2.0 Existing Conditions

2.1 Introduction

The purposes of this study are (1) to identify transportation problems along the study corridor and (2) to propose improvement projects and/or remediation strategies for those identified problems. Identified issues may be currently existing or projected for the year 2030, this study’s future year. This chapter will provide an understanding of how I-495 operates now and will identify the natural resources and socio-economic environments surrounding the roadway, ultimately enabling the reader to develop an understanding of the corridor’s environs and how transportation within the I-495 corridor and at its 25 interchanges operates.

A description in this chapter of the physical and traffic operational characteristics of I-495’s interchanges is followed by a discussion on the crash history at these same locations. Additionally, this chapter looks at existing public transportation services in the area and their ridership, as well as the area’s Intelligent Transportation Systems capabilities.

As there is a direct relationship between land use and transportation demands, this chapter then outlines the existing land use characteristics along the I-495 corridor, focusing on a one-mile radius at each of the corridor’s interchanges. Additionally, an examination of socio-economic conditions along the corridor and a summary of the natural resources located adjacent to I-495 are discussed.

2.2 I-495’s Diverse Roles

Travel demand on the I-495 corridor is strong, which is due to the fact that the Interstate fulfills a variety of critical functions. As discussed in this chapter’s section on land use and socioeconomic characteristics, I-495 is a major factor in influencing development within the multiple communities it passes through. Two distinct patterns of development in these communities prevail: the dense urban development of the mill cities seen in communities such as Lowell and Lawrence, and the evolving patterns of low-density development seen in towns such as Westford and portions of Tewksbury. In the case of older mill cities such as Lowell and Lawrence, their highest populations and development occurred prior to I-495’s construction and, thus, I-495 was not a catalyst for their initial growth. However, communities such as Westford and Tewksbury lacked the mature characteristics of older neighboring cities. The availability of undeveloped land, combined with the new accessibility and increased mobility created
by I-495, allowed for the expansion of low-density development patterns that could then be connected to higher-density employment sites. Throughout the Merrimack Valley, travel between these often-distant employment centers and mainly residential communities (or “bedroom communities”) primarily takes place on limited access highways, which has placed a strong demand on the study corridor’s transportation network.

I-495’s multifunctional role as a regional and local roadway can be illustrated by noting results from analyses that the Central Transportation Planning Staff (CTPS) performed using the latest computer modeling techniques. Currently, during the three-hour AM peak period, through trips that do not have either an origin or a destination in any one of the 13 communities along this section of I-495 make up approximately 51 percent of the traffic on the highway. Conversely, the remaining 49 percent of trips on the highway during that time have an origin and/or a destination in those same communities.

Just as I-495 has influenced development patterns, the impacts exerted by development have affected I-495’s operations. As evidenced by the traffic operations analyses presented in this chapter, these impacts vary greatly along the corridor from municipality to municipality. It is at the interchanges that impacts from local streets are transmitted to the I-495 mainline, affecting its primary role of facilitating regional and through travel.

I-495’s function as a major transportation network link is another reason for its high travel demand. I-495 fulfills a critical role in mobility as an inter-regional and interstate travel link, connecting New Hampshire, Maine, and the maritime provinces of Canada with New York and Connecticut, as well as providing connections to I-95, I-93, I-90, U.S. Route 3, and State Route 2. I-495 thus provides a vital function in the movement of people and goods. I-495’s connectivity makes it a choice route in particular for moving goods, while also avoiding the expense of time and fuel lost to congestion and distance when traveling through metropolitan Boston. As illustrated later in this chapter by the high level of trucks mixed into the total volume of traffic on I-495, this feature tends to direct longer distance trips in general, and goods movement in particular, toward this 40-mile section of I-495. Such an effect is perhaps not experienced to this degree beyond the study corridor’s boundaries.

As changes to land use, economics and other factors influence travel demands and patterns, the role and function of I-495 also changes. I-495 is a benign neighbor until it loses its utility. When that happens, either through failure of the highway or failure of the local system, I-495’s ability to meet its designated functions without impacting local travel is reduced.
2.3 Existing Conditions

2.3.1 Transportation

This section first discusses the physical characteristics of both I-495 and its 25 interchanges in the study area, followed by a discussion of the existing volumes of traffic that traverse I-495 within the study area, and the traffic volumes entering and exiting I-495 at each of the 25 interchanges. The operations of these interchanges, as well as mainline I-495 itself, in the morning and afternoon peak hours are then analyzed in terms of traffic volume demands.

For discussion purposes, the corridor has been divided into a Western Segment that extends between the western study limit at the Westford/Littleton town line to I-93 in Andover, and an Eastern Segment that continues from I-93 in Andover to I-95 in Salisbury.

This section (2.3.1) also discusses travel time runs, crash data, public transportation, park and ride facilities, transportation management associations, and Intelligent Transportation Systems. It is followed by sections on land use, socio-economics, and the natural environment.

2.3.1.1 I-495 and its Interchanges

I-495 Mainline

As stated in Chapter 1, the section of I-495 under study for this project begins at the Westford/Littleton town line and ends at the highway’s northern terminus at its junction with I-95 in Salisbury. Within this 40-mile-long study corridor, I-495 provides three 12-foot travel lanes in each direction between Westford and State Route 110 in Amesbury, and two 12-foot travel lanes between State Route 110 and Route I-95 in Salisbury. I-495 also provides one 10-foot shoulder on the inside lane and one 4-foot shoulder next to the outside lane for the entirety of the study area. Truck travel along I-495 is restricted to the two right-hand travel lanes. The posted speed limit is generally 65 miles per hour throughout the corridor except a for section of highway on either of the double-decker bridge in Lawrence where the speed limit is 55 miles per hour. There are 25 interchanges (Exits 32 through 55 plus the junction with I-95) connecting I-495 and abutting roadways within the study corridor.

Generally, the purposes of I-495’s travel lanes are to process inter-regional travel demand through the study area, and to provide intra-regional connections for travel demands from the mainline to abutting roadways and land uses at interchanges. While travel on the mainline can be congested at
times, the majority of congestion and turbulence on the mainline is directly related to traffic entering and exiting I-495 at its interchanges. From this perspective, interchange operations at the junction of interchange ramps with the mainline and with local intersecting streets are critical to I-495 meeting both local and regional travel demands. The next section presents an overview of each of the study’s 25 interchanges, which have a strong influence on I-495’s mainline operations.

**I-495 Interchanges**

Characteristics of each of the interchanges are briefly summarized below. A MassGIS/MassHighway color orthophoto or an aerial photograph taken by Fay, Spofford & Thorndike is included with a brief summary of each interchange.

### Interchange 32

<table>
<thead>
<tr>
<th>Location:</th>
<th>Westford</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-Street:</td>
<td>Boston Road</td>
</tr>
<tr>
<td>Type:</td>
<td>Full Diamond</td>
</tr>
<tr>
<td>Signalized:</td>
<td>Yes</td>
</tr>
<tr>
<td>Comments:</td>
<td>Offset intersections west of I-495</td>
</tr>
</tbody>
</table>

### Interchange 33

<table>
<thead>
<tr>
<th>Location:</th>
<th>Chelmsford</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-Street:</td>
<td>State Route 4 (North Road)</td>
</tr>
<tr>
<td>Type:</td>
<td>Partial Diamond</td>
</tr>
<tr>
<td>Signalized:</td>
<td>No</td>
</tr>
<tr>
<td>Comments:</td>
<td>No access to I-495 north and from I-495 south</td>
</tr>
</tbody>
</table>
Interchange 34

**Location:** Chelmsford  
**Cross-Street:** State Route 110 (Chelmsford Street)  
**Type:** Partial Cloverleaf  
**Signalized:** No  
**Comments:** None

Interchange 35

**Location:** Chelmsford @ Lowell city line  
**Cross-Street:** U.S. Route 3  
**Type:** Full Cloverleaf  
**Signalized:** No  
**Comments:** All ramps connect to/from parallel service roads on both I-495 and U.S. Route 3. U.S Route 3 was recently reconstructed in this area.

Interchange 36

**Location:** Lowell  
**Cross-Street:** Lowell Connector  
**Type:** Directional Trumpet  
**Signalized:** No  
**Comments:** All ramps connect to/from parallel service roads on I-495
Interchange 37

Location: Lowell
Cross-Street: Woburn Street
Type: Full Diamond
Signalized: No
Comments: One leg of diamond uses a local street (Christman Avenue) as an on-ramp

Interchange 38

Location: Tewksbury
Cross-Street: State Route 38 (Main Street)
Type: Combination Partial
Signalized: Yes
Comments: None

Interchange 39

Location: Tewksbury @ Andover town line
Cross-Street: State Route 133 (Andover Street/Lowell Street)
Type: Partial Cloverleaf
Signalized: Yes
Comments: None
Interchange 40

Location: Andover
Cross-Street: I-93
Type: Full Cloverleaf
Signalized: No
Comments: None

Interchange 41

Location: Andover
Cross-Street: State Route 28 (North Main Street & Union Street)
Type: Combination Partial Cloverleaf/Partial Directional
Signalized: No
Comments: None

Interchange 42

Location: Lawrence
Cross-Street: State Route 114 (Winthrop Avenue)
Type: Partial Cloverleaf
Signalized: Yes
Comments: None
Interchange 43

Location: North Andover @ Lawrence city line
Cross-Street: Massachusetts Avenue/Loring Street
Type: Full Diamond
Signalized: No
Comments: None

Interchange 44

Location: Lawrence @ North Andover town line
Cross-Street: Merrimack Street & Sutton Street
Type: Partial Diamond
Signalized: Yes*
Comments: No access to I-495 south and from I-495 north

*Signalized after 2006 traffic data collected, so treated as unsignalized for existing conditions analyses

Interchange 45

Location: Lawrence
Cross-Street: Marston Street
Type: Directional Interchange
Signalized: No
Comments: None
Interchange 46

Location: Methuen
Cross-Street: State Route 110 (Merrimack Street)
Type: Combination Partial
Signalized: Yes
Comments: None

Interchange 47

Location: Methuen
Cross-Street: State Route 213 (Albert Slack Hwy)
Type: Directional Trumpet
Signalized: No
Comments: None

Interchange 48

Location: Haverhill
Cross-Street: State Route 125
Type: Combination Partial
Signalized: No
Comments: None
Interchange 49

Location: Haverhill
Cross-Street: State Routes 110/113 (River Street)
Type: Combination Partial
Signalized: No
Comments: Majority of ramps connect to/from parallel service roads on I-495

Interchange 50

Location: Haverhill
Cross-Street: State Route 97 (Broadway)
Type: Partial Cloverleaf
Signalized: Yes
Comments: All ramps connect to/from parallel service roads on I-495

Interchange 51

Location: Haverhill
Cross-Street: State Route 125 (Main Street)
Type: Full Cloverleaf
Signalized: No
Comments: Ramps on the north side of I-495 connect with parallel service road
Interchange 52

Location: Haverhill
Cross-Street: State Route 110 (Amesbury Road)
Type: Partial Cloverleaf
Signalized: No
Comments: None

Interchange 53

Location: Merrimac
Cross-Street: Broad Street
Type: Full Diamond
Signalized: No
Comments: None

Interchange 54

Location: Amesbury
Cross-Street: State Route 150
Type: Combination Partial Cloverleaf/Partial Diamond
Signalized: No
Comments: None
Interchange 55

Location: Amesbury
Cross-Street: State Route 110 (Macy Street)
Type: Combination Partial
Signalized: No
Comments: No access to I-495 north and from I-495 south

Junction of I-495 with I-95

Location: Salisbury
Cross-Street: I-95
Type: Partial Diamond
Signalized: No
Comments: No access from I-495 north to I-95 south and from I-95 north to I-495 south

2.3.1.2 Traffic Volumes

2004 Mainline and Intersection Traffic Volumes

The length of the study corridor—coupled with the fact that it traverses multiple distinct communities—creates a dynamic traffic scenario that is evident in the varied traffic growth rates and volumes along the corridor. Figure 2-1 illustrates both the fluctuation in growth rates and the changes in traffic volumes along the corridor, progressing from west to east. The bars represent the largest recorded volume for that specific location between 1998 and 2002. The percentages were derived from traffic volume data collected from 8 permanent count stations along I-495 between 1998 and 2002. Volumes were then analyzed on a straight-line basis to determine the approximate annual average growth rate.
It is also useful to show long-term historic traffic volumes and growth rates on several sections of I-495 to see how they have changed over the years. For example, Figure 2-2a shows that, at a location on I-495 in Chelmsford on the western end of the study corridor, to the south of State Route 4, the average daily traffic volume in 1962 was 6,300 vehicles per day and in 1972 was 33,400 vehicles per day. By 1982, traffic here had increased to 43,100 vehicles per day, representing a 29 percent increase over that 10-year period. It had reached 75,500 vehicles per day by 1992 (a further 75 percent increase over 10 years) and 110,900 vehicles per day by 2002 (a 47 percent increase since 1992). Over the 30-year period between 1972 and 2002, a 232 percent increase in traffic volumes was experienced along this section of the highway. The latest available count for 2006 shows 113,100 vehicles per day, indicating that traffic volume continues to grow.

Looking at this same location in Chelmsford from another perspective, in the 20-year period between 1962 and 1982, daily traffic increased by close to 40,000 vehicles per day. Over the next 20-year period between 1982 and 2002, it grew by close to 70,000 vehicles per day.
ADT from 1962 – 2005 on I-495 in Chelmsford, South of Route 4

Figure 2-2a
ADTs from 1962 – 2005 on I-495 in Chelmsford, South of Route 4
At the Andover/Lawrence municipal line in the central part of the study area, Figure 2-2b shows that the average daily volume on this section of I-495 in 1972 was 45,600 vehicles per day. By 1982, it had increased to 65,000 vehicles per day, a 43 percent increase over 10 years. A daily volume of 84,500 in 1992 at this same location represented a 30 percent increase over 10 years. By 2000, daily volume here had increased to 95,700 vehicles.

Again, looking at growth along this section of roadway over 20-year increments, beginning in 1964 shortly after it opened, daily traffic was approximately 20,000 vehicles. Twenty years later in 1984, it had increased to approximately 62,000 vehicles per day, an increase of 42,000 daily vehicles over the 20-year period. The following 20-year period, from 1984 to 2004, saw daily traffic increase from 62,000 vehicles to 106,500, another increase of 44,000 daily vehicles.

At the eastern end of the study corridor in Amesbury at the Merrimac town line, Figure 2-2c shows that the average daily volume in 1972 was 23,500 vehicles per day. It had increased to 29,200 by 1982 and to 51,000 by 1992, representing increases of 24 percent and 75 percent, respectively, for each of those 10-year periods. By 2002, the daily volume had reached 62,500 vehicles, a further 23 percent increase. Between 1972 and 2002, average daily traffic volume at this particular location increased by 166 percent.

As with the two previous locations just discussed, it is of interest to look at traffic here in terms of growth over 20-year periods. From 1972 to 1992, daily traffic grew from 23,500 vehicles to 51,000 vehicles, an increase of 27,500 vehicles. Between 1982 and 2002, daily traffic grew from 29,200 vehicles to 62,500 vehicles, an increase of 33,300 vehicles. Thus, growth in traffic volumes over these two 20-year periods was in the 30,000 vehicle-range in each case.

More recently, traffic volumes were collected during the fall of 2004 and the spring of 2006 by the Massachusetts Highway Department (MassHighway). The 2004 numbers are based on 24-hour automatic traffic recorders (ATR) data from the I-495 mainline. The 2006 numbers represent weekday peak hour manual-turning-movement (MTM) counts and vehicle classification determinations obtained for all locations where the interchanger ramps intersect with local streets. (See Table B-1 in Appendix B for an itemized list of the 2006 MTM count locations along the study corridor.) The ATR and MTM data was seasonally adjusted to reflect average weekday traffic volume conditions. Figures 2-3 and 2-4 show the Average Weekday Daily Traffic (AWDT) as well as peak AM and PM directional counts along the mainline, while Figures 2-5 through 2-8 represent the AM and PM peak hour turning movements at study area interchanges.
ADT from 1962 – 2005 on I-495 at Andover/Lawrence Municipal Line

Figure 2-2b
ADTs from 1962 – 2005 on I-495 at Andover/Lawrence Municipal Line
ADT from 1962 – 2005 on I-495 at Amesbury/Merrimac Town Line

Figure 2-2c
ADTs from 1962 – 2005 on I-495 at Amesbury/Merrimac Town Line
Based on the data, it is apparent that traffic volumes are generally more concentrated in the Western Segment of the corridor than in the Eastern Segment. The AWDT numbers in Figures 2-3 and 2-4 illustrate that, overall, eastbound traffic volumes tend to decline from west to east, while westbound traffic volumes grow from east to west. The exceptions to this pattern come at locations where other major arteries running north-south bisect I-495, specifically at Exits 35, 36, and 40, where U.S. Route 3, the Lowell Connector, and I-93 interchange with I-495, respectively. Traffic close to these interchanges tends to be relatively heavier. For eastbound traffic, volumes dramatically increase just east of U.S. Route 3, indicating that this north-south artery is a large source of eastbound traffic for I-495. In the westbound direction, volumes increase just west of State Route 125 and I-93, indicating that these are both major sources for westbound traffic.

With regard to specific AWDT traffic volumes, Figures 2-3 and 2-4 show that, in the eastbound direction, the 2004 AWDT at the far western end of the study corridor is 61,000 vehicles per day. AWDT in the eastbound direction hits its peak at 69,500 vehicles per day between Exits 36 and 37 in Lowell. At the far eastern end of the study corridor, eastbound traffic decreases to only 22,000 vehicles per day. A similar pattern with regard to AWDT exists in the westbound direction. Specifically, at the far eastern end of the study area, the 2004 AWDT is 23,000 vehicles per day westbound, while at the far western end it is 62,500 vehicles per day in the westbound direction. As with the eastbound direction, the westbound AWDT peaks between Exits 37 and 36 in Lowell, in this case at 71,000 vehicles per day. Accordingly, the two-way AWDT at this location in Lowell is 140,500 vehicles per day.

Figures 2-3 and 2-4 show interesting pattern variations with regard to peak hour traffic volumes between the Western Segment of the study area and the Eastern Segment. Specifically, observing Figure 2-2 one can see that, in the Western Segment of the study area for both the AM and PM peak hours, the directional flows are close to being in balance. That is, there is approximately the same number of vehicles traveling in one direction on I-495 as in the other. However, as Figure 2-4 illustrates, this is not the case within the Eastern Segment of the study area. During the AM peak hour, traffic volumes in the westbound direction substantially exceed those in the eastbound direction. During the PM peak hour, the opposite holds true.

Other general patterns exist, as well. Eastbound traffic tends to be lower in the AM peak hour than in the PM peak hour throughout the length of study corridor. Conversely, westbound traffic tends to be higher in the AM peak hour than in the PM peak hour, especially in the Eastern Segment of the study corridor. This imbalanced flow between AM and PM peak hours indicates a large commuter presence on the study corridor.
Figure 2-3*

2004 Average Weekday Daily Traffic and 2006 AM and PM Peak Directional Volumes
Western Segment

Legend
Average Daily Traffic Volume
AM Peak Hour Directional Volume
PM Peak Hour Directional Volume

*Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs
Figure 2-4*
2004 Average Weekday Daily Traffic and 2006 AM and PM Peak Directional Volumes
Eastern Segment

Legend
Average Daily Traffic Volume
AM Peak Hour Directional Volume
PM Peak Hour Directional Volume

*Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs
Figure 2-5*

2006 AM Peak Hour Volumes
Western Segment

*Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs
Figure 2-7*

2006 PM Peak Hour Volumes
Western Segment

*Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs
Differences in peak hour volumes are also of interest. During the AM peak hour in the eastbound direction it can also be seen from Figures 2-3 and 2-4 that directional volumes range from 5,100 in Westford to only 1,300 at the far eastern end of the study corridor in Amesbury. In the opposite (i.e., westbound) direction, AM peak hour volumes range from 1,800 in Amesbury to 5,250 in Westford.

In the eastbound direction, the AM peak hour volume was found to reach its greatest value, 5,600 vehicles per hour, between Exits 36 and 37 in Lowell. This is also the same location where AWDT reaches its greatest value in the eastbound direction. However, in the westbound direction during the AM peak hour, the maximum value of 5,450 vehicles per hour occurs at two adjacent highway links, namely between Exits 38 and 37 and between Exits 37 and 36, both of which are in Lowell.

During the PM peak hour, Figures 2-3 and 2-4 show that the eastbound direction volume is 4,700 vehicles per hour in Westford at the far western end of the study corridor, and 1,750 vehicles per hour in Amesbury at the far eastern end. Westbound PM peak hour volumes are 1,500 in Amesbury and 5,000 in Westford. Between Exits 37 and 36 in Lowell, westbound PM peak hour volumes have their greatest value at 5,700 vehicles per hour. Again, westbound AWDT volumes also have their greatest value at this same location.

It should be noted that the traffic volumes presented and discussed in this Chapter represent average annual conditions. However, it is recognized that traffic volumes do vary according to season and by day of the week. Accordingly, at the request of the corridor’s two regional planning agencies, a review was carried out to determine the characteristics of these traffic variations at three locations along mainline I-495. These locations were at State Route 4 in Chelmsford, State Route 133 in Tewksbury, and the Amesbury/Salisbury town line. Multiple combinations of traffic scenarios were examined, including typical weekday AM and PM peak periods, mid-day peak periods on weekend days, AM and PM peak periods on Thursdays and Fridays, etc.

Traffic counts from these three locations do show seasonal and daily variations of traffic on I-495. For example, at the Amesbury location, traffic during the summer was determined to be greater than that during the spring and/or the fall for typical weekday peak periods, weekend mid-day peak periods, and Thursday and Friday peak periods. The summer season also was determined to dominate at the Tewksbury location, but to a lesser degree than at Amesbury. At the Chelmsford location, fall traffic dominated compared with other seasons for typical weekday peak periods, while summer traffic was determined to dominate during the weekend mid-
day peak periods. During the Thursday and Friday peak hour periods at Chelmsford, there was little difference in traffic during the summer when compared with other seasons.

In other examples of what was determined, at the Amesbury location, the heavier traffic during the summer has little or no effect on highway LOS when compared with an average day, with operating conditions remaining uncongested. On the other hand, at the Chelmsford location, it was determined that, for northbound I-495, the heavier traffic during the AM and PM peak hours during the summer results in congested LOS F conditions compared with LOS D on an average day.

A detailed memorandum regarding the results of this review of seasonal traffic variations can be found in Appendix B of this document. However, it is very important to recognize that it is not standard practice to plan and design for the extremes, particularly when those extremes might occur only a limited number of times per year. Rather, as noted above, all traffic volumes and, thus, LOS analyses, presented in this report represent average yearly conditions.

**Freight and Goods Movement**

Freight trucks also make up a large percentage of I-495 traffic within the study corridor. Based on 2005 MassHighway vehicle classification data from the permanent count station located on I-495 in Amesbury, trucks on I-495 represent 18 percent of average daily traffic. While this percentage is unusually high in and of itself, it is deceptive in that trucks are only allowed in the two right-hand lanes on I-495, accordingly making the actual percentage of trucks using these lanes on a daily basis greater than 18 percent.

Counts of truck volumes on I-495 at several key locations along the study corridor were also undertaken by staff members of the Merrimack Valley Planning Commission and the Northern Middlesex Council of Governments during 2007. These counts were directional (eastbound and westbound) in nature and were taken during the AM and PM peak periods. The resulting volumes were then compared with total peak period traffic volumes at these same locations to determine the percentage of peak period truck traffic.

Four count locations were selected, which were taken by individuals stationed on bridge overpasses looking down at the traffic below on I-495. Specifically, the count locations were at Hunt Road (Link 32-33) in Chelmsford, Trull Road (Link 38-39) in Tewksbury, Chandler Street (Link 40-41) in Andover, and Locust Street (over Link 52-53) in Merrimac.
The truck percentages at the specified locations are summarized in Table 2-1.

As can be seen in Table 2-1, the percentage of trucks during the AM peak hour, with one exception, always exceeded the percentage of trucks during the PM peak hour, in both directions at all four count locations. The one exception was at the Locust Street overpass in Merrimac in the westbound direction. The highest number of trucks was at Hunt Road in Chelmsford on the far western end of the study area, where over 500 trucks in each direction were counted during the AM peak hour. The data above shows that, in general, the percentage of trucks counted decreased from west to east during in both directions during both the AM and PM peak hours.

<table>
<thead>
<tr>
<th>Table 2-1</th>
<th>Percentages of Trucks in I-495 Study Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM</td>
</tr>
<tr>
<td></td>
<td>NB</td>
</tr>
<tr>
<td>Hunt Road (Link 32-33)</td>
<td>10%</td>
</tr>
<tr>
<td>Trull Road (Link 38-39)</td>
<td>9%</td>
</tr>
<tr>
<td>Chandler Road (Link 40-41)</td>
<td>10%</td>
</tr>
<tr>
<td>Locust Street (Link 52-53)</td>
<td>14%</td>
</tr>
<tr>
<td>Average (West of I-93)</td>
<td>9.5%</td>
</tr>
<tr>
<td>Average (East of I-93)</td>
<td>12.0%</td>
</tr>
</tbody>
</table>

Specifically, the percentage of trucks on the road was consistently greater during the AM peak hour than the PM peak hour. During the AM peak hour, truck percentages were greater in the eastbound direction than in the westbound direction. The opposite was generally found to be true during the PM peak hour. The highest percentage of trucks occurred during the AM peak hour in the eastbound direction at Locust Street in Merrimac, where approximately 14 percent of all vehicles on I-495 headed in that direction were found to be trucks. It must be noted, however, that this percentage is somewhat deceiving as this same location was also determined to have the lowest actual truck count in the eastbound direction in the AM peak hour. The high percentage results from the relatively low number of non-truck vehicles traveling on this section of roadway at that time.
The MassHighway website was consulted regarding truck percentages on similar-type highways elsewhere in the Commonwealth. While peak period data is presented, no distinction is made as to whether the peak period given in the data is AM or PM. Nevertheless, a few sample data points from locations throughout the state are presented in Table 2-2.

As shown in the table below, in general the peak period truck percentages at these locations are less than those recently observed on I-495 in the study area. The key exception to this statement is on I-84 in Sturbridge at the Connecticut state line where 18 percent of the peak period traffic in 2006 was trucks. This particular location consistently produced truck percentages in the 15 to 20 percent range over a multi-year period covered by MassHighway’s data collection efforts.

<table>
<thead>
<tr>
<th>Highway</th>
<th>Location</th>
<th>Year</th>
<th>Percent Trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-91</td>
<td>Bernardston</td>
<td>2006</td>
<td>10%</td>
</tr>
<tr>
<td>Rte. 3</td>
<td>Billerica</td>
<td>2006</td>
<td>2%</td>
</tr>
<tr>
<td>I-95</td>
<td>Canton</td>
<td>2006</td>
<td>2%</td>
</tr>
<tr>
<td>Rte. 3</td>
<td>Chelmsford</td>
<td>2006</td>
<td>3%</td>
</tr>
<tr>
<td>I-195</td>
<td>Fall River</td>
<td>2005</td>
<td>3%</td>
</tr>
<tr>
<td>Rte. 2</td>
<td>Fitchburg</td>
<td>2006</td>
<td>7%</td>
</tr>
<tr>
<td>I-95</td>
<td>Peabody</td>
<td>2006</td>
<td>3%</td>
</tr>
<tr>
<td>I-93</td>
<td>Quincy</td>
<td>2006</td>
<td>3%</td>
</tr>
<tr>
<td>I-95</td>
<td>Salisbury</td>
<td>2006</td>
<td>4%</td>
</tr>
<tr>
<td>I-84</td>
<td>Sturbridge</td>
<td>2006</td>
<td>18%</td>
</tr>
<tr>
<td>I-93</td>
<td>Woburn</td>
<td>2003</td>
<td>2%</td>
</tr>
</tbody>
</table>

The section of I-495 comprising this study’s area of interest plays an important role in providing a path for regional and interstate movement of goods. This role is reflected in the above average truck percentages found along this section of highway.

Additional information regarding truck traffic can be found in a memo contained in Appendix B of this document.

Existing traffic volumes of all vehicle types indicate that a large demand currently exists on the Western Segment of I-495. When this data is considered in conjunction with the existing levels of service at the interchanges along the corridor, it becomes apparent that if baseline traffic volume growth continues at these same rates, the existing design of I-495 will experience volumes well above its capacity in the future.
2.3.1.3 Travel Time Runs

The Central Transportation Planning Staff (CTPS) conducted travel time runs between selected interchanges along the I-495 corridor between 1999 and 2000 and between 2004 and 2005. Figure 2-9 details the travel time data compiled from the travel time runs. Based on these runs, CTPS was able to generate average speeds for I-495 between State Route 2 in Littleton and State Route 110 in Amesbury. In general, average speeds from the 2004-2005 study are slower than those from 1999-2000. However, the numbers do reflect the same general pattern, indicating that the differences in speeds may be a reflection of the specific driving habits of the individuals conducting the study and not an indication of congestion.

With few exceptions, the travel time data indicates that traffic is moving at or above the posted speed limits along the I-495 corridor. Northbound traffic slows down in the PM peak hour – most notably between Exit 45 and Exit 46, where it slows to 40 mph in 1999 and 46 mph in 2004. Likewise, southbound traffic speeds are particularly slow in the AM peak hour. Also not surprisingly, traffic travels at higher speeds prior to the AM peak hour and immediately following the PM peak hour than during either peak hour. However, due to the elevated level of traffic in the PM time frame, post-PM peak speeds are somewhat slower than pre-AM peak speeds. These findings are consistent both with the 2004 traffic volume data provided by CTPS and the volume data collected in 2006.

2.3.1.4 Traffic Operations Analysis Criteria

Level of Service (LOS), identified in the Highway Capacity Manual (HCM, 2000 Edition), is a commonly accepted measure of efficiency for peak hour traffic operating conditions. LOS accounts for such factors as automobile and truck volumes, roadway capacity, speeds, grades, traffic control devices, the progression of vehicular traffic flow along an arterial roadway, roadway types, roadway widths and geometric layouts, as well as anticipated delays. Levels of service range from A, the optimal condition, to F, the condition where traffic demands are beyond capacity or create excessive delay conditions. At LOS E and LOS F, roadway or intersection operations are typically regarded as 'undesirable'. Thus, LOS D has typically become a threshold between acceptable and undesirable peak hour traffic operations.

---

Figure 2-9
CTPS Travel Time Runs (1999 and 2000)

SB Selected Link Pre-AM Peak Hour
6:00 - 7:00 AM

SB Selected Link AM Peak Hour
7:30 - 8:30 AM

SB Selected Link PM Peak Hour
4:30 - 5:30 PM

SB Selected Link Post-PM Peak Hour
6:00 - 7:00 PM

NB Selected Link Pre-AM Peak Hour
6:00 - 7:00 AM

NB Selected Link AM Peak Hour
7:30 - 8:30 AM

NB Selected Link PM Peak Hour
4:30 - 5:30 PM

NB Selected Link Post-PM Peak Hour
6:00 - 7:00 PM

1999  2004
Traffic operations within the corridor are defined by the performance of several different components characterized by either interrupted flow (signalized and unsignalized intersections) or uninterrupted flow (highway sections and ramp junctions). In recognition of the distinctly different nature of traffic flow and driver’s expectations for these types of traffic facilities, LOS is based on average delay at intersections and on density for highway sections and ramps. This concept and the typical characteristics of various components that comprise the roadway network in the study area are explained further in the following paragraphs.

Traffic operations at unsignalized two-way stop controlled intersections are given LOS rankings based on conflicting traffic flows and anticipated control delays related to conflicting minor movement traffic flows. These conflicting flows are the vehicular turning movements at an intersection that potentially must yield the right-of-way to other traffic movements at an intersection. Examples of these conflicting movements would be left turns from a major street to a minor side street (across the opposing flow of traffic), or left and right turns from a minor street or side street to the major street.

LOS’s are only given for conflicting movements at unsignalized intersections. LOS ranking at an unsignalized intersection is determined by calculating the average total delay in seconds per vehicle. Total delay is the total elapsed time from when a vehicle stops at the end of a queue until the time when a vehicle departs from the stop line and enters the traffic stream. This includes the time required for the vehicle to travel from the last-in-queue position to the first-in-queue position. The average total delay for any particular minor movement is a function of the traffic demand flow rate and the capacity of the approach based on the number of available gaps in the conflicting traffic stream. An average total delay of 10 seconds or less per vehicle is defined as LOS A. According to the 2000 Highway Capacity Manual, total delay of 50 seconds per vehicle is assumed to be the break point between LOS E and F. LOS F exists when there are an insufficient number of gaps in the conflicting traffic stream available to allow a minor movement to safely cross a supposedly unimpeded major street traffic movement.

Signalized intersections have different criteria for acceptable total delay than unsignalized intersections. At signalized intersections, higher total delay values are generally considered to be more acceptable than at unsignalized intersections. While the LOS A criteria is the same as at unsignalized intersections, LOS F involves 80 seconds of total delay – 30 seconds more than unsignalized intersections. The relationship between LOS and average total delay at signalized and unsignalized intersections is summarized in Table 2-3.
Table 2-3
Intersection Level of Service Criteria

<table>
<thead>
<tr>
<th>Unsignalized Intersections</th>
<th>Average Total Delay Range (seconds/vehicle)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Service</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>&lt;10</td>
</tr>
<tr>
<td>B</td>
<td>&gt;10 and &lt;15</td>
</tr>
<tr>
<td>C</td>
<td>&gt;15 and &lt;25</td>
</tr>
<tr>
<td>D</td>
<td>&gt;25 and &lt;35</td>
</tr>
<tr>
<td>E</td>
<td>&gt;35 and &lt;50</td>
</tr>
<tr>
<td>F</td>
<td>&gt;50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signalized Intersections</th>
<th>Average Total Delay Range (seconds/vehicle)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Of Service</td>
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<td>&lt;10</td>
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<td>&gt;10 and &lt;20</td>
</tr>
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<td>C</td>
<td>&gt;20 and &lt;35</td>
</tr>
<tr>
<td>D</td>
<td>&gt;35 and &lt;55</td>
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<tr>
<td>E</td>
<td>&gt;55 and &lt;80</td>
</tr>
<tr>
<td>F</td>
<td>&gt;80</td>
</tr>
</tbody>
</table>


The LOS F designation at unsignalized locations involves 50 or more seconds of average total vehicle delay per vehicle and 80 or more seconds of delay at signalized locations.

Highway segments or Links are those limited access sections of I-495 between interchanges. In these areas there are no ramps and LOS is purely a function of vehicle density per lane, which provides a measure of the spacing between vehicles and the ability of a driver to travel at a desired speed without being impacted or delayed by other vehicles on the roadway.

Ramp junctions are those locations where traffic either merges with or diverges from the mainline traffic stream. Merge movements occur at those locations where vehicles entering I-495 from an on-ramp must blend with or merge into the mainline flow. Diverge movements occur as a vehicle maneuvers out of the mainline flow and onto an exit ramp. Similar to links, LOS for merge and diverge sections is a function of the density in the two right lanes on the I-495 mainline at the point of merge/diverge. The main traffic demands concerned are the merge or diverge traffic volumes and the mainline traffic volume. Capacity in these sections is reached when the combination of mainline through traffic and ramp traffic in the two right lanes equals 4,400 vehicles per hour at an off-ramp and 4,600 vehicles per hour at an on-ramp. Schematic depictions of merge and diverge movements are given on Figure 2-10. It should be noted that
lengthening an acceleration lane used for merging traffic or a deceleration lane use for diverging traffic so that they meet current standards will not improve the level of service at those locations but will serve to increase driver comfort and improve safety.

**Weaving Sections** occur in those locations where vehicles must change lanes within the traffic stream to continue on their desired path. One example of a weaving section typical of many locations along I-495 is between the inner loops of on-/off-ramps at a cloverleaf interchange. Traffic entering I-495 from the on-ramp must change lanes, “weaving” with traffic exiting I-495 to the off-ramp. Density in these locations is a function of weaving section length, number of lanes and the number of weaving vehicles. Poor LOS is typically indicative of conditions where weaving vehicles must reduce their speed to a point where it impacts the movement of through traffic on the mainline. Figure 2-10 referenced above also provides a schematic depiction of a weaving section. Note that in some cases, a weave may fail because there is not enough weaving length provided. In other cases, a weave may fail even if there is more than sufficient weave length, with volume being the controlling factor. Some weave failures may require the complete redesign of an interchange to avoid such a failure.

It is important to note that, because of the distance between study interchanges, peak hours vary from location to location. Generally speaking, in this study, the AM peak hour for a given interchange begins sometime between 7:30 and 8:00 AM and the PM peak hour between 4:30 and 5:00 PM.

### 2.3.1.5 Existing (2006) Peak Hour Traffic Operations

Existing (2006) traffic operating conditions along the study corridor are discussed in this section with regard to levels of service at unsignalized and signalized intersections; at merge, diverge, and weave locations; and for links on I-495. A series of accompanying Figures presents the results of these analyses in a graphical format and supplements the text material.

More detailed information about the analysis results can be found in Appendix B, Tables B-2 through B-7 in which such additional information as delay and queue length are presented at each intersection on a movement-by-movement basis.

**Intersections**

In this section are presented the results of the analysis of existing 2006 intersection levels of service for both the AM and PM peak periods. The
Example of a Weave

Example of a Merge

Example of a Diverge

*Source: Highway Capacity Manual 2000

Figures 2-10

Example of Weave, Merge, and Diverge Operations*
Intersections discussed here and shown on the accompanying graphics are those at each interchange along I-495 where on- and off-ramps meet the local street network.

**AM Peak Hour**

Figures 2-11 and 2-12 graphically illustrate existing 2006 AM peak hour levels of service for signalized and unsignalized intersections in the Western and Eastern Segments of the study corridor, respectively.

As can be seen from Figure 2-11, the Western Segment of the study corridor contains six interchanges with local streets. These interchanges are Exits 32 through 34 and Exits 37 through 39. These 6 interchanges, in turn, consist of 12 intersections that were the subject of the analyses. A total of 6 of the 12 intersections are signalized while 6 are unsignalized. The signalized intersections are located at Exits 32, 38, and 39.

Figure 2-11 shows that all (100 percent) of the six signalized intersections in the Western Segment currently operate with overall LOS A through LOS D conditions. There are a total of 44 movements within these 6 signalized intersections that were analyzed, with 42 of them (95 percent) determined to be currently operating at LOS D or better. The two exceptions are a left-turn movement at Exit 39 NB in Tewksbury and a through movement at Exit 39 SB in Tewksbury. LOS E conditions currently apply to these two movements within these two signalized intersections.

Unsignalized intersections do not receive an overall determination of their level of service, as do signalized intersections. Rather, level of service is determined only for conflicting movements. Of the total of 23 movements analyzed at the 6 unsignalized intersections in the Western Segment of the study corridor, 20 of them (87 percent) were determined to be currently operating in the LOS A through LOS D range. The three movements (13 percent) that were not determined to be within this range are at Exit 33 NB in Chelmsford, Exit 37 NB in Lowell, and Exit 37 SB in Lowell. In each case, the movements involved were determined to be currently operating at LOS F.

Turning now to the Eastern Segment of the study corridor, Figure 2-12 shows that five signalized intersections were analyzed. All five of these signalized intersections were determined to be operating at LOS D or better overall. These 5 intersections have a total of 34 movements that were analyzed for existing level of service. All movements (100 percent) were also determined in the analyses to be operating at LOS D or better.
A total of 15 unsignalized intersections were also examined in the Eastern Segment. These unsignalized intersections contain a total of 63 movements. Of these, 59 movements (94 percent) were determined to be currently operating at LOS D or better. The remaining four movements (six percent) operate under LOS F conditions. These latter movements occur at Exit 43 NB in North Andover, Exit 43 SB in North Andover, Exit 50 SB in Haverhill, and Exit 55 NB in Amesbury.

PM Peak Hour

Existing 2006 levels of service determinations for signalized and unsignalized intersections in the Western and Eastern Segments of the study corridor during the PM peak hour of analysis are graphically presented in Figures 2-13 and 2-14, respectively.

Looking first at the Western Segment of the corridor, Figure 2-13 shows that all six signalized intersections currently have an overall level of service in the LOS A through LOS D range. Again, however, there are several individual movements within these intersections whose levels of service do not fall within this range. Specifically, of the total of 44 movements at signalized intersections that were analyzed, there are 3 movements (7 percent) with LOS E conditions and 2 movements (5 percent) with LOS F conditions. The three movements with LOS E conditions are all located at Exit 38 NB in Tewksbury while the two movements with LOS F conditions are found at Exit 39 SB, also in Tewksbury.

With regard to unsignalized intersections in the Western Segment of the I-495 corridor, Figure 2-13 shows that 18 movements (78 percent) of the 23 movements that were analyzed currently operate in the LOS A through LOS D range. The remaining 5 movements (22 percent) currently operate with LOS F conditions. These latter movements are located at Exit 33 NB in Chelmsford, Exit 34 NB in Chelmsford, Exit 34 SB in Chelmsford, Exit 37 NB in Lowell, and Exit 37 SB in Lowell.

In the Eastern Segment during the PM peak hour, as shown on Figure 2-14, the 5 signalized intersections analyzed have 33 movements (97 percent) out of the total of 34 movements currently operating at LOS D or better. The one remaining movement (3 percent) operates at LOS E and is located at Exit 46 NB in Methuen.

The 15 unsignalized intersections contain a total of 63 movements that were analyzed. It was determined that 54 movements (86 percent) operate currently at LOS D or better. Of the remaining nine movements (14 percent), three movements (5 percent) operate at LOS E. These three
Legend

- Signalized Intersection - Overall intersection LOS shown by color of circle
- Unsignalized Intersection - Overall intersection LOS not applicable
- LOS A - D
- LOS E
- LOS F

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

Figure 2-11*
2006 AM Peak Hour LOS Intersection Operations
Western Segment

*Refer to Figure 2-15 for ramp operations
Legend

- Signalized Intersection - Overall intersection LOS shown by color of circle
- Unsignalized Intersection - Overall intersection LOS not applicable
- LOS A - D
- LOS E
- ^ LOS F
- ^ LOS was only calculated for intersections with stop and signal control
- # Intersection was signalized after data was collected for existing conditions. It is analyzed as a signalized intersection in the future 2030 case.

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

Figure 2-12*
2006 AM Peak Hour LOS Intersection Operations
Eastern Segment
Legend

- Signalized Intersection - Overall intersection LOS shown by color of circle
- Unsignalized Intersection - Overall intersection LOS not applicable
- LOS A - D
- LOS E
- LOS F

*Refer to Figure 2-17 for ramp operations

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

Figure 2-13*
2006 PM Peak Hour LOS Intersection Operations
Western Segment
Figure 2-14*
2006 PM Peak Hour LOS Intersection Operations
Eastern Segment

Legend

- Signalized Intersection - Overall intersection LOS shown by color of circle
- Unsignalized Intersection - Overall intersection LOS not applicable
- LOS A - D
- LOS E
- LOS F
- LOS was only calculated for intersections with stop and signal control
- * Intersection was signalized after data was collected for existing conditions.
  It is analyzed as a signalized intersection in the future 2030 case.

*Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs
movements are located at Exit 44 SB in Lawrence, at Exit 49 NB in Haverhill, and at Exit 52 NB in Haverhill. The remaining six movements (nine percent) operate at LOS F. They are, in turn, located at Exit 41 SB in Andover, Exit 43 NB in North Andover, Exit 43 SB in North Andover, Exit 49 NB in Haverhill, Exit 50 SB in Haverhill, and Exit 55 NB in Amesbury.

Merges, Diverses, and Weaves

In this section are presented the results of analyses performed to determine existing 2006 levels of service with regard to merge, diverge, and weave movements along the I-495 study corridor.

Before discussing the results of this analysis, a brief discussion of acceleration and deceleration lanes is in order. Acceleration lanes are features on a highway that allow a vehicle entering the highway from an on-ramp to merge into the through traffic. A deceleration lane serves the opposite purpose. That is, it is a feature on the highway that serves as a transition between the right-hand travel lane and an off-ramp. Acceleration and deceleration lanes are demarcated by paint striping. There are required lengths for acceleration and deceleration lanes that are largely based on design speed and roadway grade.

During the course of this study, the lengths of existing acceleration and deceleration lanes on I-495 were compared with required lengths. It was found that many of them are deficient with regard to their lengths. Table B-8 in Appendix B presents detailed information on those acceleration and deceleration lanes that were found to deficient. It must be noted, however, that a deficiency in length does not affect the level of service results described below for merges and diverses. Rather, such deficiencies are better regarded as safety issues. They do influence a driver’s comfort level.

AM Peak Hour

Figures 2-15 and 2-16 give a visual presentation of the analysis results for the Western and Eastern Segments, respectively, of the study corridor for the existing 2006 AM peak hour. Analysis results for both directions of I-495 are shown on these two Figures.

As Figure 2-15 illustrates, the analyses of the total of 38 existing merge, diverge, or weave movements studied in the Western Segment of the corridor indicated that 34 locations (89 percent) are operating in the desirable LOS A through LOS D range during the AM peak hour. However, one movement (three percent), a weave on the northbound side of I-495 in Chelmsford, is operating at LOS E and three movements (eight
percent), consisting of one weave at Exit 40 in Andover and two diverges, one on the northbound side of I-495 at Exit 37 in Lowell and the other on the southbound side of the highway at Exit 34 in Chelmsford, are currently operating with LOS F conditions.

The results of the merge, diverge, and weave analysis for the AM peak hour in the Eastern Segment of the I-495 study corridor are shown on Figure 2-16. A total of 65 merge, diverge, or weave movements was examined. Of this total, it was determined that 61 movements (94 percent) are operating at LOS D or better, 1 diverge movement (2 percent) at Exit 45 in Lawrence is operating at LOS E, and 3 movements (4 percent) consisting of 1 weave movement in Methuen as well as 2 diverge movements at Exits 46 and 47 in Methuen, are currently operating at LOS F.

Of note with regard to the Eastern Segment is the observation that all the merge, diverge, or weave movements that are currently operating at LOS E or LOS F are on the westbound side of the I-495 highway. This fact reflects the predominance of traffic flow in that direction in the Eastern Segment during the AM peak hour.

**PM Peak Hour**

The results of the analyses performed with regard to merge, diverge, and weave movements for the existing 2006 PM peak hour are summarized graphically on Figures 2-17 and 2-18 for Western and Eastern Segments, respectively, of the I-495 study corridor.

Looking first at the Western Segment, as illustrated on Figure 2-17, the analyses indicated that, of the 38 merge, diverge, or weave movements examined, 32 movements (84 percent) are operating at LOS D or better. The remaining six locations (16 percent) are operating at either LOS E or LOS F levels. Specifically, two movements (five percent) consisting of a weave movement at Exit 35 in Lowell and a weave movement at Exit 40 in Andover are operating at LOS E. The remaining 4 movements (11 percent), consisting of 2 weaves and 2 diverges, are operating at LOS F. The weave movements are at Exit 34 in Chelmsford and at Exit 35 in Lowell. The diverge movements in question are at Exit 34 in Chelmsford and at Exit 37 in Lowell. Of the total of six movements operating at either LOS E or LOS F, there are three in each direction of I-495.
Legend

- LOS A - D
- LOS E
- LOS F
- Diverge
- Merge
- Weave

Figure 2-15*
2006 AM Peak Hour Ramp Operations
Western Segment

*Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs
Figure 2-16*
2006 AM Peak Hour Ramp Operations
Eastern Segment

Legend
- LOS A - D  D Diverge
- LOS E  M Merge
- LOS F  W Weave

*Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs
Figure 2-17*
2006 PM Peak Hour Ramp Operations
Western Segment

Legend
- LOS A - D: Diverge
- LOS E: Merge
- LOS F: Weave

*Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs
Figure 2-18*
2006 PM Peak Hour Ramp Operations
Eastern Segment

Legend
- LOS A - D: Diverge
- LOS E: Merge
- LOS F: Weave

*Map Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs
Existing conditions in the Eastern Segment of the study corridor with regard to merges, diverges, and weaves are illustrated on Figure 2-18. As can be seen, 63 movements (97 percent) of the total of 65 movements analyzed are currently operating in the LOS A through LOS D range, with the remaining 2 movements (3 percent) experiencing LOS F conditions. These two movements with LOS F conditions are a diverge movement at Exit 43 in North Andover and a weave movement at Exit 46 in Methuen. No merge, diverge, or weave movements in the Eastern Segment were determined to be operating at LOS E during the PM peak hour.

Of the two locations that currently are experiencing LOS F conditions, both are located in the eastbound direction of the highway, reflecting the predominant flow of traffic in that direction in the Eastern Segment during the PM peak hour.

Links

Finally, with regard to LOS on I-495’s links, six links in each direction were selected for analysis. The selected links were those in a given area and cross-section with the highest traffic volumes. All of these selected links were determined to be operating at LOS D or better during both the AM and PM peak hours, as shown in Table 2-4. Since these were the links with the highest volumes, it can be stated that the remaining, non-analyzed links, also are operating at LOS D or better.

<table>
<thead>
<tr>
<th>Dir. Link</th>
<th>Location</th>
<th>AM Volume</th>
<th>Density (pc/mi/ln)</th>
<th>LOS</th>
<th>Volume</th>
<th>Density (pc/mi/ln)</th>
<th>LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NB 36 37</td>
<td>Chelmsford-Lowell</td>
<td>5,600</td>
<td>33</td>
<td>D</td>
<td>5,300</td>
<td>30</td>
<td>D</td>
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<tr>
<td>NB 39 40</td>
<td>Tewksbury-Andover</td>
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<td>24</td>
<td>C</td>
<td>5,150</td>
<td>29</td>
<td>D</td>
</tr>
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<td>5,650</td>
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<tr>
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<td>5,500</td>
<td>32</td>
<td>D</td>
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<td>SB 35 34</td>
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<td>28</td>
<td>D</td>
<td>5,450</td>
<td>31</td>
<td>D</td>
</tr>
</tbody>
</table>

1Density is expressed as passenger car per mile per lane.
2.3.1.6 Crashes

Crashes on I-495 were reviewed for the four most recent years (2002 to 2005) available from the Massachusetts Highway Department at the time the data was compiled and analyzed. Figure 2-19 summarizes data for the years 2002 to 2005 for the segments of the I-495 corridor between Westford and Salisbury, organized annually by interchange. (For detailed crash data tables organized by interchange, please see the spreadsheets in the Technical Appendices, separately bound.)

From 2002 to 2005, the total number of reported crashes along the corridor decreased. The severity of crashes from year to year remained proportionally similar, with the majority of crashes reported as property damage only and a very small percentage of fatality accidents. In general, crash volumes are higher in the western segment of the corridor than in the eastern segment. For each year, Exits 32, 35, 40 and 51 have consistently higher crash rates. This data consistently correlates with the higher traffic volumes and lower LOS for these locations.

Table 2-5 presents a summary ranking from 1 to 10 of I-495 study corridor interchanges according to several crash statistics. These statistics include total number of crashes, number of crashes involving property damage, number of crashes involving injuries, and number of crashes involving fatalities.

<table>
<thead>
<tr>
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<th>Injury</th>
<th>Fatality</th>
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<td>Int. 40</td>
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<td>Int. 42</td>
<td>Int. 47</td>
<td>Int. 41</td>
</tr>
<tr>
<td>9</td>
<td>Int. 47</td>
<td>Int. 47</td>
<td>Int. 39</td>
<td>Int. 39</td>
</tr>
<tr>
<td>10</td>
<td>Int. 39</td>
<td>Int. 39</td>
<td>Int. 37</td>
<td>Int. 38</td>
</tr>
</tbody>
</table>
As can be seen from Table 2-5, the interchange that ranks as Number 1 with regard to the total number of crashes occurring during the four-year analysis period was Exit 35. This same interchange also ranks as Number 1 with regard to property damage. Exit 32 was the location of the Number 1 interchange with regard to crashes with personal injuries, while the Number 1 interchange with regard to crashes with fatalities was Exit 40.

No attempt was made as part of this study to determine crash rates for the locations along the I-495 study corridor, one key reason being the lack of precision regarding the location of crashes in the data available from the Registry of Motor Vehicles. MassHighway is working to geocode crash data in a better manner so that more precision will be available in the future.

As a final comment on crashes, a series of lane departure crashes has been noted, particularly on the section of I-495 to the east of Boston Road in the Westford/Chelmsford area. Lane departure crashes refer to those single-vehicle crashes in which vehicles leave the traveled way, veering off the side of the paved roadway. Such crashes have been investigated by MassHighway for this particular area, but no common thread could be found to link them to any specific problem with roadway design or to traffic conditions.

2.3.1.7 Public Transportation

This section summarizes existing local and commuter transit services and additional services such as employer shuttle routes and paratransit that serve the I-495 corridor between the areas of Lowell to the south and Haverhill to the north. The existing transit services within the study area along the I-495 corridor are provided by three regional transit authorities: the Lowell Regional Transit Authority (LRTA), the Merrimack Valley Regional Transit Authority (MVRTA), and the Massachusetts Bay Transportation Authority (MBTA), and two transportation management associations (TMAs), the Junction TMO and the Merrimack Valley TMA. It should be noted that the information contained in this section (i.e., routes, schedules, operating hours, fares, etc.) was accurate at the time of its writing but is subject to occasional changes, most of which tend to be relatively minor in nature.

As shown in Figure 2-20, transit within the corridor generally radiates from each transit operator’s hub into the surrounding localities with few inter-transit agency connections. These routes are discussed below within the context of each transit authority.
Figure 2-20
Bus Routes
I-495 Corridor Transportation Study Area

Legend

- MVRTA Bus Routes
- Commuter Rail
- LRTA Bus Routes
- I-495 Exits
- Park and Ride Lots
- I-495
- Commuter Stations
- Major Highways

Source: MassGIS, CTPS, Lowell Regional Transit Authority, and Merrimack Valley Regional Transit Authority, 2004 and 2005
Lowell Regional Transit Authority (LRTA)

The LRTA serves as the central transit service provider for the City of Lowell and the surrounding towns of Chelmsford, Dracut, Westford, Billerica, and Tewksbury. Services offered include fixed-route local bus, commuter bus, a downtown shuttle, and demand response paratransit services for elderly and disabled persons.

In total, the LRTA consists of 18 bus routes, all of which emanate from the Robert B. Kennedy Bus Transfer Center at the Gallagher Intermodal Transportation Center in Lowell as listed in Table 2-6. Services are provided Monday through Saturday on most routes, with no service on Sunday.

<table>
<thead>
<tr>
<th>Route</th>
<th>Terminus/Town</th>
<th>Start Time</th>
<th>End Time</th>
<th># Daily Trips</th>
<th>Peak Headway</th>
<th>Off Peak Headway</th>
<th>Saturday Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Christian Hill</td>
<td>Village Square, Dracut</td>
<td>6:00 AM</td>
<td>7:15 PM</td>
<td>28</td>
<td>60</td>
<td>60</td>
<td>Yes</td>
</tr>
<tr>
<td>2 Belvidere</td>
<td>Lowell</td>
<td>6:15 AM</td>
<td>7:20 PM</td>
<td>56</td>
<td>30</td>
<td>30</td>
<td>Yes</td>
</tr>
<tr>
<td>3 South Lowell</td>
<td>North Billerica Station, Billerica</td>
<td>5:55 AM</td>
<td>6:35 PM</td>
<td>34</td>
<td>30</td>
<td>60</td>
<td>Yes</td>
</tr>
<tr>
<td>4 Shaw-Stevens Streets</td>
<td>V.A. Clinic, Lowell</td>
<td>5:55 AM</td>
<td>6:30 PM</td>
<td>42</td>
<td>25</td>
<td>60</td>
<td>Yes</td>
</tr>
<tr>
<td>5 Westford St/ Drum Hill</td>
<td>Drum Hill, Chelmsford</td>
<td>6:00 AM</td>
<td>7:00 PM</td>
<td>56</td>
<td>30</td>
<td>30</td>
<td>Yes</td>
</tr>
<tr>
<td>6 Broadway/ UMASS Lowell</td>
<td>UMass North &amp; South, Lowell</td>
<td>6:05 AM</td>
<td>6:00 PM</td>
<td>42</td>
<td>35</td>
<td>35</td>
<td>Yes</td>
</tr>
<tr>
<td>7 Pawtucketville</td>
<td>Lowell Regional Voke Tech, Lowell</td>
<td>5:55 AM</td>
<td>7:35 PM</td>
<td>57</td>
<td>30</td>
<td>30</td>
<td>Yes</td>
</tr>
<tr>
<td>8 Centralville</td>
<td>Hannaford, Dracut</td>
<td>6:10 AM</td>
<td>6:35 PM</td>
<td>32</td>
<td>30</td>
<td>60</td>
<td>Yes</td>
</tr>
<tr>
<td>9 Downtown Circulator</td>
<td>Lowell</td>
<td>6:10 AM</td>
<td>10:55 PM</td>
<td>25</td>
<td>30</td>
<td>30</td>
<td>Yes</td>
</tr>
<tr>
<td>10 Dracut/ Tyngsboro</td>
<td>Ayotte’s, Hudson, NH</td>
<td>6:35 AM</td>
<td>6:20 PM</td>
<td>24</td>
<td>60</td>
<td>60</td>
<td>Yes</td>
</tr>
<tr>
<td>11 IRS/Raytheon</td>
<td>Internal Revenue Service, Andover</td>
<td>6:00 AM</td>
<td>5:25 PM</td>
<td>15</td>
<td>60</td>
<td>60</td>
<td>No</td>
</tr>
<tr>
<td>12 Tewksbury</td>
<td>Silver Lake, Wilmington</td>
<td>6:45 AM</td>
<td>5:10 PM</td>
<td>22</td>
<td>60</td>
<td>60</td>
<td>No</td>
</tr>
<tr>
<td>13 Billerica/ Burlington via Edson</td>
<td>Lowell/Billerica Line</td>
<td>6:10 AM</td>
<td>6:10 PM</td>
<td>29</td>
<td>30</td>
<td>60</td>
<td>Yes</td>
</tr>
<tr>
<td>14 Burlington Mall</td>
<td>Lahey Clinic, Burlington</td>
<td>5:45 AM</td>
<td>6:35 PM</td>
<td>30</td>
<td>55</td>
<td>55</td>
<td>Yes</td>
</tr>
<tr>
<td>15 Chelmsford Via Route 129 &amp; 110</td>
<td>Kidder Road Industrial Park, Chelmsford</td>
<td>6:15 AM</td>
<td>6:35 PM</td>
<td>21</td>
<td>60</td>
<td>60</td>
<td>No</td>
</tr>
<tr>
<td>16 Chelmsford Center and Drum Hill</td>
<td>Drum Hill, Chelmsford – Starts and ends at Lowell/Chelmsford line</td>
<td>6:15 AM</td>
<td>7:25 PM</td>
<td>28</td>
<td>25</td>
<td>70</td>
<td>Yes</td>
</tr>
<tr>
<td>17 North Chelmsford via Middlesex Street</td>
<td>North Chelmsford</td>
<td>6:00 AM</td>
<td>6:35 PM</td>
<td>30</td>
<td>30</td>
<td>60</td>
<td>Yes</td>
</tr>
<tr>
<td>18 Express Shuttle</td>
<td>Lowell</td>
<td>5:30 AM</td>
<td>7:00 PM</td>
<td>55</td>
<td>30</td>
<td>30</td>
<td>Yes</td>
</tr>
</tbody>
</table>
While the LRTA does not have special shuttle bus services to employment centers other than downtown Lowell, service from Gallagher Intermodal Transportation Center to the Internal Revenue Service and Raytheon complexes in Andover is provided via Bus Route #11.

The demand response paratransit services for elderly and disabled persons, known as Road Runner, operate from 8:00 AM to 4:00 PM. Monday to Friday and require two business days advance notice. Fares are $1.00 for travel in Lowell, and $1.50 for travel to the surrounding communities in the LRTA area. In addition, the Road Runner service makes one weekly trip to Boston every Wednesday, at a cost of $25.00 per round trip.

Ridership on LRTA bus routes has remained constant from 1998 to 2005, with occasional peaks and drops. Ridership was up in the fall of 2007 and continued to climb throughout the year. It is expected to be up by three to five percent for spring 2008 counts. Fares for fixed-route service are also $1.00 for travel in Lowell, and $1.50 for travel to the surrounding communities in the LRTA area. LRTA routes ranked based on fall 2007 ridership levels are shown in Table 2-7. The Downtown Transit Center on Paige Street was relocated to the Kennedy Bus Transfer Center at the Gallagher Terminal in September 2005.

Routes to employment centers such as the Internal Revenue Service and Raytheon along State Route 133 in Andover (LRTA Bus Route #11) ranked low, averaging only 64 riders per day.

<table>
<thead>
<tr>
<th>LRTA Bus Route</th>
<th>Fall 2007</th>
<th>Percent of Ridership</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Express Shuttle</td>
<td>882</td>
</tr>
<tr>
<td>7</td>
<td>Pawtucketville</td>
<td>839</td>
</tr>
<tr>
<td>5</td>
<td>Westford Street</td>
<td>708</td>
</tr>
<tr>
<td>2</td>
<td>Belvidere</td>
<td>505</td>
</tr>
<tr>
<td>14</td>
<td>Burlington/Lahey</td>
<td>393</td>
</tr>
<tr>
<td>4</td>
<td>Shaw-Stevens</td>
<td>366</td>
</tr>
<tr>
<td>13</td>
<td>Billerica/Edson</td>
<td>265</td>
</tr>
<tr>
<td>17</td>
<td>North Chelmsford</td>
<td>262</td>
</tr>
<tr>
<td>16</td>
<td>Chelmsford/Chelms Street</td>
<td>260</td>
</tr>
<tr>
<td>3</td>
<td>South Lowell</td>
<td>260</td>
</tr>
<tr>
<td>8</td>
<td>Centerville</td>
<td>229</td>
</tr>
<tr>
<td>10</td>
<td>Dracut/Tyngsborough</td>
<td>215</td>
</tr>
<tr>
<td>9</td>
<td>Downtown Circulator</td>
<td>215</td>
</tr>
<tr>
<td>12</td>
<td>Tewksbury/Route 138</td>
<td>211</td>
</tr>
<tr>
<td>6</td>
<td>Broadway/UMASS</td>
<td>176</td>
</tr>
<tr>
<td>1</td>
<td>Christian Hill</td>
<td>171</td>
</tr>
<tr>
<td>15</td>
<td>Chelmsford/Route 129</td>
<td>112</td>
</tr>
<tr>
<td>11</td>
<td>IRS/Route 133</td>
<td>64</td>
</tr>
</tbody>
</table>

Source: Lowell Regional Transit Authority

1 NMCOLG, May 2008.
Merrimack Valley Regional Transit Authority (MVRTA)

The MVRTA serves as the primary transit agency for the Merrimack Valley communities of Andover, North Andover, Lawrence, Methuen, Haverhill, Merrimac, Amesbury, Newburyport, and Salisbury. Services offered include fixed-route local bus originating either at the Buckley Transportation Center in Lawrence, or at the Washington Square Transit Center in Haverhill. Full fare is $1.00, with reduced fares for pass programs. Other services include advance request transport (Ring & Ride), commuter bus, bus service to major employers called Special Employment Shuttles, and demand response services for elderly and disabled persons. In addition, the MVRTA provides service to the Gallagher Intermodal Transportation Center (Bus Route #41) for onward connections to points served by LRTA and the Lowell commuter line of the MBTA.

The MVRTA fixed-route bus service consists of 24 routes, which includes commuter bus and special employment shuttles. Services are provided Monday through Saturday on most routes with no service on Sunday. Hours of operation for each route are shown in Table 2-8, which also shows the number of daily trips provided.

The MVRTA operates one commuter bus route through the communities of Andover, Lawrence, and Methuen into downtown Boston via I-93. This service operates Monday through Friday and only in the peak direction. Three trips run inbound into Boston in the morning, with the first run at 5:45 AM and the last at 6:45 AM. In the evening, three trips run outbound from Boston with the first run at 4:40 PM and the last at 6:00 PM. Fares are $5.00 one-way with a 10-ride commuter pass option available at a cost of $40.

Two special employment shuttle services (Routes #72 and #73) are also operated by the MVRTA. Route #72 connects downtown Haverhill to the Ward Hill Industrial Park in Haverhill, the Lucent facility in North Andover, and Raytheon and IRS facilities in Andover. Route #73 connects downtown Lawrence to the Lucent facility in North Andover, and to the Raytheon and the IRS facilities in Andover. Route #72 runs one trip in the peak direction in the morning and evening and Route #73 runs two. Ridership on these routes has steadily declined, with Route #72 dropping from 15,406 annual riders in 2001 to 3,417 in 2003. Route #73 has dropped from 14,330 annual riders in 2001 to 2,968 in 2003. The decline in ridership could be related to a drop in employment at these two specific destinations. In 2001, MVRTA discontinued operation of two other Special Employment Service routes: Routes #76A and #76B, to River Road in Andover.

1 Reflects schedule effective October 24, 2005.
### Table 2-8

#### MVRTA Routes and Service Characteristics

<table>
<thead>
<tr>
<th>Route</th>
<th>Origin</th>
<th>Start Time</th>
<th>End Time</th>
<th># Daily Trips</th>
<th>Peak Headway</th>
<th>Off Peak Headway</th>
<th>Saturday Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Lawrence-Methuen-Haverhill</td>
<td>Lawrence</td>
<td>5:00 AM</td>
<td>7:15 PM</td>
<td>57</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>13</td>
<td>Main St/North Ave</td>
<td>Haverhill</td>
<td>5:10 AM</td>
<td>6:35 PM</td>
<td>26</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>14</td>
<td>Ward Hill/Bradford</td>
<td>Haverhill</td>
<td>5:50 AM</td>
<td>5:30 PM</td>
<td>26</td>
<td>55</td>
<td>60</td>
</tr>
<tr>
<td>15</td>
<td>Hilldale Ave./Westgate Plaza</td>
<td>Haverhill</td>
<td>5:30 AM</td>
<td>6:25 PM</td>
<td>26</td>
<td>60</td>
<td>Yes</td>
</tr>
<tr>
<td>16</td>
<td>Washington St./Westgate Plaza</td>
<td>Haverhill</td>
<td>5:40 AM</td>
<td>6:50 PM</td>
<td>27</td>
<td>60</td>
<td>Yes</td>
</tr>
<tr>
<td>18</td>
<td>Riverside</td>
<td>Haverhill</td>
<td>5:25 AM</td>
<td>5:45 PM</td>
<td>23</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>19</td>
<td>Westgate Plaza/Summer St.</td>
<td>Haverhill</td>
<td>5:40 AM</td>
<td>6:15 PM</td>
<td>24</td>
<td>60</td>
<td>75</td>
</tr>
<tr>
<td>21</td>
<td>Andover Shuttle</td>
<td>Andover</td>
<td>7:00 AM</td>
<td>6:30 PM</td>
<td>24</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>32</td>
<td>Andover</td>
<td>Lawrence</td>
<td>5:00 AM</td>
<td>7:35 PM</td>
<td>56</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>33</td>
<td>North Andover</td>
<td>Lawrence</td>
<td>5:00 AM</td>
<td>7:35 PM</td>
<td>56</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>34</td>
<td>Prospect Hill</td>
<td>Lawrence</td>
<td>5:00 AM</td>
<td>7:31 PM</td>
<td>56</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>35</td>
<td>Water St.</td>
<td>Lawrence</td>
<td>5:00 AM</td>
<td>7:32 PM</td>
<td>56</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>36</td>
<td>Lawrence St./Holy Family Hospital</td>
<td>Lawrence</td>
<td>5:00 AM</td>
<td>7:33 PM</td>
<td>56</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>37</td>
<td>Beacon St.</td>
<td>Lawrence</td>
<td>5:00 AM</td>
<td>7:30 PM</td>
<td>56</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>38</td>
<td>Hampshire St.</td>
<td>Lawrence</td>
<td>5:00 AM</td>
<td>7:34 PM</td>
<td>56</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>39A</td>
<td>Colonial Heights/ N. Andover Mall</td>
<td>Lawrence</td>
<td>5:00 AM</td>
<td>7:36 PM</td>
<td>56</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>39B</td>
<td>N. Andover Mall/Phillips St.</td>
<td>Lawrence</td>
<td>5:00 AM</td>
<td>7:35 PM</td>
<td>56</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>40</td>
<td>Methuen Sq.</td>
<td>Lawrence</td>
<td>5:00 AM</td>
<td>7:33 PM</td>
<td>56</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>41</td>
<td>Lawrence -Lowell</td>
<td>Lawrence</td>
<td>4:45 AM</td>
<td>7:15 PM</td>
<td>55</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>51</td>
<td>Haverhill/ Merrimac/ Amesbury/ Newburyport</td>
<td>Haverhill</td>
<td>5:00 AM</td>
<td>6:40 PM</td>
<td>25</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>72</td>
<td>Haverhill</td>
<td>Haverhill</td>
<td>5:50 AM</td>
<td>3:25 PM</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>73</td>
<td>Lawrence</td>
<td>Lawrence</td>
<td>5:55 AM</td>
<td>4:20 PM</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>83</td>
<td>Salisbury Beach/ Hampton Beach</td>
<td>Lawrence</td>
<td>8:15 AM</td>
<td>4:20 PM</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Notes:  
1. Special employment bus  
2. Special bus operating July through September. The fare is $2.00 to Salisbury Beach and $3.00 to Hampton Beach. Multiple ride passes are also available.

Advance request services known as Ring & Ride also provides curb-to-curb transit service along predetermined routes. MVRTA operates eight Ring & Ride routes that offer bus service to the areas of Boxford, Georgetown, Groveland, Salisbury, and West Newbury. These routes all operate from 5:00 AM to 7:00 PM Monday to Friday and from 9:00 AM to 6:00 PM on Saturday. No service is available on Sunday or holidays.

The demand response services for elderly and disabled persons are known as EZ Trans. Similar to the Ring & Ride service, the advance request service provides curb-to-curb service in accessible vehicles that meet
Americans with Disabilities Act (ADA) requirements and special needs. Two levels of service are offered, ADA and non-ADA, with the difference being ADA pickups and drop offs are within ¼-mile of an existing bus line and pay a lower fare.

Annual ridership on the MVRTA was more than 1,942,275 riders in 2006, steadily rising from 2000. The top MVRTA routes based on 2006 ridership levels are shown in Table 2-9. The top two routes account for more than 26 percent of all riders, and these routes connect Lawrence to the urbanized areas within the Merrimack Valley, which the I-495 corridor parallels.

<table>
<thead>
<tr>
<th>Table 2-9</th>
</tr>
</thead>
</table>

**Top MVRTA Routes in 2002**

<table>
<thead>
<tr>
<th>MVRTA Route</th>
<th>2002 Annual Riders</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lawrence – Methuen – Haverhill</td>
<td>301,143</td>
<td>15.5%</td>
</tr>
<tr>
<td>Lawrence – Lowell</td>
<td>217,864</td>
<td>11.2%</td>
</tr>
<tr>
<td>North Andover Mall/Phillips Street</td>
<td>176,848</td>
<td>9.1%</td>
</tr>
<tr>
<td>Beacon Street</td>
<td>143,321</td>
<td>7.4%</td>
</tr>
<tr>
<td>Haverhill-Amesbury-Newburyport</td>
<td>130,863</td>
<td>6.7%</td>
</tr>
<tr>
<td>Andover</td>
<td>301,143</td>
<td>15.5%</td>
</tr>
</tbody>
</table>

Source: Merrimack Valley Metropolitan Planning Organization 2007 Regional Transportation Plan. Refer to for additional information.

**Massachusetts Bay Transportation Authority (MBTA)**

The MBTA is the major transit provider for the Boston metropolitan area. Within the I-495 corridor study area, the MBTA operates two radial commuter rail lines to Boston, the Lowell line and Haverhill/Reading line.

The Lowell line operates from North Station in Boston and serves seven stations in addition to its terminus at the Gallagher Intermodal Transportation Center in Lowell. The commuter train operates seven days a week with reduced service on the weekends. Weekday service consists of 22 inbound trains from Lowell to Boston and 22 outbound trains to Lowell, with trains departing from 5:35 AM to 12:10 AM1. Two stations on the Lowell line are located within the study area; Lowell, located in Zone 6 and North Billerica, located in Zone 5. One-way fares from these stations to North Station in Boston are $6.75 and $6.25, respectively, with reduced ticket prices available on monthly passes.

The Lowell line averages about 6,500 inbound boardings per day.2 Nearly 38 percent of these boardings occur at two stations located within the study area.

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1 MBTA Commuter Rail Train Schedule, effective October 29, 2007
2 MBTA FY’08 Average Ridership for the period of July 2007 through April 2008.
area: Lowell and North Billerica stations. On a train audit conducted on
February 28, 2008, the Lowell station had 1,398 boardings and North
Billerica had 1,043 boardings, out of a total of 6,434 daily boardings for the
line. These boarding numbers are consistent with ridership levels seen at
the Lowell and North Billerica stations since 2000-2001, which would
indicate a constant demand. However, this constant demand may be due at
least partially to the unavailability of parking and rolling stock capacity
limitations.

The Haverhill/Reading line operates from North Station and serves twelve
stations in addition to its terminus station in Haverhill. The commuter train
operates seven days a week with reduced service on the weekends.
Weekday service consists of 13 inbound trains to Boston and 13 outbound
trains from Boston, with trains departing from 5:10 AM to 12:10 AM.¹
Typical travel time between Haverhill and Boston is approximately 1 hour
to 1 hour and 10 minutes, depending on the number of station stops. One-
way fares from Haverhill are $7.25 (Zone 7), with reduced ticket prices
available on monthly passes. This line roughly parallels I-495 in the study
area with five stations located in this section: Ballardvale, Andover,
Lawrence, Bradford, and Haverhill.

The Haverhill line averages about 5,000 inbound boarding per day.²
Roughly 46 percent of these boardings occur at the five stations located
within the study area. On a train audit conducted on February 28, 2008,
daily boardings for each of the five stations were: Haverhill station 583,
Bradford station 480, Lawrence station 738, Andover station 553, and
Ballardvale station 292, for a total of 2,646 out of 5,727 boardings.

**AMTRAK**

Amtrak’s *Downeaster* train offers five daily roundtrips seven days a week
between Boston’s North Station and Portland, Maine. This train makes
station stops at Haverhill Station. The journey time from Haverhill to
Boston is approximately 50 minutes. The one-way fare is $10.00, with
discounts available for multi-trip and monthly passes. It is possible to use
the *Downeaster* service to commute between Haverhill and Boston.
However, the MBTA offers more frequent service at a lower fare, making
the *Downeaster* a less attractive option as a commuter service.
Nevertheless, some people do use the *Downeaster* to commute to Boston
because its travel time is faster (50 minutes versus 69-70 minutes on
commuter rail) and it arrives in Boston at a good time (8:25 AM).

¹ MBTA Commuter Rail Train Schedule, effective October 29, 2007
² MBTA FY’08 Average Ridership for the period of July 2007 through April 2008.
Interstate 495 Corridor Transportation Study

Intercity Bus

Intercity bus transportation is available within the region in Lowell on Peter Pan Bus Lines and Vermont Transit Lines. Peter Pan Bus Lines has two routes from Lowell, Route #226 and Route #227. Both these routes utilize I-495 and extend south to Washington, DC via Springfield, Massachusetts; but neither have a stop in Boston. Vermont Transit Lines, a subsidiary of Greyhound Lines, offers transportation to Manchester, New Hampshire or Boston. The company operates three daily trips in each direction connecting Manchester and Boston, one of which stops in Lowell at the Gallagher Intermodal Transportation Center. Fares from Lowell and Manchester are between $12.50 and $14.50 for non-refundable tickets, with no commuter discounts available. Additional service connecting Manchester and Boston is operated by Concord Trailways. This commuter service offers fares of $11 one way, $20 round trip, and $65 per month, however, it does not have stops within the I-495 corridor.

2.3.1.8 Transportation Management Associations (TMAs)

TMAs are private non-profit associations created to alleviate the burdens of commuting for one specific employer or a collection of employers in a geographically proximate area. Their mission is to reduce the number of single-occupant vehicles on the roadway system and to promote alternative modes of transportation. Within the Merrimack Valley there are two TMAs, the Junction TMO that handles the I-93 junction area of Andover, Wilmington, and Tewksbury; and the Merrimack Valley TMA that handles the employers in the communities of Andover, North Andover, Lawrence, and Methuen.

Junction TMO

The Junction Transportation Management Organization (TMO) operates the Call & Commute shared van and ride-matching services and serves approximately 110 riders per day, primarily the employees of Wyeth BioPharma in Andover, one of the largest employers in the Merrimack Valley with 1850 personnel. Gillette, which is located adjacent to Wyeth, operates its own in-house ride-matching and commuter service for employees. The service operates only during morning and evening peak hours with reservations required one day in advance.

A daily shuttle van from Wyeth also serves the Ballardvale commuter rail station located in Andover for two morning trips and two evening trips. The majority of users of services provided by the Junction TMO are located in New Hampshire along the I-93 corridor.
All services operated in conjunction with the Junction TMO include the guaranteed ride home emergency services that serve as backup to taxi service, ensuring users with a way home.

**Merrimack Valley TMA (MVTMA)**

This association, formerly known as the River Road TMA, serves the greater Andover area and offers a comprehensive package of transportation incentives designed to encourage commuters who currently drive alone to work to travel to work together. Participating commuters who choose transit are eligible for Commuter Check vouchers to purchase a monthly pass, up to a maximum of $35 per month for three months. The MVTMA currently operates four vanpools, all of which originate in New Hampshire and serve the I-93 corridor. Although no transit or bus service is provided by MVTMA, ride matching and the Guaranteed Ride Home taxi program are available.

**2.3.1.9 Park & Ride Lots**

Park & Ride lots offer commuters the ability to carpool or use transit where none may be available. Many of these lots are located near major highways and all day parking is often free of charge. Usage of Park & Rides reduces the number of single-occupant vehicles on the highway and parking demand at the final destination. There are three Park & Ride lots in the study area operated by MassHighway and the MVRTA. With one exception, these lots are located along I-93 and all generally serve commuters traveling to Boston. Park & Ride lots in the study area are listed in Table 2-10.

<table>
<thead>
<tr>
<th>Park &amp; Ride</th>
<th>Location</th>
<th># Parking Spaces</th>
<th>Available Transit Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andover</td>
<td>I-93 exit 42</td>
<td>71</td>
<td>None</td>
</tr>
<tr>
<td>Methuen</td>
<td>I-93 exit 47</td>
<td>189</td>
<td>MVRTA – # 40; also service to Boston</td>
</tr>
<tr>
<td>Haverhill</td>
<td>Routes 97 &amp; 113</td>
<td>40</td>
<td>MVRTA – # 1, 18, 51; also service to Boston</td>
</tr>
</tbody>
</table>

**2.3.1.10 Summary Evaluation of Existing Transit Conditions**

Existing transit service within the study area centers on the older industrial cities of the Merrimack Valley: Lowell, Lawrence, and Haverhill, with bus service radiating into adjacent communities. The existing routes primarily serve the population within these cities, and most service ends in the early
evening (6-7 PM). None of the LRTA or MVRTA bus routes operates on I-495. Limited service to major employment centers is offered at peak times, with trips often restricted to one to two trips in the peak periods and often only in the peak direction. Service is offered between the Lowell and Lawrence areas via one route, Bus Route #41, operated by the MVRTA, which ranks as the MVRTA’s second most popular bus route based on ridership. In addition, the MVRTA had offered special employment bus routes from Lawrence to employment centers along River Road in Andover, but bus these routes were discontinued in 2001. At that time, annual ridership the routes was 8,748 and 6,329 respectively, for a combined total of 15,077 annual riders.

Commuter rail service provided by the MBTA connects the greater Lowell, Lawrence, and Haverhill areas to Boston.

2.3.1.11 Regional Transit Travel Times

Table 2-11 shows transit travel times for selected points within the study area using existing transit. The points selected are those locations that have available transit service that rated highly in commuting based on ridership levels or 1990 journey-to-work data.

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Travel Time (min)</th>
<th>Routing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haverhill</td>
<td>IRS</td>
<td>40</td>
<td>MVRTA 72</td>
</tr>
<tr>
<td>Lawrence</td>
<td>Haverhill</td>
<td>40</td>
<td>MVRTA 01</td>
</tr>
<tr>
<td>Lawrence</td>
<td>IRS</td>
<td>25</td>
<td>MVRTA 73</td>
</tr>
<tr>
<td>Lawrence</td>
<td>Lowell</td>
<td>35</td>
<td>MVRTA 41</td>
</tr>
<tr>
<td>Lawrence</td>
<td>IRS</td>
<td>25</td>
<td>LRTA 11</td>
</tr>
<tr>
<td>Methuen</td>
<td>Lawrence</td>
<td>17</td>
<td>MVRTA 40</td>
</tr>
<tr>
<td>Andover</td>
<td>Lowell</td>
<td>62*</td>
<td>MVRTA 32/MVRTA 41</td>
</tr>
<tr>
<td>North Andover</td>
<td>Lowell</td>
<td>55*</td>
<td>MVRTA 33/MVRTA 41</td>
</tr>
<tr>
<td>Lowell</td>
<td>IRS</td>
<td>25</td>
<td>LRTA 11</td>
</tr>
</tbody>
</table>

* Includes 10 minute transfer time at Buckley Station

2.3.1.12 Trends

It is expected that the current travel patterns and transit usage within the study area will continue, with the providers focused primarily on serving the traditional urban areas of the Merrimack Valley.

According to the 2007 Merrimack Valley Regional Transportation Plan (RTP), the total number of Merrimack Valley residents traveling to work increased 12.4 percent between 1990 and 2000, from 130,672 workers to 146,923 workers. This is slightly greater than the 10.5 percent increase in
the region’s population from 288,280 persons to 318,556 persons over the same period, based on 2000 U.S. Census data. The overall number of Merrimack Valley residents that traveled to work within the Merrimack Valley region dropped by 1.1 percent between 1990 and 2000, while the percentage commuting to all other areas except I-495 increased. Also of note is that the number of Merrimack Valley residents traveling to Central New Hampshire more than doubled (104 percent increase), and that the overall percentage of residents that live and work in the Valley declined from 60.3 percent in 1990 to just under 53 percent in 2000.

The number of jobs in the Merrimack Valley that people traveled to also grew, from 124,015 in 1990 to 138,068 in 2000, an 11.3 percent increase. Census data shows that most of this growth took place in the communities located in the eastern half of the Valley, with additional employment growth taking place in Andover and Haverhill.

With the exception of Southern New Hampshire, there were significant increases in the percentage of persons traveling to work located in Merrimack Valley from all regions, with the I-495 region being most striking at 485.5 percent. In 1990, 61.2 percent of the 133,955 commuters living in the Valley remained in the region for their work. The City of Lawrence was the workplace destination of the greatest number of the region's commuters (over 17,000), followed by Andover and Haverhill. The City of Newburyport had the greatest percentage of intra-town commuters (people who live and work in the same community). By comparison, only 53 percent of the region’s 146,943 commuters remained in the Valley for their work in 2000, a drop of over eight percent. Lawrence continued to be the workplace destination of the greatest number of the region’s commuters (14,357), but with a marked reduction from the 1990 figure.

Over 50,000 residents of the Valley (38.8 percent) commuted outside the region in 1990. That figure grew markedly by 2000 as 69,074 residents commuted outside the region. The largest work community destination for Valley residents in 1990 was Boston. Over 7,000 commuted into Boston (5.2 percent of all commuters). In 2000, 9,124 Valley residents (6.2 percent of all commuters) worked in Boston. Many residents also commute to one of several towns to the south and west in the Route 128 corridor.

The development of additional park and rides at or near interstate or highway interchanges could facilitate and increase the use of transit and carpooling to all destinations. In addition, a connecting service between the two terminal points of the MBTA Lowell and Haverhill commuter rail lines connecting employment centers in Andover and Lowell could increase mobility and access to employment for transit users.
2.3.1.13 Intelligent Transportation Systems (ITS)

Intelligent Transportation Systems (ITS) refers to transportation systems that apply the latest in information technology to mitigate transportation congestion problems. ITS is designed to reduce unnecessary traffic delays by providing the public with the latest information on construction, traffic congestion and accidents via telephone and the Internet. For example, satellite surveillance systems could be used to locate the early stages of congestion on a given route, and traffic then redirected to alternate routes to prevent further aggravation of the problem.

Massachusetts is in the process of developing a regional network of ITS, and has thus grouped the Commonwealth’s 13 MPO’s into four regions: the Western Massachusetts, the Southeastern Massachusetts, the Central Massachusetts, and the Metropolitan Boston regions. The Metropolitan Boston region covers the area generally within I-495, and thus I-495 serves as a defining boundary for this system.

2.3.1.14 I-495 Rest Areas

A rest area provides a location for drivers to pull off a highway for temporary periods. They are often equipped with toilet facilities.

Four rest areas are currently located along I-495 within the study corridor. In Chelmsford, there are two rest areas just to the west of Westford Road, one on each side of I-495. Further to the east is another rest area located in Haverhill on the eastbound side of I-495 just to the east of State Route 108. The fourth rest area is located in Merrimack near the Haverhill boundary line on the westbound side of I-495.

There are no requirements at the Federal level regarding the need for or spacing of rest areas along an Interstate highway such as I-495.

2.3.2 Land Use

Land use patterns within the study area include the dense urban development of the traditional mill cities of Lowell, Lawrence, and Haverhill that developed along the Merrimack River, and the low-density suburban development as exemplified by Westford and North Andover, that developed in response to the increased accessibility and mobility created by the advent of the Interstate highway. In general, the highway corridor is most densely developed between Exits 33 in Chelmsford and Exit 51 in Haverhill. The eastern end of Haverhill (Exit 52) and the towns of Merrimac, Amesbury and Salisbury (Exits 53 – 55) at the eastern end of the corridor are less densely developed, and are primarily residential in character. (See Figures B-1, B-2, and B-3.)

1 Please see Appendix B of this document for all figures in this section (Figures B-1 through B-83).
The thirteen study area communities encompass an area of approximately 277 square miles, of which 35.4 percent is residential, 2.4 percent is commercial, and 4.5 percent is in industrial land uses. More than half (56.2 percent) of all industrial land use is in five of the corridor communities: Billerica (15.7 percent), Andover (11.3 percent), Lowell (10.7 percent), Westford (9.7 percent) and Lawrence (8.8 percent). Commercial and industrial uses are either located within the historic city downtowns or along state highways with access to I-495. The U.S. Route 3 and I-93 corridors, in particular contain a large concentration of industrial land uses. Forested land comprises 35.5 percent of the study area, while agricultural and horticultural uses occupy 4.9 percent of the study area.\(^1\) (See Table 2-12.)

An analysis of the full buildout potential of each of the study area communities was conducted by the Massachusetts Executive Office of Environmental Affairs (EOEA). This analysis indicates that there is a potential for more than 34,000 additional residential units and an additional 141 million square feet of commercial and industrial development within the study area, which is based on current (2001) zoning and the amount of developable land available. This analysis does not take into account market demand and the rate of development. The communities with the potential to add the greatest number of housing units are Haverhill (6,838), Lowell (5,495), Westford (4,697), and Andover (3,590). Communities with high potential commercial and industrial growth include: Lowell (23.72 million square feet (msf)), Billerica (18.20 msf), Westford (17.96 msf), Andover (17.71 msf), and Haverhill (17.21 msf). Table 2-13 provides a summary of additional growth potential at full build for the study area communities.

Land use and zoning within one mile of Exits 32 to 55 were analyzed in more detail to identify existing and potential land uses that contribute to travel demand. The following provides a discussion of land use and zoning at each of the interchanges by community.

**Westford**

Land use at Exit 32 (Boston Road) in Westford is primarily forested, residential and agricultural to the north of I-495. The major commercial area within the Town of Westford, comprised of a series of strip malls and free-standing commercial buildings, is located to the south of I-495 on State Route 110 (Littleton Road) at the intersection of Boston Road. Industrial uses (primarily office parks) as well as scattered commercial development continue in either direction along State Route 110. (See Figure B-4.) Almost the entire State Route 110 corridor within one mile of the interchange is zoned Industrial, comprising an area of 402 acres. (See

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\(^1\) MassGIS Land Use Summary Statistics, 1999 data
Figure B-5.) Of this, about half (221 acres) has been developed for industrial and commercial uses, with the remainder available for future development.

**Chelmsford**

Three of the study area interchanges are located within the Town of Chelmsford: Exit 33, providing access to State Route 4; Exit 34, providing access to State Route 110 (Chelmsford Street); and Exit 35 on the Lowell border, providing access to U.S. Route 3 and the Lowell Connector from northbound I-495. As in Westford, land use to the north of I-495 is primarily residential. Commercial uses are clustered along State Route 4 and State Route 110. Industrial land use in Chelmsford is primarily centered on State Route 129 (Billerica Road) along the U.S. Route 3 corridor. (See Figures B-6, B-7, and B-8.) Commuter traffic from I-495 uses State Route 4 (Exit 33) or Golden Cove Road via State Route 110 (Exit 34) to access the State Route 129 industrial area.

The State Route 110 corridor is zoned primarily for commercial use, much of which has already been developed. The U.S. Route 3 corridor in Chelmsford has been zoned industrial. (See Figures B-9, B-10, and B-11.) A block of industrially zoned land south of I-495 near Exit 35 remains undeveloped; however, this area is traversed by River Meadow Brook and contains wetlands and protected species habitats, limiting its development potential.

**Lowell**

I-495 skirts the edge of Lowell, with access to the city provided by the Lowell Connector via Exits 35 and 36, and via Woburn Street at Exit 37. Exits 38 and 39 in Tewksbury also provide access to Lowell.

Much of the area at the intersection of I-495 and U.S. Route 3, as well as along the Lowell Connector is zoned industrial. (See Figure B-13.) The CrossPoint development, located to the north of I-495 near Exits 35 and 36 between U.S. Route 3 and the Lowell Connector, contains 1.2 million square feet of office space and represents the largest concentration of employment in Lowell in close proximity to I-495. (See Figure B-12.) Significant future development potential exists at CrossPoint, although 2001 plans for an additional office tower were put on hold due to market conditions.

The land use adjacent to the Exit 37 interchange is primarily residential. However, Woburn Street provides access to industrial and office development in Tewksbury and Billerica (see Figures B-14 and B-15), as well as to the MBTA commuter rail station in North Billerica.
Table 2-12
Land Use

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<tbody>
<tr>
<td>Agriculture1</td>
<td>624</td>
<td>447</td>
<td>324</td>
<td>80</td>
<td>477</td>
<td>519</td>
<td>7</td>
<td>1,108</td>
<td>671</td>
<td>2,182</td>
<td>592</td>
<td>1,108</td>
<td>559</td>
<td>8,698</td>
<td>4.9%</td>
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<tr>
<td>Forest</td>
<td>9,562</td>
<td>3,625</td>
<td>5,486</td>
<td>1,106</td>
<td>4,275</td>
<td>7,901</td>
<td>308</td>
<td>8,571</td>
<td>4,187</td>
<td>8,180</td>
<td>2,844</td>
<td>3,161</td>
<td>3,675</td>
<td>62,881</td>
<td>35.5%</td>
<td></td>
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<tr>
<td>Wetlands2</td>
<td>791</td>
<td>463</td>
<td>603</td>
<td>92</td>
<td>741</td>
<td>644</td>
<td>11</td>
<td>325</td>
<td>858</td>
<td>505</td>
<td>172</td>
<td>186</td>
<td>2,689</td>
<td>8,080</td>
<td>4.6%</td>
<td></td>
</tr>
<tr>
<td>Industrial3</td>
<td>772</td>
<td>653</td>
<td>1,246</td>
<td>848</td>
<td>600</td>
<td>899</td>
<td>694</td>
<td>568</td>
<td>457</td>
<td>638</td>
<td>71</td>
<td>258</td>
<td>220</td>
<td>7,924</td>
<td>4.5%</td>
<td></td>
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<tr>
<td>Open Land4</td>
<td>766</td>
<td>654</td>
<td>818</td>
<td>1,024</td>
<td>1,099</td>
<td>1,077</td>
<td>478</td>
<td>571</td>
<td>1,072</td>
<td>1,583</td>
<td>152</td>
<td>499</td>
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<td>Recreation5</td>
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<td>278</td>
<td>557</td>
<td>142</td>
<td>229</td>
<td>335</td>
<td>568</td>
<td>11</td>
<td>187</td>
<td>233</td>
<td>3,604</td>
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<tr>
<td>Residential6</td>
<td>6,234</td>
<td>7,306</td>
<td>7,038</td>
<td>4,516</td>
<td>5,315</td>
<td>7,365</td>
<td>2,243</td>
<td>4,946</td>
<td>5,930</td>
<td>6,504</td>
<td>1,457</td>
<td>2,169</td>
<td>1,620</td>
<td>62,643</td>
<td>35.4%</td>
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<tr>
<td>Commercial</td>
<td>182</td>
<td>426</td>
<td>329</td>
<td>514</td>
<td>350</td>
<td>417</td>
<td>426</td>
<td>276</td>
<td>338</td>
<td>473</td>
<td>50</td>
<td>126</td>
<td>271</td>
<td>4,178</td>
<td>2.4%</td>
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<td>Transportation</td>
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<td>400</td>
<td>317</td>
<td>198</td>
<td>469</td>
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<td>341</td>
<td>496</td>
<td>193</td>
<td>547</td>
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<td>719</td>
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<td>722</td>
<td>94</td>
<td>500</td>
<td>0</td>
<td>4,701</td>
<td>2.7%</td>
<td></td>
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<tr>
<td>Total</td>
<td>20,067</td>
<td>14,776</td>
<td>16,842</td>
<td>9,305</td>
<td>13,526</td>
<td>20,395</td>
<td>4,477</td>
<td>17,623</td>
<td>14,396</td>
<td>21,951</td>
<td>5,563</td>
<td>8,411</td>
<td>9,800</td>
<td>177,132</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>
### Table 2-13
Potential Additional Development within the I-495 Corridor Communities

<table>
<thead>
<tr>
<th></th>
<th>Additional Residential Units</th>
<th>Additional Developable Land Area (acres)</th>
<th>Additional Commercial/Industrial Buildable Floor Area (million sq ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westford</td>
<td>4,637</td>
<td>6,727</td>
<td>17.96</td>
</tr>
<tr>
<td>Chelmsford</td>
<td>1,053</td>
<td>1,756</td>
<td>6.07</td>
</tr>
<tr>
<td>Billerica</td>
<td>1,748</td>
<td>2,515</td>
<td>18.20</td>
</tr>
<tr>
<td>Lowell</td>
<td>5,495</td>
<td>1,238</td>
<td>23.72</td>
</tr>
<tr>
<td>Tewksbury</td>
<td>1,268</td>
<td>1,712</td>
<td>4.72</td>
</tr>
<tr>
<td>Andover</td>
<td>3,590</td>
<td>4,743</td>
<td>17.71</td>
</tr>
<tr>
<td>Lawrence</td>
<td>706</td>
<td>211</td>
<td>1.60</td>
</tr>
<tr>
<td>North Andover</td>
<td>2,324</td>
<td>2,583</td>
<td>8.37</td>
</tr>
<tr>
<td>Methuen</td>
<td>1,723</td>
<td>3,081</td>
<td>10.25</td>
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<tr>
<td>Haverhill</td>
<td>6,838</td>
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<tr>
<td>Merrimac</td>
<td>606</td>
<td>1,477</td>
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<tr>
<td>Amesbury</td>
<td>3,094</td>
<td>2,169</td>
<td>7.05</td>
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<tr>
<td>Salisbury</td>
<td>1,125</td>
<td>2,401</td>
<td>5.83</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>34,207</strong></td>
<td><strong>37,457</strong></td>
<td><strong>141.14</strong></td>
</tr>
</tbody>
</table>


---

**Tewksbury**

Exit 38 provides access to State Route 38 in Tewksbury and Lowell. Land use adjacent to the interchange is primarily commercial, with commercial and industrial land uses extending in each direction along State Route 38. The remainder of the area within one mile of the interchange is a mix of residential and forested land uses. (See Figure B-16.) Much of the State Route 38 corridor is zoned commercial. There is a significant amount of industrially zoned land around the interchange, extending along the south side of I-495 to Exit 39. (See Figure B-17.)

Exit 39 is located on the Tewksbury/Andover town line providing access to State Route 133. There are a number of industrial and office parks located in the Tewksbury area, with industrial land uses located along the northwest quadrant of the interchange, and extending along either side of I-495 to the south. Ames Pond is located in the southeast quadrant of the interchange. Residential and forested land uses are predominating in the remainder of the one-mile area around the interchange. (See Figures B-18 and B-19.)

**Andover**

The I-495 interchange with I-93 (Exit 40) is located within the Town of Andover. Land uses adjacent to this interchange are primarily forest, wetland, and residential. (See Figure B-20.) No access to local streets is provided at this location, and there is very little industrial or commercial land use within the...
vicinity of this interchange. Almost all of the area within one mile of this interchange is zoned residential. (See Figure B-21.)

Exit 41, located near the Lawrence city line, provides access to State Route 28. Most of the area within one mile of the interchange has been developed. Land use immediately adjacent to the interchange is primarily residential, with an area of wetland located along the southeast quadrant. The MBTA Haverhill line tracks pass under I-495 to the east of the interchange, with industrial land uses within one mile of Exit 41 located primarily along the rail line. (See Figure B-22.) The zoning is consistent with the existing land use pattern. (See Figure B-23.)

Lawrence

Three of the study corridor interchanges are located in Lawrence. Exit 42 provides access to State Route 114 in Lawrence and North Andover. Land use adjacent to the interchange is primarily commercial, although there is a residential neighborhood adjacent to the southbound I-495 on-ramp. Land use and zoning within one mile of the interchange is primarily residential, with an area of forested land and wetlands along the Shawsheen River to the east of I-495 between Exit 41 and Exit 43, which is located in North Andover. (See Figures B-24 and B-25.)

Exit 44 provides access to Merrimack Street in Lawrence and Sutton Street in North Andover. The Merrimack Street corridor contains numerous traditional mill buildings, which have been classified as an industrial land use. However, many of these mill buildings are being redeveloped for mixed commercial, office, and residential uses. A new MBTA commuter rail station and parking garage was opened in 2005 at the corner of Merrimack and Union Streets, approximately 0.75 miles west of the interchange. Sutton Street contains a mix of commercial and residential uses, and provides access to the Lawrence Municipal Airport (located in North Andover) and associated industrial park. (See Figures B-26 and B-27.)

Land uses adjacent to the interchange include industrial and open land to the west of I-495, commercial land to the southeast, and forested land to the northeast along the Merrimack River.

Exit 45 is located on the north side of the Merrimack River, providing access to Marston Street and downtown Lawrence. The river is located on the east side of interchange, with residential and industrial land uses to the west side of the interchange. (See Figures B-28 and B-29.)

North Andover

Located in North Andover on the border with Lawrence, Exit 43 provides access to Massachusetts Avenue (North Andover) and Loring Street (Lawrence). Land use adjacent to the interchange is primarily residential, with commercial land use adjacent to the I-495 southbound off-ramp, and forest land and the Shawsheen
River adjacent to the I-495 southbound on-ramp. The Shawsheen River crosses under I-495 just to the south of Exit 43. (See Figures B-30 and B-31.)

**Methuen**

In Methuen, the I-495 corridor is primarily residential. Exit 46 provides access to State Route 110 and to Holy Family Hospital, which is a major employer in Methuen. Land use immediately adjacent to the interchange on the east is primarily commercial, with another area of commercial land located on State Route 110 adjacent to the southbound I-495 off-ramp. Most of the area within one mile of the interchange in Methuen has been developed, primarily for residential use. (See Figures B-32 and B-33.)

Exit 47 provides access to State Route 213, a limited-access highway providing a connection between I-495 and I-93. Land use adjacent to the interchange is primarily residential, with an area of forest land adjacent to the State Route 213 on-ramp from I-495 southbound. (See Figure B-34.) One mile west of the interchange are approximately 50 acres of available land across from the Methuen Mall that is zoned commercial, offering the potential for additional large-scale commercial development such as a shopping mall near. In addition, there is an area of industrially zoned land to the north of State Route 213, and currently forested land bordering I-495 on the west offering the potential for additional industrial development near Exit 47. (See Figure B-35.)

**Haverhill**

Exit 48 in Haverhill provides access to the State Route 125 Connector. Land use adjacent to the interchange is primarily industrial on the east and forested and agricultural land on the west. (See Figure B-36.) All of the land abutting Exit 48 and the State Route 125 connector is zoned industrial, offering the potential for a significant amount of future development that would access this interchange. (See Figure B-37.)

Exit 49 provides access to State Route 110/113 (River Street). Land uses immediately adjacent to the interchange are commercial in the northeast quadrant, with open and recreational land adjacent to the Merrimack River in the southeast quadrant. On the west side of I-495, the predominant land uses are residential with a strip of forested land abutting the interstate in the southwest quadrant; and residential and open land, with a small area of commercial land in the northwest quadrant. (See Figure B-38.) There is a commercially zoned district adjacent to northbound I-495. However, most of the land appears to have been previously developed for commercial and recreational uses. (See Figure B-39.)

Exit 50 provides access to State Route 97 (Broadway). Land uses to the east of the highway are predominately residential, with an area of agricultural land in the northeast quadrant of the interchange. The southwest quadrant is primarily forested and open land. (See Figure B-40.) A large industrial-zoned district is
located to the west of I-495 along State Route 97. (See Figure B-41.) However, this area contains wetlands and protected species habitat, thereby limiting its potential for development. The east side of the highway corridor is residential. A recent large retail development near this interchange includes Lowe’s and Target stores.

Exit 51 provides access to State Route 125 (Main Street). Land use and zoning adjacent to, and within one mile of the interchange, is primarily residential. (See Figures B-42 and B-43.) I-495 crosses the Little River and associated forested and open land south of the interchange. A section of this forest land extends along the northbound I-495 off-ramp to State Route 125.

Exit 52 provides access to State Route 110 (Amesbury Road). Land use directly to the south of the interchange is primarily residential, with a small area of abutting commercial land use on State Route 110. An area of commercial land use along State Route 110 also abuts the interchange on the north side of I-495. The remainder of the area within one mile of the interchange is predominantly forest, residential, wetlands and surface water. Kenoza Lake is located to the south of the interchange. The southwest quadrant of the interchange is zoned commercial between State Route 108 and State Route 110. However, a portion of this commercial zoning district contains wetlands and protected species habitat, limiting its development potential. There is also an area of commercial zoning extending approximately 0.5 miles along State Route 110 to the north of the interchange. There is no industrial zoning within one mile of the interchange. (See Figures B-44 and B-45.) Exit 52 serves the Northern Essex Community College, which is a major trip generator and which is located about one mile from the interchange.

**Merrimac**

The Town of Merrimac contains one I-495 interchange, Exit 53, providing access to Broad Street. Land use to the south of the highway in the vicinity of the interchange is a mix of forest, residential and open land. Small areas of commercial and industrial land abut the interchange on the north, with the reminder of the area consisting of forest and residential land. Most of the area within one mile of Exit 53 is zoned residential, with much of the State Route 110 corridor, which runs parallel to I-495 on the north, zoned commercial. The area roughly bounded by I-495, Broad Street, the State Route 110 (East Street) commercial district, and the North Shore Trailer Park is zoned as other, which is an institutional use. (See Figures B-46 and B-47.)

**Amesbury**

The Town of Amesbury contains two interchanges that are approximately one mile apart, Exit 54 providing access to State Route 150, and Exit 55 providing access to State Route 110 at the Powwow River. Land use adjacent to Exit 54 is primarily forest, agricultural and open space, with an area of industrial land in the
southwest quadrant of the interchange. There is an area of open land containing a number of cemeteries to the northeast of the interchange. The land in the northwest and southwest quadrants of the interchange along State Route 150 is zoned commercial, with industrially zoned land along the south side of I-495 to the west of the commercial zone. There is also an area of industrially zoned land on the north side of State Route 110, to the northwest of the interchange. These areas of Commercial and Industrially zoned land indicate the potential for additional development that would access Exit 54. (See Figures B-48 and B-49.)

Land use adjacent to Exit 55 includes the Powwow River and associated wetlands and forested areas. Commercial land uses are located on State Route 110 to the west of the interchange, and residential land to the north. Industrial land uses are located to the north of I-495, along the border with the town of Salisbury. The zoning adjacent to the interchange, along State Route 110 to the Salisbury line and between I-495 and I-95 is commercial. (See Figures B-50 and B-51.) Areas of industrially zoned land are located to the north of I-495 along the Salisbury line, with another area of industrially zone land along the Powwow River in the center of Amesbury. The remainder of the area within one mile of the interchange is zoned residential.

2.3.3 Socio-Economics

2.3.3.1 Population and Households

The population of the thirteen study area corridor communities in 2000, based on census data, was approximately 491,000 people. The cities of Lowell, Lawrence, and Haverhill represent major population centers, containing almost half (48 percent) of the population of the study area. Suburban communities in proximity to these population centers comprise another 46 percent of study area population. The three communities at the eastern end of the corridor—Merrimac, Amesbury, and Salisbury—are less developed and represent only 6 percent of the population within the study area. (See Figure B-52.)

Based on 2025 population projections developed by the Northern Middlesex Council of Governments and the Merrimack Valley Regional Planning Commission, the population of the study area overall is expected to grow 13 percent by 2025, to a total of about 556,000 people. The cities of Lowell, Lawrence, and Haverhill are expected to remain as the major population centers, although their share of the regional population drops to 46 percent. The growth rate in Lowell is expected to be moderate (9 percent), with little growth in Lawrence (1 percent); however, the population of Haverhill is expected to grow at a rate of 20 percent, with 11,705 people added in the period of 2000-2025. Westford is expected to have the highest growth rate in the study area at 41 percent, with high rates of growth in Andover (28 percent), and North Andover.

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1 Westford, Chelmsford, Billerica, Tewksbury, Andover, North Andover and Methuen
2 Please see the Appendix, separately bound.
(23 percent). Merrimac, Amesbury, and Salisbury have some of the highest growth rates in the study area, but due to their smaller 2000 populations, are only expected to add about 9600 people in total.

Table 2-14 present a summary of existing and projected population growth in the I-495 corridor communities.

<table>
<thead>
<tr>
<th>Community</th>
<th>Population 2000</th>
<th>Population 2025</th>
<th>Percent Change</th>
<th>Total Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westford</td>
<td>20,754</td>
<td>29,350</td>
<td>41%</td>
<td>8,596</td>
</tr>
<tr>
<td>Chelmsford</td>
<td>33,858</td>
<td>36,900</td>
<td>9%</td>
<td>3,042</td>
</tr>
<tr>
<td>Billerica</td>
<td>38,981</td>
<td>41,650</td>
<td>7%</td>
<td>2,669</td>
</tr>
<tr>
<td>Lowell</td>
<td>105,167</td>
<td>112,010</td>
<td>7%</td>
<td>6,843</td>
</tr>
<tr>
<td>Tewksbury</td>
<td>28,851</td>
<td>32,500</td>
<td>13%</td>
<td>3,649</td>
</tr>
<tr>
<td>Andover</td>
<td>31,247</td>
<td>39,935</td>
<td>28%</td>
<td>8,688</td>
</tr>
<tr>
<td>Lawrence</td>
<td>72,043</td>
<td>72,623</td>
<td>1%</td>
<td>580</td>
</tr>
<tr>
<td>North Andover</td>
<td>27,202</td>
<td>33,352</td>
<td>23%</td>
<td>6,150</td>
</tr>
<tr>
<td>Methuen</td>
<td>43,789</td>
<td>47,404</td>
<td>8%</td>
<td>3,615</td>
</tr>
<tr>
<td>Haverhill</td>
<td>58,969</td>
<td>70,674</td>
<td>20%</td>
<td>11,705</td>
</tr>
<tr>
<td>Merrimac</td>
<td>6,138</td>
<td>7,619</td>
<td>24%</td>
<td>1,481</td>
</tr>
<tr>
<td>Amesbury</td>
<td>16,450</td>
<td>21,251</td>
<td>29%</td>
<td>4,801</td>
</tr>
<tr>
<td>Salisbury</td>
<td>7,827</td>
<td>10,636</td>
<td>36%</td>
<td>2,809</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>491,276</strong></td>
<td><strong>555,904</strong></td>
<td><strong>13%</strong></td>
<td><strong>64,628</strong></td>
</tr>
</tbody>
</table>

Source: Northern Middlesex Council of Governments (NMCOG) and the Merrimack Valley Regional Planning Commission (MVRPC)

The number of households in the study area is expected to increase by 18 percent in 2025 to 208,700. Household size is expected to decrease from an average of 2.77 persons/household in 2000 to 2.66 in 2025. The number of households is expected to increase in all communities, with the exception of Lawrence, which is expected to have fewer households in 2025. Trends in household growth parallel trends in population growth, with the largest number of households added in Haverhill, followed by Andover, Westford, Lowell, and North Andover, respectively. (See Figures B-53 and B-54)

Table 2-15 presents a summary of existing and projected household growth in the I-495 corridor communities.

---

1 Please see the Appendix, separately bound.
### Table 2-15

<table>
<thead>
<tr>
<th>Community</th>
<th>2000 Households</th>
<th>2025 Households</th>
<th>Percent Change</th>
<th>Total Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westford</td>
<td>6,808</td>
<td>10,846</td>
<td>59%</td>
<td>4,038</td>
</tr>
<tr>
<td>Chelmsford</td>
<td>12,812</td>
<td>14,232</td>
<td>11%</td>
<td>1,420</td>
</tr>
<tr>
<td>Billerica</td>
<td>12,919</td>
<td>15,215</td>
<td>18%</td>
<td>2,296</td>
</tr>
<tr>
<td>Lowell</td>
<td>37,887</td>
<td>41,570</td>
<td>10%</td>
<td>3,683</td>
</tr>
<tr>
<td>Tewksbury</td>
<td>9,964</td>
<td>12,048</td>
<td>21%</td>
<td>2,084</td>
</tr>
<tr>
<td>Andover</td>
<td>11,305</td>
<td>15,553</td>
<td>38%</td>
<td>4,248</td>
</tr>
<tr>
<td>Lawrence</td>
<td>24,463</td>
<td>23,080</td>
<td>-6%</td>
<td>-1,383</td>
</tr>
<tr>
<td>North Andover</td>
<td>9,724</td>
<td>12,553</td>
<td>29%</td>
<td>2,829</td>
</tr>
<tr>
<td>Methuen</td>
<td>16,532</td>
<td>18,905</td>
<td>14%</td>
<td>2,373</td>
</tr>
<tr>
<td>Haverhill</td>
<td>22,976</td>
<td>28,712</td>
<td>25%</td>
<td>5,736</td>
</tr>
<tr>
<td>Merrimac</td>
<td>2,233</td>
<td>2,925</td>
<td>31%</td>
<td>692</td>
</tr>
<tr>
<td>Amesbury</td>
<td>6,380</td>
<td>8,577</td>
<td>34%</td>
<td>2,197</td>
</tr>
<tr>
<td>Salisbury</td>
<td>3,082</td>
<td>4,491</td>
<td>46%</td>
<td>1,409</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>177,085</strong></td>
<td><strong>208,707</strong></td>
<td><strong>18%</strong></td>
<td><strong>31,622</strong></td>
</tr>
</tbody>
</table>

Source: NMCOG and MVPC

#### 2.3.3.2 Employment

There were about 247,000 jobs within the I-495 corridor study area in 2000. (See Table 2-16.) The Town of Andover contains the most jobs in the region, followed by Lowell, Billerica, Lawrence, and Chelmsford. These five communities contain 61 percent of all employment within the study area. The eastern end of the corridor (Merrimac, Amesbury, and Salisbury) contains relatively few jobs, with total employment within the three communities representing only 4 percent of the employment in the study area. (See Figure B-55.)

Employment is anticipated to grow about 16 percent by 2025, with about 39,700 jobs added to the region. Andover and Lowell are expected to remain as the most important employment centers in the corridor, followed by Haverhill, Billerica, and Lawrence; together constituting about 60 percent of the employment in the region in 2025. Haverhill and Westford are anticipated to have high rates of job creation, at 40 percent and 39 percent, respectively, in part because of the availability of industrially zoned land for development (See the discussion of land use in Section 2.3.2.) Merrimac, Amesbury, and Salisbury are also anticipated to have high rates of employment growth, but due to the small total number of existing jobs, total employment within these three communities is expected to remain at 4 percent of the employment in the study area. (See Figure B-56.)

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1 Please see the Appendix, separately bound.
### Table 2-16

**Existing and Projected Employment**

<table>
<thead>
<tr>
<th>Community</th>
<th>2000 Employment</th>
<th>2025 Employment</th>
<th>Percent Change</th>
<th>Total Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westford</td>
<td>11,977</td>
<td>16,700</td>
<td>39%</td>
<td>4,723</td>
</tr>
<tr>
<td>Chelmsford</td>
<td>23,770</td>
<td>25,200</td>
<td>6%</td>
<td>1,430</td>
</tr>
<tr>
<td>Billerica</td>
<td>27,769</td>
<td>29,111</td>
<td>5%</td>
<td>1,342</td>
</tr>
<tr>
<td>Lowell</td>
<td>36,185</td>
<td>44,065</td>
<td>22%</td>
<td>7,880</td>
</tr>
<tr>
<td>Tewksbury</td>
<td>18,003</td>
<td>19,837</td>
<td>10%</td>
<td>1,834</td>
</tr>
<tr>
<td>Andover</td>
<td>37,363</td>
<td>44,460</td>
<td>19%</td>
<td>7,097</td>
</tr>
<tr>
<td>Lawrence</td>
<td>25,767</td>
<td>26,700</td>
<td>4%</td>
<td>933</td>
</tr>
<tr>
<td>North Andover</td>
<td>21,018</td>
<td>21,950</td>
<td>4%</td>
<td>932</td>
</tr>
<tr>
<td>Methuen</td>
<td>15,454</td>
<td>18,385</td>
<td>19%</td>
<td>2,931</td>
</tr>
<tr>
<td>Haverhill</td>
<td>20,897</td>
<td>29,245</td>
<td>40%</td>
<td>8,348</td>
</tr>
<tr>
<td>Merrimac</td>
<td>1,044</td>
<td>1,535</td>
<td>47%</td>
<td>491</td>
</tr>
<tr>
<td>Amesbury</td>
<td>5,206</td>
<td>6,201</td>
<td>19%</td>
<td>995</td>
</tr>
<tr>
<td>Salisbury</td>
<td>3,022</td>
<td>3,768</td>
<td>25%</td>
<td>746</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>247,475</strong></td>
<td><strong>287,157</strong></td>
<td><strong>16%</strong></td>
<td><strong>39,682</strong></td>
</tr>
</tbody>
</table>

Source: NMCOG and MVPC

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### 2.3.4 Natural Environment

The following sections describe existing environmental constraints within the corridor that could potentially be affected by the alternatives developed to address transportation problems identified in the I-495 corridor. Documentation of environmental resources in the corridor was based on available MassGIS data. Figures B-57, B-58, and B-59\(^1\) illustrate environmental resources throughout the corridor. Figures B-60 through B-82\(^1\) indicate environmental resources present within one mile of each of the interchanges in the corridor study area.

#### 2.3.4.1 Wetlands, Floodplains and Surface Waterbodies

The Merrimack River and its tributaries and associated wetlands and floodplain areas represent a significant environmental resource within the I-495 corridor study area. The highway crosses the Merrimack River in Lawrence between Exits 44 and 45, and again in Haverhill between Exits 47, 48, and 49, as well as numerous tributary streams and rivers throughout the corridor. Surface water bodies occupy a total of 2,094 acres (4 percent) of the area within one mile of the highway alignment, with wetlands occupying an additional 5,134 acres (10 percent). Floodplains occupy 6,158 acres (12 percent) and are often found coincident with wetlands and waterbodies. Additional information regarding wetlands, floodplains and surface waterbodies in the vicinity of the study area interchanges is presented below.

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\(^1\) Please see the Appendix, separately bound.
Westford – Andover (Exits 32-40)

An area of wetlands and floodplain abut the northbound on-ramp and southbound off-ramp and mainline at Exit 32 in Westford. Scattered wetland areas are located to the south of I-495 between Exits 33 and 34 in Chelmsford, although none appear to abut the interchange ramps themselves. I-495 crosses River Meadow Brook and associated floodplain west of Exit 35 in Chelmsford, and an unnamed tributary to River Meadow Brook and associated wetlands and floodplains to the east of Exit 36. The highway then crosses the Concord River and associated wetlands and floodplains on the Chelmsford/Lowell line. There are no surface water bodies or wetlands in proximity to Exit 37 in Lowell or Exit 38 in Tewksbury, but the highway again crosses a large wetland system known as the Great Swamp approximately 0.5 miles to the east of Exit 38. Ames Pond is located to the south of Exit 39 in Tewksbury, near the Andover town line. Fish Brook, with associated wetlands and floodplain, is located to the west of Exit 40 and I-93 in Andover, with Haggets Pond located approximately 0.5 miles southwest of the interchange.

Andover – Haverhill (Exits 41-51)

The highway crosses a tributary of Hussey Brook in Andover, approximately one mile east of Exit 40. The Shawsheen River and associated wetland and floodplain borders I-495 on the east between Exits 41 and 42. It then crosses under I-495 south of Exit 43, where it borders I-495 on the west until it reaches the Merrimack River in Lawrence at Exit 44. The highway crosses the Merrimack River between Exits 44 and 45, and abuts the river’s floodplain up to the Lawrence/Methuen town line. At Exit 46, a wetland abuts the highway near the I-495 southbound off-ramp to State Route 110. Bare Meadow Brook, and associated wetlands and floodplain, are located in Methuen to the west of I-495 between Exit 47 and the Merrimack River. The highway then crosses the river twice to the south and once to the north of Exit 48. Wetlands have been mapped within the interchange ramps at Exit 48 and Exit 49. There is also a small unnamed stream located to the west of I-495 between the I-495 southbound off-ramp at Exit 48 and the Merrimack River. An unnamed tributary to Creek Brook, with associated wetlands and floodplain, are located between the I-495 northbound and southbound mainline in Haverhill, to the south of Exit 50. This brook extends through the southeast quadrant of the interchange. The highway then crosses the Little River, and associated wetlands and floodplains, to the south of Exit 51. However, there are no mapped wetlands in the immediate vicinity of the interchange.

Haverhill – Salisbury (Exits 52 – 55)

A large wetland is located in the northeast quadrant of the interchange at Exit 52 in Haverhill, and is crossed by the highway approximately 0.5 miles to the east of the interchange. At Exit 53 in Merrimac, wetlands are mapped on either side of the I-495 southbound off-ramp, although they do not appear to abut the ramp.
itself. The highway crosses Cobbler Brook in Amesbury to the east of Exit 53. An unnamed stream flows under I-495 and the northbound ramps at Exit 54 in Amesbury. There are no mapped wetlands associated with this stream. Exit 55 in Amesbury abuts the Powwow River and associated wetlands and floodplain.

2.3.4.2 Public Water Supplies

At the western end of the corridor, I-495 overlies a groundwater aquifer in the vicinity of Exits 34 and 35. Several Chelmsford public water supply wells associated with this aquifer are located within one mile of I-495 to the south, including Riverneck Road Wells #1 and #2, Canal Street Wells #1, #2, and #3, and the Turnpike Road Well #1. I-495 crosses several smaller mapped aquifer areas in the remainder of the study area, but based on the MassGIS data, these aquifers do not have public water supply wells associated with them.

There are also a number of public surface water supplies within the I-495 study corridor, including Haggets Pond in Andover, located to the south of Exit 40; and Kenoza Lake and Round Pond in Haverhill, both located southwest of Exit 52.

2.3.4.3 Rare Species Habitat

Several protected species habitat areas have been identified within one mile of the study corridor, including the entire Merrimack River. I-495 is in proximity to the Merrimack River and associated protected species habitat in Lawrence between Exit 44 and the Methuen town line; in Methuen and Haverhill between Exits 47 and 49; and in Merrimac and Amesbury, between Exits 53 and 55. There is also a protected species habitat area adjacent to Exit 55 in Amesbury along the Powwow River, which is tributary to the Merrimack River.

At the western end of the corridor, a protected species habitat area associated with River Meadow Brook in Chelmsford is located on the south side of the highway corridor between Exits 34 and 35. A protected species habitat within the Great Swamp abuts I-495 on the south in Tewksbury between Exits 38 and 39. Another area of protected species habitat is located to the southwest of Exit 40 along Fish Brook between I-93 on the east and Haggets Pond on the west.

In the eastern part of the corridor, protected species habitat associated with wetlands to the north of Kenoza Lake abuts I-495 to the southwest of Exit 52. In addition, an area of protected species habitat, located in Amesbury between Exits 53 and 54, abuts I-495 on the north.

2.3.4.4 Historic Resources

The MassGIS database has identified numerous individual historic resources within one mile of the study corridor. However, none of these appear to be in
close enough proximity to the interchanges to be affected by any proposed improvements.

The only identified historic resource in close proximity to I-495 that could be affected by the proposed alternatives is the Chelmsford Center Historic District located along Boston Road (State Route 4) in Chelmsford, directly to the south of Exit 33.

2.4 Summary of Existing Conditions/Issues

I-495 Infrastructure

- The I-495 study corridor is approximately 40 miles long and contains 25 interchanges.
- Not including I-495’s major interchanges with U.S. Route 3, I-93, and I-95, the study corridor contains 11 signalized intersections and 21 unsignalized intersections at the remaining interchanges.
- I-495 features three 12-foot travel lanes in each direction between Exit 32 in Westford and Exit 55 in Amesbury, with the remaining short section of roadway between Exit 55 and I-495’s junction with I-95 having two 12-foot travel lanes in each direction.
- A total of 24 of I-495’s acceleration and deceleration lanes at its interchanges are deficient with regard to length.

Traffic Volumes

- Large growth in traffic volumes has occurred since the highway opened in the 1960s, although growth had lessened in recent years. In some locations, daily traffic has grown by 20,000 or more vehicles over a 20-year period.
- Average weekday traffic volumes on I-495 currently range from 123,500 vehicles per day at the far end of the study corridor in Westford to 45,000 vehicles per day at the eastern end of the corridor in Amesbury.
- During the AM peak hour in the eastbound direction, volumes range from 5,100 vehicles in Westford to 1,300 in Amesbury. In the opposite westbound direction, they vary from 1,800 in Amesbury to 5,250 in Westford. For the PM peak hour in the eastbound direction, traffic volumes range from 4,700 in Westford to 1,750 in Amesbury. Westbound, PM peak hour volumes vary from 1,500 in Amesbury to 5,000 in Westford.
- Traffic volumes vary according to season, which can affect the quality of travel that motorists experience during certain times. However, planning and engineering for highway improvements is based on average conditions, not the seasonal peaks.
• I-495 plays an important role with regard to the movement of freight and goods. On a daily basis, trucks make up approximately 18 percent of the roadway’s traffic.

Traffic Analyses

For purposes of the analysis of existing 2006 traffic conditions, the I-495 study corridor was divided into a Western Segment and an Eastern Segment, the boundary between the two being between Exits 40 and 41 in Andover.

Existing traffic operating conditions were examined 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 and (3) key links on I-495 between interchanges. In each case, level of service determination was made for both the existing AM and PM peak hour periods. In general LOS A through D conditions can be viewed as being uncongested and desirable, while LOS E and LOS F conditions can be viewed as congested and undesirable. Key results of these analyses of existing traffic conditions are as follows:

Intersections

• In the Western Segment in the AM peak hour, all six signalized intersections (100 percent) operate at LOS D or better overall, as do 42 (95 percent) of their 45 individual movements. For the six unsignalized intersections, 20 (87 percent) of their 23 individual movements currently operate at LOS D or better.

• For the Eastern Segment in the AM peak hour, all 5 signalized intersections operate at LOS D or better overall, as do 100 percent of their individual movements. The 15 unsignalized intersections contain a total of 63 movements that were analyzed, of which 59 movements (94 percent) operate at LOS D or better.

• During the PM peak in the Western Segment, all six signalized intersections currently operate at an overall LOS D or better, as do 39 (88 percent) of their 44 individual movements. At the six unsignalized intersections, 18 (78 percent) of their 23 individual movements operate at LOS D or better.

• In the Eastern Segment, all five signalized intersections (100 percent) operate at an overall LOS D or better, along with 33 (97 percent) of their 34 individual movements. The 15 unsignalized intersections have 54 movements (86 percent) of their total of 63 individual movements currently operating at LOS D or better.
Merge, Diverges, and Weaves

- In the Western Segment during the AM peak hour, 34 (89 percent) of the total of 38 of these types of movements currently operate at LOS D or better. Similarly, 61 (94 percent) of a total of 65 of these same types of movements in the Eastern Segment operate at LOS D or better.

- During the PM peak hour, 32 (84 percent) out of total of 38 of these types of movements in the Western Segment are currently operating at LOS D or better. In the Eastern Segment, 63 (97 percent) out of a total of 65 of these types of movements operate currently at LOS D or better.

Links

- All (100 percent) of the key links in the study area currently are operating at LOS D or better during both the AM and PM peak hours in both the Western and Eastern Segments of the study corridor.

Conclusion

The vast majority of I-495’s signalized and unsignalized intersections with local streets at its interchanges; merge, diverge, and weave movements on the highway itself; and highway links between interchanges currently operate at uncongested LOS A through LOS D conditions.

Safety

- Records of crashes, organized by interchange were analyzed for the four-year period of 2002-2005. Crashes were categorized by type (property damage, injuries, fatalities), with interchanges ranked by each category. Exit 35 ranks first in terms of total number of crashes and crashes with property damage. Exit 32 ranks first with regard to personal injuries, while Exit 40 ranks first with regard to fatalities.

- The 24 acceleration and deceleration lanes on I-495 determined to be deficient in length present a safety concern.

Public Transportation

- Several forms of public transportation are available in the study corridor.
- Fixed-route local bus service in the Lowell and five surrounding communities is provided by the Lowell Regional Transit Authority. They also provide commuter bus, downtown shuttle and demand responsive paratransit services for the elderly and disabled. Similar services in Lawrence and eight nearby communities is provided by the Merrimack Valley Regional Transit Authority. Services provided by both agencies
are locally oriented and centered on the Lowell and Lawrence hubs, not along the I-495 corridor.

- The Massachusetts Bay Transportation Authority provides commuter rail service on its Lowell and Haverhill/Reading lines. This service is oriented toward Boston, not the I-495 corridor for the most part.
- Other providers of public transportation include AMTRAK, with its Boston to Portland service, stopping in Haverhill, and several intercity bus lines.
- Two transportation management associations, the Junction TMO and the Merrimack Valley TMA, provide carpool matching services to limited areas within the study corridor.
- Three Park & Ride lots are located in the study area. Two are served by public transportation.

Other

Although having no direct connection with this I-495 Corridor Planning Study, MassHighway has placed several projects along I-495 in the study area on its Type II Priority List for noise barrier implementation. These potential projects are located in Westford, Chelmsford, and Lowell. No timetable for their implementation has been developed by MassHighway. More details regarding these projects can be found in Appendix B.