Jobs located within 5 miles of corridor (2030)
	Environmental Justice (EJ)	EJ populations located along corridor
System Connectivity	Interchange Spacing	Interchanges per mile
	Connectivity to Other/ Candidate Managed Lanes	Number of system connections
	Connectivity to Freight or Intermodal Facilities	Number of freight connections
	Connectivity to Transit	Presence of existing express bus service Presence of planned express bus or Bus Rapid Transit (BRT) Service Presence of park and ride lots Presence of planned park and ride lots
	Previous or On-Going Studies	Corridor identified as a candidate for Truck Only Lane (TOL) implementation by Truck Only Lane Study Design activities already underway PPI (public private initiative) present on corridor Corridor Identified as priority in HOV System Plan

To achieve a better understanding of how some potential policy decisions could affect the suitability for managed lanes along these corridors, several sensitivity tests were conducted. The following policy scenarios were used to test sensitivity:

- Mobility Option – Policy decision to give users maximum mobility options
- Throughput – Policy decision to move the most amount of people through the transportation system
- Support Transit Investment – Policy decision to support express bus service and Bus Rapid Transit
- Revenue Maximization – Policy decision to maximize the revenue for managed lanes
- Truck Movement – Policy decision to enhance the movement of trucks and freight

- Fast Track Implementation – Policy decision to emphasize projects which have already moved forward in the planning and design process

Upon review of the results of the candidate corridor screening and the flexibility of each candidate corridor under various policy decisions, the following initial candidate corridor screening tiers were developed:

- MLSP Candidate Corridor Tier 1 (Highest Priority)
  - I-75 North from I-285 North to SR 20
  - I-85 North from I-285 North to SR 211
  - I-20 East from I-285 East to SR 138
  - I-285 North from I-85 North to I-75 North
  - I-285 East from I-20 East to I-85 North
  - SR 400 from I-85 to SR 20
- MLSP Candidate Corridor Tier 2
  - I-75 South from I-285 South to SR 16
  - I-20 West from I-285 West to Post Road
  - I-285 Northwest from I-75 North to I-20 West
  - Inside I-285 (I-75, I-85, I-20, Langford Parkway)
  - I-575 from I-75 to SR 20
- MLSP Candidate Corridor Tier 3 (Lowest Priority)
  - I-85 South from I-285 South to US 29
  - I-285 South from I-75 South to I-20 East
  - I-285 Southwest from I-20 West to I-75 South
  - I-675 from I-75 to I-285
  - I-985 from I-85 to SR 13
  - SR 316 from I-85 to SR 81
  - US 78 from N. Druid Hills Road to Rockbridge Road

These three tiers (high, medium and low priorities) were then utilized in the MLIP analysis as part of the needs identification process.

Table 5.2: MLSP Initial Screening Ordinal Ranking

MLSP Candidate Corridor Screening	Ordinal Rating
Tier 1	1.00
Tier 2	0.75
Tier 3	0.00

A composite score based on a variety of criteria was developed as part of the MLIP to identify and rank corridors with the highest needs. **Table 5.2** shows the ordinal rating employed for assigning points to the MLIP screening based on the MLSP initial candidate corridor screening tier.

5.2.2 Existing Congestion (Field Data)

The existing operational performance criterion based on the three observed data sources (NaviGAtor data, Skycomp data and TomTom GPS data) was utilized in the needs assessment and screening process. The existing congestion was designed to increase the priority of corridors by identifying corridors with lower operating travel speed and longer congested distance during the peak hour, and more prolonged periods of congestion during the day.

5.2.2.1 Peak Hour Congested Speed

Peak hour congested speeds, typically in the peak travel direction, were used to identify corridors with severe congested speeds and therefore longer travel times. The lower the congest speed, the higher the likelihood that managed lanes is an appropriate strategy along a particular corridor.

Table 5.3: Peak Hour Congested Speed Ordinal Rating

Peak Hour Congested Speed	Ordinal Rating
< 25 mph	1.0
25 - 35 mph	0.8
35 - 45 mph	0.5
> 45 mph	0.0

Peak hour congested speeds provided by NaviGAtor data and TomTom GPS data were used in the analysis. An ordinal rating was employed for assigning points for the peak hour congested speeds by peak direction, as presented in **Table 5.3**.

5.2.2.2 Congested Distance

Managed lane concepts are typically designed to address capacity issues and serve longer distance trips. It requires that travel time savings provided by managed lanes, when compared to the general purpose lanes, are sufficient to warrant paying a toll. The longer the congested distance is for the general purpose lanes, the higher potential the travel time savings could be and therefore more suited for managed lane investment.

Congested distance during the peak hour in the peak travel direction based on NaviGAtor, SkyComp and TomTom GPS data was used in the analysis. The following measures were used in determining congested distance:

- Congested Distance where speed is below 35 mph (NaviGAtor and TomTom data)

- Congested Distance where LOS is below 'E' (SkyComp data)

Table 5.4: Peak Hour Congested Distance Ordinal Rating

Peak Hour Congested Distance (miles)	Ordinal Rating
5	1.0
3	0.5
0	0.0

An ordinal rating was employed for assigning points for the congested distance by peak direction, as presented in **Table 5.4**.

5.2.2.3 Duration of Congestion

Duration of congestion is designed to identify and prioritize the corridors with prolonged periods of congestion during the day. The following measures were used in determining duration of congestion based on the NaviGAtor, SkyComp and TomTom data:

- Duration of time when speed is below 35 mph (NaviGAtor and TomTom data)
- Duration of time when LOS is below 'E' (SkyComp data)

Table 5.5: Daily Congestion Duration Ordinal Rating

Daily Congestion Duration (hours)	Ordinal Rating
> 6	1.0
4 - 6	0.9
2 - 4	0.6
1 - 2	0.3
< 1	0.0

The total number of congested hours was calculated based on the above criteria for each segment along all the study corridors. The maximum duration was determined and used in this analysis by identifying the segment along the facility experiencing the highest number of congested hours. An ordinal rating was employed for assigning points for the duration of congestion, as presented in **Table 5.5.**

5.2.3 MLIP Corridor Screening Results

The results of the existing conditions analysis based on updated field data revealed that the three candidate corridor screening tiers initially developed in MLSP still reflect the right needs and priorities in the future.

Based on the screening criteria and their ordinal ratings, the overall ranking results of candidate corridors for the application of managed lane strategies are presented in **Table 5.6**. It is important to note that corridors that are either currently in operation, in the process of being let for construction or environmental documentation is under development were excluded from the MLIP analysis. Those corridors include I-75 North and I-575 (known as the Northwest Corridor) and I-285 North (known as Revive285). Although I-85 North (I-85 Express and its extension) and I-75 South either currently operate with managed lanes or will soon have construction for managed lanes, additional managed lane treatments were considered and these corridors were moved forward through the corridor screening process.

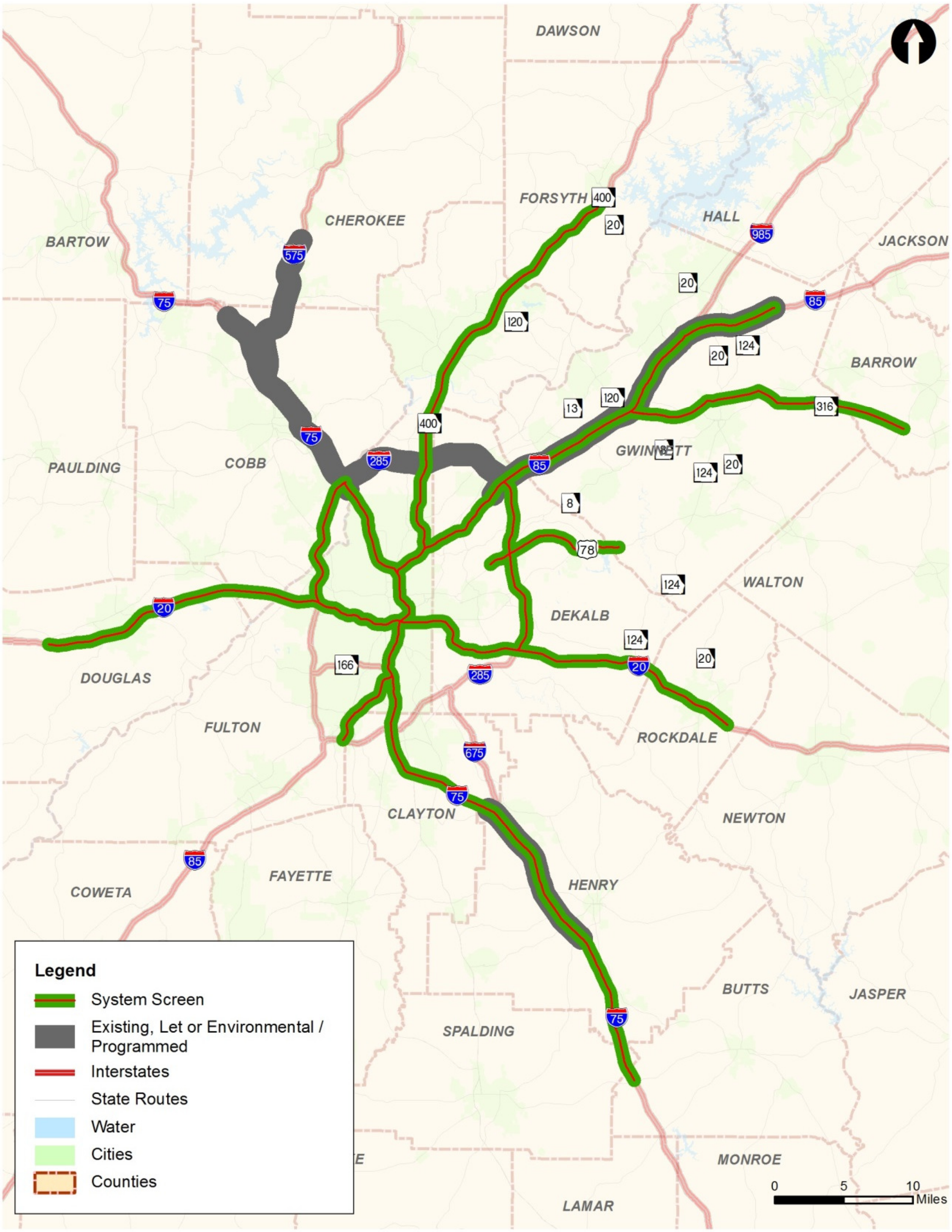
The detailed calculation worksheets, including the information gathered through NaviGAtor, Skycomp and TomTom, as well as the individual points used to calculate the overall scores, can be found in **Appendix D.**

Table 5.6: Managed Lane Corridor Screening Results

Corridor	Score	Needs Identified	Carry Forward in MLIP
I-285 N	97.0	Yes	No, under current study
SR 400	95.5	Yes	Yes
I-75 N	94.0	Yes	No, scheduled to let in 2014
I-85 N	94.0	Yes	Yes
I-285 E	93.0	Yes	Yes
I-75 Inside	88.8	Yes	Yes
I-85 Inside	88.8	Yes	Yes
SR 400 Inside	84.3	Yes	Yes
I-75 S	82.8	Yes	Yes
I-20 E	82.8	Yes	Yes
I-575	82.8	Yes	No, scheduled to let in 2014
I-20 W	80.8	Yes	Yes
I-285 NW	80.3	Yes	Yes
I-20 Inside	77.3	Yes	Yes
SR 316	41.0	Yes	Yes
US 78	39.5	Yes	Yes
Peachtree Industrial Blvd	19.5	No	No
I-985	13.0	No	No
I-285 S	11.5	No	No
I-675	9.5	No	No
I-285 SW	4.0	No	No
SR166/ Langford Pkwy	1.5	No	No
I-85 S	0.0	No	No

Figure 5.2 illustrates the corridors that moved forward for evaluating potential managed lane strategies.

Figure 5.2: Candidate Corridors for Further Managed Lane Evaluation



5.3 MANAGED LANE STRATEGY SCREENING

Three managed lane strategies were evaluated at various locations as part of the MLIP. This section discusses the applicability of managed lane strategy evaluations only; managed lane findings are located in **Chapter 9**. In addition to new lanes, the MLIP also looked at reversible lanes using moveable barriers, as well as dynamic flex lanes. The objective was to determine if there were lower cost solutions that could be implemented faster. Further detail on each is provided in the following sections.

5.3.1 New Managed Lanes

In metro Atlanta, the I-85 Express Lanes from Chamblee Tucker Road north to Old Peachtree Road in Gwinnett County were the first priced managed lanes in operation. The existing HOV lanes were converted and have employed dynamic toll rates to keep the managed lanes free-flowing, even during the height of rush hour. There are two other managed lanes that were let for construction in 2014 in the Atlanta region: Northwest Corridor (I-75 North and I-575) and a portion of I-75 South.

The priced managed lanes in operation today are successful models for using multiple operating strategies to achieve intended objectives. More managed lanes are expected to be implemented in metropolitan areas as a strategy that can improve travel time reliability. Based on the local experience and experience in other metropolitan areas around the country, the following are some of the lessons learned regarding managed lanes:

- Tolling existing capacity (HOV and GP) can be challenging due to potential public opposition and issues related to 'retrofitting' an existing lane for managed use
- Effective outreach is essential and must continue throughout project planning, implementation, and operation
- Understand that priced managed lanes are not self-supporting and typically require a funding source, particularly during the early years, for operation and maintenance
- Evaluate potential funding resources early
- Recognize ramp-up period for tolling as there is an adjustment time for motorists
- Interfacing between differing managed lane types (HOV to HOT) has been less of an issue than anticipated during the MLSP
- Ideally provide users with travel time estimates and speed limits by using dynamic signs to demonstrate the benefits of using the priced managed lanes
- Complete camera coverage aids in operations and enforcement
- Occupancy detection, declaration and enforcement impacts revenues
- Access points may need modification after opening to traffic
- Adequate signage is necessary to identify access points
- Design and operation should be flexible enough to accommodate fluctuating traffic patterns

More detailed information regarding the needs, key considerations and best practices related to the planning and implementation of priced managed lanes can be found in MLIP technical report titled *Priced Managed Lanes Case Study* located in **Appendix C**.

Figure 5.3 shows the before and after typical sections for the application of new managed lanes along a facility.

Figure 5.3: Typical Sections for New Managed Lanes

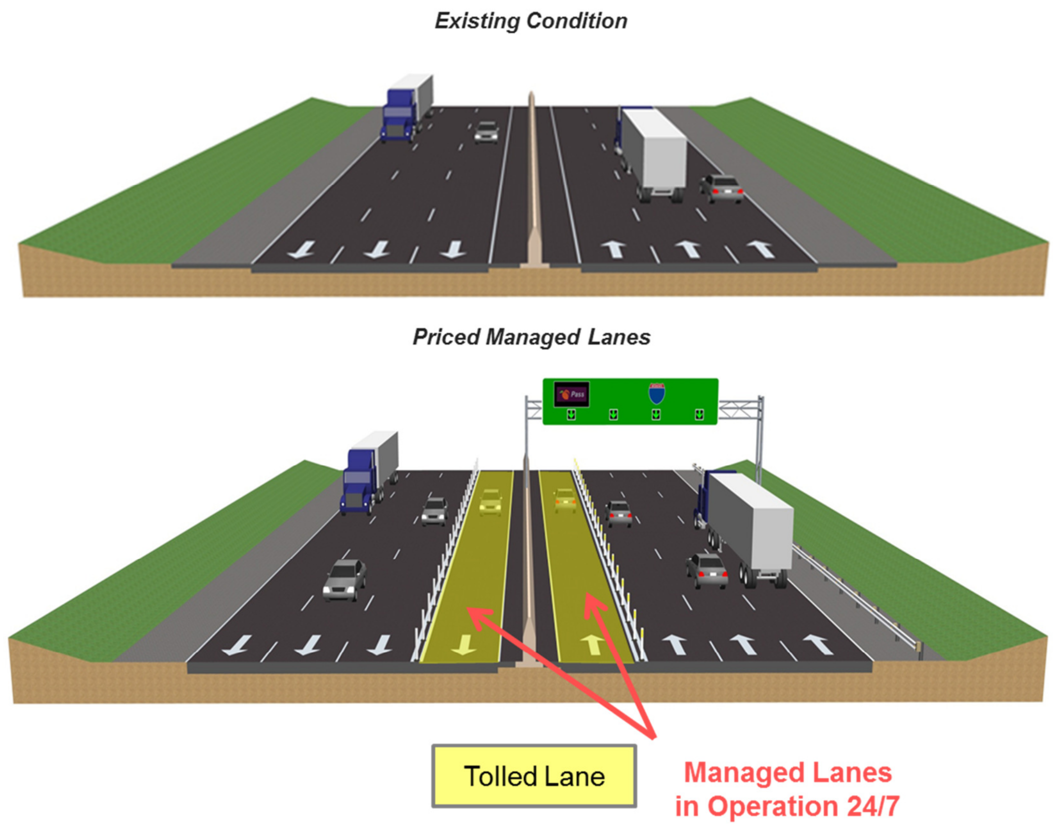
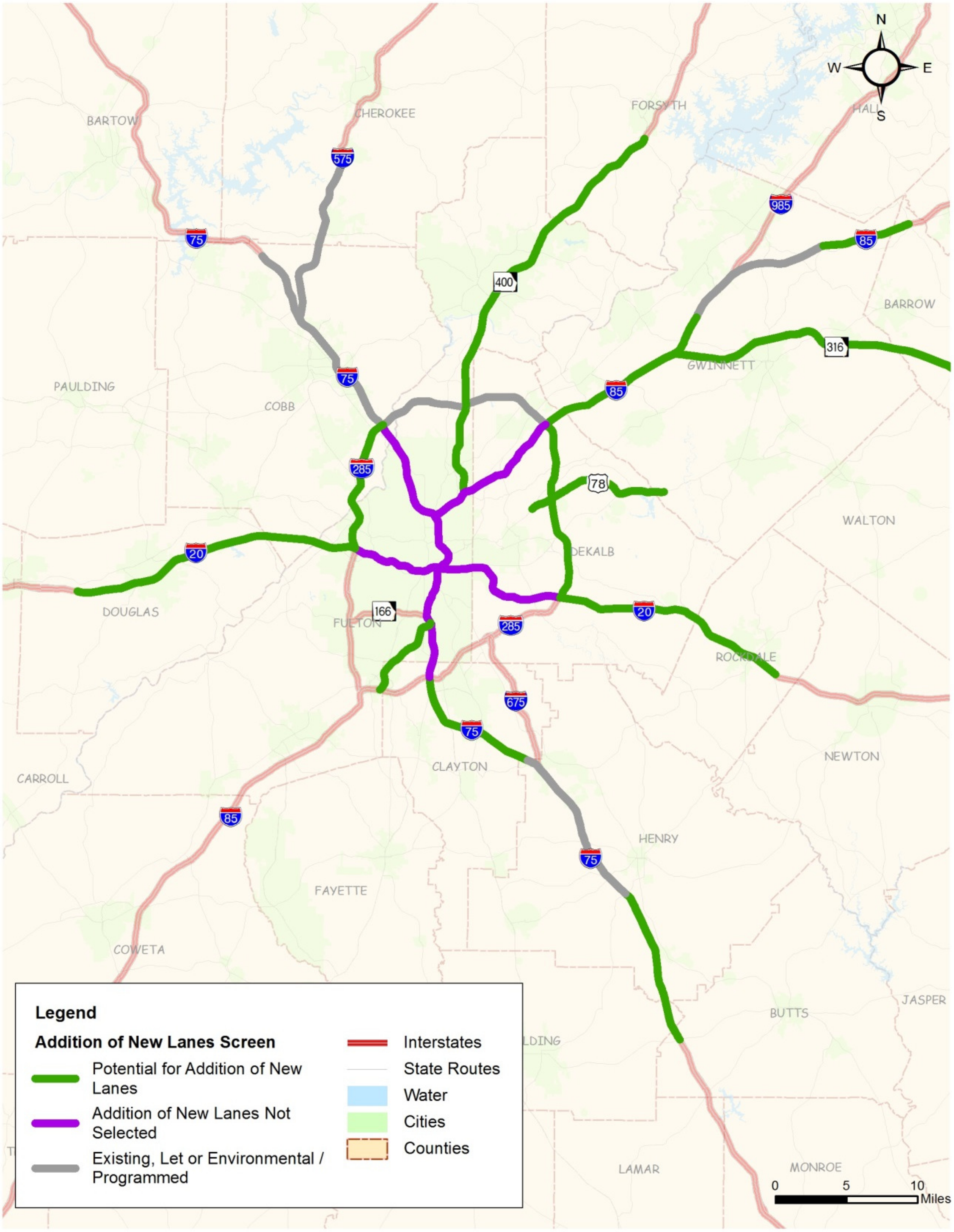


Figure 5.4 shows the corridors selected for new priced managed lane *evaluation*.

Figure 5.4: Corridors Selected for New Managed Lane *Evaluation*



5.3.2 Reversible Lanes Using Moveable Barriers

To mitigate increasing peak-period congestion, various transportation planning strategies have been considered and developed in many metropolitan areas, including the implementation of reversible lane systems. As part of the MLIP, reversible lanes utilizing moveable barriers were evaluated for the candidate corridors that moved forward for managed lane strategy development and evaluation.

Moveable barrier reversible lanes are referred to as lanes separated from the off-peak flow by moveable concrete barriers and are normally implemented where additional right-of-way may not be available. The fundamental objective of this managed lane strategy is to take advantage of any underutilized capacity in one direction of travel by reorienting the direction of traffic flow in the opposite direction. Moveable barrier reversible lanes are typically placed in the inside freeway lane and during non-peak hours, the lanes revert back to normal use. The before and after typical sections of moveable barrier reversible lanes considered in this study are illustrated in **Figure 5.5**.

As noted in the figure, this strategy assumed that the moveable barrier would be deployed in the second lane which creates an inside shoulder for both the newly created reversible lane as well as the remaining off-peak lanes. In order to mitigate the use of two off-peak lanes, the off-peak shoulder was opened as a general purpose lane. Based on a peer review of other moveable barrier applications along with an assessment of needs for the Atlanta region, several assumptions were made in order to successfully deploy reversible lanes using moveable barriers. They included:

- Equipment:
  - One barrier machine would be utilized for each traffic direction and additional machines would be required if the managed lane stretched longer than ten miles
  - Moveable barrier machines would need to be replaced every ten years
  - Moveable barrier machines are required for both directions of traffic to accommodate barrier shifting times of less than three hours
  - Cost estimates include two barrier machines per employee shift plus 50 percent overtime since the shifts will exceed eight hours per day for barrier operators
  - Unit costs include estimates for two warning gates and one barrier gate
  - Five percent of the moveable barriers would likely need to be replaced every year, or 50 percent over a ten year period
- Pavement:
  - All asphalt shoulders are partial depth construction only and require full depth replacement
  - All concrete shoulders are full depth construction only and require no replacement
  - Portland cement concrete (PCC) widening costs are based on 12'' PCC slab construction with 12'' graded aggregate base (GAB)
  - Asphalt widening is based on 12'' asphalt concrete construction with 12'' GAB

- Asphalt mill and overlay cost is based on 2'' milling and 3'' overlay and replaced every 15 years
- Pavement demolition is based on unit cost for removal asphalt pavement including base

- Signing:
  - Overhead sign unit cost is based on the cost for structural support of a type one overhead sign
  - Unit costs for removing overhead signs include cost for removal of overhead sign as well as the cost for removal of structural support for signs
  - Unit cost for retrofitting overhead signs includes costs for reconstruction of overhead signs as well as the cost for reconstruction of structural support for signs
  - Roadside signs and changeable warning signs unit costs assume 15 square feet sign as well as sign post
  - Changeable message signs need to be replaced at a rate of ten percent every ten years with the additional operations cost per sign per year

Operational characteristics of moveable barriers are illustrated in **Figure 5.6**.

Figure 5.5: Typical Sections for Moveable Barrier Reversible Lanes

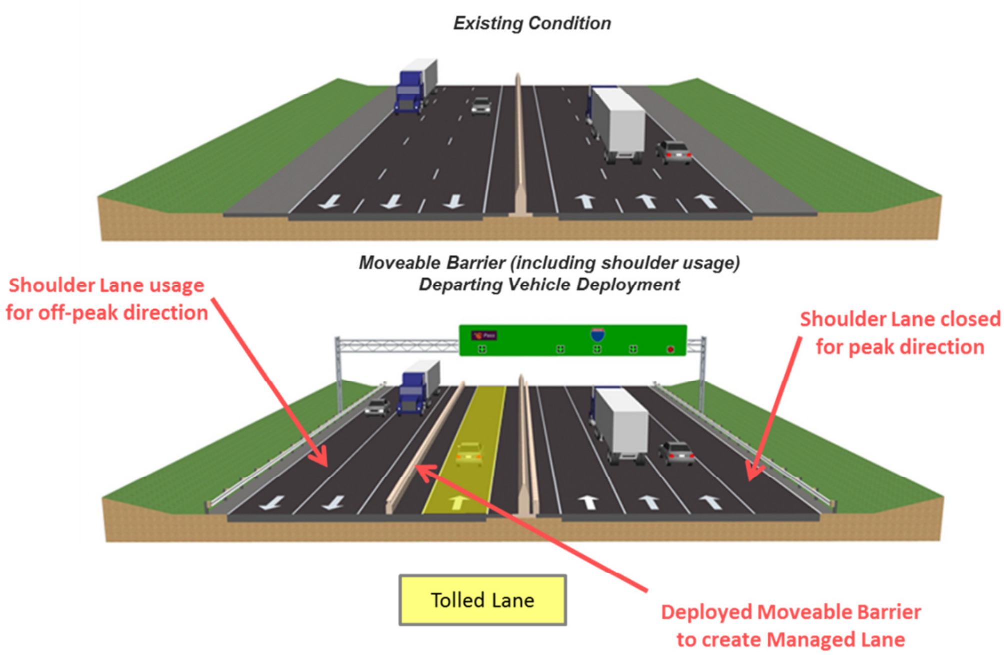
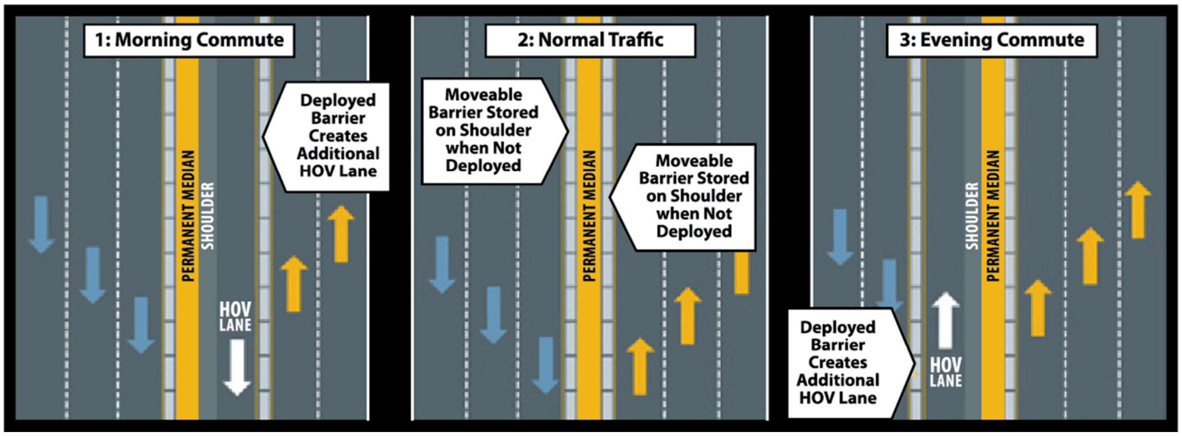


Figure 5.6: Moveable Barrier Reversible Lane System Operation



Source: Barrier Systems, Inc. http://www.barriersystemsinc.com/

Specific to moveable barrier reversible lanes, the following key factors should be considered:

- Plan ahead (traffic impacts, physical limitations, storage, etc.)
- Develop standard operating procedures
- Plan for enforcement (if operated as managed lane)
- Develop and implement public education program
- Utilize dependable contractor (if operation is privatized)
- Maintain spare parts inventory
- Maintain aggressive preventative maintenance regimen
- Provide adequate staffing for enforcement, traffic incident management and maintenance
- Consider multiple access points

More detailed information regarding the needs, lessons learned and best practices related to the implementation of permanent and/or moveable barriers reversible lanes can be found in MLIP technical report titled *Reversible Lanes Case Study* located in **Appendix C**. This case study, conducted as part of the MLIP, included a scan of reversible lanes using moveable barriers across the country, including I-30/Thornton Freeway in Dallas, Texas and I-93 in Boston, Massachusetts.

The following analysis was performed to screen moveable barrier reversible lane strategies on candidate managed lane corridors within metro Atlanta:

- Directional split analysis to calculate whether there is an appropriate split in directional traffic in order to not deteriorate conditions in the off-peak direction
- Engineering screening to determine whether it can be constructed mostly within the existing typical section

5.3.2.1 Directional Split Analysis

An initial analysis was conducted to determine the directional split of traffic along the managed lane candidate corridors. Barrier Systems, Inc. provided **Table 5.7** as a "rule of thumb" for where moveable barriers could be applicable based on the number of freeway lanes and percentage of traffic in peak traffic flow direction. Corridors that meet the minimum percentage of traffic in peak traffic flow direction may be able to allow the reduction of one lane in the off-peak direction and still maintain an acceptable level of traffic flow in the off-peak direction.

Table 5.7: Minimum Percentage of Traffic in Peak Traffic Flow Direction

No. of Lanes on Freeway	Max % Traffic Off-Peak Direction	Min % Traffic – Peak Direction
4	33	67
6	40	60
8	43	57
10	44	56

Source: Barrier Systems
Assumptions:
1. *Traffic flow in the peak direction is at capacity.*
2. *The maximum traffic rate of flow per lane is the same for the peak and off-peak direction.*

Notes:
1. *The percentages above remain the same irrespective of assumed maximum rate of flow per lane.*
2. *Values in table calculated by Barrier Systems, Inc.*

Traffic volumes used to calculate the directional split were obtained from the Atlanta MPO's latest 2010 travel demand model. The results of the directional analysis are provided in **Figure 5.7** (AM peak period, 6:00 a.m. to 10:00 a.m.) and **Figure 5.8** (PM peak period, 3:00 p.m. to 7:00 p.m.), respectively.

Figure 5.7: Moveable Barrier Directional Split Screening – AM Peak Period

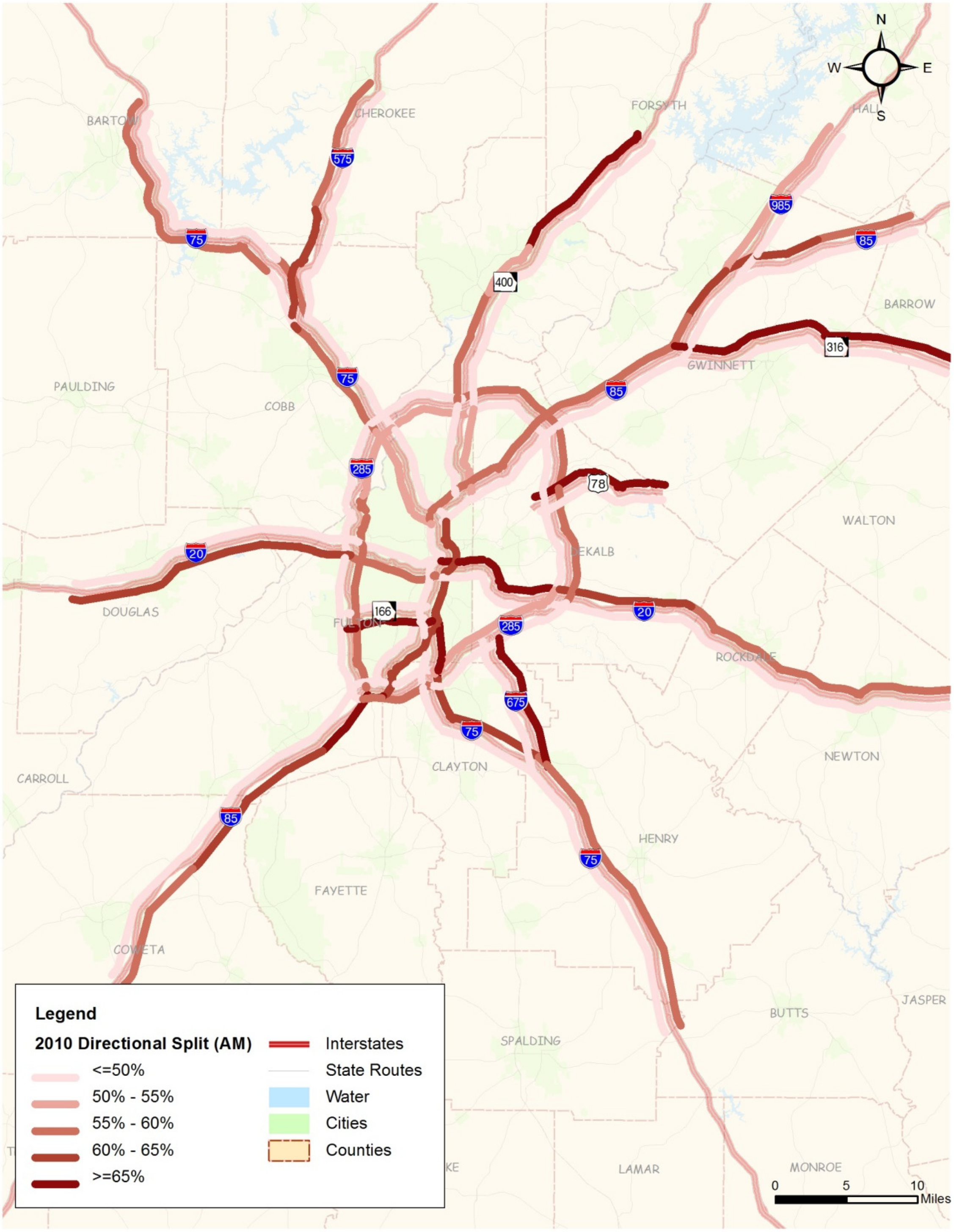
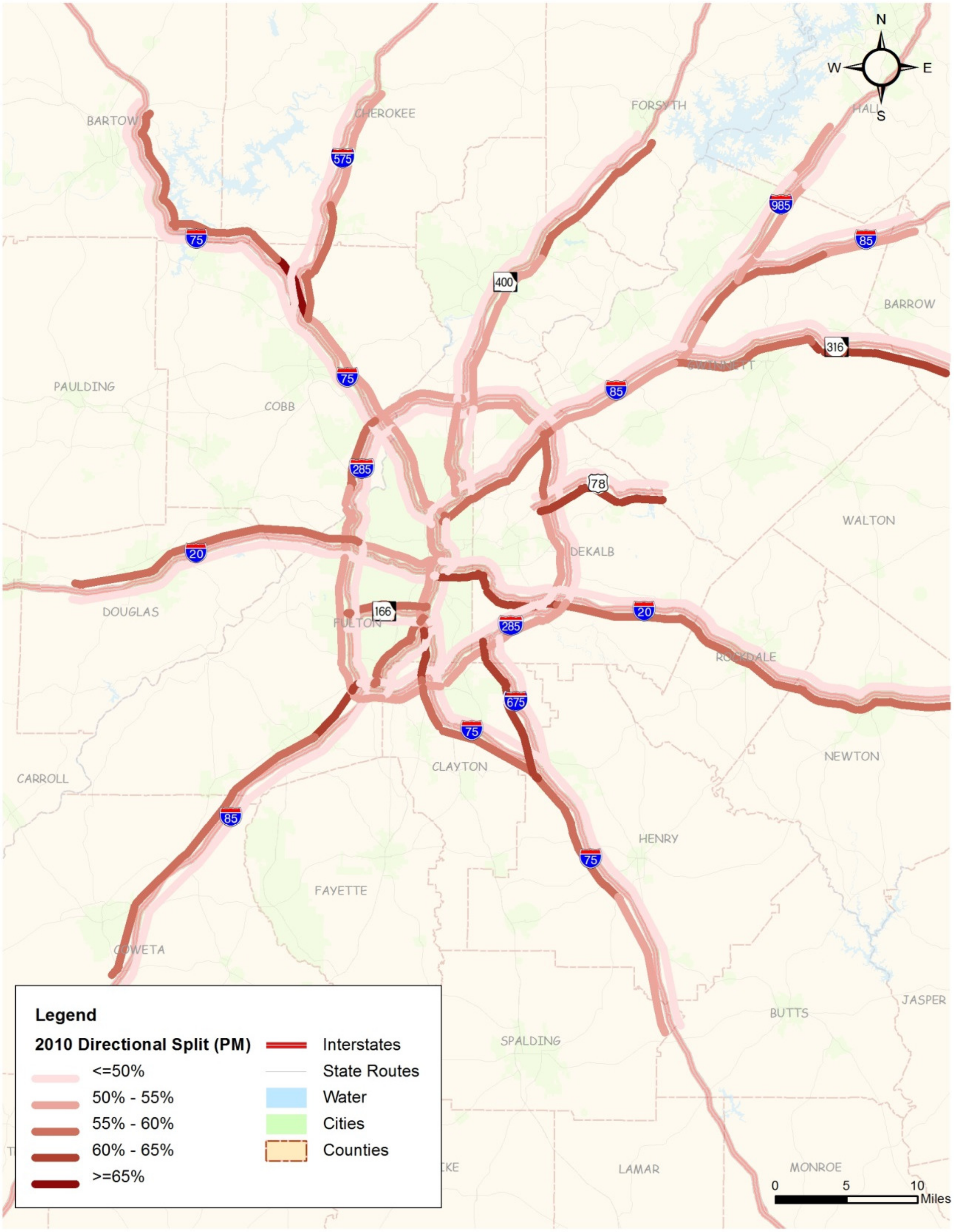


Figure 5.8: Moveable Barrier Directional Split Screening – PM Peak Period



5.3.2.2 Engineering Screening

Engineering screening was also conducted to determine whether moveable barrier reversible lanes can be constructed mostly within the existing pavement along the managed lane candidate corridors.

It is important to note that many of the corridors in metro Atlanta where moveable barriers were being considered have very narrow inside shoulders. This, in combination with the curve radii, may not allow for adequate sight distance around the moveable barrier if it is simply placed along an existing lane line, removing only a single lane in the off-peak direction. Therefore, this strategy assumed that the moveable barrier would be deployed in the second off-peak lane which creates an inside shoulder for both the newly created reversible lane, as well as the remaining off-peak lanes. No locations identified for potential application of this strategy would operate at an acceptable level of service with two off-peak lanes being used. In order to mitigate the use of two off-peak lanes, the existing off-peak shoulder was opened as a general purpose lane.

The ideal shoulder width required is twelve (12) feet due to complications with striping. If the existing outside shoulder was not wide enough, the location was reviewed to determine if a limited shoulder widening could be accomplished or the existing travel lanes could be narrowed to achieve the desired width.

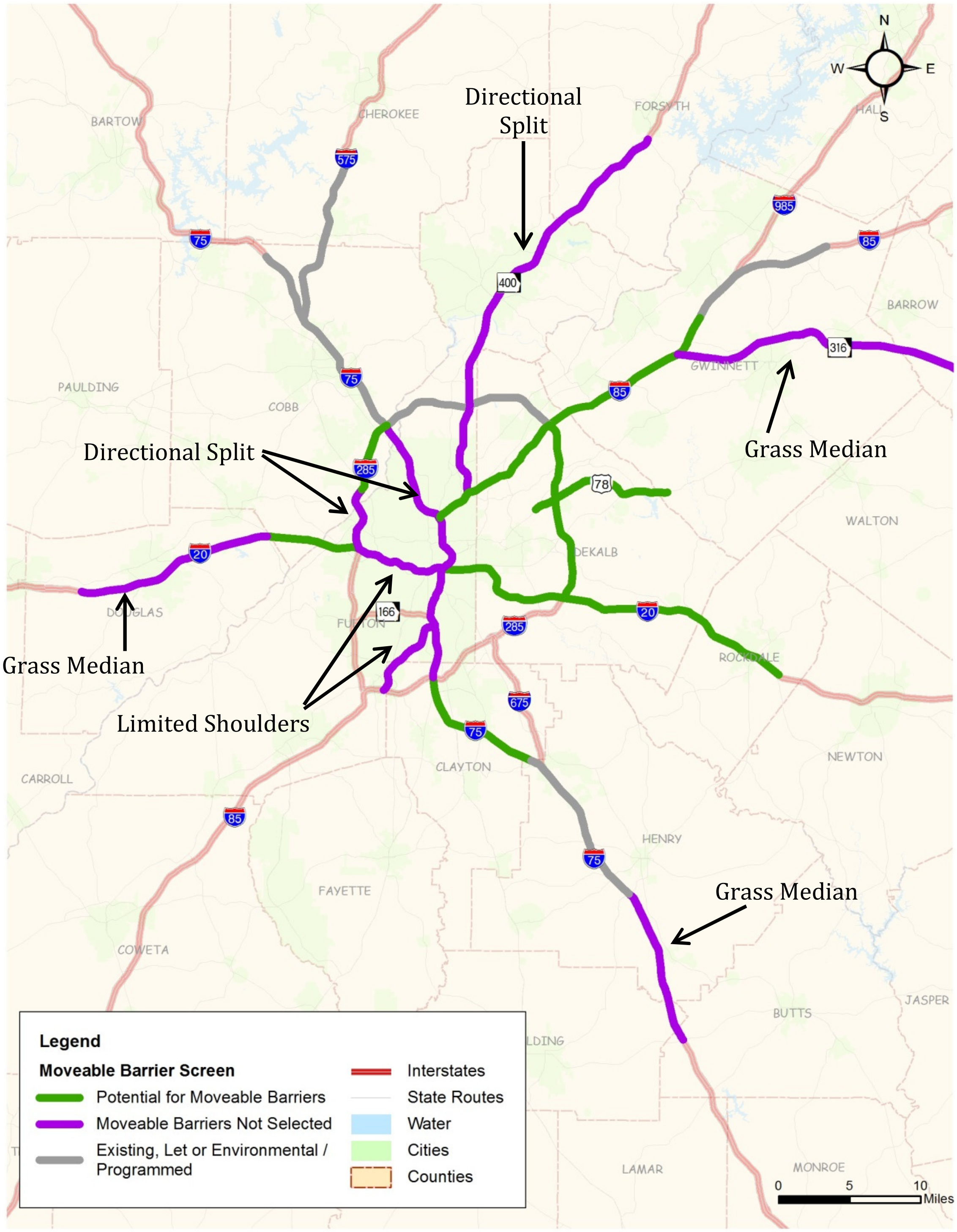
In addition, traffic traveling inside the moveable barrier section must cross the existing concrete center barrier at points to allow access to and from the general purpose lane traffic and their ramps. This would be accomplished through a one mile long gap in the barrier in order to safely accommodate ingress and egress movements. There are three items of importance to be noted along the center barrier during the field inspection:

- Bridge columns
- Street lighting
- Elevation differences between the two sides of the expressway

All other items are relatively easily shifted or placed on different support systems. The field survey of the proposed corridors was performed with these constraints in mind to determine if some form of moveable barrier system could be used.

Figure 5.9 illustrates the corridors selected for further moveable barrier reversible lane evaluation based on the directional split analysis and engineering screening results. The results of the evaluation are documented in **Chapter 6**. Reasons why specific corridors were determined not appropriate for further evaluation of reversible lanes using moveable barriers are indicated in text on the map.

Figure 5.9: Corridors Selected for Moveable Barrier Reversible Lane *Evaluation*

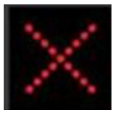


5.3.3 Dynamic Flex Lanes

> ***There is no evidence that dynamic flex lanes have a significant effect on crash frequency during peak hours.*** *FHWA - Efficient Use of Highway Capacity Summary*

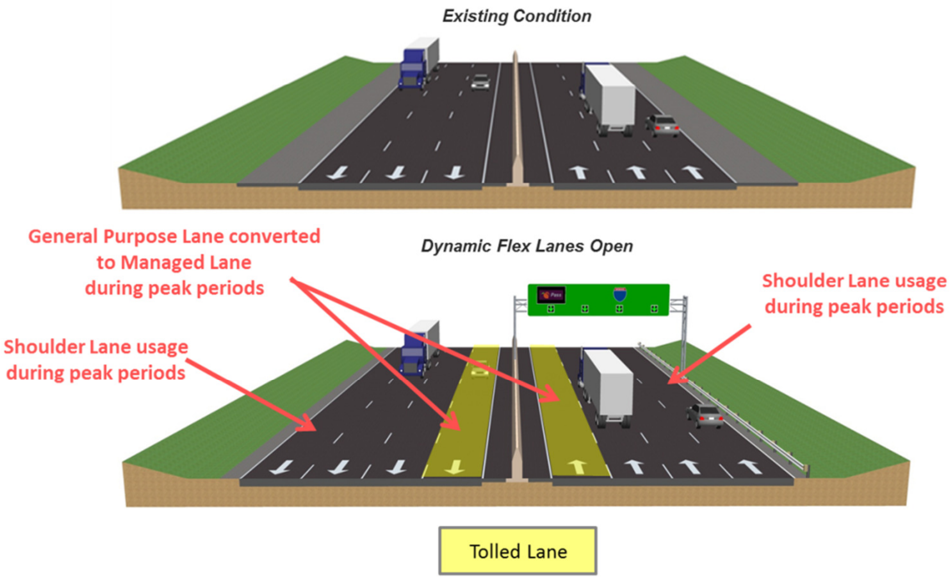
In addition to moveable barrier reversible lanes, dynamic flex lanes were also considered and evaluated as another non-traditional managed lane solution as part of MLIP.

Typically, dynamic flex lanes allow the DOT or operating agency to change lane eligibility under pre-determined traffic conditions or when conditions warrant. Lane eligibility or status can be portrayed to users through fixed roadside signage or variable message signs located on gantries. The gantries have the capability to display either a green arrow pointed ahead to indicate that the shoulder lane is open, a red 'X' to indicate the shoulder lane is closed, or a yellow arrow pointed diagonally to tell traffic to merge out of the shoulder.



For the purpose of the MLIP, dynamic flex lanes were used to describe the condition where the inside lane is tolled during the peak periods and the outside shoulder operates as a general purpose lane during that same peak period (during the off peak periods, the inside lane would revert to general purpose use and the outside lane would revert to shoulder use). Since the outside shoulder lane is operated as a new general purpose lane during the time the inside lane is tolled, there is no net reduction in free general purpose lanes. Therefore, this strategy meets the MAP-21 requirements of maintaining the same number of general purpose lanes when implementing priced managed lanes along a facility. The typical sections of dynamic flex lanes, both before and after retrofitting the dynamic flex lanes, are illustrated in **Figure 5.10**.

Figure 5.10: Typical Sections for Dynamic Flex Lanes



Most dynamic flex lane applications use the inside lane for carpooling operations, while the outside shoulder is used for general purpose traffic so as to maintain the same number of existing general purpose lanes. According to FHWA, the ideal design for any shoulder lane should be 12 feet, which allows for adequate width for trucks to travel in the lane. Twelve feet is a common width for shoulder lane usage and has been utilized in many other parts of the U.S. including I-66 in Virginia, where vehicles have been allowed to use the right shoulder during peak travel periods for more than 20 years. Maximum speeds allowed on I-66 are 55 mph, and an overhead lane control system indicates to motorists that the shoulder lane is open. More detailed information regarding the needs, key considerations and best practices related to the implementation of dynamic flex lanes can be found in the MLIP technical report titled *Active Traffic Management Case Study* located in **Appendix C**.

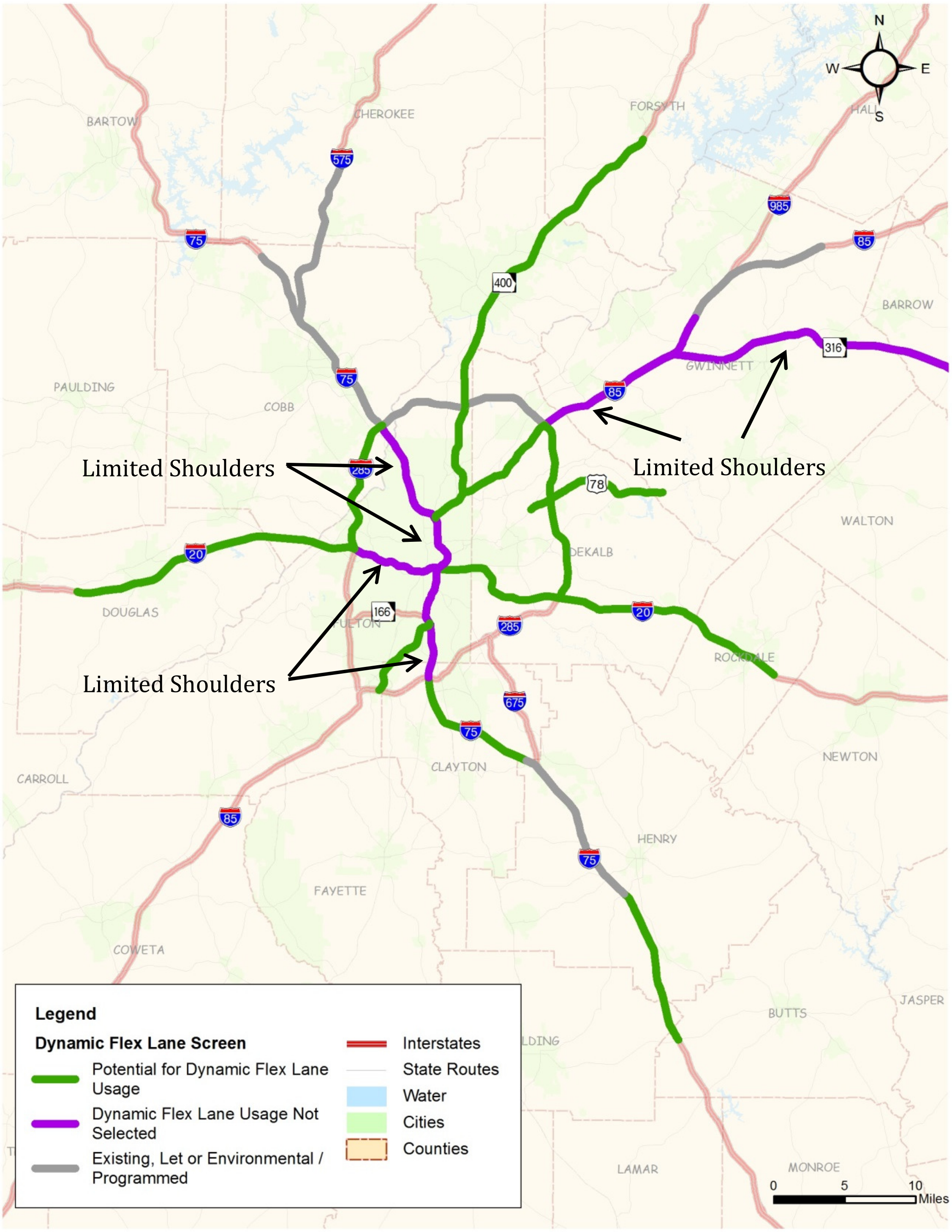
There are a wide range of issues to consider when determining whether dynamic flex lanes are appropriate for specific corridors. The following are some of the lessons learned regarding dynamic flex lanes based on experience both overseas and domestically:

- Manage expectations as not all shoulders lend themselves to travel
- Capital costs vary dramatically based on existing infrastructure
- Develop an active traffic management system concept
- Pre-determine enforcement roles/processes, incident response, training, public outreach and education
- Strategically place cameras to monitor traffic
- Strategically place emergency refuge areas, along with proper signing

A high-level engineering screening was performed to determine whether dynamic flex lanes can be constructed mostly within the existing typical sections along the managed lane candidate corridors. Similar to the moveable barrier reversible lanes, many of the corridors where shoulder use as an additional travel lane would be considered are urban expressways with very limited cross sections. In most cases, inside shoulders have already been minimized to 11 feet or less. The few areas that appeared wider were along tight horizontal curves where stopping sight distance required additional width from the inside shoulder. Frequently, the outside shoulder was the only available location to expand without requiring a major construction project (increased expense and right-of-way needs). However, widening outside shoulders can negatively impact bridge spans, since any narrowing of the outside shoulder at bridges would require some form of bridge construction.

If the existing shoulder was not wide enough, the location was reviewed to determine if a limited shoulder widening could be accomplished or the existing travel lanes could be narrowed to achieve the desired width. The field survey of the study corridors was performed with these constraints in mind to determine if some form of shoulder use as a travel lane could be considered. The results of this effort can be found in **Figure 5.11,** which highlights corridors that will move forward with further evaluation for dynamic flex lanes.

Figure 5.11: Corridors Selected for Dynamic Flex Lane *Evaluation*



5.3.4 Managed Lane Strategy Screening Results

The screening process evaluated each corridor against several metrics of congestion including congested speed, distance and duration. Higher levels of congestion indicated that a corridor may be a good candidate for managed lanes. Then, the three managed lane strategies were evaluated based on their constructability and then carried forward into evaluation of cost and performance (revenue and operations) parameters to inform decision makers about the managed lane strategy that is most likely to operate successfully in the future.

It is important to note that corridors that are currently let, programmed for the near future, or under environmental study (including Northwest Corridor and I-285 North (Revive285)) were excluded from the MLIP analysis.

Corridors not selected for further priced managed lane evaluation include:

- I-85 South
- I-285 South
- I-285 Southwest
- I-675
- I-985
- SR 166
- Peachtree Industrial Boulevard

Those corridors have relatively lower congestion levels, in comparison to other, more highly congested routes in Metro Atlanta. Priced managed lanes are not recommended as viable options for these corridors because there are other corridors that are highly likely to be more successful and should be considered first for implementation from a system perspective.

The corridors that have the highest congestion were selected for further priced managed lanes evaluation. These include:

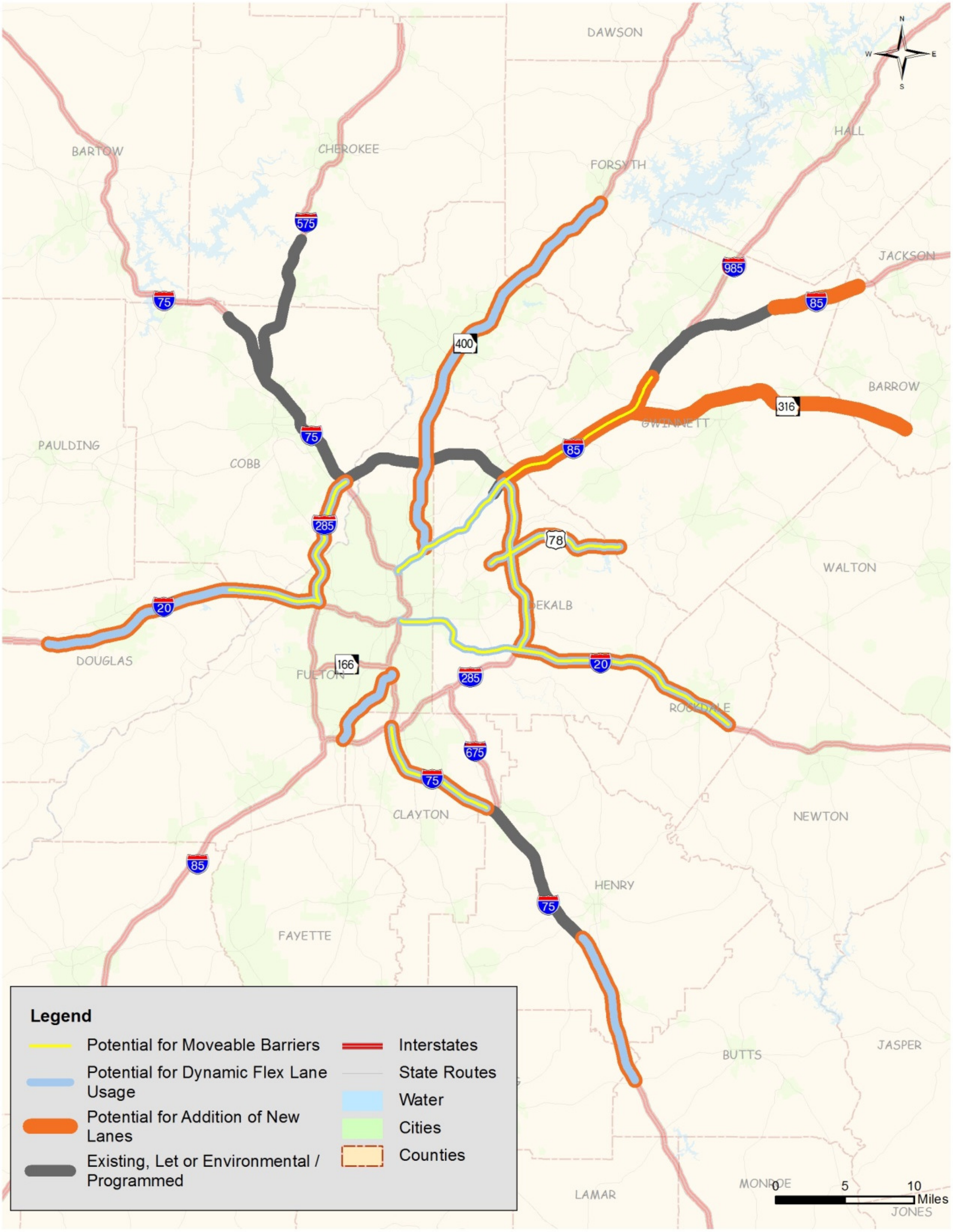
- Potential for New Lanes
    - I-20 West (from I-285 to Post Road in Douglas, Cobb, and Fulton Counties)
    - I-85 Inside (from I-285 North to Downtown Connector and Downtown Connector to I-285 South in Fulton and Clayton Counties)
    - I-75 South (from I-285 to SR 138 and from SR 155 to SR 16 in Clayton, Henry, Spalding, and Butts Counties)
    - I-20 East (from I-285 to Post Road in DeKalb and Rockdale Counties)
    - I-285 East (from I-20 to I-85 in DeKalb County)
    - US 78 (from I-285 to Rockbridge Road in DeKalb County)
    - I-85 North (from I-285 to Old Peachtree Road and from Hamilton Mill Road to SR 211 in DeKalb, Gwinnett, and Barrow Counties)
    - SR 316 (from I-85 to SR 81 in Gwinnett and Barrow Counties)
    - SR 400 Inside (from Downtown Connector to I-285 in Fulton County)

- SR 400 (From I-285 to SR 20 in Fulton and Forsyth Counties)

- Potential for Moveable Barriers
  - I-20 West (from I-285 to SR 6 in Cobb and Fulton Counties)
  - I-285 Northwest (from I-75 to I-20 in Cobb and Fulton Counties)
  - I-75 South (from I-285 to SR 138 in Clayton and Henry Counties)
  - I-20 Inside (from Downtown Connector to I-285 in DeKalb County)
  - I-20 East (from I-285 to Post Road in DeKalb County)
  - I-285 East (from I-20 to I-85 in DeKalb County)
  - US 78 (from I-285 to Rockbridge Road in DeKalb County)
  - I-85 Inside (from I-285 to Downtown Connector in DeKalb and Fulton Counties)
  - I-85 North (from I-285 to Old Peachtree Road in DeKalb and Gwinnett Counties)
- Potential for Dynamic Flex Lanes
  - I-20 West (from I-285 to Post Road in Douglas, Cobb, and Fulton Counties)
  - I-285 Northwest (from I-75 to I-20 in Cobb and Fulton Counties)
  - I-85 Inside (from I-285 North to Downtown Connector and Downtown Connector to I-285 South in DeKalb, Fulton, and Clayton Counties)
  - I-75 South (from I-285 to SR 138 and from SR 155 to SR 16 in Clayton, Henry, Spalding, and Butts Counties)
  - I-20 Inside (from Downtown Connector to I-285 in Fulton and DeKalb Counties)
  - I-20 East (from I-285 to Post Road in DeKalb and Rockdale Counties)
  - I-285 East (from I-20 to I-85 in DeKalb County)
  - US 78 (from I-285 to Rockbridge Road in DeKalb County)
  - SR 400 Inside (from Downtown Connector to I-285 in Fulton County)
  - SR 400 (from I-285 to SR 20 in Fulton and Forsyth Counties)

Figure 5.12 Illustrates the managed lane corridors that moved forward for further evaluation as part of the MLIP and which strategies are being considered on each corridor. The development of costs and revenues for the various managed lane strategies moving forward in analysis are presented in **Chapter 6**.

Figure 5.12: Managed Lane Corridors Evaluated



6 DEVELOPMENT OF COSTS AND REVENUES

6.1 INTRODUCTION

Using the framework established in the development of priced managed lanes strategies, an initial assessment of traffic and toll revenue was conducted for potential managed lane corridors for the three strategies: New Lanes, Reversible Lanes Using Moveable Barriers, and Dynamic Flex Lanes. The objective of this effort was to evaluate the overall financial and operational feasibility of implementing various management techniques on highways throughout the Atlanta region. It is important to note that this was a preliminary traffic and revenue (T&R) analysis, and is not intended for use in support of project financing.

This chapter presents a summary of the preliminary traffic and revenue analysis including an overview of the methodology used in developing T&R forecasts; the preliminary traffic and revenue streams from the three managed lane strategies; capital and operations and maintenance costs; and results of the financial feasibility analysis.

6.2 PRELIMINARY TRAFFIC AND REVENUE FORECASTING METHODOLOGY

6.2.1 Atlanta MPO's Regional Travel Demand Model

The primary tool used to quantify the traffic impacts and forecast revenue is the Atlanta MPO's *Plan2040* travel demand model. In order to capitalize on previous efforts, the MLIP incorporated the travel demand model analysis from the previous MLSP to use as a starting point. However, since some of the matrices and characteristics used in the MLSP screening process are based on the 2030 ARC *Envision6* travel demand model results, it was important for this study to compare the results from the recently adopted ARC *Plan2040* to the previous MLSP to determine if any of the needs have changed and to ensure the identified needs are still valid and relevant.

The Atlanta MPO's travel demand model follows the traditional four-step process: trip generation, trip distribution, mode choice and trip assignment. The model also includes other sub-models, such as a commercial vehicles (truck) model, air passenger model, etc. to estimate travel on both highway and transit facilities throughout the region.

This study employed the latest version of ARC's *Plan2040* travel demand model at the time (November 2012). The travel demand model reflects the most up-to-date short-term and long-term transportation projects in the Atlanta region, as well as the most recent population and employment forecasts from the ARC.

6.2.2 Model Inputs

In order to calculate the expected traffic and revenue for the managed lane strategies, a variety of model inputs and assumptions must first be reviewed and in some cases, updated accordingly. These included the input roadway network, trip tables, analysis years and time periods, toll diversion model, and managed lane tolling policies. Further detail is provided below.

6.2.2.1 Roadway Network Update

The roadway network in the Atlanta MPO travel demand model included all regionally and locally important roadways. The candidate managed lane corridors discussed in the previous chapter for each strategy were validated against aerial photography or field experience and coded into the roadway network with the proposed access locations. Three networks were developed to represent the system of managed lanes for each of the three strategies: New Lanes, Reversible Lanes Using Moveable Barriers, and Dynamic Flex Lanes.

Additionally, a No-Build network was created to represent only the programmed managed lane network and other roadway enhancements that were a part of *Plan2040*. The No-Build network assumed that no additional managed lanes would be in place in 2020 and 2040. The only managed lanes in this network were either existing or let, which included the existing I-85 HOT3+ lanes, Northwest Corridor (I-75 North and I-575), and I-75 South Express Lanes from SR 138 to SR 155.

The New Lane network was coded into the travel demand model as a separate parallel facility similar to the way managed lanes have traditionally been modeled not only in the Atlanta model, but in a majority of the larger metropolitan models throughout the United States. This was done for all eligible corridors as documented in **Chapter 5** (shown in **Figure 5.4**). The New Lane networks assumed four access types, including potential system-to-system interchanges, dedicated arterial managed lane access, direct merges from the general purpose lanes and terminal slip ramps. The network coding changes were included for all time periods for the corridors.

The Reversible Lanes Using Moveable Barriers networks assumed that one reversible managed lane would be added in the peak direction by removing one general purpose lane from the off-peak direction for all eligible corridors (shown in **Figure 5.9** in the previous chapter) during peak periods. Similar to the New Lanes, a separate series of links were added parallel to the study corridors to represent the priced managed lane. Additionally, the AM and PM networks varied based on the provision of the moveable barrier for the peak directions; no additional priced managed lanes were included in the off peak (midday and nighttime networks). The moveable barrier networks assumed only terminal slip ramps, as no interim access would be provided along the eligible corridors.

Since the Dynamic Flex Lanes assumed the existing outside shoulder would be utilized as a general purpose lane for both directions during the peak periods to mitigate the pricing of the most inside lane, the networks were adjusted to add a series of new links along all eligible corridors (shown in **Figure 5.11** in the previous chapter) similar to the way the new lanes were coded. This was done for both the AM and PM networks since the dynamic flex lanes would only operate during those time periods; no additional priced managed lanes were included in the off peak (midday and nighttime networks). The dynamic flex lane networks assumed only two access types: terminal slip ramps and direct merge access from the general purpose lanes. The access spacing is every two to three miles, which is consistent with the current I-85 HOT lanes. **Figure 6.1** illustrates the model periods for each priced managed lane strategy.

Table 6.1: Model Periods and Directions

Time of Day	New Lanes	Moveable Barrier	Dynamic Flex Lanes
Morning (6AM to 10AM)	✓ (both directions)	✓ (peak direction only)	✓ (both directions)
Midday (10AM to 3PM)	✓ (both directions)		
Afternoon (3PM to 7PM)	✓ (both directions)	✓ (peak direction only)	✓ (both directions)
Nighttime (7PM to 6AM)	✓ (both directions)		

The access locations along the managed lanes went through an engineering assessment for each of the managed lane strategies looking at available right-of-way, interchange spacing and forecasted demand. The access locations are illustrated in the **Appendix D** for each candidate corridor under each priced managed lane strategy.

6.2.2.2 Trip Tables

The development of trip tables, which defines the number of roadway and transit trips between various traffic analysis zone pairs, is another major step in the modeling process. Trip tables from the Atlanta MPO's model included auto trips (single occupancy vehicle (SOV), HOV2, HOV3, and HOV4+), commercial vehicle trips and truck trips (medium-duty trucks and heavy-duty trucks). These trip tables were then used as inputs into the diversion model which were used to establish a baseline of demand for the traffic and revenue forecasts further discussed in the next section.

6.2.2.3 Toll Diversion Model

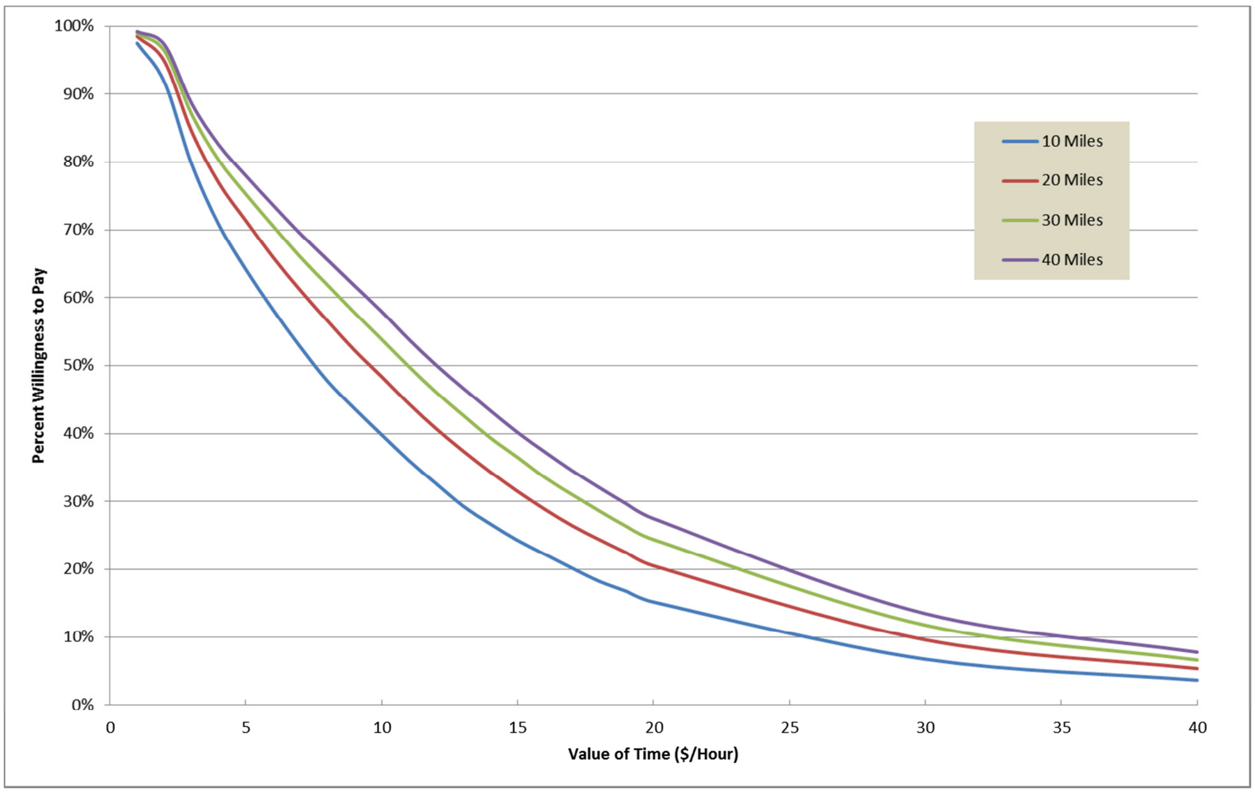
To accurately forecast priced managed lanes utilization within the regional transportation network, the toll diversion model developed for the *Atlanta Regional Managed Lane System Plan (MLSP)* was used for the MLIP T&R analysis for consistency. The toll diversion model incorporates willingness to pay (WTP) methodology into the standard equilibrium highway assignment process. The WTP methodology helps determine a driver's probability of using the priced managed lanes based on the various trade-offs related to travel time savings, toll cost, and other trip characteristics.

The WTP curves for potential priced managed lane users were initially developed based on the passenger car stated preference (SP) survey results conducted in the Atlanta region for the *MLSP* in 2007. In 2012, GDOT conducted another stated preference survey for automobile and commercial vehicle drivers to better understand value of time (VOT) for potential new priced managed lane facilities and new toll road facilities in the State of Georgia. This latest 2012 SP survey showed the values of time for automobile travelers ranged from $8.73/hour to $10.74/hour, while the VOT for commercial vehicle travelers was $27.70/hour. Those values of time remained consistent with the 2007 MLSP survey and are also in line with what the Atlanta MPO uses in their *Plan2040* travel demand model.

Figure 6.1 illustrates an example of passenger car WTP curves during the AM period, with the ratio of the toll rate to amount of travel time savings on the x-axis and percentage of WTP on the y-axis. The figure shows that for the same amount of travel time savings, more users are willing to pay small amounts, but fewer users are willing to pay larger amounts. For example, about 40 percent of auto users are willing to pay $10 in order to save an hour on their 10-mile trip while only 25 percent are willing to pay $15 in order to save an hour on their 10-mile trip.

Figure 6.1 also illustrates the relationship between the willingness to pay and the total trip distance. Under the condition with the same ratio of toll rates to the amount of travel time savings, less people are willing to pay for the short distance trip than for the long distance trip. For example, about 40 percent of auto users are willing to pay $10 in order to save an hour on their 10-mile trip while about 58 percent of auto users are willing to pay $10 in order to save an hour on their 40-mile trip.

Figure 6.1: Willingness to Pay Curves – AM Peak Period



The willingness to pay curves were incorporated into the equilibrium highway assignment process to estimate the percentage of travelers who could choose a tolled travel option given a certain value of travel time savings. After the determination of willingness to pay, the individual trip table for each vehicle type is split in two: one table for those willing to pay tolls (under certain travel circumstances) and another table for those who are not willing to pay tolls (under any circumstances). Then the standard travel demand model equilibrium assignment methodologies were applied. Those who are not willing to pay a toll are all assigned to paths without tolls. Those who are willing to pay a toll become eligible for tolled facilities and are assigned to both tolled and non-tolled roads based on congestion levels. It is important to note that the various vehicle types were handled separately in the assignment process to recognize different restrictions on specific lane uses and toll charges. For example, medium-duty trucks and heavy-duty trucks were not permitted to use the priced managed lanes.

6.2.2.4 Analysis Years and Time Periods

The two horizon years selected for the T&R analysis were 2020 and 2040. These two analysis years are not representative of the opening year and design year for the priced managed lane strategies; rather, they served as two individual timeline points for revenue estimation. The travel demand models for years 2020 and 2040 reflect the assumptions of future land use, population and employment forecasts and other transportation investments identified as part of *Plan2040* developed by the Atlanta MPO for both horizon years.

6.2.2.5 Managed Lane Tolling Policies

The current I-85 Express Lanes operate under a HOT3+ policy. This policy allows carpools with three or more passengers to "self-declare" and travel within the priced managed lanes for free. All alternatives for adding additional managed lane capacity or extending the limits of the managed lanes along this corridor maintained a HOT3+ eligibility policy.

The eligibility policy assumed for all the remaining study corridors for all three priced managed lane strategies in this T&R analysis was an Express Toll Lane (ETL) policy. ETL refers to a managed lane designation in which all vehicles in the managed lane pay a toll. With ETL, free managed lane eligibility can potentially be extended to specific types of vehicles, such as registered transit vehicles, emergency vehicles and military vehicles, among others. As part of this modeling effort, all transit vehicles were allowed to use the priced managed lanes for free. It was assumed that medium-duty and heavy-duty trucks are not eligible to travel in the ETL. With the exception of the I-85 HOT lane extension between Old Peachtree Road and Hamilton Mill Road, all recently let priced managed lanes (Northwest Corridor and I-75 South Express Lanes) are utilizing an ETL eligibility policy.

The tolling policy for all corridors was to set toll rates that maximized the efficiency of the priced managed lane while maintaining the operational threshold for the priced managed lanes targeted as 45 miles per hour. This insured that the priced managed lane was fully optimized for vehicle throughput and maintained the desired performance.

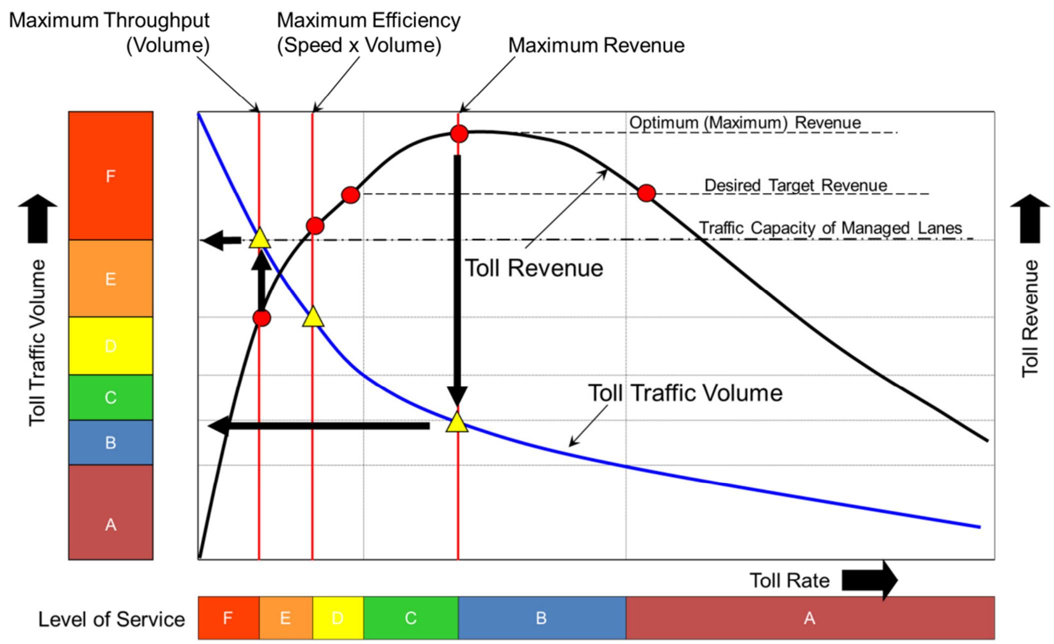
6.3 TRAFFIC AND REVENUE ANALYSIS

6.3.1 Toll Sensitivity Analysis

The traffic and revenue methodology described in the previous section was used to conduct a toll sensitivity test for each managed lane candidate corridor and segment under different strategies, separately by time-of-day and direction. The goal of performing a toll sensitivity analysis was to understand the relationship between toll rates, traffic impacts and revenue levels.

Figure 6.2 shows an example of a toll sensitivity curve (in black) and an associated toll traffic volume curve (in blue), with the toll rate along the x-axis and the revenue/toll traffic volume along the y-axis. As seen from the toll traffic volume curve, lower toll rates in the managed lanes result in higher usage (higher traffic volumes), while higher toll rates result in lower usage (lower traffic volumes). The toll sensitivity curve shows different trends. As the x-axis values (toll rates) increase from left to right, revenue increases to a high point and then begins to decline. With a higher percent of the corridor's global demand in the managed lanes, demand, and more specifically operating speeds, in the general purpose lanes improve leading to an overall reduction in congestion. Consequently, improving the conditions in the general purpose lanes erodes the value of the managed lane to paying traffic. Constantly changing conditions results in a delicate balance between the operating conditions in the managed lanes and the general purpose lanes and the price associated with the managed lanes. The resulting toll sensitivity curves illustrate the relative levels of potential toll revenue and the traffic associated with each hypothetical toll charge.

Figure 6.2: Toll Sensitivity Curve



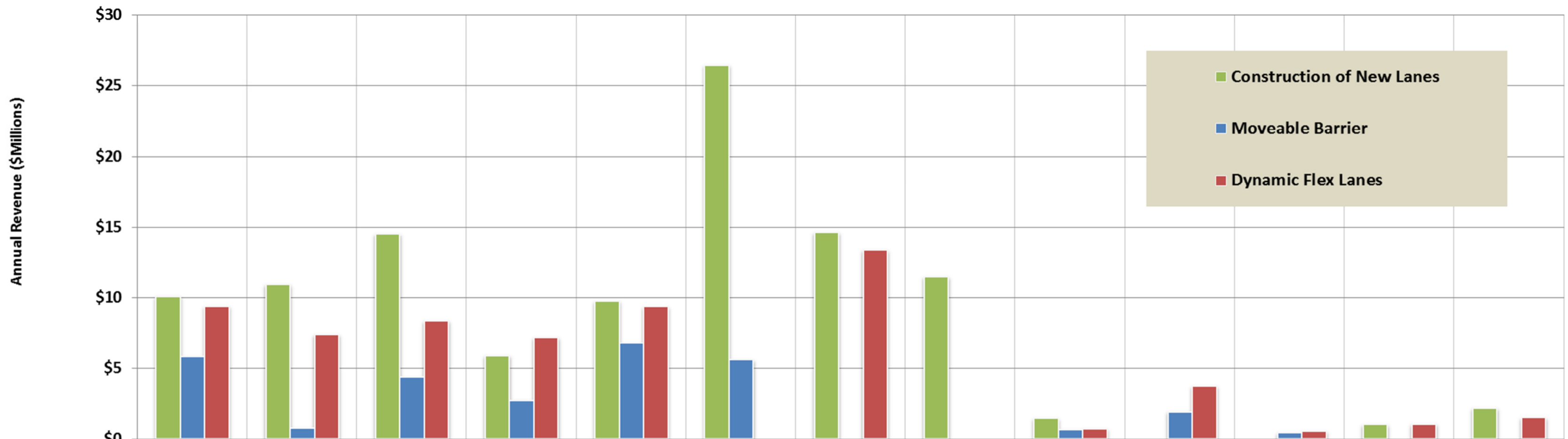
A series of toll sensitivity curves were created by time period, travel direction, analysis year and segment to illustrate the relationships between the toll rates and revenue potential for each segment under all three managed lane strategies evaluated. Based on these toll sensitivity curves, toll rates were set to maximize the travel efficiency in the priced managed lanes without unnecessarily diverting traffic to general purpose lanes and alternative roadways. Under the maximum traffic efficiency condition, the operational threshold for the priced managed lanes is targeted at 45 miles per hour.

6.3.2 Annual Gross Revenue Projections

Based on the toll sensitivity analysis, a toll rate structure was established for each corridor under each strategy. The model estimated typical weekday toll traffic volumes and revenue was converted to annual gross revenue by multiplying by 250 weekdays and 115 weekend/holidays. The weekend/holiday revenues were assumed to be 50 percent of the typical weekday revenues.

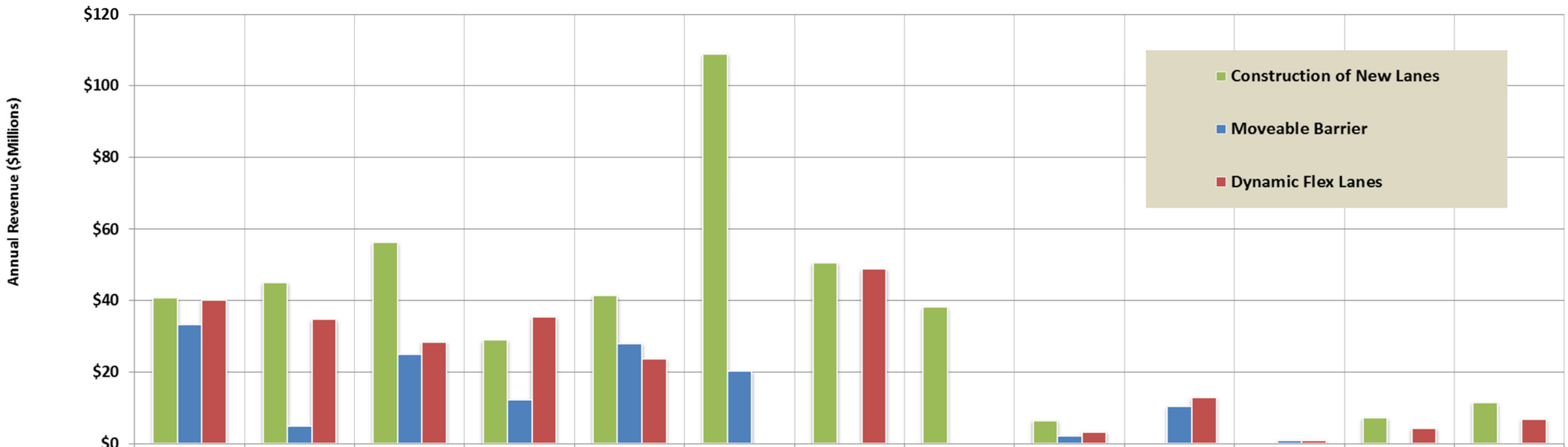
Year 2020 and 2040 traffic and revenue forecasts are represented in **Figure 6.3** and **Figure 6.4** for all candidate managed lane corridors with the ETL eligibility policy. Note that corridor strategies with zero revenue indicate that a particular strategy was not considered for that corridor.

Figure 6.3: Year 2020 Annual Revenue



	I-20E	I-20W	I-285E	I-285NW	I-75S	I-85N	SR 400 Outside	SR 316	US 78	I-20E Inside	I-85N Inside	I-85S Inside	SR 400 Inside
Construction of New Lanes	$10.0	$10.9	$14.5	$5.8	$9.7	$26.5	$14.6	$11.5	$1.4	$0	$0	$1.0	$2.1
Moveable Barrier	$5.8	$0.7	$4.3	$2.7	$6.7	$5.5	$0.0	$0	$0.6	$1.9	$0.4	$0	$0
Dynamic Flex Lanes	$9.3	$7.4	$8.3	$7.2	$9.3	$0	$13.32	$0	$0.7	$3.7	$0.5	$1.0	$1.5

Figure 6.4: Year 2040 Annual Revenue



	I-20E	I-20W	I-285E	I-285NW	I-75S	I-85N	SR 400 Outside	SR 316	US 78	I-20E Inside	I-85N Inside	I-85S Inside	SR 400 Inside
Construction of New Lanes	$40.6	$44.9	$56.0	$29.0	$41.2	$108.9	$50.5	$37.9	$6.3	$0	$0	$7.1	$11.3
Moveable Barrier	$33.3	$4.7	$24.8	$12.2	$28.0	$20.1	$0	$0	$2.0	$10.3	$0.8	$0	$0
Dynamic Flex Lanes	$40.0	$34.6	$28.4	$35.3	$23.5	$0	$49	$0	$3.2	$12.8	$0.9	$4.2	$6.7

6.3.3 30-Year Gross Revenue Projections

Using the estimated annual gross revenue for 2020 and 2040, a revenue stream for each corridor strategy was developed by linearly interpolating for the intermediate years 2021 to 2039 and assuming a dampened, 50 percent revenue growth rate beyond 2040. A ramp-up period was assumed for the first four years of operation during which accounts for the development of public acceptance and utilization. The ramp-up schedule was assumed to be 55 percent for year one, 65 percent for year two, 80 percent for year three, and 97 percent for year four. For the financial calculations, revenues are in 2013 dollars, with no inflation, to provide a direct comparison to potential capital financing packages.

Total 30-year cumulative gross revenue (**Table 6.2** below) was used to compare the corridor strategies based on three categories: high (greater than $500 million), medium (between $300 and $500 million) and low (less than $300 million) revenue**. Table 6.3** provides a summary of the total 30-year gross revenue for corridors under each of the three strategies. Full revenue streams for each of the corridors and strategies are provided in **Appendix E**.

Table 6.2: Total 30-Year Gross Revenue ($M)

Revenue	New Lanes	Moveable Barrier	Dynamic Flex Lanes
I-20 E Segment 1 (from I-285 to SR 124)	$649.4	$420.7	$602.5
I-20 E Segment 2 (from SR 124 to Salem Rd)	$320.8	$341.7	$346.7
I-20 W Segment 1 (from I-285 to SR 6)	$347.9	$107.1	$223.2
I-20 W Segment 2 (from SR 6 to SR 92)	$392.1	N/A	$337.6
I-20 W Segment 3 (from SR 92 to Post Rd)	$331.8	N/A	$250.3
I-285 E Segment 1 (from I-20 to US 78)	$733.0	$342.8	$365.9
I-285 E Segment 2 (from US 78 to I-85)	$614.4	$225.7	$331.3
I-285 NW Segment 1 (from I-75 to SR 280)	$341.0	$43.4	$468.6
I-285 NW Segment 2 (from SR 280 to I-20)	$334.1	$244.0	$353.3
I-75 S Segment 1 (from I-285 to SR 138)	$363.3	$266.2	$192.9
I-75 S Segment 3 (from SR 155 to SR 16)	$150.3	N/A	$83.7
I-85 N Segment 1* (from I-285 to Old Peachtree Rd)	$2,238.5	$489.3	N/A
I-85 N Segment 2 (from Old Peachtree Rd to Hamilton Mill Rd)	$359.3	N/A	N/A
SR 316 Segment 1 (from I-85 to SR 120)	$466.3	N/A	N/A
SR 316 Segment 2 (from SR 120 to SR 81)	$468.1	N/A	N/A
SR 400 Segment 1 (from I-285 to McFarland Rd)	$971.7	N/A	$884.3
SR 400 Segment 2 (from McFarland Rd to SR 20)	$263.5	N/A	$296.6
US 78 (from North Druid Hills Rd to Rockbridge	$149.2	$49.5	$75.5

Revenue	New Lanes	Moveable Barrier	Dynamic Flex Lanes
Rd)			
I-20 Inside Segment 2 (from Downtown Connector to I-285)	*N/A*	$236.3	$313.8
I-85 Inside Segment 1 (from I-285 to Downtown Connector)	*N/A*	$20.8	$25.7
I-85 Inside Segment 3 (from Downtown Connector to I-285)	$159.0	*N/A*	$99.7
SR 400 Inside (from I-85 to I-285)	$261.5	*N/A*	$157.7

*****
I-85 North Segment 1 – assumed adding an additional managed lane in each direction along the existing managed lane.

Table 6.3: 30-Year Gross Revenue Summary

Revenue Ranking	New Lanes	Moveable Barrier	Dynamic Flex Lanes
High (> $500M)	▪I-20 E Segment 1 ▪I-85 N Segment 1* ▪I-285 E Segment 1 & 2 ▪SR 316 Segment 1 ▪SR 400 Segment 1	▪None	▪I-20 E Segment 1 ▪SR 400 Segment 1
Medium ($300 - $500M)	▪I-20 E Segment 2 ▪I-20 W Segment 1, 2 & 3 ▪I-75 S Segment 1 ▪I-85 N Segment 2 ▪I-285 NW Segment 1 & 2 ▪SR 316 Segment 2	▪I-20 E Segment 1 & 2 ▪I-85 N Segment 1 ▪I-285 E Segment 1	▪I-20 E Segment 2 ▪I-20 W Segment 2 ▪I-20 Inside Segment 1 ▪I-285 E Segment 1 & 2 ▪I-285 NW Segment 1 & 2
Low (< $300M)	▪I-75 S Segment 3 ▪I-85 Inside Segment 3 ▪SR 400 Inside ▪SR 400 Segment 2 ▪US 78	▪I-20 W Segment 1 ▪I-20 Inside Segment 1 ▪I-75 S Segment 1 ▪I-85 Inside Segment 1 ▪I-285 E Segment 2 ▪I-285 NW Segment 1 & 2 ▪US 78	▪I-20 W Segment 1 & 3 ▪I-75 S Segment 1 & 3 ▪I-85 Inside Segment 1 & 3 ▪SR 400 Inside ▪SR 400 Segment 2 ▪US 78

*****
I-85 North Segment 1 – assumed adding an additional managed lane in each direction along the existing managed lane.

Figure 6.5, **Figure 6.6**, and **Figure 6.7** represent the managed lane revenue of candidate corridors for each of the three strategies.

The forecasted gross revenues provided important input to the evaluation of the corridor project financeablity under each strategy. Another important input included in the project financeability was the project cost, including capital cost and operation and maintenance cost, which are discussed in the next section.

Figure 6.5: Gross Revenue for Construction of New Lane Strategy Corridors

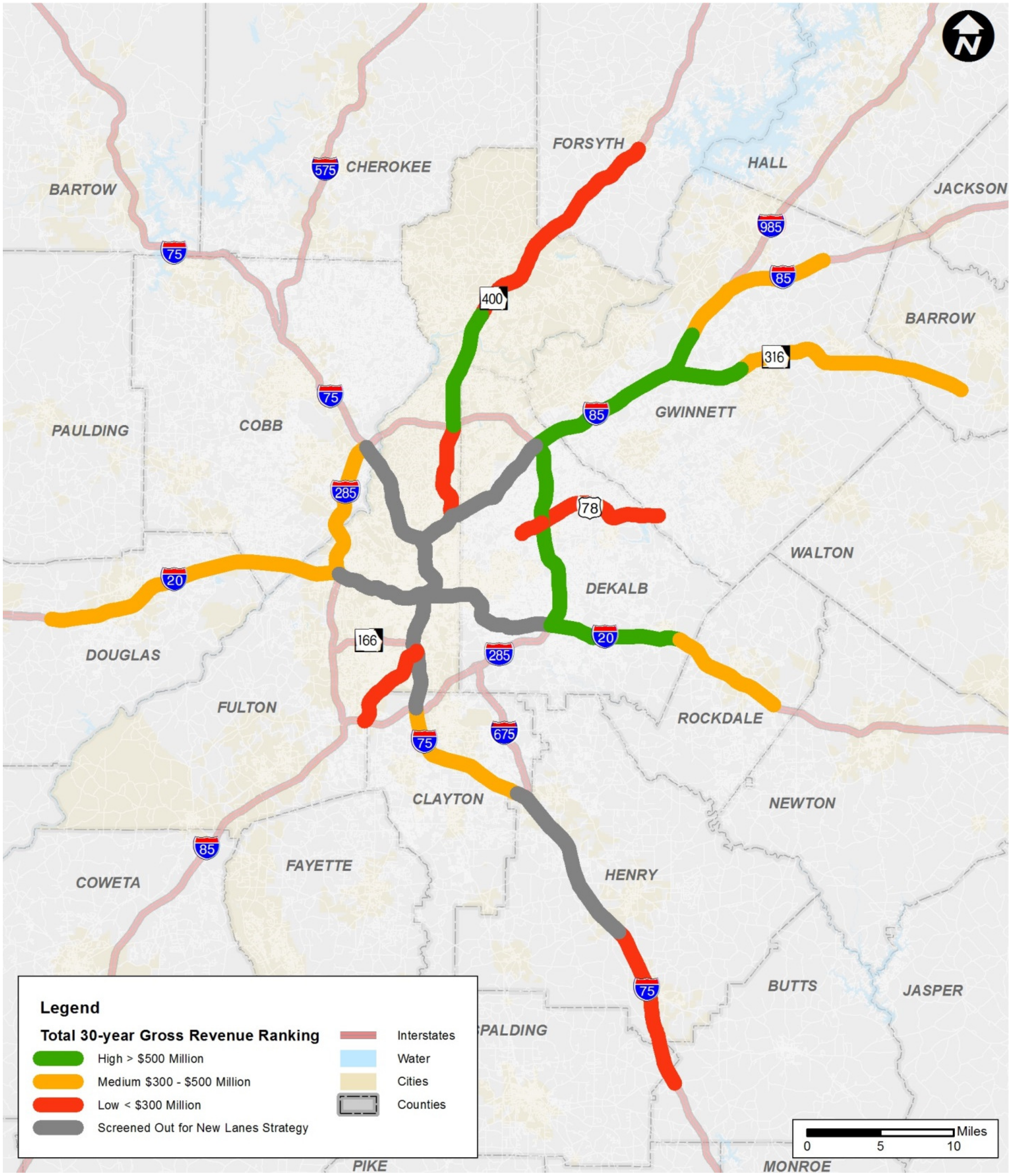


Figure 6.6: Gross Revenue for Reversible Lanes Using Moveable Barriers Strategy Corridors

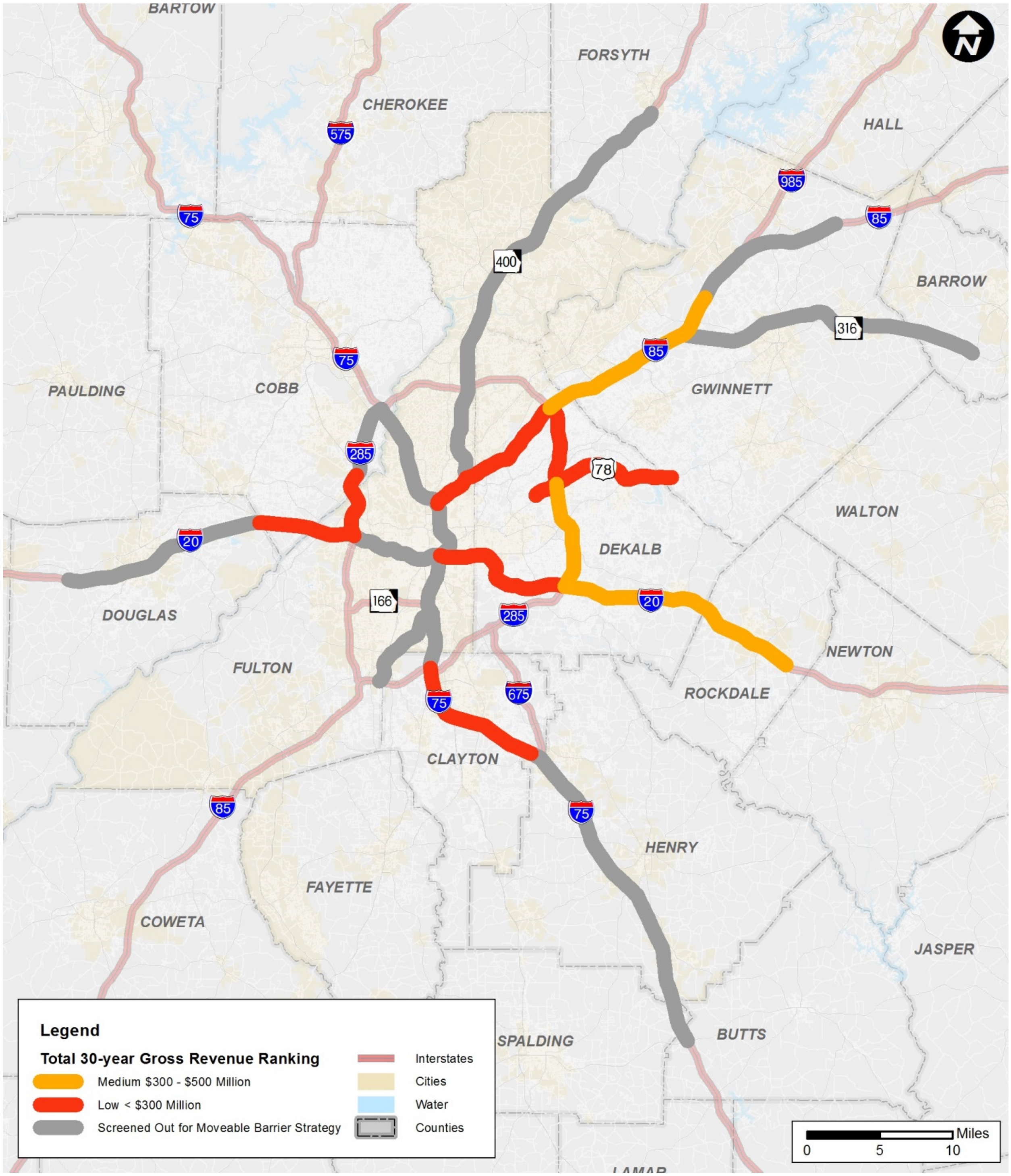
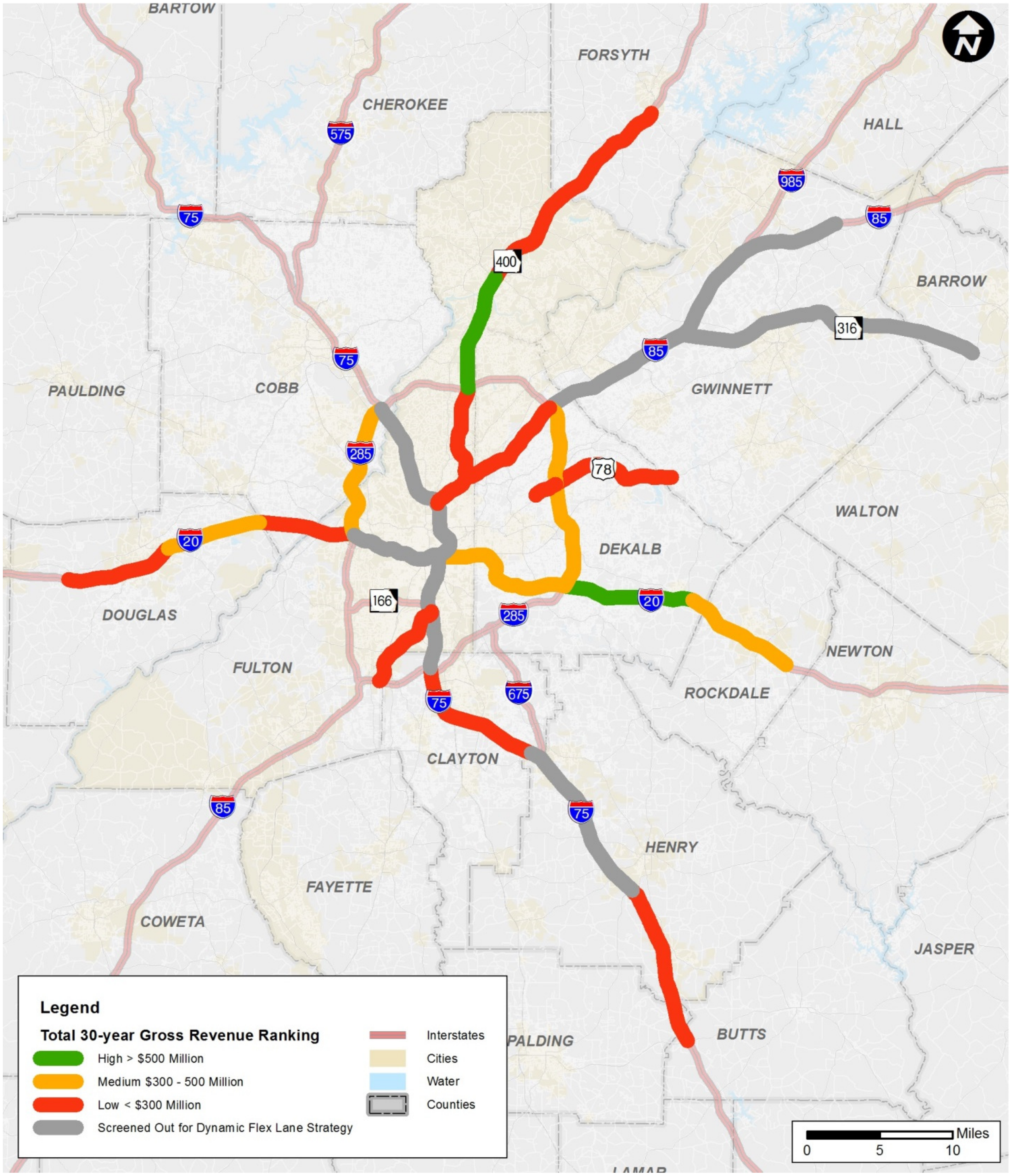


Figure 6.7: Gross Revenue for Dynamic Flex Lane Strategy Corridors



6.4 PRELIMINARY COST ESTIMATES

This section discusses both the capital and operations and maintenance (O&M) costs associated with the roadway and tolling equipment needs developed for each of the strategies. In general, the capital costs were estimated by determining the appropriate unit costs for the identified cost elements and the cost element quantities from conceptual alignments and interchange/access plans prepared for each corridor and strategy.

The O&M activities are in place to prevent, reduce and restore deterioration of the roadway and toll system infrastructure. This also ensures adequate budget for the upkeep of the maintenance fleets and specialized service vehicles, as well as the employees needed to run these operations. The O&M costs were developed for the project forecast period (30-years) in line with the traffic and revenue estimates.

Each cost element is defined along with the methods and assumptions applied in each case. The programming costs were developed to provide a conceptual level estimate in Year 2013 construction dollars. Two major factors in cost variations for major projects that were not developed specifically for this level of cost estimate are environmental impacts and existing soil/site conditions. However, these factors are accounted for in the 30 percent contingency. Mitigation costs and encountering unforeseen geological features, such as rock, can drive up costs. While significant engineering analysis went into developing project costs, the estimates are still planning grade and primarily employed for comparative analysis. Key assumptions and development parameters are discussed below. Cost summaries sheets containing the details discussed in the sections below are provided in **Appendix F**.

6.4.1 Roadway Capital Cost

The roadway capital cost estimates developed for each of the strategies are divided into six major components: linear mile costs, corridor-specific costs, right-of-way costs, utility costs, engineering and inspection costs, as well as corridor contingencies. Improvements to existing general purpose deficiencies (defined as variations from ideal design standards) were not considered. The potential system-to-system interchanges were estimated separately. All roadway cost estimates were based on the unit cost from the latest Item Mean Summary published on the GDOT website. At this stage in the process, design exceptions were considered. Design exceptions were created based off of the site-specific conditions and constraints that varied from the accepted design criteria and are included in **Appendix F**.

6.4.1.1 Linear Mile Costs

Linear mile costs include unit costs and lump sum costs. The unit costs were developed based on quantities and lengths of the existing and proposed typical section. The lump sum costs were computed based on the size and complexity of project area. Each project area was evaluated independently for lump sum costs. Each of the items included in the linear mile costs and their assumptions are described in **Table 6.4**.

Table 6.4: Linear Mile Roadway Cost Assumptions

Item	Description

Pavement Items	• All asphalt shoulders are partial depth construction only and require full depth replacement
	• All concrete shoulders are full depth construction only and require no replacement
	• Average shoulder removal width of 10' to be used if a location-specific width could not be determined and average construction width of 14'
	• Travel lanes and outside shoulders are proposed to have a full depth pavement design structure as follows:
	    o Portland Cement Concrete (PCC) widening cost is based on 12" PCC Slab construction with 3" Asphalt Concrete Construction (ACC) cap layer and 12" Graded Aggregate Base (GAB)
	    o Asphalt widening is based on 12" Asphalt Concrete Construction (ACC) with 12" GAB
	• Asphalt Mill and Overlay cost is based on 2" milling and 3" overlay, replaced every 15 years
	• Pavement Demolition is based on unit cost for "Removal Asphalt Pavement including Base"

Item	Description
Drainage Items	• Assumed 24-inch concrete drainage pipes • One-half of the total length of 24-inch pipes was assumed to be in the 1-10 foot depth category, while the other half is assumed to be in the 10-15 foot depth category • Longitudinal concrete pipes were assumed to be along the median and general purpose outside shoulders • Cross drains are assumed every 800 feet • Drainage inlet structures are assumed to be at a 350 foot longitudinal spacing and are located along the general purpose outside shoulders and along the median • One-half of the total number of drainage inlets was assumed to have an average additional depth of 5 feet per structure • The total length of existing pipe to be plugged with flowable material was assumed to be approximately 10% of the total length of proposed drainage pipes for the corridor, if the existing system was not maintained • Assumed two 7 ft x 7 ft culvert extensions per mile. Culverts are regarded as the outfalls for the proposed longitudinal drainage systems and were assumed to be extended by a length to match the proposed typical section widths. Existing box culverts were assumed to cross the entire existing interstate. Required rip rap for each culvert was estimated to be 49 square yards
Signing and Marking Items	• Overhead Signs' unit cost is based on the cost for Structural Support of Type 1 Overhead Signs • Unit cost for "Retrofit Overhead Signs" includes cost for reconstruction of overhead sign as well as the cost for reconstruction of structural support for signs • Unit cost for "Remove Overhead Signs" includes cost for reconstruction of overhead sign as well as the cost for reconstruction of structural support for signs • "Roadside Signs" and "Changeable Warning Signs" unit costs assume 15 square feet sign as well as sign post • Unit cost for Striping is for each lane of new striping per linear mile • Unit cost for 'Remove Exist Solid Traffic Stripe' is based on the cost of removal of existing 8 inch solid thermoplastic stripes

Item	Description
Traffic Items	• Cost for Signal Reconfiguration is used for adjustments to signal timing at the end of exit ramp • Unit cost for New Signal/Warning Lights is for single signal warning light • Lift Gates/Moveable Barrier unit cost is for two warning gates and one barrier gate
Median Barrier Items	• New median barriers were assumed along the centerline of all corridors where the barrier will be compromised
Existing Pavement Removal Items	• Existing pavement removal is assumed for all alternatives at a rate of $35 per square yard
Lump Sum Items	• Traffic control costs are assumed to be 10 percent of the total construction cost excluding right-of-way cost • The unit cost for 'Grading Complete' is a lump sum cost based on the estimated required grading of the project • Erosion control unit cost is based on per acre of disturbed acreage. It was assumed that 24 feet wide along the length of the general purpose outside shoulder should be protected • Earthwork costs are assumed to be 5 percent of the total sub-construction cost (unit costs total). For the alternatives in which no widening was required, the cost was assumed to be $0 • Mobilization costs are assumed to be 5 percent of the total sub-construction cost (unit costs total)

6.4.1.2 Corridor-Specific Costs

Corridor-specific costs were identified and calculated based on the unique characteristics of each corridor. **Table 6.5** lists the items considered as corridor-specific and the assumptions associated with each.

Table 6.5: Corridor-Specific Roadway Cost Assumptions

Item	Description
Bridges	• Total bridge replacement and widening costs were assumed to be $150 per square foot
Bridge Demolition	• Bridge demolition was assumed to be 33 percent of the total bridge replacement cost
Retaining Walls	• In general, MSE walls were assumed on both sides in urban areas • When the difference between the existing and proposed footprint is less than 10 feet, the MSE walls are assumed to replace only existing walls • MSE walls were assumed to be an average height of 10 feet • A traffic barrier is assumed to be mounted on all MSE walls • It was assumed any existing retaining walls outside of urban areas will be replaced with MSE walls
Guardrails	• In areas considered suburban or rural, fill slopes are proposed at tie-ins with existing ground; it was assumed that half of these slopes would require guardrail treatments
Railroads	• Rail bridge replacement cost was computed using a $150 per square foot rate • Additional costs were assumed to tie the existing rail track with the new bridge; the track cost was assumed to be $150 per linear foot • Incidental road and right-of-way impacts were also included and were based accordingly on each location; the road cost was assumed to be $3.1 million per mile and the right-of-way costs were assumed to be $100,000 per acre

6.4.1.3 Right-of-Way Costs

Right-of-way costs include the purchase of land and/or easement rights necessary to accommodate the managed lane improvements. This includes relocation assistance and demolition costs. Property values and acquisition costs can range from quite modest in undeveloped areas, to quite significant in areas of high-value commercial properties. These costs include title searches, appraisals, legal fees, title insurance, surveys, and various other processes.

Land use types and existing property lines were determined using county and Geographic Information System (GIS) maps. The land use categories identified were residential, commercial and undeveloped land for urban and suburban area types.

Right-of-way impacts were calculated based on existing right-of-way and the proposed typical sections. The cost of right-of-way was estimated by taking the number of additional acres required for the managed lanes multiplied by the cost per acre. In addition to the cost of land, some parcels were occupied by residents and business. The cost of displacements was estimated based on appraisal costs indicated in county databases. When appraisal values were not available, the cost per type of displacement was assumed.

It is assumed that a cost of $200 per square yard is incurred for right-of-way acquisition. A contingent right-of-way cost of $1,000,000 each was assumed on corridors in areas where no required right-of-way is needed per the typical section footprint. A 3.5 factor was applied to right-of-way costs. This factor is typical for this level of estimate.

6.4.1.4 Utility Costs

Utility costs were assumed to be 2.6 percent of the total construction cost, plus a 30 percent contingency.

6.4.1.5 Engineering and Inspection Costs

Engineering and inspection costs were assumed to be 10 percent of the total construction cost.

6.4.1.6 Corridor Contingencies

A corridor contingency was applied to the total cost, which included the construction costs, right-of-way costs, utility costs and engineering and inspection costs. The cost was assumed to be 6 percent of the total cost.

6.4.2 Tolling Capital Cost

The tolling capital costs were identified and calculated based on the unique characteristics of each corridor and strategy. The following items were considered in the development of the tolling capital costs:

- Hardware components
- Optical character recognition (OCR) development and license fee
- Mobilization
- System Integrator design, PM, testing and documentation
- Installation

- System testing and oversight
- Toll host/plaza server
- Lane software

6.4.3 Roadway O&M Costs

Roadway-related O&M costs were identified and calculated based on the unique characteristics of each corridor and strategy. **Table 6.6** presents the roadway O&M cost items considered and the assumptions associated with each.

Table 6.6: Roadway O&M Costs

Item	Description
Changeable Message Signs (CMS)	Changeable message signs cost approximately $1,000 per year per sign to operate and maintain
CMS Signs	Each changeable message sign gets replaced at a rate of 10 percent over a 10 year period
Detection Sensors (MDS and VDS)	Operations and maintenance of microwave detection systems (MDS) and video detection systems (VDS) used by GDOT to measure traffic performance and detect incidents, but not used to set toll rates
HERO Operators	Four new HERO operators will be employed per corridor. This assumes two units per shift will be added to support the managed lanes. There will be no third shift coverage
HERO Units	HERO unit vehicles are assumed to be replaced every three years
HERO Unit Maintenance	Maintenance on the HERO trucks is assumed to be the cost for new tires, vehicle maintenance and general wear and tear on the vehicles
Asphalt Mill and Overlay	Cost is based on 2” milling and 3” overlay, replaced every 15 years
TRIP	Emergency towing per corridor is $100 for each tow
Barrier Moving Vehicles	Two machines (one in each direction) will be required for each corridor to accommodate a lane shifting time of less than three hours
Barrier Operators	Four new employees are required to operate barrier machines on each corridor. This assumes two machines per shift plus 50 percent overtime since shifts will exceed eight hours per day
Barrier Vehicle Replacement	The barrier vehicles will be replaced at a rate of two machines per 10 years

Item	Description
Moveable Barriers	Moveable barriers will be replaced at a rate of approximately five percent per year for a replacement of 50 percent of the barriers over a 10 year period
Snow and Ice Removal	Response to two snow and ice events per year. Snow and ice removal includes two full cycles of clearing each lane. It is assumed that 30 gallons of salt brine will be used per lane. Equipment, labor, solution and application of solution are estimated at $2,000
Other Special Events	It is assumed that there will be 15 special events and 10 emergency weekend closures per corridor per year. Each event will last eight hours and assumes two trucks per shift with two staff per truck

6.4.4 Toll System O&M Costs

Cost estimates associated with operating and maintaining the toll system were estimated for both the toll equipment and the customer service center costs for each of the corridors and strategies.

6.4.4.1 Toll Equipment O&M Costs

Table 6.7 below presents the toll equipment O&M cost items considered in the managed lane cost estimates. The responsibility (GDOT or SRTA) for the costs, the allocation of costs and the unit costs used for the estimates were the same as those used to estimate the O&M costs for the Northwest Corridor Project.

Table 6.7: Toll Equipment O&M Costs

Item	Description
CCTV Cameras: GDOT	Operations and maintenance of closed circuit television cameras with infrared (IR) capability for vision in low light and total darkness, providing full visual coverage during lane reversing operations
CCTV Cameras:(SRTA	Operations and maintenance of cameras used to monitor changeable message signs displaying toll rates and monitor traffic around toll gantries
Changeable Message Signs (not incl. CMS/Toll Rate)	Operations and maintenance of advanced guide signs used to notify drivers of either the miles to entrance or "CLOSED"
Toll Rate Signs	Operations and maintenance of changeable message signs that provide the toll rates

Item	Description
Detection Sensors (Shared MDS)	Operations and maintenance of microwave detection systems used to measure traffic performance, detect incidents, and set toll rates
Fiber Trunk Maintenance (Pullbox)	Operations and maintenance of the fiber optic communication network by investigating connections at each pullbox
Fiber Cuts	Emergency repair of severed fiber lines causing service outage
Back-office Toll System Hosting Maintenance	Software and data hosting services and maintenance of the back-office toll collection system, including hardware, software and operating systems
ETC Lane Equipment Maintenance, Hosting, Software Maintenance	Software and data hosting services and maintenance of the in-lane toll collection system, including hardware, software and operating systems; hardware maintenance also includes all in-lane toll equipment and communication network, and replacement of equipment as needed
Communication Hub	Routine maintenance for the building aggregating the fiber communication network into a single location for transmission to back offices; the hub also houses electrical and fiber cable, equipment racks, work table and 2 chairs
Travel Time Sensors and Readers	Operations and maintenance of sensors reading transponders used in post processing and calculating travel times
Traffic Control Signals (Blank Out Signs)	Operations and maintenance of blank out signs located at the intersections of access ramps and local access roads to indicate whether the managed lanes are open or closed
Roadside Cabinets (IR CCTV, CMS)	Routine maintenance of the cabinet housing for ITS devices directly related to tolling operations
Roadside Cabinets (ITS and Toll): SRTA	Routine maintenance of the cabinet housing for the ITS and toll devices
Reversible Gate Routine Maintenance	Operations and maintenance of the reversible gates used to restrict access from specific locations to the managed lanes
Annual Reversible Gate Replacement (60% not reimbursed by insurance)	Replacement of damaged reversible gates

Item	Description
Generators	Operations and maintenance of natural gas-powered generators to provide power to toll-related ITS devices, the toll system, access control gate system, and the hub buildings during power outages
Network Management Software: SRTA	Industry standard software maintenance for the software to monitor and manage SRTA's communication network along the corridor to the back office
Annual Utilities: GDOT Toll Related	Utility costs associated with ITS devices directly related to toll operations, including the reversible gate system and lighting at ingress locations and toll zones
Annual Utilities: SRTA	Utility costs associated with ITS and toll-related ITS devices directly related to toll operations
HERO Vehicle Maintenance	Operations and maintenance of HERO emergency response vehicles
NaviGAtor Upgrade Maintenance	Industry standard software maintenance for the software to assist the Traffic Management Center in monitoring and managing traffic conditions, controlling the reversible gate system, and responding to traffic incidents within the managed lanes and general purpose lanes
SRTA Integration Maintenance	Industry standard software maintenance for integration of the in-lane toll collection system and back office toll collection system with NaviGAtor
WAN Access: SRTA	Provision of a back-up, third-party provided Wide Area Network (WAN) communication lines to access equipment and transmit toll collection data to the back office in the event of an interruption to the fiber communication backbone
Admin	Agency administrative costs associated with project development and oversight work
Transponders	Advance purchase of Peach Passes for distribution to customers
Traffic Management Center	Personnel to monitor and manage traffic conditions and incidents on the corridor
Emergency Towing	Emergency towing services to remove disabled and stranded vehicles from the corridor in an expeditious manner so that lanes can be reversed
Toll Operations Center Staff	Personnel to monitor traffic conditions and manually adjust toll rates

Item	Description
Special Events and Emergency Closures Weekends	Personnel and equipment to reverse the flow of traffic from the default direction because of special events or congestion relief for the general purpose lanes during emergencies and severe traffic incidents

6.4.4.2 Customer Service Center Costs

Estimated costs associated with processing tolled transactions in the managed lanes were also developed. There are several categories of costs associated with collecting revenue on tolled facilities, and the team employed a cost model to estimate these costs over the forecast period for each project. The cost model, which was developed in collaboration with SRTA, was the same as that used for GDOT's Northwest Corridor Project and 75 Express Project. However, the model inputs used were specific to each project under consideration. Cost items included:

- Electronic Toll Collection Processing Fee (per transaction)
- Credit Card Fees
- Image Review Costs
- Department of Motor Vehicles Lookup Costs
- Violation Notice Costs
- Collection Costs

6.5 FINANCIAL FEASIBILITY ANALYSIS

Using project costs (Capital and O&M costs) and revenue forecasts as inputs, a key financial indicator is a Project Financeability Index (PFI) that was calculated for each of the managed lane corridors/segments. The following equation was used to calculate PFI:

$$PFI = \left(\frac{30\ Yr\ Gross\ Revenue\ -\ 30\ Yr\ Roadway\ O\&M\ Cost\ -\ 30\ Yr\ Tolling\ O\&M\ Cost}{Capital\ cost} \right)$$

The objective of calculating PFI was to assess a high–level financial feasibility of various managed lane concepts along the study corridors prior to conducting detailed financial analysis. The higher the PFI, the higher the likelihood for project supported revenue. Additionally, a negative PFI would indicate the costs to build, operate, and maintain a facility exceeds the expected revenue and a PFI less than 1.0 indicates the capital costs exceed the forecasted net revenue.

The PFI was also used as a performance measure during the evaluation process to give higher priority to the projects with less potential funding gap. It is important to note that PFI is a very preliminary financial indicator and is not intended for direct use in support of project financing. In addition, the PFI does not replace further financial analysis needed or any additional business case studies expected to be completed as individual projects move toward implementation. **Table 6.8** provides an overview of the calculated PFIs for each corridor strategy.

Table 6.8: Preliminary PFIs for Each Corridor Strategy

Corridor	New Lanes	Moveable Barrier	Dynamic Flex Lanes
I-20 E Segment 1	**1.8**	**2.3**	**5.9**
I-20 E Segment 2	0.9	**1.3**	**1.7**
I-20 W Segment 1	**1.0**	-0.5	0.7
I-20 W Segment 2	**1.2**	*N/A*	**2.3**
I-20 W Segment 3	0.7	*N/A*	**1.2**
I-285 E Segment 1	**5.0**	**1.4**	**3.1**
I-285 E Segment 2	**5.1**	**1.1**	**4.9**
I-285 NW Segment 1	0.8	**1.7**	**4.0**
I-285 NW Segment 2	**1.8**	*N/A*	**3.6**
I-75 S Segment 1	0.5	0.4	**1.0**
I-75 S Segment 3	0.1	*N/A*	-0.6
I-85 N Segment 1	**2.3**	-0.8	*N/A*
I-85 N Segment 2	**1.6**	*N/A*	*N/A*
SR 316 Segment 1	0.6	*N/A*	*N/A*
SR 316 Segment 2	**1.1**	*N/A*	*N/A*
SR 400 Segment 1	**1.9**	*N/A*	**1.7**
SR 400 Segment 2	0.9	*N/A*	**1.7**
US 78	0.1	-0.7	-0.3
I-20 Inside Segment 1	*N/A*	0.6	**3.0**
I-85 Inside Segment 1	*N/A*	-0.7	-0.6
I-85 Inside Segment 3	0.2	*N/A*	-0.3
SR 400 Inside	0.9	*N/A*	0.3

Note: Red text indicates a negative PFI, whereas bold black text indicates a PFI greater than 1.0.

The revenues, costs and financial feasibility results were just a few of the metrics used to evaluate projects, which are detailed further in the next chapter.

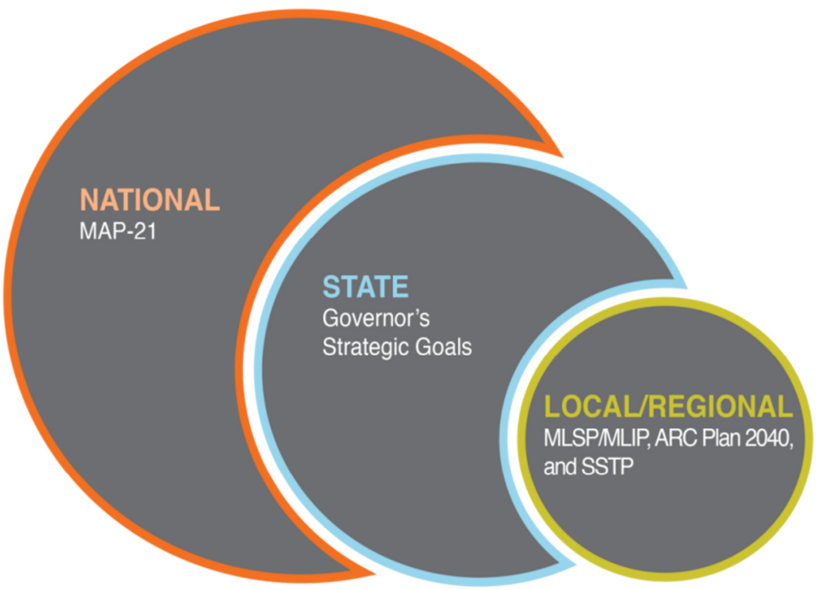
7 CORRIDOR STRATEGY EVALUATION

There are a range of potential managed lane strategies that are applicable for improving limited-access freeways in metro Atlanta. The following sections discuss the corridor strategy evaluation process to evaluate which strategies are most applicable for each of the study corridors. More detailed technical reports discussing strategy evaluation and scoring results are located in **Appendix G**.

7.1 GOALS

All effective transportation projects should align with and seek to accomplish the wider transportation goals of the region, state, and nation. The applicable goals for each of these levels, as well as for this study, are described below. **Figure 5.1** displays the MLIP screening framework.

Figure 7.1: Managed Lane Goals



At the Federal level, President Obama signed into law the Moving Ahead for Progress in the 21st Century (MAP-21) transportation bill in July 2012, which included national transportation goals and necessitated consideration of:

1. Safety
2. Infrastructure condition
3. Congestion reduction
4. System reliability
5. Freight movement and economic vitality
6. Environmental sustainability
7. Reduced project delivery delays

At the state level in April 2012, Governor Deal released the Governor's Strategic Goals for Georgia, which included a vision of "… a lean and responsive state government that allows communities, individuals and businesses to prosper." Specifically, it envisioned a Georgia that is "educated, mobile, growing, healthy, safe, and fiscally responsible." Several of these attributes are very relevant to transportation and were considered within the goals of the MLIP. Transportation mobility was considered to improve the movement of people and goods across and within the state, expanding Georgia's role as a major logistics hub for global commerce and leveraging public-private partnerships to improve intergovernmental cooperation for successful infrastructure development. Economic growth was considered as transportation projects can contribute to job creation and future business growth in the region. Health and safety were considered as transportation projects can provide important access to healthcare and protect the public by providing a safe means of travel that reduces the risk of incidents on Georgia's roads.

At the local or regional level, the Atlanta MPO Regional Transportation Plan (RTP), *Plan2040*, was reviewed to develop a preliminary list of goals for the MLIP. Also, goals were developed from a review of the 2010 Statewide Strategic Transportation Plan (SSTP). These goals are summarized below:

Atlanta MPO Plan2040 RTP Goals

1. Lead as the global gateway to the South
2. Encourage healthy communities
3. Expand access to community resources

Statewide Strategic Transportation Plan (SSTP) Goals

1. Increase the number of people who can reach a major employment center within 45 minutes
2. Increase the number of people taking reliable trips
3. Reduce the financial burden of wasted hours and fuel caused by traffic congestion
4. Fix bottlenecks
5. Improve interregional and last-mile connectivity

Finally, the goals established in the 2010 Managed Lane System Plan and carried forward in the MLIP are as follows:

MLSP Goals

1. Protect mobility
2. Maximize person/vehicle throughput
3. Minimize environmental impacts
4. Provide a financially feasible system
5. Design and maintain a flexible infrastructure for varying lane management

All goals, regardless of their source, have some level of commonality. As a result, all goals were integrated into a more robust set of final study goals for MLIP, which are presented here:

1. Improve mobility options available to people and for freight
2. Provide a financially feasible system
3. Enhance the inter-regional connectivity and reliability of the transportation system for people and freight, and facilitate economic growth
4. Emphasize the efficiency, operation, and preservation of the existing transportation system while promoting environmental sustainability
5. Reduce project delivery delays

The following sections present the individual planning themes that were used to evaluate potential managed lane strategies.

7.2 PLANNING THEMES

Both qualitative and quantitative evaluation factors were established to evaluate the managed lane strategies for each corridor. This section presents the individual criteria within each theme that were used to evaluate the strategies. For each criterion, an ordinal rating scheme was developed and used to score a strategy between 0 and 100 based on its performance for that specific criterion. These scores were used to estimate the total points each strategy received and then rank-ordered by the total number of points.

The criteria were categorized into five themes that followed the goals developed through the study process, as noted earlier. They are listed here, in no particular order:

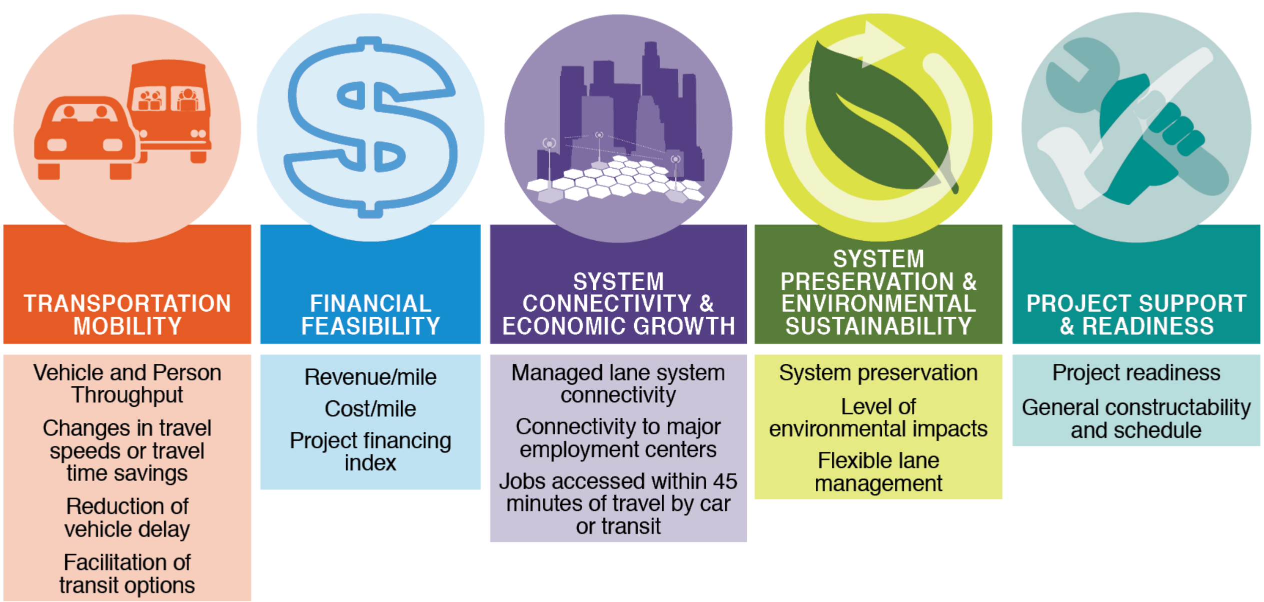
1. Transportation Mobility
2. Financial Feasibility
3. System Connectivity and Economic Growth
4. System Preservation and Environmental Sustainability
5. Project Support and Readiness

Table 7.1 demonstrates how many of the goals from the federal, state, and regional level were overlapping and aligned with the five planning themes developed as part of the MLIP. **Figure 7.2** lists each of the evaluation criteria that fall within each Planning Theme.

Table 7.1: MLIP Candidate Corridor Screening Criteria

	Goals	Transportation Mobility	Financial Feasibility	System Connectivity and Economic Growth	System Preservation and Environmental Sustainability	Project Support and Readiness
National	MAP-21	Goals 3 & 4	-	Goals 3 & 5	Goal 6	Goal 7
State	Governor's Strategic Goals	Goal 1	Goal 1	Goal 2	-	-
Local/Regional	Atlanta MPO *Plan2040*	Goal 3	Assumed*	Goal 1	Goal 1	Assumed*
Local/Regional	SSTP	Goals 1, 2 & 3	-	Goals 1, 3 & 5	-	-
Local/Regional	MLSP/ MLIP	Goals 1 & 2	Goal 4	Goals 1 & 2	Goals 3 & 5	Goal 5

Figure 7.2: Planning Theme Evaluation Criteria



7.2.1 Planning Theme 1 - Transportation Mobility

Theme 1 was used to assess potential strategies that are considered to address an operational or major capacity deficiency. Four individual evaluation criteria – three quantitative and one qualitative – were included in Theme 1, which included person throughput, travel time, reduction in vehicle delay, and facilitation of transit options. Further detail on each are provided below.

7.2.1.1 Person Throughput

Person throughput is the total number of persons in all lanes in the morning (AM) and evening (PM) period for the corridor segment being evaluated. The Atlanta MPO's *Plan2040* travel demand model was used to estimate the person throughput. The scoring scheme employed for vehicle throughput is presented in **Table 7.2**. Corridors and strategies with higher vehicle throughput received a higher score than those with lower vehicle throughput.

Table 7.2: Person Throughput Scoring Scheme

Person Throughput (# of persons in AM & PM Period)	Score
0 - 10,000	20
10,000 - 20,000	40
20,000 - 30,000	60
30,000 - 40,000	80
> 40,000	100

7.2.1.2 Travel Time

The end-to-end travel time for the corridor segment saved in the Build option for each strategy, compared to the No-Build, was estimated using the Atlanta MPO's travel demand model. The time period used to estimate the travel time was the worst of the AM and PM periods. As indicated in **Table 7.3,** corridors and strategies with higher travel time savings received a higher score.

Table 7.3: Travel Time Savings Scoring Scheme

Travel Time Savings (min)	Score
0 - 10	25
10 - 20	50
20 - 30	75
30 - 40	100

7.2.1.3 Reduction in Vehicle Delay

The reduction in vehicle delay for each corridor was projected using the Atlanta MPO's travel demand model by estimating the total number of daily vehicle-hours saved in the Build option for each strategy, compared to the No-Build option. The time period used to estimate the travel time was the worst of the AM and PM periods. As indicated in **Table 7.4,** corridors and strategies with a higher reduction in vehicle delay received a higher score.

Table 7.4: Reduction in Vehicle Delay Scoring Scheme

Reduction in Vehicle Delay (hours)	Score
0 - 3,000	10
3,000 - 6,000	25
6,000 - 9,000	50
9,000 - 12,000	75
> 12,000	100

7.2.1.4 Facilitation of Transit Options

A qualitative criterion was included under the Transportation Mobility Theme to evaluate whether the potential improvements would facilitate transit options. The transit routes for each of the following bus operators were considered:

- Georgia Regional Transportation Authority (GRTA)
- Metropolitan Atlanta Rapid Transit Authority (MARTA)
- Gwinnett County Transit (GCT)
- Cobb Community Transit (CCT)
- Cherokee Area Transportation System (CATS)

GIS was used to evaluate if a corridor was served by a transit route. Also, if the strategy facilitated transit options in both directions, it received a higher score than if it facilitated transit options in one direction. Therefore, moveable barrier, which provided enhanced travel in only one direction, received a lower score than the dynamic flex lane and new lane options. Strategies that did not provide transit facilitation received a score of 0, ones that provided one-way transit facilitation received a score of 75 and ones that provided facilitation in both directions received a score of 100.

7.2.2 Planning Theme 2 - Financial Feasibility

Theme 2 was used to evaluate the strategies based on their financial feasibility. Three individual evaluation criteria, all quantitative, were included in Theme 2, which included revenue per mile, cost per mile, and Project Financing Index (PFI). Further detail on each are provided below.

7.2.2.1 Revenue/Mile

The 30-year gross revenue/mile was estimated for all the strategies. It was based on the Traffic and Revenue (T&R) analysis, as previously discussed in **Chapter 6**, and was estimated using the Atlanta MPO 2040 travel demand model. As indicated in **Table 7.5**, corridors and strategies with higher revenue/mile received a higher score.

Table 7.5: Revenue/Mile Scoring Scheme

30-Year Gross Revenue/mile (2013 M$)	Score
$0 - $30	25
$30 - $60	50
$60 - $90	75
> $90	100

7.2.2.2 Cost/Mile

The cost/mile is the total of capital cost, 30-year roadway O&M cost and 30-year tolling O&M cost. Details on cost estimation is discussed previously in **Chapter 6**. As indicated in **Table 7.6,** corridors and strategies with higher revenue/mile received a higher score.

Table 7.6: Cost/Mile Scoring Scheme

Cost/mile (2013 M$)	Score
$0 - $25	20
$25 - $30	40
$30 - $40	60
$40 - $50	80
> $50	100

7.2.2.3 Project Financeability Index

The Project Financeability Index was used to assess a high–level financial feasibility of various managed lane concepts on the study corridors prior to conducting detailed financial analysis and is defined as:

$$\mathrm{PFI} = \left(\frac{\text{30 Yr Gross Revenue} - \text{30 Yr Roadway O\&M Cost} - \text{30 Yr Tolling O\&M Cost}}{\text{Capital cost}}\right)$$

More details are provided in **Chapter 6**. As indicated in **Table 7.7,** corridors and strategies with a higher PFI received a higher score.

Table 7.7: PFI Scoring Scheme

PFI	Score
< 0	0
0 - 1	20
1 - 2	40
2 - 3	60
3 - 4	80
> 4	100

7.2.3 Planning Theme 3 - System Connectivity and Economic Growth

Theme 3, System Connectivity and Economic Growth, consisted of one quantitative and two qualitative measures, including managed lane system connectivity, connectivity to major employment centers, and access to jobs. Further detail on each is provided below.

7.2.3.1 Managed Lane System Connectivity

A qualitative measure was used to score the managed lane scenarios based on their ability to provide a connection to other managed lanes. A visual analysis was done using ArcGIS. The analysis was done at the corridor level and not at the segment level. Therefore, all the segments of a corridor strategy that provided a system connection received the same score. None of the corridors with moveable barriers provided system-to-system connections. All of the new lane and some of the dynamic flex lane corridors provided system-to-system connections. The corridors and strategies that provided a connection received a score of 100 and the ones that did not received a score of 0.

7.2.3.2 Connectivity to Major Employment Centers

A qualitative measure was used to score the managed lane strategies based on their ability to provide a connection between the major employments centers. ArcGIS was used and the analysis was done at the corridor level. Thirteen employments centers, as identified by the Atlanta MPO, were considered, as follows:

1. Hartsfield–Jackson Atlanta International Airport
2. Buckhead
3. Cumberland/Galleria
4. Downtown (Atlanta Central Business District)
5. Emory/Centers for Disease Control and Prevention (CDC)
6. Fulton Industrial District
7. Gwinnett Place
8. Midtown Alliance

9. Norcross
10. North Point
11. Perimeter Center
12. Southlake
13. Town Center

The corridors that provided a connection between two or more employment centers received a score of 100 and the ones that did not provide a direct connection received a score of 0.

7.2.3.3 Access to Jobs

This criterion was used to determine if a managed lane strategy facilitates enhanced access to major employment centers. The thirteen employment centers previously discussed were considered for this criterion. Using the Atlanta MPO 2040 travel demand model, populations within 45 minutes were established for each activity center for the AM and the PM time periods, for the No-Build and each managed lane scenario. The change in population was distributed to each of the managed lane corridors based on their contribution to that particular activity center. The distribution percentage for each corridor was decided by visual analysis using ArcGIS. Once each corridor got its share of population from each activity center, the population from all the activity centers was added for that corridor and a score was assigned. The higher the increase in population for a corridor or strategy, the higher the score. The scoring scheme is presented in **Table 7.8**.

Table 7.8: Access to Jobs Scoring Scheme

Incremental Population	Score
0 – 200,000	20
200,000 – 400,000	40
400,000 – 600,000	60
600,000 – 800,000	80
> 800,000	100

7.2.4 Planning Theme 4 - System Preservation and Environmental Sustainability

Theme 4 was used to identify managed lane strategies that were considered to better preserve the transportation system and provide environmental sustainability. The terms “system preservation” and “environmental sustainability” are best explained in the extent of changes (or lack thereof) to the existing facility and level of environmental impacts anticipated (level of environmental documentation required). This included three quantitative measures including system preservation, flexible lane management, and level of environmental impacts. Further detail is provided below.

7.2.4.1 System Preservation

System preservation for a managed lanes strategy was evaluated based on the following factors:

- If it required development of new transportation infrastructure
- If it required improvement to existing transportation infrastructure
- If it maximized the use of existing transportation infrastructure

The new lanes required development of new transportation infrastructure and received the minimum score of 0. The moveable barriers required improvement to existing infrastructure and received a score of 50; and the dynamic flex lanes maximized the use of existing transportation infrastructure receiving the maximum score of 100.

7.2.4.2 Flexible Lane Management

The managed lane strategies were evaluated based on how flexible they would be to changes in lane management. Dynamic flex lanes are controlled by electronic lane designation signs and the easiest to manage and therefore received the highest score of 100. The new lanes are most difficult to manage since they are a permanent lane management application and received the lowest score of 0. The moveable barrier, being more difficult than dynamic flex lanes due to slower lane management change times, received a score of 50.

7.2.4.3 Level of Environmental Impacts

A desktop analysis of environmentally sensitive areas, such as wetlands, streams, historical properties, archeological areas, and endangered species, was conducted to determine the potential for fatal flaws. Google Earth aerial photography was used to locate potential environmentally sensitive areas. Any wooded areas or areas with no development were targeted as potential environmentally sensitive areas and investigated further. Depending on the proximity of these area(s), it was determined if a managed lane strategy would impact the influence area. The extent of the impacts was then used to determine the level of environmental documentation required to complete the potential improvement. Rankings were then based on the least overall impact and environmental documentation effort. Each managed lane strategy was categorized as a high, moderate or low impact project and received a score of 0, 50 or 100, respectively.

7.2.5 Planning Theme 5 - Project Support and Readiness

The main goal of this theme was to determine how quickly a managed lane strategy could be constructed and put into operation along a corridor. It consisted of two qualitative measures, project readiness and general constructability and schedule. Further detail is provided below.

7.2.5.1 Project Readiness

Project readiness was evaluated based on the duration required to complete the managed lane strategy. The following three factors impact the completion timeframe of a potential improvement:

- Extent of required studies (specifically environmental)
- Extent of required design

- Need for right-of-way acquisition

The managed lane strategies were separated into two categories of “Yes” and “No,” based on the extent of engineering required (environmental and design) and the amount of right-of-way impacts anticipated, and received a score of 100 or 0, respectively.

7.2.5.2 General Constructability and Schedule

The general constructability of a managed lane strategy is proportionate to its overall complexity. Some of the driving factors that dictate the complexity and, therefore, extended construction schedules are as follows:

- Size – The sheer volume of work can dictate a lengthy schedule
- Maintenance of Traffic – Anything that requires long-term multiple lane shifts, closed lanes, speed limit reductions, etc., will usually have a lengthy construction schedule
- Bridges (Structures) – Building any form of structures-related work lengthens the schedule
- Environmentally Sensitive Areas – Anytime there are items or areas that construction must avoid inherently increases the time needed to complete the task. Environmentally sensitive areas were noted elsewhere in this report but also used here in determining construction complexity

Each corridor strategy was categorized into high, moderate or low-construction complexity based on professional engineering judgment that considered maintenance of traffic, as well as constructability, and received a score of 0, 50 or 100, respectively.

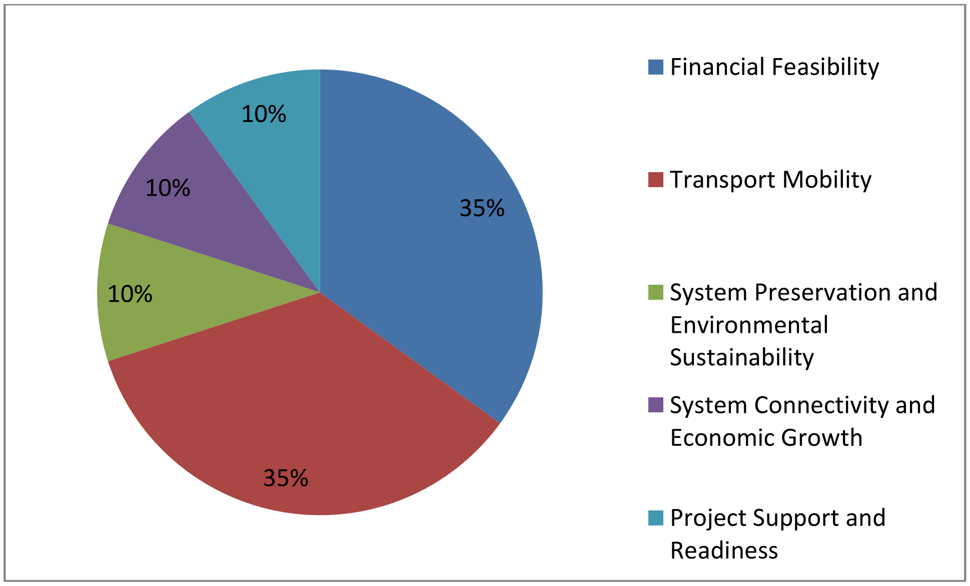
7.3 SCREENING OF CORRIDOR STRATEGIES

7.3.1 Corridor Strategy Evaluation Spreadsheet Tool

A spreadsheet-based tool was developed to evaluate and compare the corridor strategies. The inputs required were the values of each individual evaluation criterion in each theme for every strategy. The tool converted each of these values (provided in the scoring schemes in **Tables 7.2 to 7.8**) to a score between 0 and 100. Once the scores were established, the user had the flexibility of changing the weighting factors for each planning theme or even the individual evaluation criteria within a planning theme. **Appendix G** shows the equations and percentages used by the tool to estimate rankings for comparison purposes, followed by tables with ranking results based on different priority weighting scheme selections.

The next step was to use the spreadsheet tool to screen strategies and corridors for those with the highest scores. The total points each managed lane strategy received were calculated by summing up the scores of all the evaluation criteria. The weights of each planning theme used are provided in **Figure 7.3**.

Figure 7.3: Planning Theme Weighted Scores



The heavier weighting for Transportation Mobility and Financial Feasibility were employed based on the primary principles of priced managed lanes – the ability to provide travel time reliability and travel options for drivers through dynamic pricing. The corridors and strategies that received the higher points received the highest ranking and therefore were assumed to represent the most beneficial managed lanes solutions.

Table 7.9 provides the total scores for each of the screened managed lane strategies along the study corridors. A table showing the full breakdown of scores for each planning theme and individual criteria is presented in **Appendix G.**

Table 7.9: Corridor Strategy Screening

Corridor	New Lanes	Moveable Barrier	Dynamic Flex Lanes
I-20 E Segment 1	57.7	51.3	71.5
I-20 E Segment 2	45.8	42.7	53.0
I-20 W Segment 1	47.3	32.7	45.2
I-20 W Segment 2	55.2	*NA*	64.2
I-20 W Segment 3	49.1	*NA*	56.0
I-285 E Segment 1	72.5	45.1	63.1
I-285 E Segment 2	70.2	41.6	60.3
I-285 NW Segment 1	40.8	40.3	67.2
I-285 NW Segment 2	42.1	*NA*	58.5
I-75 S Segment 1	50.9	43.9	59.6

Corridor	New Lanes	Moveable Barrier	Dynamic Flex Lanes
I-75 S Segment 3	25.2	*NA*	38.1
I-85 N Segment 1	52.6	37.3	*NA*
I-85 N Segment 2	67.3	*NA*	*NA*
SR 316 Segment 1	48.5	*NA*	*NA*
SR 316 Segment 2	48.4	*NA*	*NA*
SR 400 Segment 1	61.8	*NA*	75.6
SR 400 Segment 2	53.1	*NA*	66.0
US 78	37.3	26.2	32.5
I-20 Inside Segment 1	*NA*	41.3	63.0
I-85 Inside Segment 1	*NA*	28.5	39.1
I-85 Inside Segment 3	38.5	*NA*	45.3
SR 400 Inside	51.3	*NA*	42.7

While the corridor strategy screening was based on the qualitative and quantitative criteria discussed previously, it should be noted that the scores are not meant to be the final decision on whether a corridor or strategy should be implemented. Rather, they reflect the relative ranking of each strategy within the study area compared to the other corridors and their managed lane strategies. This information will further provide input and guidance for planners, engineers, and decision-makers.

7.3.2 Strategy Results

Corridors and their respective strategies that moved forward for more in-depth financial analysis included:

- I-20 East Segment 1 and 2 (from I-285 to SR 162) for New Lanes and Dynamic Flex Lanes
- I-20 West Segment 1, 2 and 3 (from I-285 to Post Road) for New Lanes and Dynamic Flex Lanes
- I-285 East Segment 1 and 2 (from I-20 to I-85) for New Lanes
- I-285 Northwest Segment 1 and 2 (from I-75 to I-20) for New Lanes and Dynamic Flex Lanes
- I-75 South Segment 1 (from I-285 to SR 138) for New Lanes and Dynamic Flex Lanes
- I-85 North Segment 1 (from I-285 to Old Peachtree Road.) for New Lanes
- SR 316 Segment 1 (from I-85 to SR 120) for New Lanes
- SR 400 Segment 1 and 2 (from I-285 to SR 20) for New Lanes

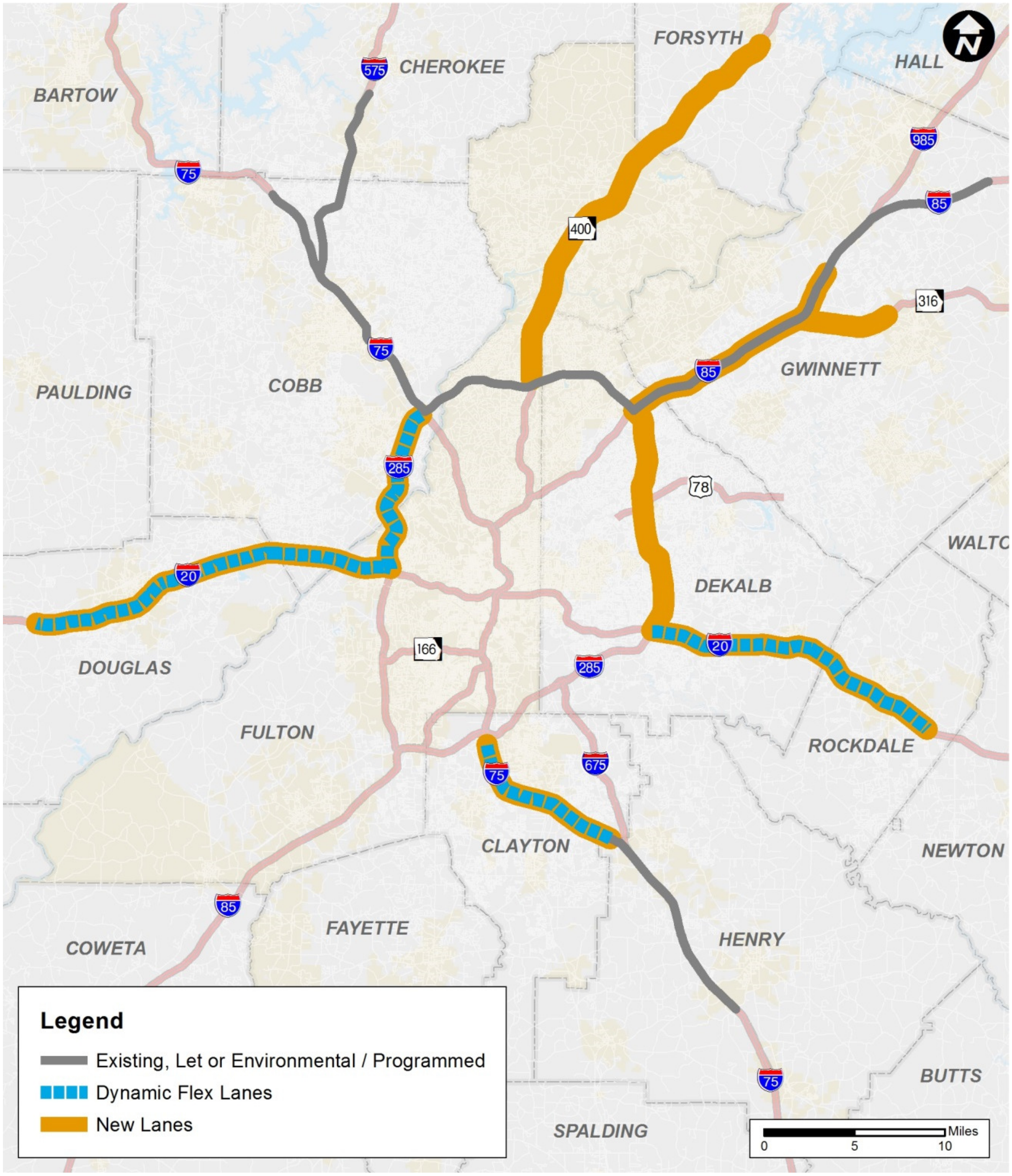
It was found that along the study corridors, the use of moveable barriers was not a cost-effective strategy compared to adding new lanes or providing dynamic flex lanes. This was primarily due to the fact that two off-peak lanes were required to accommodate the moveable barrier, appropriate shoulders, and the priced lane. To mitigate the use of two off-peak direction lanes, the outside shoulder in the off-peak direction was open to general-purpose use. In most cases, this still resulted in a decay of level of service for the off-peak direction.

Several segments and corridors were removed for additional analysis because of their lower ranking scores (typically below 45), as well as their lower PFI rating (typically less than 1.0), as indicated previously in **Table 6.8**. These included:

- I-75 South Segment 3 (from SR 155 to SR 16)
- SR 316 Segment 2 (from SR 120 to SR 81)
- US 78 (from I-285 to Rockbridge Road)
- I-20 Inside Segment 1 (I-285 to Downtown Connector)
- I-85 Inside Segment 1 and 3 (from I-285 to Downtown Connector and from Downtown Connector to I-285 South)
- SR 400 Inside (from I-85 to I-285)

Additionally dynamic flex lanes along I-285 East generated some operational concerns regarding left hand ramps in the middle of the corridor. The analysis of dynamic flex lanes along SR 400 Segment 1 also provided some operational concerns because of the recently implemented shoulder lanes along this facility and the desire to keep this configuration during the peak hours. Finally, I-85 North Segment 2 was removed from further evaluation because this segment of the corridor was let for construction. It should also be noted that the evaluation of new lanes along this segment was consistent with the project being moved forward for construction. **Figure 7.4** displays the identified corridor strategies that moved forward for more detailed financial analysis.

Figure 7.4: Corridor Strategies Moved Forward for Detailed Financial Analysis



8 FINANCIAL ANALYSIS

This chapter documents the financial analysis for the corridors which moved forward from the corridor strategy prioritization in **Chapter 7**. The purpose of this financial analysis is to:

- Assess the net revenue and financing potential of numerous scenarios
- Utilize a consistent methodology to compare scenarios

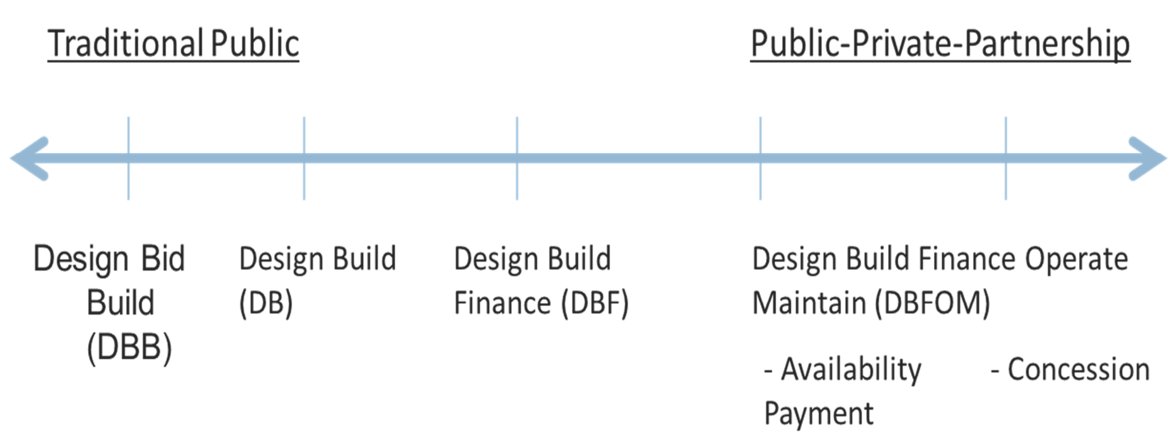
The financing assumptions are not representative of a financing but rather are meant to establish a baseline for comparing all scenarios.

8.1 POTENTIAL DELIVERY OPTIONS

Traditional funding for surface transportation projects has come from local, state, and federal agencies primarily through motor fuel taxes and local sales tax measures. Federal funding is established by Congress through multi-year transportation authorization bills and contains numerous programs to support the nation's transportation system. As traditional funding sources have struggled to keep pace with inflation, our aging infrastructure and new capacity needs, tolling has taken an increased role in contributing funding to expand the nation's highway system and manage congestion. The tolling component of managed lanes provides a new revenue stream that can fund its operations and maintenance expenses and can be leveraged through financing to contribute upfront funding toward its project development costs. In most cases, managed lane projects will rely on multiple funding sources to complete the financing plan.

Based on the goals and objectives of a project, GDOT has several options to deliver a project. The spectrum of options starts with GDOT retaining more control and risks of project delivery through traditional design-bid-build approaches and continues through various Public-Private Partnership approaches in which the private sector has an increased role and responsibility in project delivery. **Figure 8.1** compares the levels of private sector involvement and levels of private sector risk for different delivery approaches.

Figure 8.1: Project Delivery Spectrum



Managed lane project development commonly utilizes a financing mechanism to fund all or a portion of initial development costs. Under traditional project delivery, the public owner will fully fund and finance the project. Under the P3 project delivery approach, the private sector can be responsible for financing all or a portion of the project development costs. The most common methods to finance managed lanes are presented below.

- **Public Toll Revenue Bonds -** Long-term, tax-exempt revenue bonds backed by forecast revenues from managed lane collections. This is further discussed in Section 8.1.2.
- **Federal TIFIA Loan -** Long-term direct loan backed by forecast toll revenues and approved by USDOT with attractive terms and borrowing rates.
- **P3 Financing -** The private sector is responsible for providing the funds necessary for project development through private debt and/or private equity.
    - Private debt can be backed by toll revenues or government appropriations
    - Private debt types include Private Activity Bonds, bank loans and taxable bonds
- **Public Contributions -** Federal, state and local funds and debt can contribute funding to complete a total financing plan.

Managed lane implementation, similar to all capital highway projects, competes for limited federal, state, and local funding. All three delivery categories can be used for managed lanes and several can give options to engage the private sector by leveraging funding to help advance the design, construction, operations, and maintenance of the system.

As part of this study, design build finance (DBF) was used to evaluate potential financing options for each of the strategies which moved forward. Additionally, the use of toll revenue bonds was evaluated for the strategies with a corridor PFI greater than 1.0. The following sections further discuss these financing evaluations.

8.1.1 Design Build Finance

Design-Build (DB) delivery approach combines both the project design and construction under one contract. The optimum time to award a DB contract is when the environmental process, land acquisition, and utilities are taken care of. There are several advantages to DB such as:

- Allows for innovation due to contractor and engineer collaboration
- Reduces claims
- Cost and schedule certainty
- Can select the most qualified contractor
- Proven delivery approach
- Potential cost and time savings over traditional design bid build (DBB)

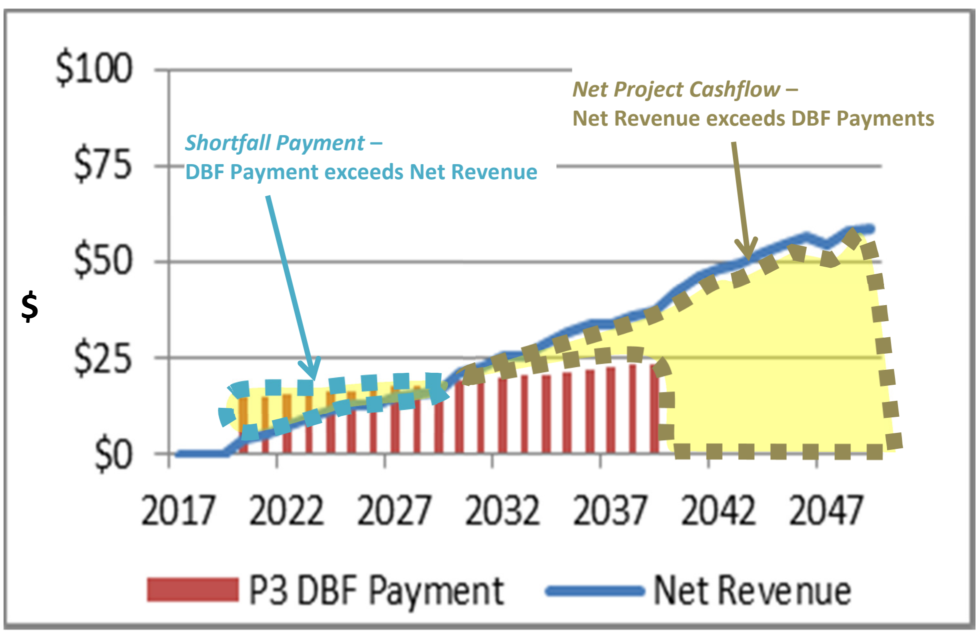
Some disadvantages of DB include contractor's risk is added to the cost of the project in the front end not necessarily reducing overall project cost; and claims or adjustments can occur from unforeseen conditions.

Design Build Finance (DBF) uses the same approach as DB except financing is added by the contractor and built into the cost of the project. The contractor builds the finance cost into the cost of the project. The DBF option can help the client accelerate a critical project by two to five years by having the funds available and moving the project to construction under the DB option. Other characteristics of DBF include:

- Typically for gap financing or cashflow management
- Construction term loans are common
- Final term can vary
- Financing amount (% of construction cost) can vary

Figure 8.2 provides an illustration of how a DBF finance structure can look over a 30-year period. The blue line represents the annual net revenue (annual gross revenue minus the O&M costs discussed in **Chapter 6**). Each red bar represents the annual DBF payment. This example is showing a 30-year net revenue with a 20-year DBF payback period. When the DBF payment (red bar) is below the net revenue (blue line) then additional revenues are generated beyond what is owed to the DBF entity. If the DBF payment (red bar) extends above the net revenue (blue line) then additional funds beyond the facilities revenue collection would be required to pay back the DBF entity.

Figure 8.2: DBF Structure



As part of the financial analysis, several DBF scenarios were considered including:

- 45% upfront costs with 55% paid back over 20-years
- 45% upfront costs with 55% paid back over 10-years
- 70% upfront costs with 30% paid back over 10-years

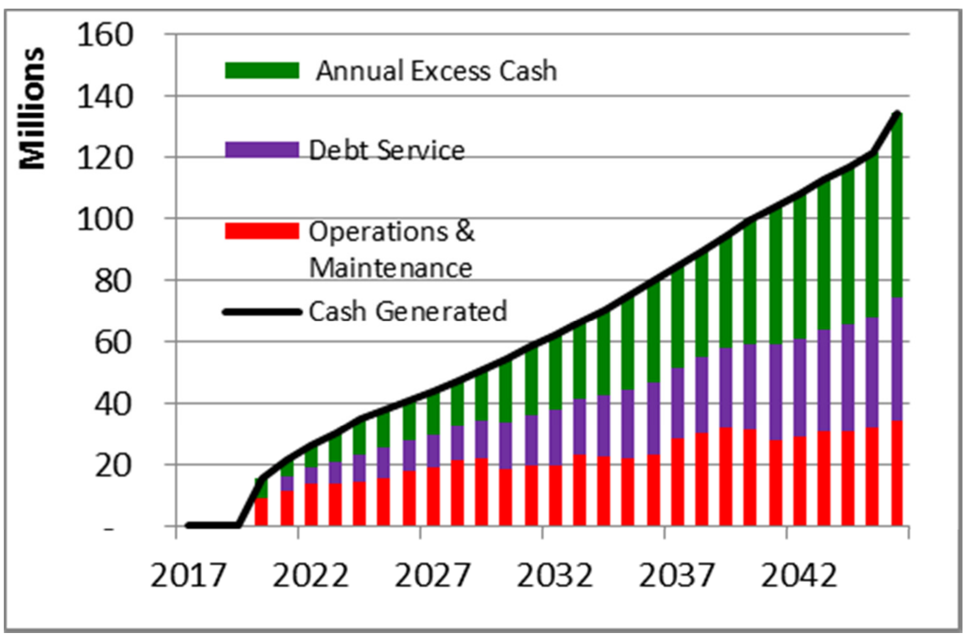
The results of the DBF financial analysis as well as the financial assumptions can be found in **Appendix H**.

8.1.2 Toll Backed Bonds

Toll revenue bonds are a project finance debt tool secured by toll revenues on a pledged asset or assets. Most toll revenue bonds are issued as non-recourse bonds, meaning that only toll revenues support the repayment of the bonds' principal and interest payments without any additional or back-up pledges from other revenue sources (i.e. taxes). Since non-recourse bonds do not obligate the State or issuing entity to make any debt service payments if toll revenues are insufficient, they generally do not affect the credit ratings or financing capacity of other governmental entities. In some cases toll revenue bonds can also utilize additional revenue pledges (motor fuel taxes or general obligation pledge) to help obtain a higher credit rating and lower borrowing costs. Toll revenue bond debt service is structured against forecasted toll revenues. Toll revenue bonds with a net revenue pledge pay all O&M requirements of the asset before paying bond holders while bonds with a gross revenue pledge pay bond holders first and all other obligations after the debt service payments are made. Coverage ratios are a common metric used to evaluate the ability of a project to repay its debt (revenues over debt service).

Figure 8.3 provides an illustration of how a toll revenue bond finance structure can look over a 30-year period. Under this structure the cash generated (black line) represents the annual gross revenue.

Figure 8.3: Toll Back Bonds Structure



As part of this financial analysis, a 30-year toll revenue band was assumed. The results of the toll revenue bonds financial analysis as well as the financial assumptions can be found in **Appendix H**.

9 FINDINGS

As indicated in **Figure 9.1**, the MLIP found that managed lanes were an appropriate solution along I-20 East and West, I-285 East and Northwest, I-85 North, SR 316, SR 400 North, and I-75 South. All of these corridors were deemed feasible for new lanes. Furthermore, a subset of these corridors was also deemed feasible for further engineering to possibly explore the potential use of dynamic flex lanes, including I-20 East and West, I-285 Northwest, and I-75 South. How the managed lane will be delivered (new lane versus dynamic flex lane) will be determined during the project development process as part of an independent study or preliminary engineering, as well as the planning process, as part of the Atlanta MPO's Regional Transportation Plan.

As discussed in **Chapter 7**, a variety of evaluation criteria were used to determine the feasibility of each managed lane treatment. **Table 9.1** (New Lanes) and **Table 9.2** (Dynamic Flex Lanes) on the following pages, provide a summary of the financial criteria, including the 30-year revenue, capital costs, and 30-year O&M costs for each of the managed lane strategies that could move forward for further analysis and consideration.

As noted earlier, an additional criterion, Project Financeability Index (PFI), was also used to determine the project's likelihood of success. PFI works well to measure a corridor's anticipated performance because it is a function of the corridor's traffic demand (based on congestion), project implementation costs and the cost/ability to finance the improvement. Each of these items are key in determining the viability of a priced managed lane project. Specifically, the PFI is calculated as:

$$PFI = \left(\frac{30\,Yr\,Gross\,Revenue\;-\;30\,Yr\,Roadway\,O\&M\,Cost\;-\;30\,Yr\,Tolling\,O\&M\,Cost}{Capital\,costs}\right)$$

For example, a PFI of 2.0 indicates the 30-year net revenue (gross revenue minus all O&M costs) is twice that of the up-front capital cost.

Figure 9.1: MLIP Findings

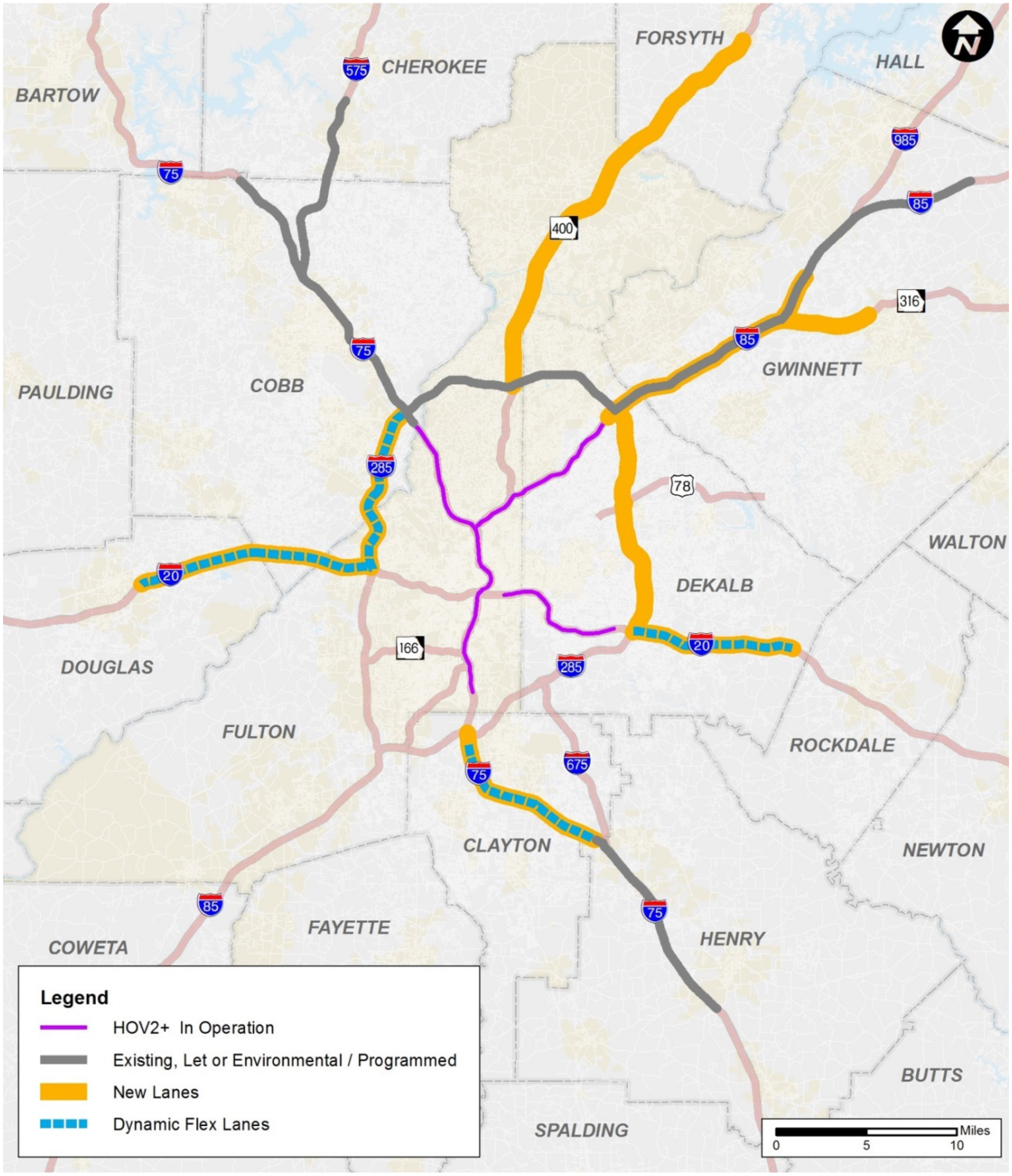


Table 9.1: New Lanes Segment Costs and Revenues

Corridor	Termini	Length (miles)	New Lanes - Revenue and Costs ($ in Millions, 2013)			
			30-Year Gross Revenue	Capital Cost	30-Year O&M Cost	PFI
I-20 E	I-285 E to SR 124	9.8	$730	$268	$240	1.8
I-20 W	I-285 W to SR 92	11.0	$690	$366	$300	1.1
I-285 E	I-20 E to I-85 N	13.4	$1,246	$274	$419	3.0
I-285 NW	I-75 N to I-20 W	8.9	$660	$311	$297	1.2
I-75 S	I-285 S to SR 138	10.6	$338	$313	$194	0.5
I-85 N	I-285 N to Old Peachtree Rd	17.0	$1,053	$333	$302	2.3
SR 316	I-85 to SR 120	6.5	$256	$151	$172	0.6
SR 400	I-285 N to SR 20	21.9	$1,235	$497	$412	1.7
Total		**99.1**	**$6,208**	**$2,513**	**$2,336**	**1.5**

Notes
1) Total capital cost includes roadway capital cost and tolling capital cost.
2) Total 30-year O&M cost includes roadway O&M, tolling O&M, and transaction cost.
3) I-85 N involves adding an additional managed lane in each direction.

Table 9.2: Dynamic Flex Lanes Segment Costs and Revenues

Corridor	Termini	Length (miles)	Dynamic Flex Lanes - Revenue and Costs ($ in Millions, 2013)			
			30-Year Gross Revenue	Capital Cost	30-Year O&M Cost	PFI
I-20 E	I-285 E to SR 124	9.8	$695	$80	$225	5.9
I-20 W	I-285 W to SR 92	11.0	$568	$190	$302	1.4
I-285 E	I-20 E to I-85 N	-	-	-	-	-
I-285 NW	I-75 N to I-20 W	8.9	$841	$137	$321	3.8
I-75 S	I-285 S to SR 138	10.6	$332	$148	$181	1.0
I-85 N	I-285 N to Old Peachtree Rd	-	-	-	-	-
SR 316	I-85 to SR 120	-	-	-	-	-
SR 400	I-285 N to SR 20	-	-	-	-	-
Total		**40.3**	**$2,436**	**$555**	**$1,029**	**2.5**

Notes
1) Total capital cost includes roadway capital cost and tolling capital cost.
2) Total 30-year O&M cost includes roadway O&M, tolling O&M, and transaction cost.
3) Dynamic flex lanes were deemed unfeasible for some corridors based on limited available shoulders and other physical constraints.