Table of Contents

Table of Contents Continued

Table of Contents Continued

List of Appendices

Compact Disk

Main Report

Appendices A-D

Technical Appendix:

- 2006 Existing Intersection Analysis
- 2006 Existing Traffic Counts
- 2030 No-Build Intersection Analysis
- Crashes
- CTPS Data and Info
- Improvement Costs
- Intersection Analysis with Improvements
- Known Developments
- Link Analysis
- Merge, Diverge, & Weave Analysis
- Truck Percentages

List of Figures

List of Figures
Continued

List of Figures Continued

List of Figures
Continued

List of Tables

Summary

I. Introduction

The Interstate 495 Corridor Transportation Study examined existing and future transportation conditions on a 40-mile section of I-495 between Westford and Salisbury, Massachusetts. Within this distance, I-495 traverses 13 communities and 2 regional planning boundaries-the Northern Middlesex Council of Governments (NMCOG) in the corridor's Western Segment and the Merrimack Valley Planning Commission (MVPC) in the Eastern Segment. Between the study area's western and eastern termini, I-495 includes 25 interchanges, 3 of which are interchanges with limited-access highways. This summary outlines the study framework, findings, and recommendations for improvements. For more detailed information, please refer to the remainder of the report and the appendices.

Based on analyses of 2006 and 2030 operating conditions as well as the public participation process, the study evaluates a range of potential solutions to identified problems. The possible solutions include expanded transit, managing trip generation from future development, carpooling from Park & Ride lots, Transportation System Management (TSM) actions, and, finally, roadway capacity increases.

II. Study Goals and Objectives/Public Involvement

As developed in coordination with the Study Advisory Group (SAG), which consisted of representatives from corridor communities, state and regional agencies, and legislators, the goal for this study was to provide improved safety and mobility on the I-495 mainline and at its interchanges. This goal focused study efforts on those points where drivers enter or exit the Interstate at the junction of its ramps with local streets and on operations of its travel lanes proper.

During the course of this study, several meetings were held with the SAG and a newsletter was prepared. A project-specific web site was established for use by interested parties in reviewing study progress and through which they could offer their comments. Meetings were also held with the two regional planning agencies to discuss identified issues. Near the conclusion of the study, two public informational meetings were held to present study findings, conclusions, and a program of potential improvements.

III. Existing 2006 Conditions

Existing conditions along the I-495 study corridor have been documented with regard to transportation, land use, socio-economic characteristics, and the environment.

The study has examined existing daily and peak hour traffic volumes on I-495, level of service (LOS), a four-year vehicle crash history at the highway's interchanges, operational characteristics of existing public transportation services in the area, and the location of Park & Ride lots.

Existing traffic volumes vary widely along the corridor. For example, at the far western end of the study corridor in Westford, average weekday daily traffic (AWDT) is 123,500 vehicles, while at the far eastern end of the corridor in Salisbury AWDT is only 45,000 vehicles. Similar variations were determined to occur during the AM and PM peak hours.

A key emphasis of the examination of existing conditions was the determination of how well I-495 and its interchanges are currently operating. Using the concept of LOS, which is a measure of the efficiency of traffic operations, analyses were undertaken from three perspectives: (1) signalized and unsignalized intersections at locations where ramps to and from I-495 meet the local street system, (2) merge, diverge, and weave movements at points along I-495 such as on-ramps and off-ramps, and (3) key links on I-495 between interchanges. In all cases, analyses were performed for both the AM and PM weekday peak hours.

In the Western Segment (Exits 32-40) of the I-495 study corridor, there are 6 signalized intersections, all of which were determined to be operating at overall levels of service (LOS A-D) during both the AM and PM peak hours, although a small number of individual movements (2 out of a total of 44, or 5 percent) within these intersections do experience congestion (LOS E or LOS F) during the AM peak hour. During the PM peak hour, 3 movements out of a total of 44, or 7 percent, experience congested operations.

For the 15 unsignalized intersections in the Western Segment, LOS is determined only for individual conflicting movements within the intersections and not for the intersections as a whole. Analysis results showed that 20 (87 percent) of the 23 such movements operate without congestion during the AM peak hour, while 18 (78 percent) do so during the PM peak hour.

With regard to the Eastern Segment (Exits 41-55) of the corridor, all five signalized intersections currently operate at overall acceptable LOS during both the AM and PM peak hours. No individual movements at signalized

intersections were determined to be operating unacceptably during the AM peak hour, with only 1 movement (3 percent out of a total of 34 movements) having congestion during the PM peak hour.

The 15 unsignalized intersections in the Eastern Segment contain a total of 63 movements that were analyzed. During the AM peak hour, 59 movements (94 percent) operate at LOS D or better, while during the PM peak hour 54 movements (86 percent) operate at LOS D or better.

In summary, all signalized intersections currently operate at LOS D or better overall during both the AM and PM peak hours. Only a small number of individual traffic movements within these intersections currently experience congested operations. For unsignalized intersections, the vast majority of individual traffic movements within these intersections currently operate at LOS D or better during both the AM and PM peak hours.

In the Western Segment, the analysis of merges, diverges, and weaves determined that 34 locations (89 percent) out of a total of 38 that were examined currently operate at LOS D or better during the AM peak hour. During the PM peak hour, 32 locations (84 percent) currently operate uncongested at LOS D or better. In the Eastern Segment, a total of 65 merge, diverge, and weave locations was examined. For the AM peak hour, it was determined that 61 locations (94 percent) operate at LOS D or better. The corresponding figures for the PM peak hour in the Eastern Segment are 63 locations (97 percent) at LOS D or better.

Also identified were deficiencies in the length of 24 acceleration lanes or deceleration lanes serving I-495's on- and off-ramps, respectively.

Key links between interchanges along the length of the I-495 study corridor were examined for their existing LOS. All were found to be operating at LOS D or better.

Data on crashes was compiled for a four-year period from 2002 to 2005. Interchanges were subsequently ranked according to total number of crashes, crashes involving property damage, crashes involving personal injuries, and crashes involving fatalities.

Public transportation in the study area consists largely of systems concentrated in the Lowell and Lawrence areas and of commuter rail service to and from Boston. Several transportation management agencies specializing in carpooling also operate in the area.

IV. Projected 2030 Conditions

Traffic volumes along I-495 are expected to grow into the future, but at a slower rate than they have been growing in the past. On the western end of the study corridor, AWDT on I-495 in Westford will grow from its existing volume of 123,500 vehicles in 2006 to 146,400 in 2030. At the eastern end of the study corridor in Salisbury, AWDT will grow from 45,000 vehicles in 2006 to 62,000 in 2030.

The projected increases in traffic volumes by 2030 will be accompanied by increases in traffic congestion, both on the I-495 mainline and at many of its 25 interchanges within the study corridor.

The effects of increased traffic volumes will be more profound with respect to some aspects of the roadway system than with others. For example, all six currently signalized intersections in the Western Segment of the study corridor will continue to operate at LOS D or better in 2030 during both the AM and PM peak hours, as they did in 2006. During the AM peak hour at these same intersections, the number of individual movements operating at LOS D or better will decrease from 42 out of 44 movements (95 percent) in 2006 to 40 movements (91 percent) by 2030, a relatively small change.

Seven signalized intersections in the study corridor's Eastern Segment will operate at LOS D or better during the AM peak hour, but only six (86 percent) of the seven will do so during the PM peak hour.

Further, it was determined that all (100 percent) highway links currently are operating at LOS D or better in 2006 during both the AM and PM peak hours. However, this is not projected to be the case in 2030. By that time, in the Western Segment of the study corridor during the AM peak hour, only 39 percent of the links will be operating at LOS D or better. During the PM peak hour, 56 percent of these same links will operate at LOD D or better. In the Eastern Segment, 22 links (74 percent) of 30 will operate at LOS D or better during the AM peak hour, while 23 links (77 percent) will do so during the PM peak hour. More details of future traffic conditions can be found in Chapter 3 and the appendices.

V. Alternatives Analysis

Various highway and non-highway alternatives were evaluated for their effectiveness in addressing capacity deficiencies. These types of alternatives included additional transit services, promotion of land uses that have lower trip generation rates, provision of more Park & Ride lots, intersection improvements, and merge and diverge improvements.

VI. Improved 2030 Operating Conditions

The recommended program of improvements, summarized below, addresses identified problems at signalized and unsignalized intersections; merge, diverge, and weave locations; and the I-495 mainline links and interchanges themselves. With the exception of several locations involving weaves, the program, if implemented, would restore all operations to LOS D or better. Several weave locations at interchanges where congested levels of service are projected to exist would require the involved interchange to be totally redesigned or relocated in order for the weaving problems to be solved. While these locations are identified, solutions for these particular problems are beyond the scope of this corridor study.

VII. Recommended Improvements Plan

Based on the results of the analyses of existing (2006) and future (2030) operating conditions as well as the public participation process, a set of recommended improvements was developed, and is shown in more detail in Chapter 4. These improvements were grouped according to the time periods during which they would be implemented.

Near-term improvements are those requiring less than two years to implement and are all responses to existing problems. For this program, all recommended near-term improvements involve the retiming of certain traffic signal systems. Specifically, two signal systems are recommended to be retimed in the corridor's Western Segment and one in the Eastern Segment. No environmental impacts from these actions are anticipated.

Mid-term improvements require from two to eight years for implementation, and are intended to solve existing problems. Included is the installation of traffic signal systems at five new locations in the Western Segment and at two new locations in the Eastern Segment. Also included is the lengthening, by means of pavement re-striping, of 8 existing acceleration or deceleration lanes in the Western Segment along with 16 acceleration or deceleration lanes in the Eastern Segment. This lengthening would bring these lanes up to standard and would also improve safety.

Other recommended actions for the mid term would consist of the reconfiguration of the cross-section of a one-mile section of State Route 125 to the north of Exit 50 in Haverhill and the study of the feasibility of constructing new direct connections in Salisbury between I-495 NB and I-95 SB and between I-95 NB and I-495 SB. With the potential exceptions of traffic signal installation work at two locations and the reconfiguration of State Route 125, all mid-term projects are expected

to have little or no environmental impacts. The projects listed as exceptions may involve work in the buffer zones of protected resources and may require coordination with the conservation commissions of the affected communities.

Long-term improvements are those recommended for implementation eight years or more into the future. They are responses to future identified problems. A key recommendation is the widening of I-495 by one travel lane in each direction between Exit 32 and Exit 40 in the Western Segment, exclusive of that portion of the highway between Exits 35 and 36, and the widening of I-495 by one travel lane in each direction to beyond Exit 49, with the exception of the highway segment from just before Exit 43 to just beyond Exit 45. In addition to increasing I-495's mainline capacity, this widening will also improve conditions at many of the previously identified merge and diverge locations with poor LOS. The proposed widening of the I-495 mainline would very likely have substantial environmental impacts.

Also part of the recommended long-term improvement program are the retiming of two existing traffic signal systems (one in the Western Segment and one in the Eastern Segment) and the installation of traffic signal systems at three new locations (all in the Eatern Segment). With regard to deficient weave operations that were identified, several interchanges would require further study for their complete redesign. Also, intersection capacity improvements at one interchange and traffic signal installation at another may involve work within the buffer of a protected resource which would require coordination with the conservation commissions of the communities where those projects are located.

While the above recommendations relate to increasing the roadway system's capacity to accommodate the traffic demands on I-495, other actions aimed at reducing the demand itself (public transportation improvements, additional Park & Ride lots, land use changes) will not by themselves be able to negate the need for roadway capacity improvements. However, these actions should be encouraged wherever possible as components of a total package of strategies to manage traffic throughout the corridor, both now and in the future.

Cost estimates for the recommended improvements plan have been developed in present day (2008) dollars. Summed over the near term, mid term, and long term, they are approximately $102 million for the Western Segment of the study corridor and approximately $77 million for the Eastern Segment, giving a grand total of approximately $179 million.

The next steps for advancing these recommendations involve project initiation and development through coordination with MassHighway, with future steps involving programming of the mid-term projects in the Transportation Improvement Programs (TIP) of the two regional planning agencies. The long-term improvements would also need to be incorporated in the regional long-range transportation plans.

1.0 Introduction

The Massachusetts Executive Office of Transportation and Public Works (EOTPW), in consultation with the Merrimack Valley Metropolitan Planning Organization and the Northern Middlesex Metropolitan Planning Organization, recognized the need to evaluate and address transportation issues in the 40-mile-long section of Interstate 495 (I-495) between Westford and Salisbury. This study, officially called the ***Interstate 495 Corridor Transportation Study***, was initiated by EOTPW to provide a forum for state and regional agencies, municipal officials, business leaders, legislators, transportation service providers, and the general public to collaboratively develop reasonable solutions to identified existing and expected future transportation problems in the study area.

Over time, the role I-495 played in connecting corridor communities to a wider transportation system contributed to their growth and, in part, economic well being. However, following years of expansion in population and employment, the continuing travel demands now placed on I-495 by corridor communities, combined with demands for travel from outside this corridor, are stressing the capacity of I-495.

The concept of this study is to understand the quality of travel afforded by I-495 today and how that quality of travel is likely to change by 2030. The study evaluates how travel limitations that exist now, and may exist in the future, can be resolved over time in a manner that reflects the level of complexity and cost for the needed improvements. Additionally, the roles of transit and, in a general sense, land use are also included in the evaluation of how to attain and maintain an acceptable quality of travel on I-495.

1.1 Development of the I-495 Corridor

The concept of an outer loop highway for eastern Massachusetts was first announced by the Massachusetts Department of Public Works (MDPW), MassHighway's predecessor, in the late 1940s. This proposed outer loop was to be located at an approximate 30-mile radius from Boston and would supplement the "Relocated Route 128", which was to be built to serve the towns in an inner ring at an approximate 15-mile radius from Boston. As conceived, the outer loop highway would be approximately 87 miles in length between Route 1 in Salisbury and Route 1 in Foxborough. Its purpose would be to provide an economic boost to the communities that it would serve by offering greatly improved access to all

parts of the state and nation. This outer loop was initially referred to as "Relocated Route 110" but was ultimately redesignated as I-495. Construction occurred in stages, with the first section completed between Exit 29 (Route 2) in Littleton and Exit 32 (Route 225) in Westford in 1961. The remaining sections of roadway in the Merrimack Valley followed in subsequent years. Specifically, the section of roadway between Exit 32 in Westford and Exit 36 (Route 3) in Chelmsford was completed in 1962, while the section between Exit 36 in Chelmsford and Exit 42 (Route 114) in North Andover was opened to traffic in 1963. Next to come on line, in 1964, was the roadway section between Exit 42 in North Andover and Exit 53 (Broad Street) in Merrimac. The final section in the valley, between Exit 53 in Merrimac and I-95 in Salisbury, opened in 1967.

Numerous technology firms have established business locations along the I-495 corridor, mirroring the Route 128 experience. Traffic volumes in some sections of the corridor are now triple what they were in 1977.

As presented in Figure 1-1, this project's study area extended from Westford east to Salisbury, a distance of approximately 40 miles. Concerns about transportation issues in this corridor resulted in state, regional, and local interest in exploring potential alternative solutions for alleviating existing and expected future traffic congestion, improving regional mobility, and improving safety.

The study involved the development and evaluation of a full range of transportation improvement alternatives, including interchange, highway, and non-highway improvements, as well as multimodal options. A recommended plan of future transportation improvements for the near term (up to 2 years), mid term (2 to 8 years) and long term (more than 8 years) was a key study product.

This report is also a major product of the study. It documents all phases of the work efforts completed, including input from the *Working Group*, the *Study Advisory Group (SAG)*, and the general public. The following chapters comprise this report:

- Chapter 1 – Introduction
- Chapter 2 – Existing Conditions
- Chapter 3 – Future No-Build Conditions
- Chapter 4 – Recommended Improvements Plan

1.2 Study Area

The study area for this project was finalized during the initial stages, with input from the *Working Group* and the *SAG*. The area of the study, depicted in Figure 1-1, extended along the I-495 corridor from Westford in the west to Salisbury in the east. Growth in the study area and growing traffic congestion on I-495 and its interchanges prompted the need to study transportation improvements that would better serve existing and expected future corridor transportation needs.

The study area included the following I-495 interchanges:

Western Segment

- Exit 32: Boston Road in Westford
- Exit 33: State Route 4 (North Road) in Chelmsford
- Exit 34: State Route 110 (Chelmsford Street) in Chelmsford
- Exit 35: U.S. Route 3 at the Lowell city line in Chelmsford
- Exit 36: Lowell Connector in Lowell
- Exit 37: Woburn Street in Lowell
- Exit 38: State Route 38 (Main Street) in Tewksbury
- Exit 39: State Route 133 (Andover Street/Lowell Street) at the Tewksbury/Andover municipal line
- Exit 40: I-93 in Andover

Eastern Segment

- Exit 41: State Route 28 (North Main Street and Union Street) in Andover
- Exit 42: State Route 114 (Winthrop Avenue) in Lawrence
- Exit 43: Massachusetts Avenue/Loring Street at the North Andover/Lawrence municipal line
- Exit 44: Merrimack Street/Sutton Street at Lawrence/North Andover municipal line
- Exit 45: Marston Street in Lawrence
- Exit 46: State Route 110 (Merrimack Street) in Methuen
- Exit 47: State Route 213 (Albert Slack Highway) in Methuen
- Exit 48: State Route 125 in Haverhill
- Exit 49: State Routes 110/113 (River Street) in Haverhill
- Exit 50: State Route 97 (Broadway) in Haverhill
- Exit 51: State Route 125 (Main Street) in Haverhill
- Exit 52: State Route 110 (Amesbury Road) in Haverhill
- Exit 53: Broad Street in Merrimac
- Exit 54: State Route 150 in Amesbury
- Exit 55: State Route 110 (Macy Street) in Amesbury
- Junction of I-495 with I-95

1.3 Goals and Objectives

Goals and objectives identify the purpose of the study and provide a "mission statement" for addressing a particular issue or set of issues. The defined goals and objectives shape the framework of the entire study. As established by the *Working Group*, this study's key objective was:

- ***To achieve improved mobility and safety on I-495 and at its interchanges.***

This goal was endorsed by the Study Advisory Group (SAG) at its initial meeting in 2006.

By focusing study efforts on the I-495 mainline and its interchanges, a conscious decision was made to maximize the understanding of how I-495 operates as a corridor and as a series of locations where corridor residents transition between the local street system and the Interstate.

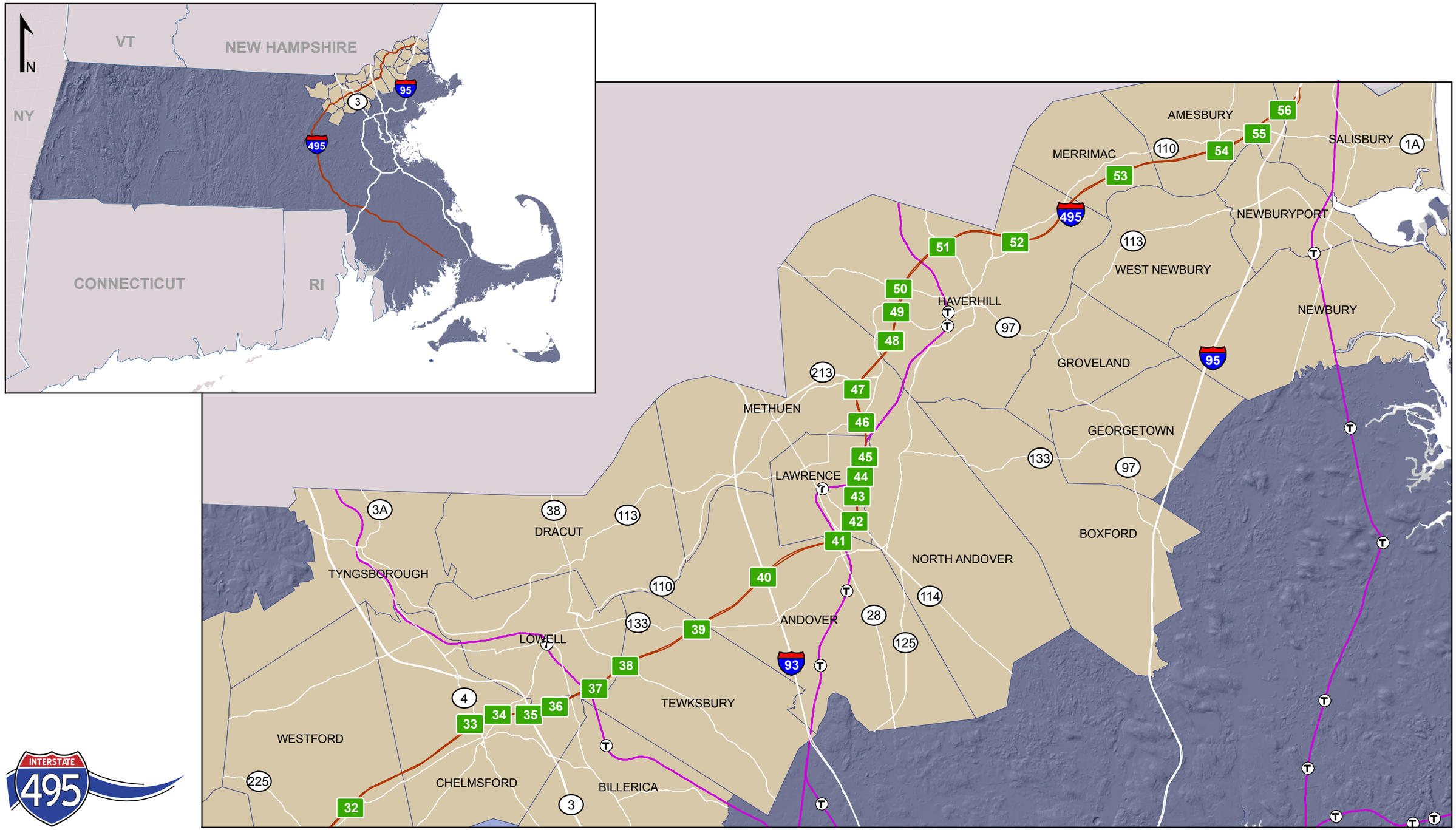
1.4 Study Context

It is recognized that as a corridor planning study, this report is an initial step toward the ultimate improvement of the transportation problems identified in the following chapters. As a first step, this study is intended to collect and explain a large amount of location-specific data, understand how locations operate individually and, where appropriate, to collectively define the user experience of traveling throughout this 40-mile-long corridor.

Consequently, this study's intent is to describe existing and expected future operating conditions along 80 miles (40 miles in each direction) of limited access highway, including the operational and crash characteristics of 25 interchanges involving approximately 50 intersections of local streets with Interstate ramps.

Then, based on analysis, the study identifies which of these locations exhibit operational or crash problems today or in 2030. With that knowledge, a range of improvement options for today and the future is evaluated. Finally, this study recommends potential improvements for appropriate locations.

In this way, the study separates I-495's roadway segments, interchanges, and intersections into two basic groups--those that have problems and those that do not. Consequently, this identification of problem and, equally important, non-problem locations is a major product of this corridor study.



Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs

I-495 Corridor Study
Figure 1-1
Study Area

Without understanding where the problems exist, little progress can be made toward their resolution.

While potential solutions are identified for problem locations, it is imperative to understand that this is the first step toward the eventual resolution of these identified problems. Later steps will introduce these potential improvements into the public transportation improvements review, approval, and funding process. It is within those later stages that advanced engineering design will occur that will ultimately result in plans upon which improvements will be constructed.

1.5 Public Involvement

A key component of this study was the public involvement process. One of the first tasks of the work effort was to develop a Public Involvement Plan, the details of which can be found in Appendix A of this document along with meeting notes from all public meetings.

The intent of the Public Involvement Plan was to establish a structure and forum for interested and affected parties to provide input and comment on the study process, to provide education and awareness about the project, and to engage key stakeholders in the process as well as to build agreement and support for implementation. Principles to which the public involvement process adhered were also developed at the same time. Included were commitments to create an environment in which decisions were based on an objective, transparent, and inclusive planning process; to ensure open, honest, and clear communications; and to facilitate two-way communications.

The Public Involvement Plan called for the creation of both a *Working Group* and a *SAG* to participate with the EOTPW and the Consultant Team in the process. The roles of each of these Study Participants were specifically defined by the Public Involvement Plan to provide guidance to the involved parties.

The Consultant Team's roles in the public participation process were to perform technical work, to prepare material and presentations for *SAG* meetings, and to prepare material and presentations for public informational meetings.

The roles of the EOTPW, as the study's proponent, were to review the work of the Consultant Team, manage the project, review recommendations, and make final decisions.

The *Working Group* consisted of the EOTPW, the Northern Middlesex Council of Governments (NMCOG); the Merrimack Valley Planning Commission (MVPC); and Fay, Spofford & Thorndike. The latter organization was the prime member of the Consultant Team while NMCOG and MVPC are the two regional planning agencies serving the communities along the I-495 corridor. Roles of the *Working Group* included providing input to the study process, reviewing and revising technical work, and providing input on the recommendations to the EOTPW.

By far the largest group participating in the public involvement process was the *SAG*. Its membership comprised two members of Congress whose districts include the study area, State Representatives and State Senators from the study area, several chambers of commerce representing the business community, representatives from all of the cities and towns in the study area, and representatives from several providers of public transportation in the area. The purpose of the *SAG* was to provide input to the study process, assist with alternatives development, and provide input on the technical materials and alternatives. A complete listing of *SAG* members can be found in Appendix A of this document.

Specific types of public participation activities that occurred throughout this study included stakeholder interviews, *SAG* meetings, regional planning agency briefings, public informational meetings, communication with *SAG* members, and distribution of study information and materials.

Other means that were used to keep the public informed about the study included media releases at key points; the preparation of fact sheets for inclusion in newsletters, etc.; the preparation of articles about the project; and the establishment for use by the public of a project-specific web site (www.495studyinfo.com).

While the I-495 Corridor Study was underway, the public had the opportunity to post any comments that they might have on the study website. A total of 27 comments was posted, and are available for viewing in Appendix A. They ranged from requests for improvements/changes at specific interchanges to comments about the highway's speed limit.

Some of the suggestions for improvements made by the public in their comments are included in the potential improvements specifically discussed in Chapter 4. Examples include traffic signal installations at Exits 33 and 37 and the need to increase mainline capacity in the future by adding travel lanes. This study also recommends that the potential for a full interchange between I-495 and I-95 be examined. Comments regarding issues at the I-495/I-93 interchange have been noted, with

further study being recommended. Other suggestions were out of the scope of this study, such as a request for pothole repairs.

In any case, all of the comments posted by the public on the website were considered when developing the recommended improvements plan presented in Chapter 4.

Table 1-1 lists the *Working Group*, *SAG*, agency, and public informational meetings that were held over the course of the ***Interstate 495 Corridor Transportation Study.*** Notes from these meetings can be found in Appendix A of this document.

Table 1-1
Public Involvement

Group	Date	Location	Agenda
Working Group	April 21, 2005	State Transportation Building	Traffic count program, study-area boundaries, SAG membership, goals and objectives
Study Advisory Group	July 28, 2005	Methuen	Introduction to the study; scope, goals and objectives; evaluation criteria.
Study Advisory Group	Nov. 28, 2006	Tewksbury	Overview of existing conditions.
Working Group	Dec, 20, 2006	NMCOG	Traffic Counts
Working Group	June 14, 2007	State Transportation Building	Model results, seasonality, trucks
Study Advisory Group	Feb. 7, 2008	Haverhill	Review of existing conditions; 2030 projections for traffic; and improvement ideas for the Corridor.
Northern Middlesex COG Councilors	Mar. 19, 2008	Lowell	Overview of key findings; review of proposed Westford interchange at Rte. 225
Merrimack Valley Planning Commission	April 17, 2008	Haverhill	Overview of key findings
Study Advisory Group	April 23, 2008	Tewksbury	Review of proposed non-highways improvements and refined highway improvements.
Western Segment Public Informational Meeting	May 22, 2008	Lowell	Open-house-style meeting and detailed presentation to review the study, problems, and recommended improvements.
Eastern Segment Public Informational Meeting	May 27, 2008	Haverhill	Open-house-style meeting and detailed presentation to review the study, problems, and recommended improvements.