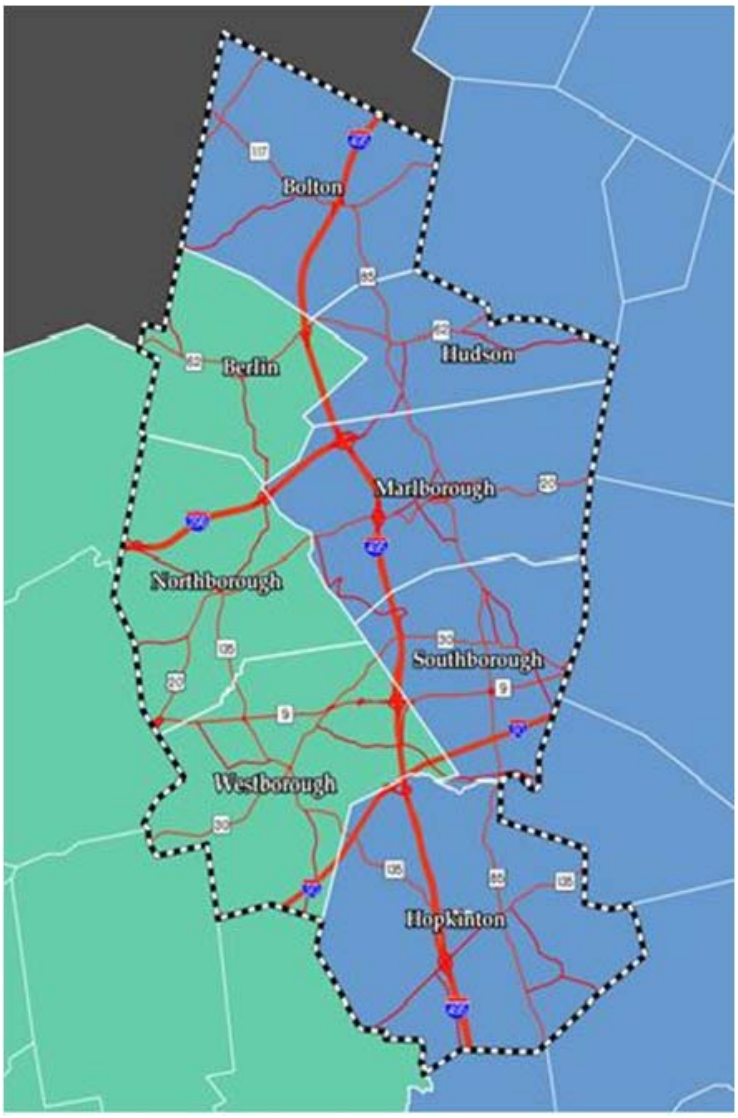
I-495 STUDY – I-290 to I-90



FINAL REPORT

September 16, 2009

CMRPC
Central Massachusetts Regional Planning Commission

MAPC

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I. Background

Constructed between 1958 and 1982, I-495 is one of two major circumferential interstate highways that stretches for 120 miles along a 30-mile radius west of Boston from the Town of Salisbury in the north to the Town of Wareham in the south. The roadway varies in width throughout its length from two lanes in each direction to five lanes in each direction and has a total of approximately 58 interchanges.

The portion of I-495 reviewed for this study is an 18-mile stretch through the towns of Berlin, Bolton, Hopkinton, Hudson, Marlborough, Northborough, Southborough and Westborough. The five interchanges under review along this stretch of I-495 (from north to south) are I-290, U.S. Route 20, Simarano Drive, State Route 9, and I-90/MassPike. Since this section of I-495 was opened between 1964 and 1969, the roadway has undergone a tremendous increase in traffic. Particularly over the past twenty years, the communities abutting I-495 have experienced rapid population and employment growth as a result of their location on the western edge of the Boston urbanized area. This growth has resulted in some current capacity issues associated with the I-495 interchanges along this section of the road and there is an expectation that future growth will cause major traffic issues if not managed properly.

The overall goal of this I-495 Study is to identify the existing and future capacity constraints associated with the I-495 Corridor, and to identify both methods to move more people through the interchanges and strategies that might reduce the single-person auto trips now moving through these interchanges. It is recognized at the outset that it is not economically prudent, nor fiscally likely, to propose that the problems can be solved solely by adding more capacity to the interchanges. Rather, a variety of strategies will be reviewed here including 1) adding capacity, 2) encouraging the redistributing of future employment and population growth, and 3) developing alternatives to the single-occupant vehicle.

II. Existing Conditions

A) Population and Employment

With the completion of I-495, vacant land surrounding the roadway became attractive for all types of development (residential, commercial and industrial) in the late 1970s and early 1980s. Over the last 30+ years, a number of new or relocated large employers have positioned themselves along this portion of I-495, particularly companies in the high-tech, financial and professional sectors, such as Compaq, Hewlett Packard, EMC and Fidelity Investments. In addition to these sectors, the manufacturing, life science, retail and business services industries also have a large presence along or near this corridor.

When I-495 was being constructed in the 1960s many of these communities along I-495 were essentially rural or suburban, with small populations and a number of private schools, local farms, and other rural-type activities. However, along with the increasing relocation of major corporations beginning in the late 1970s to this area of I-495, residential population has also increased, in some cases substantially, in all eight study-area communities.

In 2009, CMRPC and MAPC researched the current employment levels, population numbers and density within this eight community segment of I-495. Tables 1 through 3 show the results of this analysis:

Table 1
Number of Jobs and Population in
Study-Area Communities (2007)

Community	*Number of Jobs within the Community (2007)*	*Number of Residents within the Community (2007)*	*Local Jobs as a Percent of Population*
Berlin	669	2,600	26%
Bolton	2,259	4,864	44%
Hopkinton	9,929	13,873	67%
Hudson	9,697	19,001	48%
Marlborough	31,219	37,201	74%
Northborough	7,120	14,601	49%
Southborough	5,952	9,283	61%
Westborough	26,273	18,700	141%
TOTALS	**93,118**	**120,123**	**73%**

Source: U.S. Census 1980-2007

Table 2
Population Change within Study-Area Communities – 1980 to 2007

Community	*1980*	*1990*	*2000*	*2007*	*Pop. Change 1980-2007*	*% Increase in Pop. (1980-2007)*
Berlin	2,215	2,293	2,380	2,600	**385**	**17%**
Bolton	2,530	3,134	4,148	4,864	**2,334**	**92%**
Hopkinton	7,114	9,191	13,346	13,873	**6,759**	**95%**
Hudson	16,408	17,233	18,113	19,001	**2,593**	**16%**
Marlborough	30,617	31,813	36,255	37,201	**6,584**	**22%**
Northborough	10,568	11,929	14,013	14,601	**4,033**	**38%**
Southborough	6,193	6,628	8,781	9,283	**3,090**	**50%**
Westborough	13,619	14,133	17,997	18,700	**5,081**	**37%**

Source: U.S. Census 1980-2007 and CMRPC/MAPC Projections

Table 3
Population Density within Study-Area Communities (2007)

Community	*Persons per Square Mile*
Berlin	177
Bolton	157
Hopkinton	346
Hudson	1,497
Marlborough	1,508
Northborough	643
Southborough	468
Westborough	689

Source: DHCD Community Profiles

As shown, Marlborough and Westborough have the largest number of jobs and population within the eight community area. This is not a surprise as these two communities are the most densely developed in both commercial and industrial land use. The City of Marlborough has a number of large office parks located near I-495, but its traditional downtown area also is vibrant and includes general service, retail and food service establishments. Similarly, the Town of Westborough has large office parks located at I-495 and Route 9, but also has a large commercial development corridor along Routes 9 and 30, as well as small-scale business in its traditional downtown area.

The Town of Berlin, despite being home to the largest retail shopping mall in the area, is primarily a "bedroom" community. Many of its jobs are related to agriculture or small or at-home businesses; however, the Solomon Pond Mall offers many retail and service type jobs. Like Berlin, Bolton can also best be described as a "bedroom" community. Bolton has the second fewest number of jobs in the eight town I-495 region and the second lowest population.

It also had the second lowest population increase from 1980-2007 and the lowest population density.
Southborough ranks sixth in the total number of jobs in the study area, however it ranks fourth when comparing number of jobs to population in town. Many of the jobs are primarily in the professional office, service and retail sectors located along Route 9 near I-495. Southborough also ranks fifth in population density among the eight towns.

Hudson ranks fourth in the number of jobs in the region but it has the second highest population. It is also the second densest community in the eight town region.

Hopkinton's population ranks it as the fifth most populous community in the eight communities. It has the third highest number of jobs but a relatively low population density.

Northborough had the fourth highest population growth between 1980 and 2007. The Town also has the fifth highest number of jobs with the area, located primarily along Route 20 near I-495.

B) Roadway Characteristics

As mentioned previously, this 18-mile stretch of I-495 intersects with five major routes: I-290, U.S. Route 20, Simarano Drive, State Route 9, and I-90/MassPike. Since 1970, and with the changes in population and employment described in the previous section, through traffic on the mainline of I-495 has increased significantly over time. Table 4 shows this change with the average weekday daily traffic (AWDT) counts at various segments along mainline I-495 within the study area between Hopkinton and Hudson:

Table 4
AWDT on I-495 between Hopkinton and Hudson – 1970-2007

Location	*1970*	*1980*	*1990*	*2000*	*2007*	*% Increase Annually (1970-2007)*
North of West Main Street, Hopkinton	18,000	28,000	60,000	98,000	105,700	13%
North of MassPike, Westborough	16,000	30,000	66,000	100,000	111,700	16%
North of Route 9, Southborough	18,000	32,000	66,000	98,000	101,500	13%
North of Simarano Drive, Marlborough	18,000	32,000	66,000	95,000	98,300	12%
North of Route 20, Marlborough	24,000	40,000	68,000	97,000	100,400	9%
North of I-290, Hudson	30,000	48,000	80,000	110,000	113,800	8%

Sources: 1970-2000 data - "Traffic Volumes on Major Highways in Massachusetts" CTPS Report, May 2007
2007 data - CMRPC Travel Demand Model

Similar to the traffic increases on mainline I-495, the five interchanges have also seen increases in traffic volume. Table 5 shows the current number of vehicles moving through the interchange per day, as well as the A.M. and P.M. peak Volume to Capacity (v/c) ratios for each interchange.

Table 5
Traffic Volumes at Interchanges (2007)

Interchange	***Year Opened to Traffic***	***Current Vehicles Moving through the Interchange***	***Average AM Peak Volume to Capacity (v/c) Ratios***	***Average PM Peak Volume to Capacity (v/c) Ratios***
I-290	1970	52,100 vpd	0.38	0.61
Route 20	1964	50,700 vpd	0.39	0.45
Simarano Drive	2001	7,400 vpd	0.11	0.14
Route 9	1964	57,900 vpd	0.46	0.55
I-90/MassPike	1969	53,800 vpd	N/A	N/A

Source: CMRPC Travel Demand Model

According to the Transportation Research Board's *Highway Capacity Manual*, a roadway's capacity is defined as "the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic and control conditions." The Volume to Capacity (v/c) ratio measures whether the interchange is operating at, near, or over capacity. A v/c of 1.00 indicates that the interchange is at capacity and severely congested. Based on the results above, the data shows that each interchange overall is not at capacity. While the interchanges as a whole are not at capacity, some ramps at each of the interchanges are already over capacity during various peak periods. For example, the I-495/Route 9 interchange has an overall P.M. peak v/c of 0.55, yet four of its eight ramps have a v/c above 1.00 and are currently overcapacity. Figures 1 through 4 shows this information graphically highlighting each interchange's ramps that were over capacity in 2007.

Figure 1
I-290/I-495 Interchange Congestion by Volume to Capacity (2007 – AM and PM Peak)

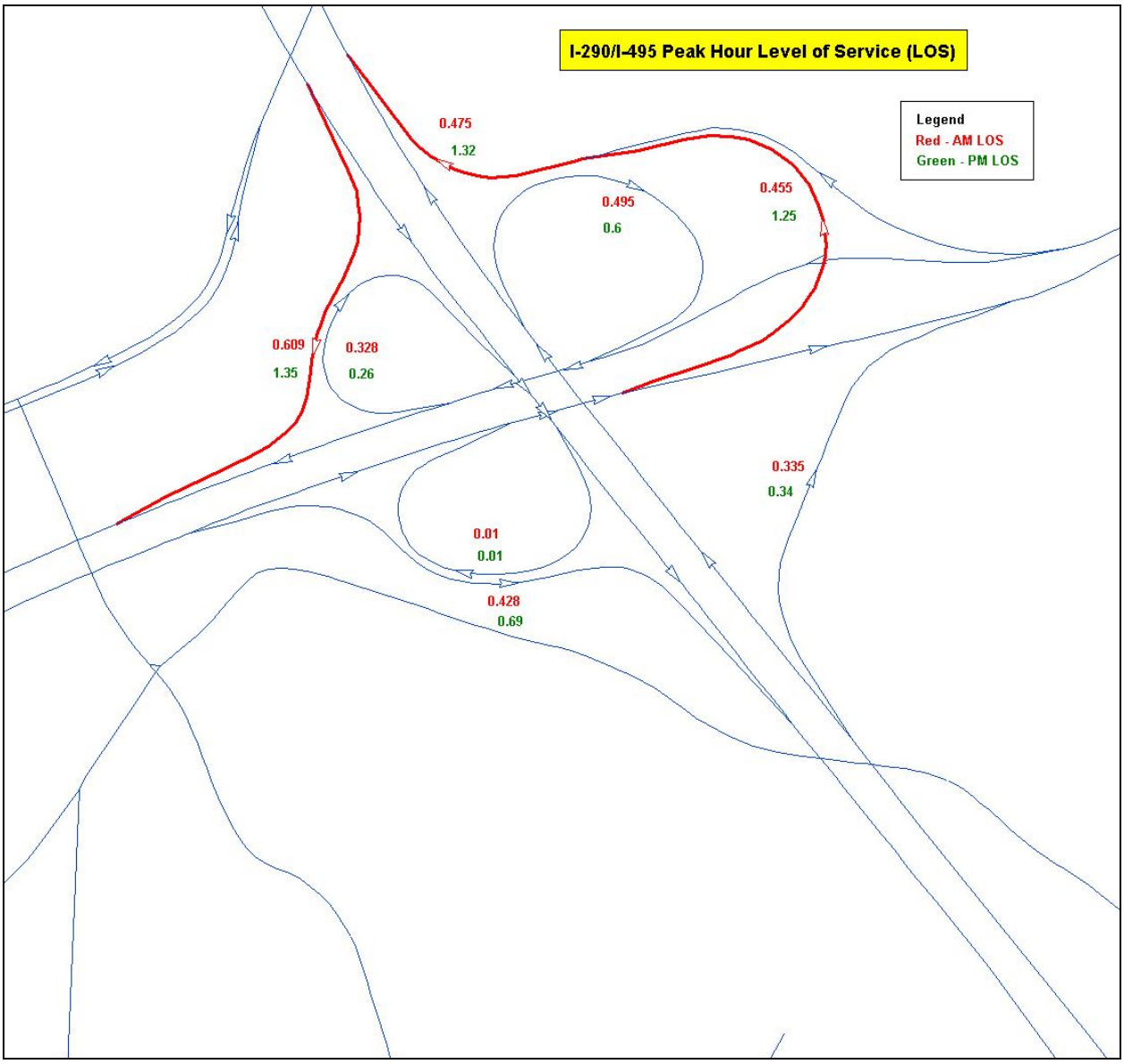


Figure 2
Route 20/I-495 Interchange Congestion by Volume to Capacity (2007 – AM and PM Peak)

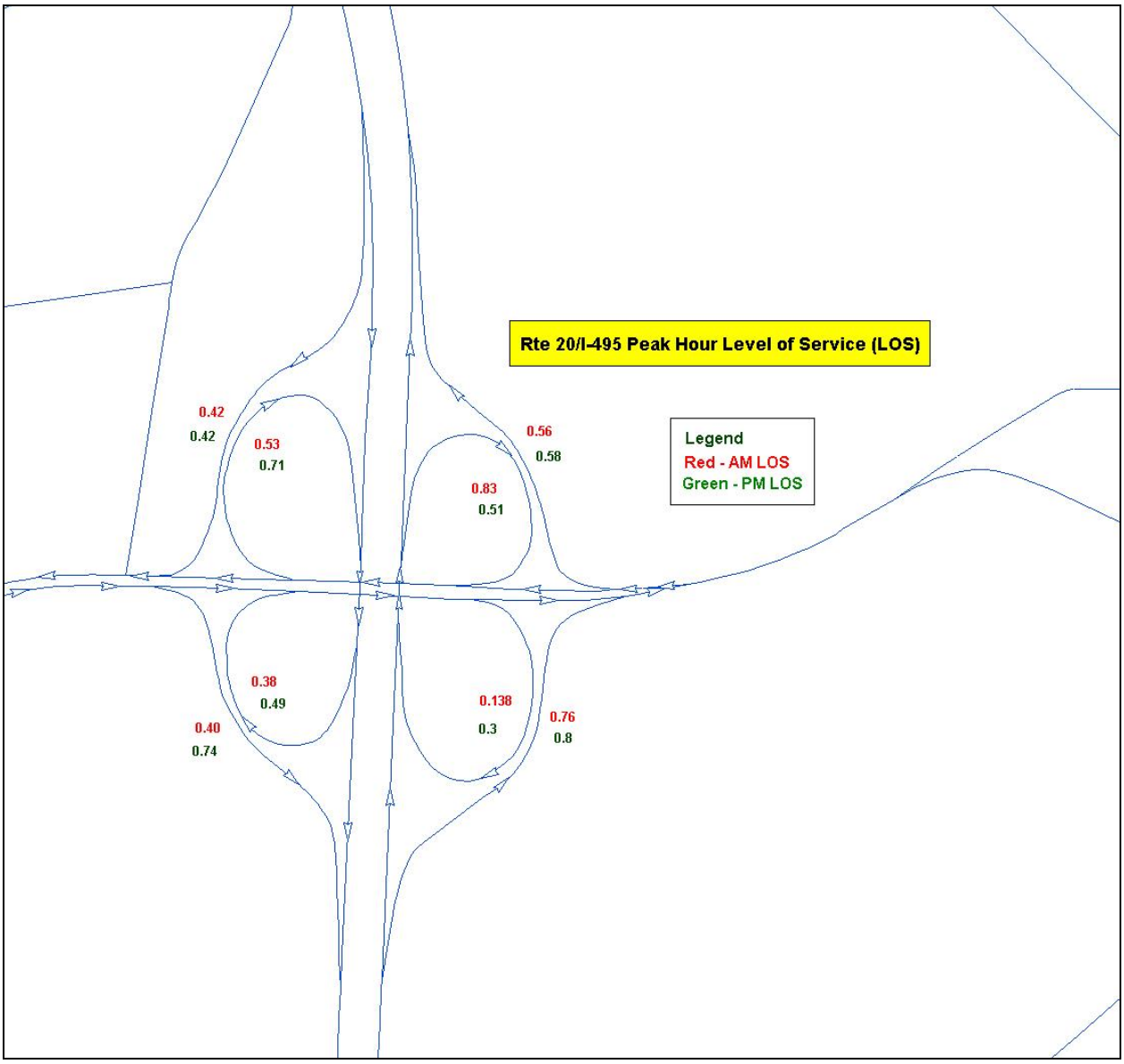


Figure 3
Simarano Drive/I-495 Interchange Congestion by Volume to Capacity
(2007 – AM and PM Peak)

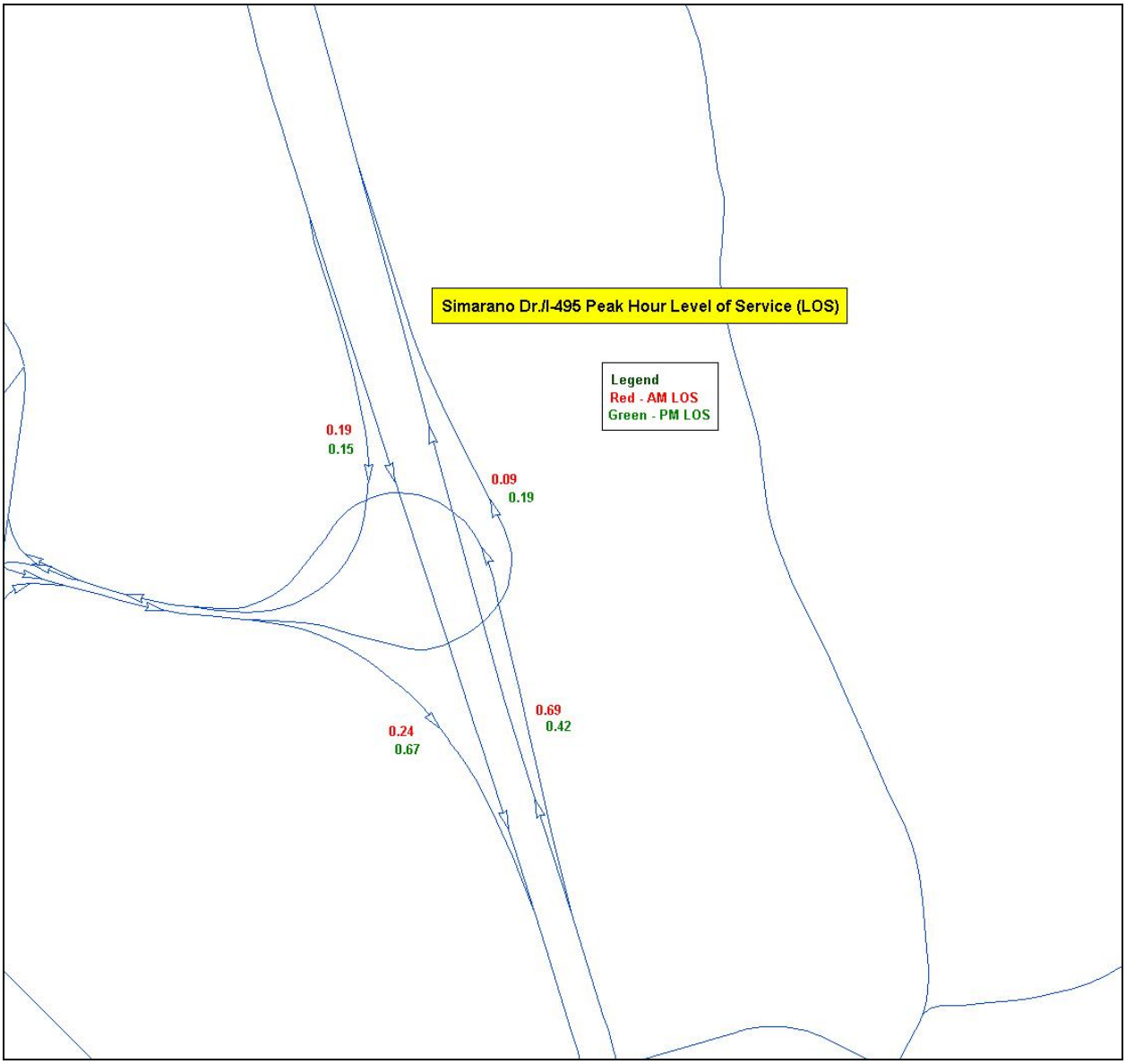
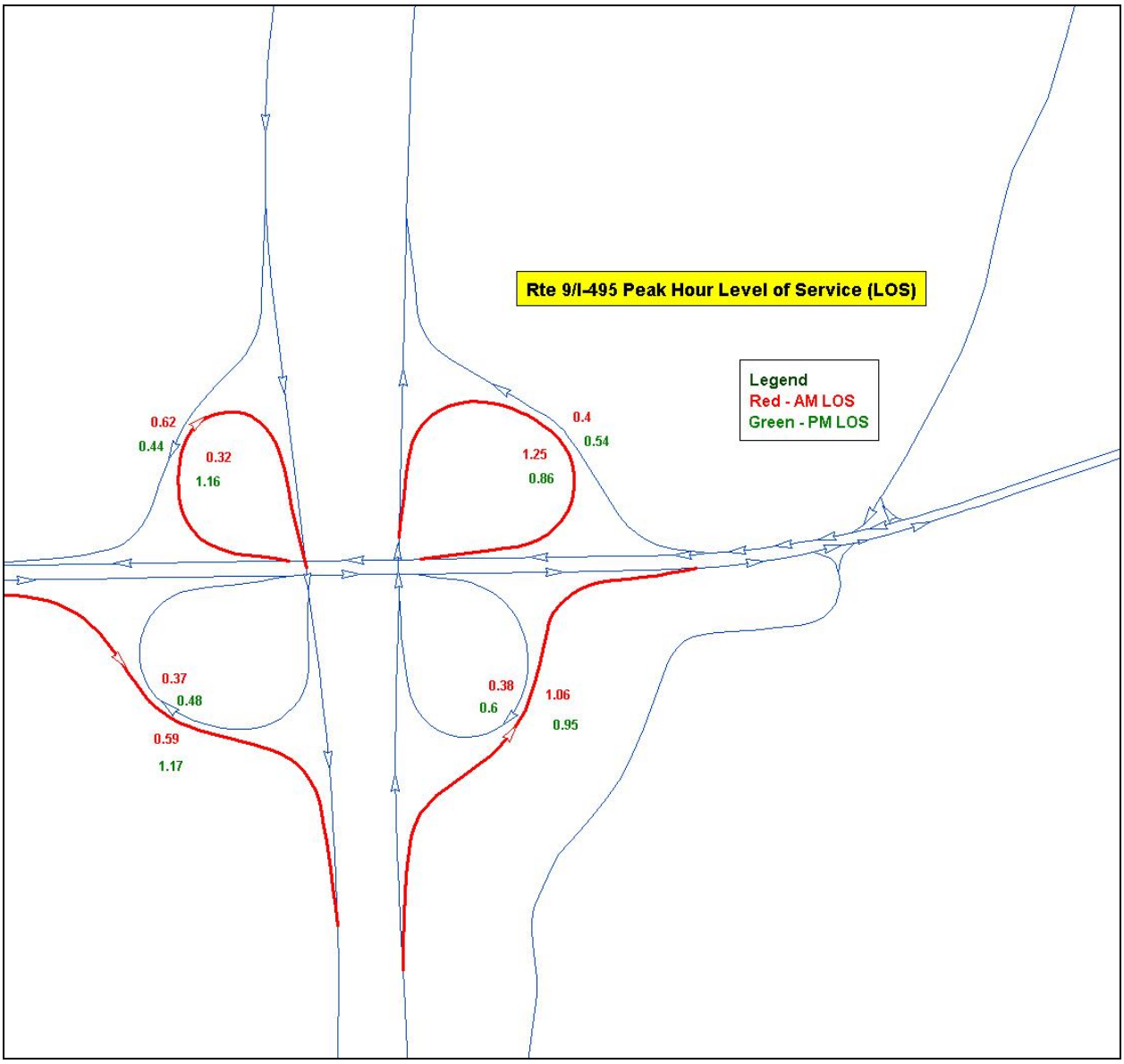


Figure 4
Route 9/I-495 Interchange Congestion by Volume to Capacity (2007 – AM and PM Peak)



C) Existing Alternatives to Single Occupancy Vehicles (SOVs)

As noted throughout earlier text, the construction of I-495 has had significant impact on the development of this area. Not surprising, the area has been very auto-dependent thus far. Still, there is a growing desire to provide alternatives to single occupancy vehicles in order to provide for individuals who: 1) do not drive, 2) can't afford an automobile, 3) are concerned about the environmental effects of auto-dependency, and 4) would like to counteract congested roadways. There are currently a few existing transportation alternatives within the study area. Beginning operations in July 2008, the MetroWest Regional Transit Authority (MWRTA) was established to meet the transit needs of those living in the MetroWest area. The MWRTA continues to expand and refine transit service in the area and has a current service region of 11 towns. Originally operated by the Worcester Regional Transit Authority (WRTA), The Local Connection (TLC) was a dial-a-ride transit service that provided connections throughout Southborough and Marlborough to area employers, downtowns, retail centers and the Southborough MBTA commuter rail station. Now under the operation of the MWRTA, the TLC has been renamed The Dial-a-Ride. The service is contracted to a private transportation company and provides van service to elderly and disabled riders and some employees of area companies. The Dial-a-Ride service provides approximately 2,000 trips per month.

The MetroWest/495 Transportation Management Association (TMA) is a member-based organization that strives to reduce congestion and improve air quality by promoting carpooling, vanpooling, taking public transit, biking and walking to work to nearly 40,000 employees of more than 30 member companies in Framingham, Hopkinton, Marlborough, Natick, Southborough, Sudbury and Westborough. Operated under the auspices of the MetroWest and the Marlborough Regional chambers of commerce, the TMA's five key efforts include:

- Promoting a free, secure ridematching database for employees of member companies
- Offering a free Guaranteed Ride Home to member company employees who leave their cars at home at least two days a week.
- Reaching out to employees in member companies at regular onsite events, to educate them on the supporting programs and benefits of giving their cars a break.
- Promoting public transit in the region by sharing schedules, routes and maps of public transit in the region.
- Advocating, lobbying and joining coalitions locally, state-wide and nationally to change American's habit of driving a car alone to work.

In an effort to assist with carpooling, vanpooling and ridesharing efforts, MassHighway and the Massachusetts Turnpike Authority have constructed Park and Ride lots at various locations within the study area. One is located at the I-495 and Route 62 interchange in Berlin and is owned by MassHighway. The facility has a total of 45 parking spaces with an average of 33 of them used primarily for carpooling and vanpooling during daytime work hours on weekdays, however on some days the lot is more heavily used. Amenities such as bicycle racks, telephones and lighting are not included with the facility and transit access is also not available for the area. Continued monitoring of this lot could show further increases in use and possible expansion of its capacity in the future.

III. Current Growth Trends and Associated Projections

A) Population and Employment Growth

It is projected that population and employment will continue to grow in this area over the coming decades. Using population and employment projections from both the Central Massachusetts and Boston Region Metropolitan Planning Organization's 2007 Regional Transportation Plans, population is expected to grow by 15.4% and jobs are expected to rise by 9.7% within the eight community region between 2007 and 2030. During this period, the study area's population is expected to rise to a total of 138,683 residents and have a total of 102,168 jobs. Table 6 shows the projected population and employment numbers for 2030 by each community.

Table 6
Population and Employment Projections by Community (2007-2030)

Community	***2007 Pop.***	***2030 Pop.***	***Pop. Change 2007-2030***	***% Increase in Pop. (2007-2030)***	***2007 Emp.***	***2030 Emp.***	***Emp. Change 2007-2030***	***% Increase in Emp. (2007-2030)***
Berlin	2,600	3,100	**500**	19%	700	800	**100**	14%
Bolton	4,900	7,200	**2,300**	47%	2,300	2,600	**300**	13%
Hopkinton	13,900	15,600	**1,700**	12%	9,900	11,600	**1,700**	17%
Hudson	19,000	21,900	**2,900**	15%	9,700	11,400	**1,700**	18%
Marlborough	37,200	40,300	**3,100**	8%	31,200	32,200	**1,000**	3%
Northborough	14,600	16,400	**1,800**	12%	7,100	8,300	**1,200**	17%
Southborough	9,300	10,900	**1,600**	17%	5,900	6,900	**1,000**	17%
Westborough	18,700	23,200	**4,500**	24%	26,300	28,600	**2,300**	9%
Totals	***120,200***	***138,600***	***18,400***	***15%***	***93,100***	***102,400***	***9,300***	***10%***

Source: Central Massachusetts and Boston Metropolitan Planning Organizations

As is shown, the largest growth in population is projected to occur in Westborough, Marlborough, and Hudson, and the largest growth in jobs is projected to occur in Westborough, Hudson, and Hopkinton. This will further impact I-495, especially at I-90/MassPike, Route 9, and I-290.

B) Current and Projected Land Use

The following local project bullets shown are only a sample of what is being developed and/or permitted in a community:

1) Berlin

The Town of Berlin is divided into seven Zoning Districts: Residential and Agricultural (RA), Multiple Dwelling (MD), Commercial – Village (CV), Commercial (C), Limited Business (LB), Limited Industrial (LI), Agricultural-Recreation-Conservation (ARC). Except in the

Residential–Agricultural District, more than one principal use may be established on a lot, pursuant to a special permit issued by the Board of Appeals. At the spring 2008 Town Meeting, voters approved a rezone of 80 acres at the Hudson/Berlin town line to accommodate the construction of the Highland Commons development (see page 14). In addition, developers have continued to show interest in the River Road area south of the Berlin Rotary to I-290. While various proposals have been presented, Town Meeting has voted down rezoning land along River Road twice.

Other projects completed, under construction or expected to be developed in Berlin include:

- Pure Hockey – a 25,000 square foot commercial space (now half occupied) that sells hockey equipment. This development is located near the Solomon Pond Mall on River Road
- Sawyer Hill EcoVillage – a 65-unit co-housing development modeled after ones in Europe that was constructed as a Chapter 40B development
- Two additional Chapter 40B developments have been approved by the Planning Board; however no action has begun on them as of yet

2) Bolton

The Town of Bolton is divided into six zoning districts and a Wireless Communication Overlay District. These districts include Residential, Business, Limited Business, Industrial and Limited Recreation Business. Farmland and Open Space Planned Residential Developments (FOSPRD) are allowed by special permit on parcels zoned residential which are at least 10 acres. The majority of current development is residential or municipal. There are four 40B developments and the rest of the residential development is occurring under the FOSPRD regulations. The town's web site lists the following current projects:

- Bolton Manor is a 40B condominium development consisting of 36 single family detached condos. This project has been approved and permitted
- Regency at Bolton, a 40B condominium development consisting of 60 townhouses is under construction
- Century Mills Estates is a single family detached development consisting of 71 units and has been approved
- The Oaks is a residential development of 34 lots. Individual lots are currently for sale or under construction
- The Bolton Public Library is undergoing a two story addition to the existing history library. There is also an addition to the fire station for a public safety facility which is under construction now

3) Hopkinton

The Town of Hopkinton is divided into the following zoning districts: Residence A, Residence B, Residence Lake Front, Agricultural, Business, Downtown Business, Rural Business, Industrial A, Industrial B, Professional Office. The Town has the following overlay districts: Water Resources Protection Overlay and Open Space Mixed Use Development, Floodplain and a Hotel Overlay.

The Town of Hopkinton reports the following development projects:

- Legacy Farms, the development of a portion of Weston Nurseries, will have 940 residential units and 450,000 sf of commercial space. The project is in the permitting process
- Highland Park IV has been permitted and will have 24 single family lots
- Maspenock Woods will have 31 condominiums and has been permitted
- Hopkinton Square has been permitted for 100,000 sf retail and office
- 77 West Main Street is a 10,000 sf medical office building which is under construction

4) Hudson

The Town of Hudson is divided into six zoning districts and five overlay districts. The zoning districts are: Single Residence, Multiple Residence, Mobile Home, Commercial, Limited Commercial and Light Industrial, Industrial. The overlay districts are the Floodplain/Wetlands District, Watershed Protection Overlay District, Retirement Community Overlay District, Wireless Communications Facility Overlay District and Adaptive Re-use Overlay.

The Towns' website lists the following residential projects:

- Brigham Hill III is a 36 lot subdivision which is under construction
- Westridge Retirement Community is a 55+ age restricted community with 147 units under construction
- A 22,000 sf expansion of the Wal-Mart on Washington Street has been approved
- The Senior Center on Church Street is being expanded and renovated. The project is 14,000 sf
- Route 85 is slated for an expansion along a 1.5 mile stretch and will be converted from a two-lane cross section to a four-lane cross section. The widening of this roadway will enable additional commercial growth and expansion, particularly at the intersection of the I-290 Connector Road and Route 85

5) Marlborough

There are eleven regular zoning districts and three overlay districts. The regular zoning districts are: Rural Residence, Residence A-1, Residence A-2, Residence A-3, Residence B, Residence C, Retirement Community Residence District, Business District, Commercial and Automotive District, Limited Industrial and Industrial. The overlay districts are: Retirement Community Overlay, Floodplain and Wetland Protection District and the Water Supply Protection District.

- A definitive plan has been approved for a commercial development with 3 lots called Devonshire at 495
- Mauro Farms is a residential development with 27 lots which has been approved
- Cider Mill Estates is a 20 lot subdivision which is under construction
- Water's Edge is a 50 lot subdivision which is complete
- Fay Farm Estates is a 53 lot subdivision at which the homes have been completed and work is still underway on roadways

6) Northborough

The Town of Northborough is divided into 14 Zoning Districts, four of which are overlay districts. These districts include three single-family residential districts (A, B and C), General Residential Districts, Apartment Districts, Business Districts (A, B and C), Industrial Districts (A and B), and Overlay Districts (Floodplain Overlay District, Groundwater Protection Overlay District, Historic Overlay District and Senior Residential Community Overlay District). The Town is currently focusing commercial and/or industrial development on the southwest end of town after granting two use variances for The Loop/Avalon Bay mixed-use development, which includes 570,000 square feet of retail space plus 350 apartments with 20 percent of them being affordable. Development in this area is most likely to impact the I-495/Route 20 interchange. Other projects completed, under construction or expected to be developed in Northborough include:

- A. Duie Pyle's 100,000 sq. ft distribution center on 24 acres – occupied 12/2007
- Saint-Gobain facility expansion from 96,918 sq ft to 240,000 sq ft with 730 parking spaces. Construction to take place over 10-15 years. This development is located off I-290 near the I-495 interchange
- Two warehouse facilities, four office facilities, three industrial lots, one residential lot and a Stop and Shop supermarket have totaling approximately 400,000 sq ft in various locations around town have been permitted but not built
- One hundred fifty-nine (159) units of residential housing, including 65 units of senior community housing and 67 units of Chapter 40B housing, in various locations around town have been built. Another residential project is currently at a standstill
- Three potential commercial projects currently under review totaling 1,784,000 sq ft with the potential of including 6,000 parking spaces in various locations around town

7) Southborough

Southborough has eleven zoning districts. They are: Residence A, Residence B, Industrial, Industrial Park, Conservation, Wetland and Floodplain, Research, Scientific and Professional, Critical Resource, Village Business, Highway Business and Wireless Communication Service District. The following is a list of current development activity:

- Meetinghouse Farm is a development with 29 condominiums which is under construction
- Woodland Meadows is a 40B development with 16 condominium units which is in the permitting process
- The Fay School Master Plan is a multiphase development consisting of two village dorm buildings, a wastewater treatment plan, a maintenance building, wellness center, athletic fields, access drives and an enhanced pedestrian system. Construction has begun
- Southborough Place is a recently completed office building in the 100,000-200,000 sf range
- The Verizon property is a 51.5 acre site with a 362,676 sf building. Verizon occupies the building and has a two year lease. The property was recently purchased and development of some type is expected after the expiration of the lease

8) Westborough

The Town of Westborough is divided into 15 Zoning Districts, one of which is an overlay district. These districts include four residential (Single Residential, Neighborhood Residential,

Garden Apartment and High Rise Apartment) districts, three business (Highway Business, Downtown Business and Gateway 2) districts, three industrial (Exclusive Industrial, General Industrial and Mixed Use Industrial) districts, two Conservation Districts, one State, MDC and Municipal district, one Town-owned property district, one Adult Entertainment district, one Downtown Planning Overlay District and a new Transit-Oriented Development (TOD) district near the Westborough commuter rail station

The following is a list of current development activity in Westborough:

- Since January 1, 2006, the Town had 379 valid single family home sales and 101 valid condominium sales
- Constructed "Bay State Commons" which is a mixed-use development containing 325,000 sf of retail and restaurant space with 64 residential condominiums and a parking garage on a former industrial site. A two-acre public park was also created by the developer. Bay State Commons was completed in 2008
- Westborough Village is a mixed-use transit-oriented village containing 325 residential home ownership units within walking distance to the Westborough MBTA commuter rail station. This new project also will contain 20,000 sf of commercial use and has yet to begin construction
- Two new Herb Chambers automobile dealerships were completed in July 2009 at the intersection of Route 9 and Otis Street
- A new industrial subdivision located at 9 Otis Street is in the final stages of the approval process

C) Additional Major New Developments Currently Planned

Within the eight community area, the following three development projects were considered "regionally significant" because of the size of the development proposed and the number of significant impacts to area land use, transportation infrastructure, roadway capacity and regional vehicle traffic.

1) EMC Corporation

EMC Corporation has completed Final Environmental Impact Reports (FEIRs) for a planned expansion of its existing facility at the Route 9/I-495 interchange in Southborough and Westborough. The project consists of the construction of approximately 2,180,000 square feet of new and renovated research and development space, as well as office space, on two connected parcels totaling 445 acres between 2007 and 2016. The project includes approximately 8,550 parking spaces and is expected to generate approximately 15,500 new vehicle trips per day. Further, the site layout includes a common driveway that accesses both parcels, large areas of open space, and a conservation restriction that will preserve approximately 76 acres of the site.

2) Highland Commons

This multi-phased development has undergone an Expanded ENF as well as a Single EIR and will be built near the Route 62/I-495 interchange on the Hudson/Berlin town lines. This project originally consisted of the construction of a commercial shopping center, hotel and residential subdivision. With a May 2009 Notice of Project Change approval, the project has dropped the hotel and residential subdivision from its plan and replaced them with 540,000 square feet of

retail space and redevelopment of an existing office building from 16,700 square feet to a 29,400 square foot two-story office building. Full build-out of this project will result in the generation of 39,750 new daily trips and 3,630 new weekday evening trips. Because of the impact from this project, the proponent is proposing mitigation at three intersection locations: Route 62 at I-495 Northbound Ramps, Route 62 at I-495 Southbound Ramps, and Route 62 and Gates Pond Road. This project has been approved at the local level and is currently under construction.

3) Beacon at 495

This project consist of a mixed-use development which includes 675,000 square feet of office and retail space, two restaurants, 2,150 surface parking spaces, 560 underground parking spaces and access points off Route 20 and Ames Street. The site is an 80-acre site in Marlborough at the Route 20 and I-495 interchange. The project is also adjacent to another retail center project by the same developer and therefore, the impacts and mitigation measures should be considered together.

D) Roadway Projections

Using the study area's Travel Demand Model, traffic volumes were estimated for each study interchange for the model year 2030 to determine their use on an average weekday. Tables 7 and 8 show the projected use of each interchange by the number of vehicles per day and by the A.M. and P.M. peak period volume to capacity ratio:

Table 7
Comparison of Traffic Volumes at Interchanges (2007 – 2030)

Interchange	*Year Opened to Traffic*	*Projected Vehicles Moving through the Interchange (2007)*	*Projected Vehicles Moving through the Interchange (2030)*	*Percent Growth between 2007 and 2030*
I-290	1970	52,100 vpd	59,700 vpd	15%
Route 20	1964	50,700 vpd	68,300 vpd	35%
Simarano Drive	2001	7,400 vpd	18,300 vpd	147%
Route 9	1964	57,900 vpd	78,600 vpd	36%
I-90/MassPike	1969	53,800 vpd	76,400 vpd	42%

Source: CMRPC Travel Demand Model

Table 8
AM and PM Peak Volume to Capacity Ratios – 2007 and 2030

	Current (2007)		*Projected (2030)*	
Interchange	***Average AM Peak Volume to Capacity (v/c) Ratios***	***Average PM Peak Volume to Capacity (v/c) Ratios***	***Average AM Peak Volume to Capacity (v/c) Ratios***	***Average PM Peak Volume to Capacity (v/c) Ratios***
I-290	0.38	0.61	0.39	0.72
Route 20	0.39	0.45	0.50	0.56
Simarano Drive	0.11	0.14	0.30	0.35
Route 9	0.46	0.55	0.62	0.77
I-90/MassPike	N/A	N/A	N/A	N/A

Source: CMRPC Travel Demand Model

Similarly, Table 9 shows projected increases in traffic volume on the I-495 mainline between 2007 and 2030 within the study area.

Table 9
Projected AWDT on I-495 between Hopkinton and Hudson – 2007-2030

Location	**2007**	**2030**
North of West Main Street, Hopkinton	105,700	139,600
North of MassPike, Westborough	111,700	150,200
North of Route 9, Southborough	101,500	131,600
North of Simarano Drive, Marlborough	98,300	123,900
North of Route 20, Marlborough	100,400	121,200
North of I-290, Hudson	113,800	134,100

Source: CMRPC Travel Demand Model

Similar to Figures 1 through 4, Figures 5 and 6 show the regional impact of each interchange's ramps, as well as the I-495 mainline, that is over capacity in both 2007 and projected for 2030. When comparing Figures 5 and 6 side by side, traffic volume along I-495 and the interchanges are projected to increase significantly. In 2030, the I-495 mainline is completely congested throughout the entire study area and two additional interchange ramps at the Route 9 interchange have become more congested in the A.M. and P.M. peak periods. This is a significant piece of information because it shows that as future traffic volumes increase, these already overcapacity ramps in 2007 will continue to worsen if no action is taken by 2030.

Figure 5
Current Interchange and Mainline Congestion by Volume to Capacity
(2007)

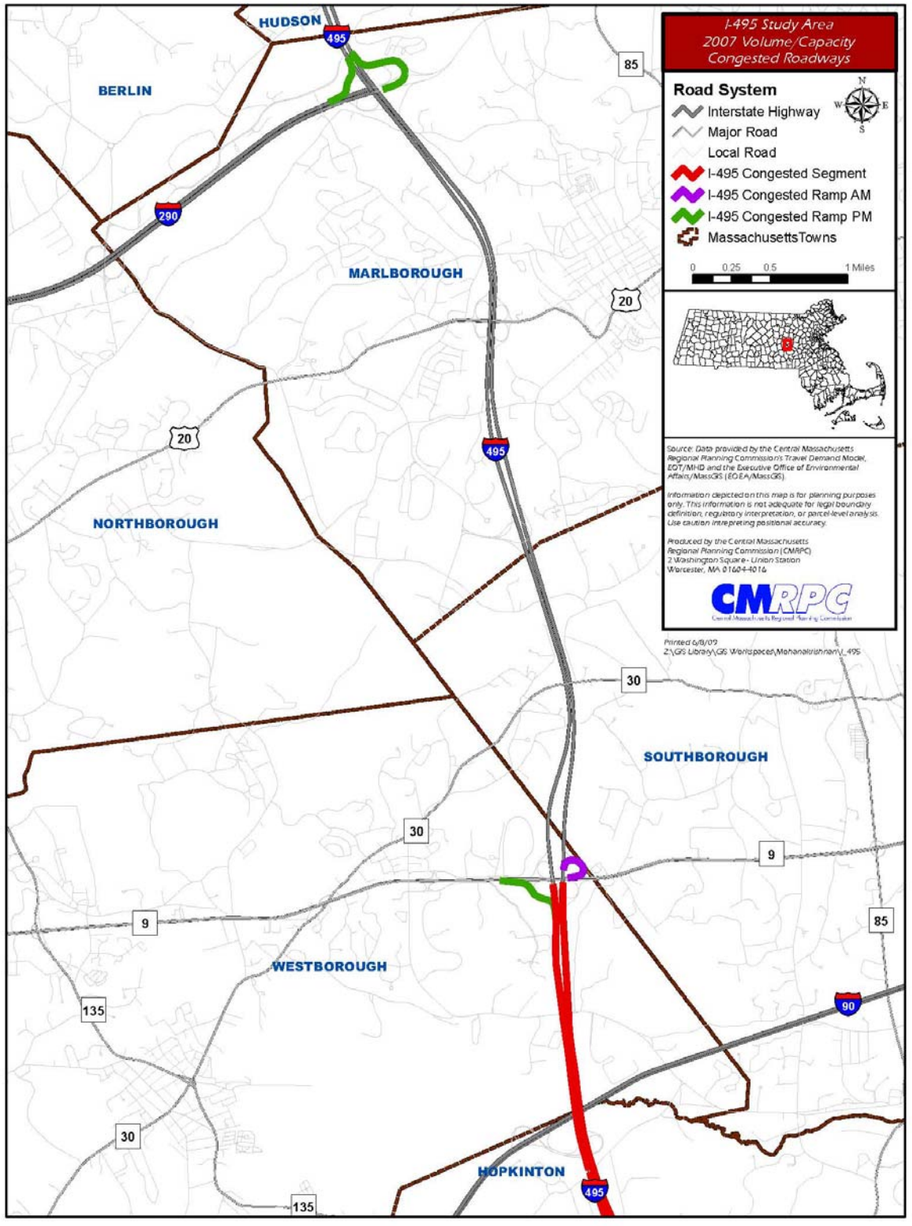
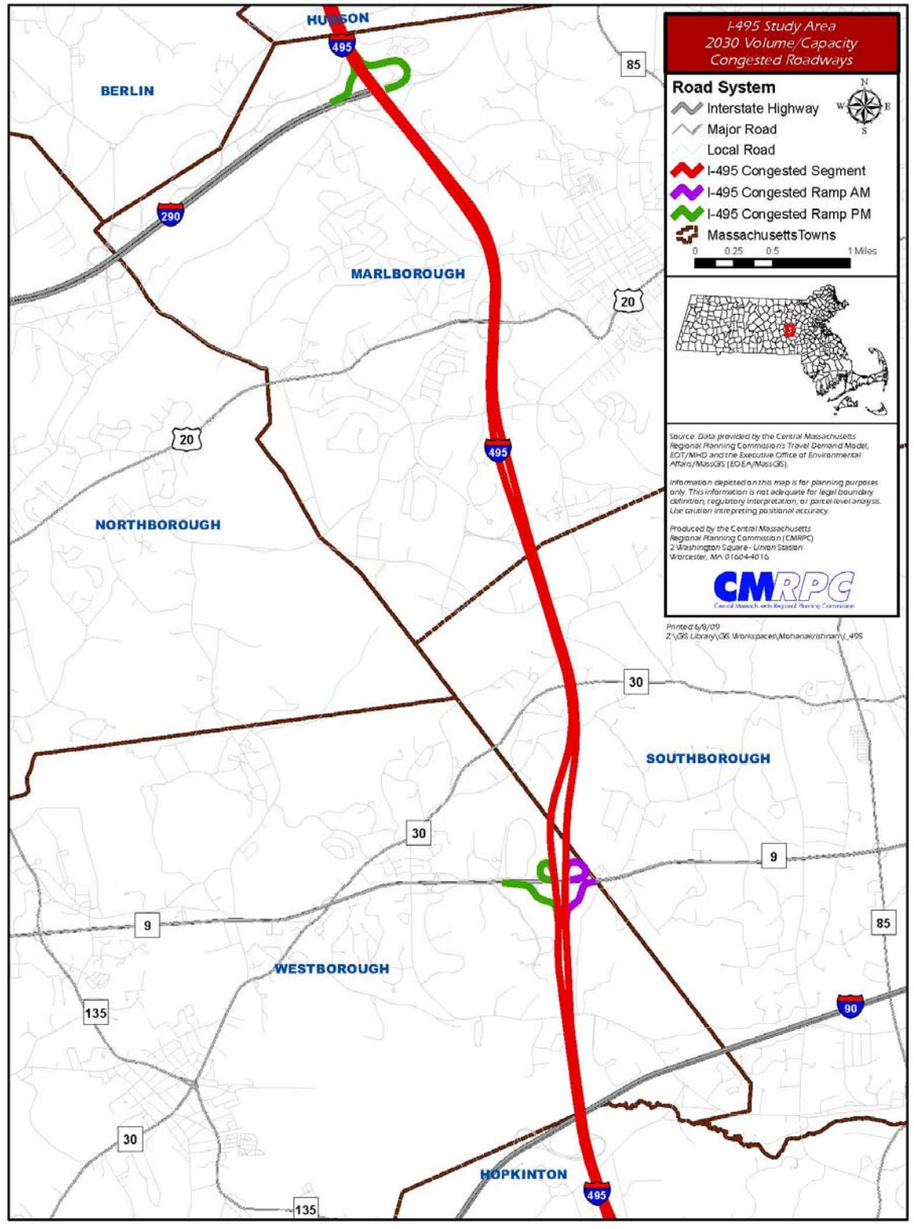


Figure 6
Projected Interchange and Mainline Congestion by Volume to Capacity
(2030)



IV. Alternatives Consideration

A) Roadway Infrastructure Improvements

A number of highway alternatives and improvements were analyzed for their ability to relieve congestion at key interchanges and/or move traffic more efficiently along I-495. These concepts/alternatives include:

- Physical separation of through trip traffic along parts of I-495 from I-290 to the MassPike
- New ramp designs at Route 9, Route 20 and I-290
- Siting of collector-distributor road(s) between Route 9 and I-90/MassPike and between Route 20 and Route 9
- Siting of collector-distributor road(s) along Route 9 (Lyons Street to I-495)
- Proposed roadway improvements to Flanders Road
- Eliminating all weaves at the I-495/MassPike toll plaza

After presenting these initial concepts to set groups of stakeholders, the concepts were further refined and the following combination of alternatives were analyzed using the travel demand model.

Please see below for definitions of transportation terms used in the description of alternatives:

Collector-Distributor (C/D) Road: Is a one-way road next to a freeway that is used for some or all of the ramps that would otherwise merge into or split from the main lanes of the freeway. In the simplest form, all ramps that would normally touch the freeway are instead shifted outwards to the C/D road. There is still weaving, but it is no longer on the main lanes.

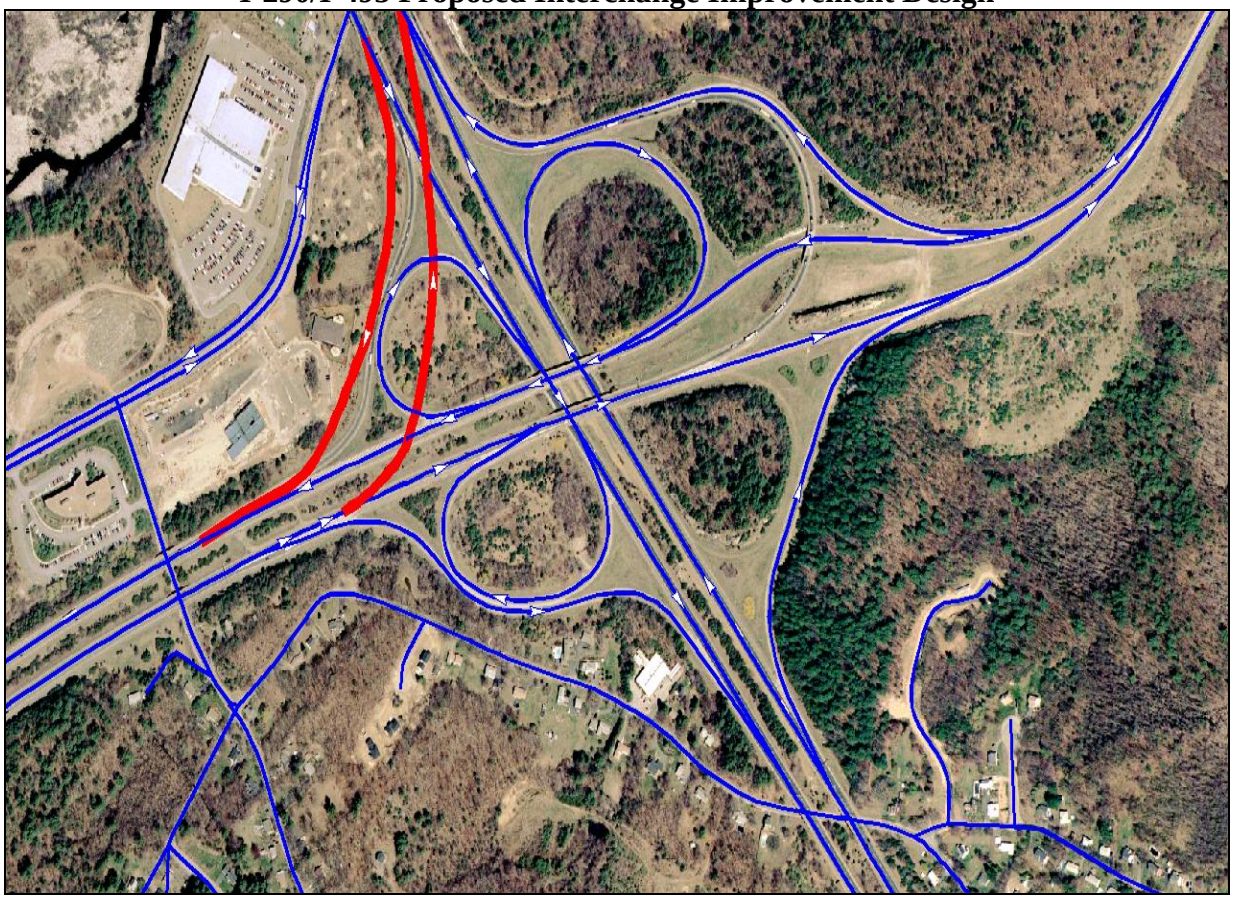
Weaving: Occurs when one vehicle movement crosses the path of another along a highway facility section without the intervention of a control device (e.g. traffic signal).

Merge: Two separate traffic streams form a single one.

1) *I-290/I-495 Interchange improvements:*

This interchange is currently being studied by MassHighway and the proposed design concept as recommended by MassHighway was modeled. This design concept was modified by MassHighway from a preferred alternative presented previous in an effort to expedite construction and lower project costs. This alternative eliminates the existing sharp/hairpin turn from I-290 eastbound to I-495 northbound and replaces it with a flyover ramp. Also the ramp from I-495 southbound to I-290 westbound will be straightened to improve safety. Both of these new ramps will be constructed two lanes wide and will increase capacity over the existing one lane ramps. Figure 7 depicts the proposed improvements in red. The blue lines show the existing infrastructure that will remain unchanged and the non-highlighted lines are the infrastructure that will be eliminated in the proposed improvements.

Figure 7
I-290/I-495 Proposed Interchange Improvement Design

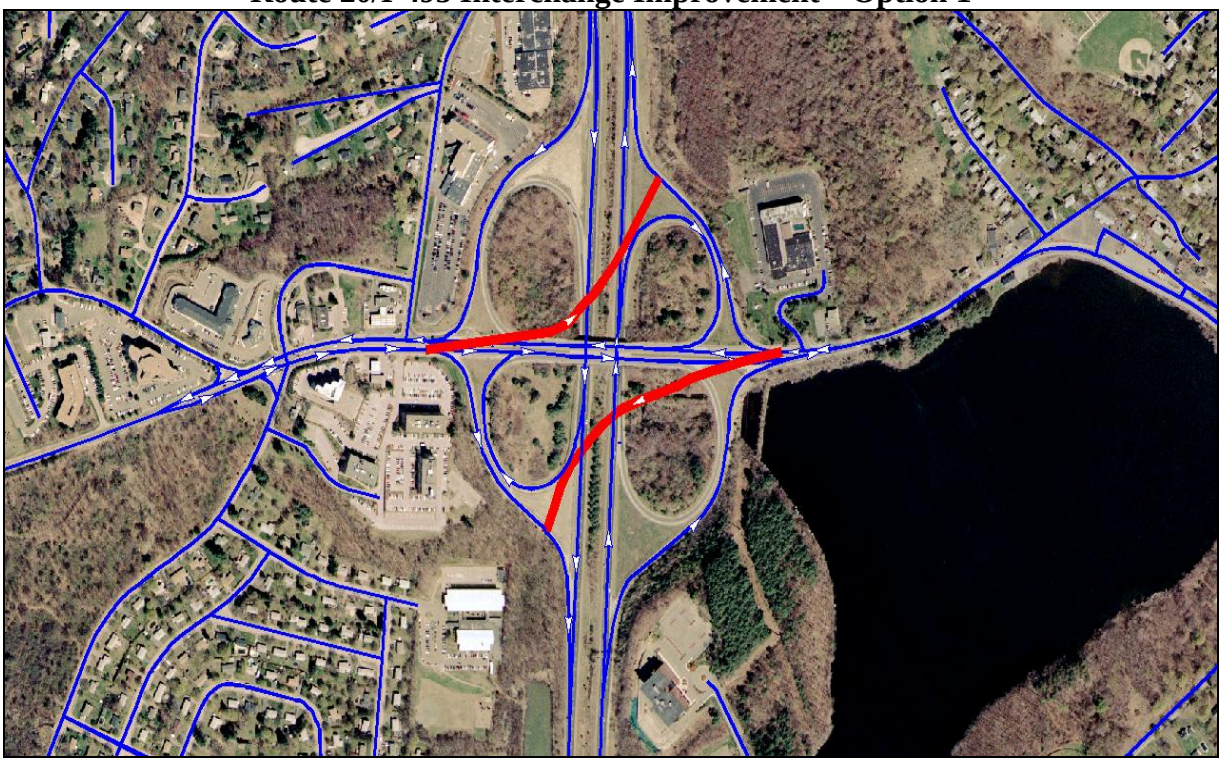


Footnote: The alignment for the I-290/I-495 interchange as shown was provided by MassHighway, however the City of Marlborough has stated that the preferred alternative shows an additional flyover ramp from I-495 northbound to I-290 Westbound and that this alternative should be considered in any future study of the I-495 corridor.

2) *Route 20/I-495 Interchange improvements:*

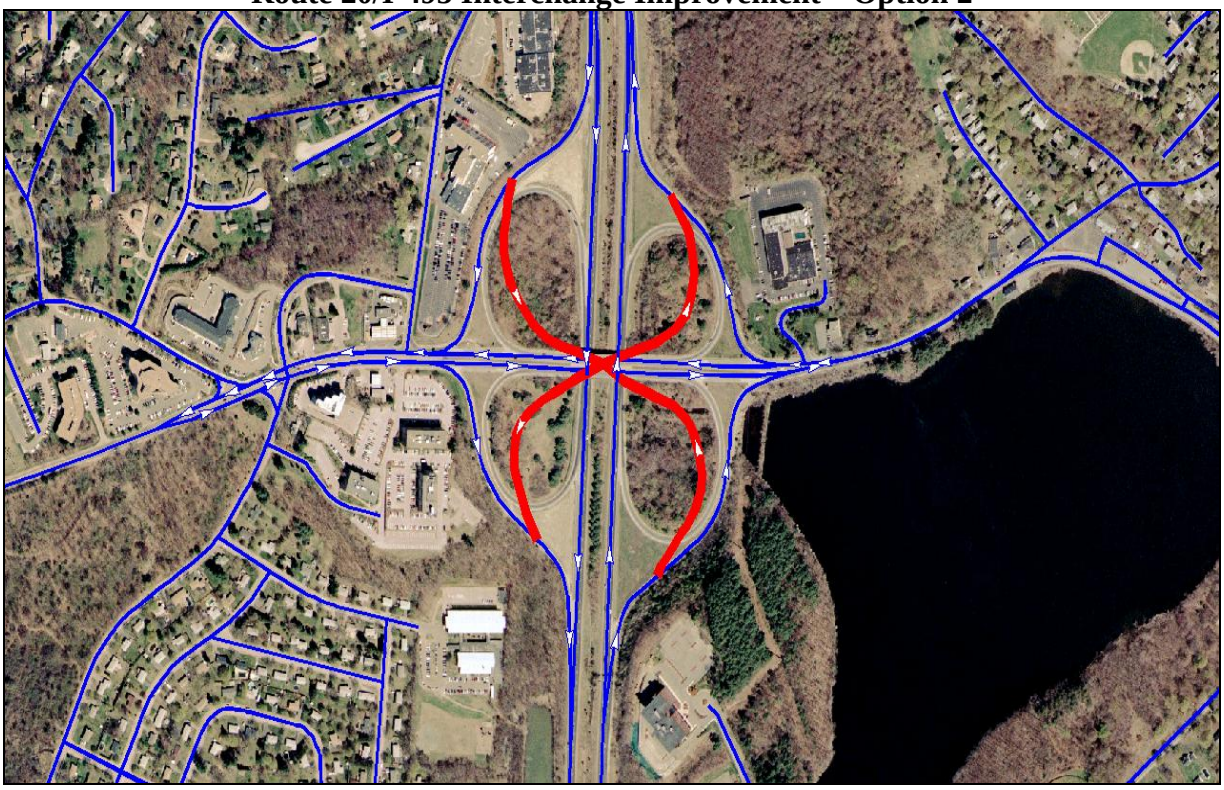
a) *Option 1:* This improvement modifies two sharp turn moves from Route 20 to I-495 with flyover ramps. These ramps reduce the number of weave sections at this interchange by combining all the traffic from Route 20 in both directions to I-495 northbound and southbound before it enters the mainline. This reduces the number of entrance ramps from four to two, thereby enhancing capacity and safety at the interchange. Figure 8 depicts the proposed improvements in red. The blue lines show the existing infrastructure that will remain unchanged and the non-highlighted lines are the infrastructure that will be eliminated in the proposed improvements.

Figure 8
Route 20/I-495 Interchange Improvement – Option 1



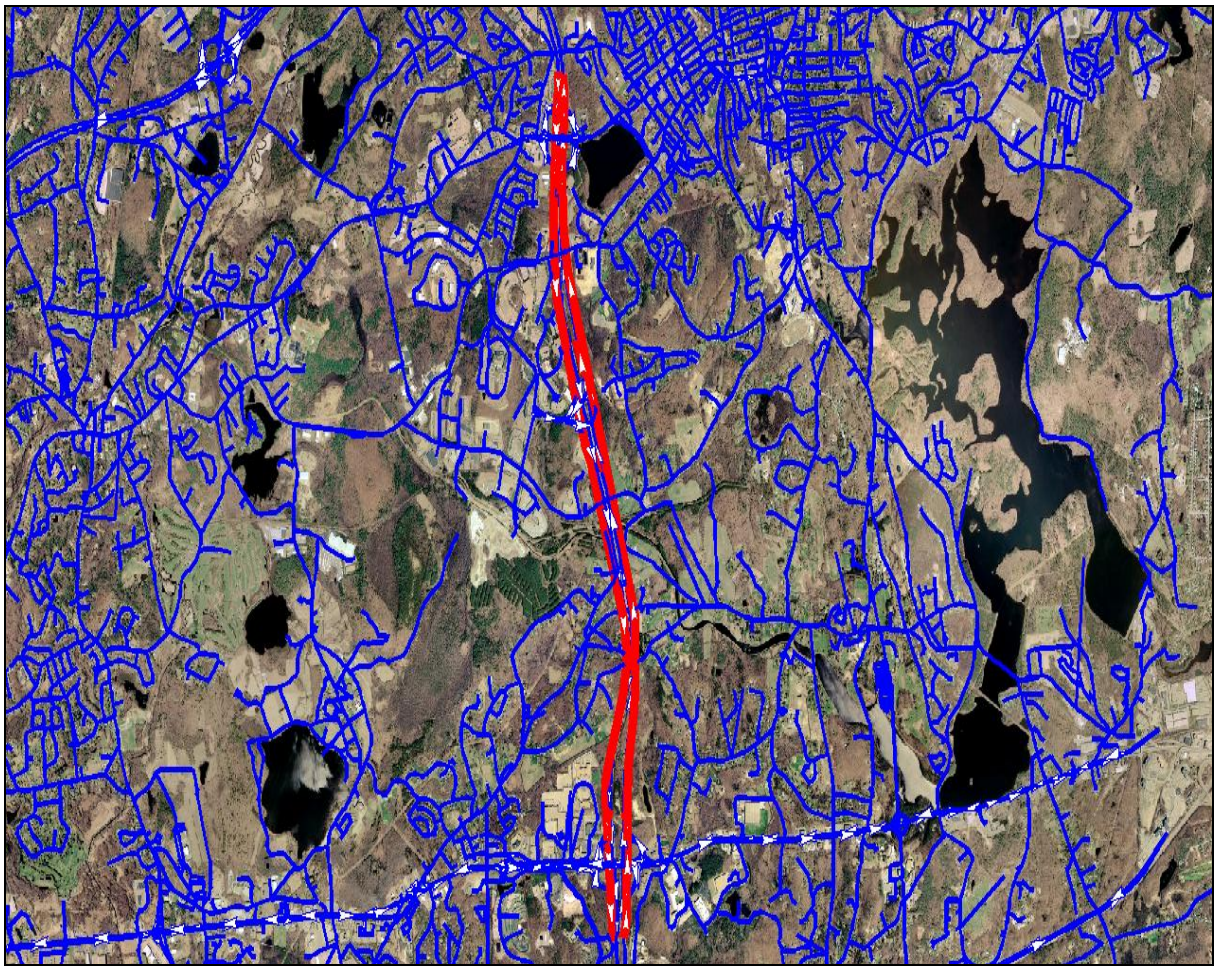
b) *Option 2:* This improvement creates a single point interchange on Route 20 that would be controlled by a traffic signal on Route 20 and bring all directional movements between I-495 and Route 20 to one location. This option would eliminate all weave movements on I-495 and also eliminate the sharp turn maneuver on the cloverleaf ramps. Figure 9 depicts the proposed improvements in red. The blue lines show the existing infrastructure that will remain unchanged and the non-highlighted lines are the infrastructure that will be eliminated in the proposed improvements.

Figure 9
Route 20/I-495 Interchange Improvement – Option 2



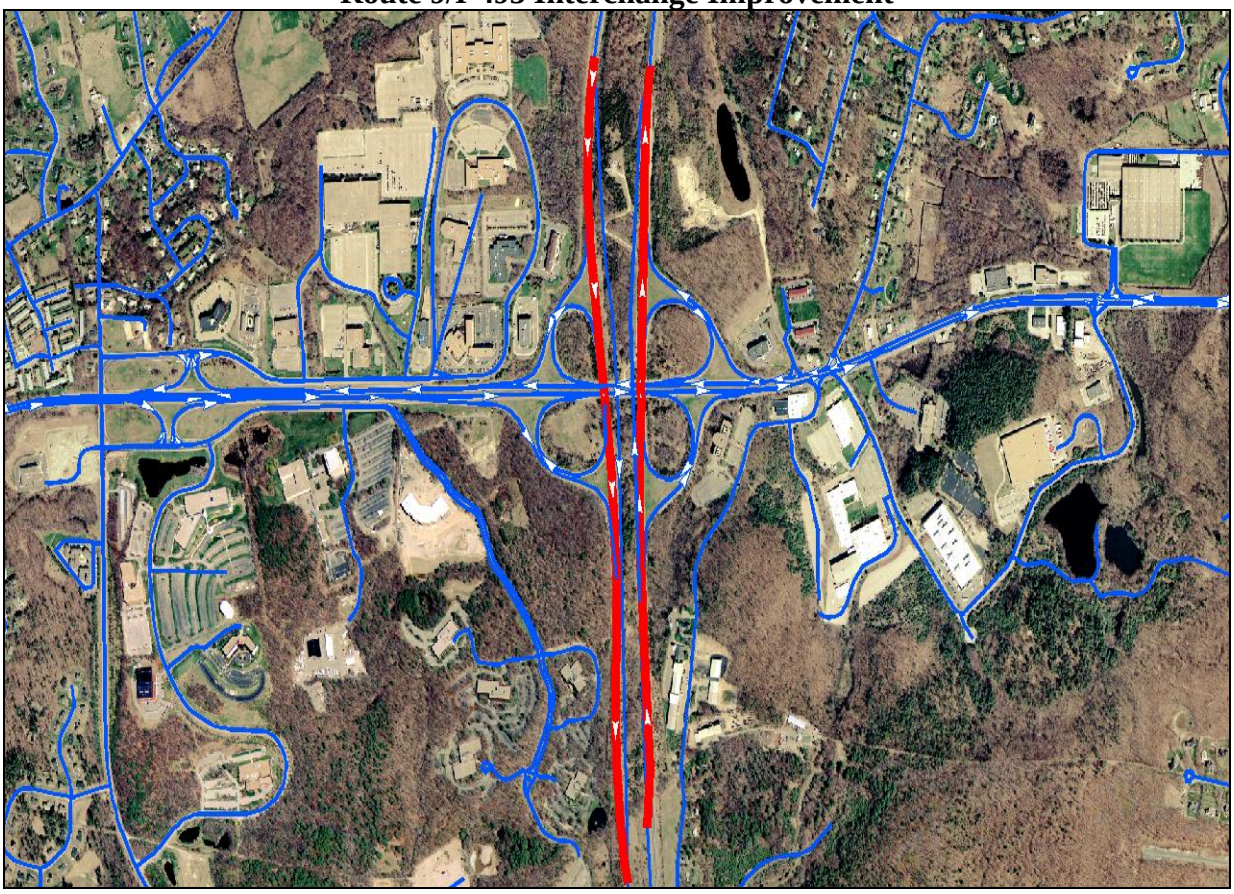
3) *Route 20 to Route 9 C/D (Collector-Distributor) Road:*
This improvement will separate through traffic on I-495 from traffic destined for the current interchanges at Route 20, Simarano Drive and Route 9. The C/D road would eliminate weaves on I-495 and the interchanges, which in turn would increase capacity on mainline I-495. Figure 10 depicts the proposed improvements in red. The blue lines show the existing infrastructure that will remain unchanged.

Figure 10
Route 20 to Route 9 Collector-Distributor Road



4) *Route 9/I-495 Interchange improvements:*
This improvement utilizes the available median space to create a C/D road at the interchange of Route 9 and I-495. This improvement would reduce the number of weaves on I-495 thereby increasing the capacity of the interchange. Flyover ramps and single point interchange options were considered for this interchange, however the C/D road option is less expensive and achieves the same results. Figure 11 depicts the proposed improvements in red. The blue lines show the existing infrastructure that will remain unchanged.

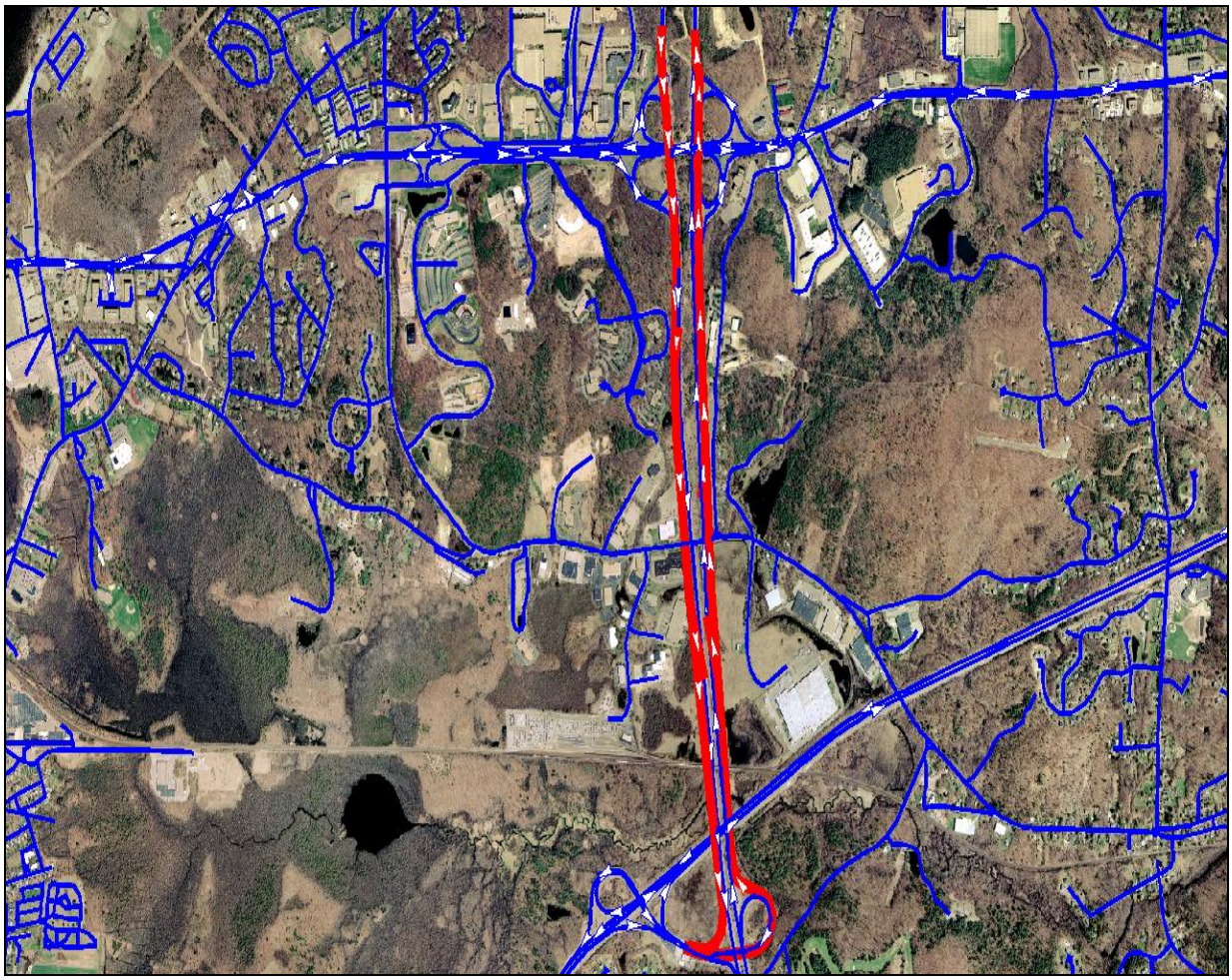
Figure 11
Route 9/I-495 Interchange Improvement



Footnote: In May 2009, federal design funds were obtained to specifically improve this interchange. While this alternative was considered in this study to have the largest impact on congestion, this interchange will also require more intensive review from a safety and socio-economic standpoint, and may not be what is constructed in the future.

5) *Route 9 to MassPike CD Road:*
This improvement will separate through traffic on I-495 from traffic trying to use the interchanges of Route 9 and MassPike. The C/D road would eliminate weaves on I-495 and the interchanges, which in turn would increase capacity on mainline I-495. Figure 12 depicts the proposed improvements in red. The blue lines show the existing infrastructure that will remain unchanged.

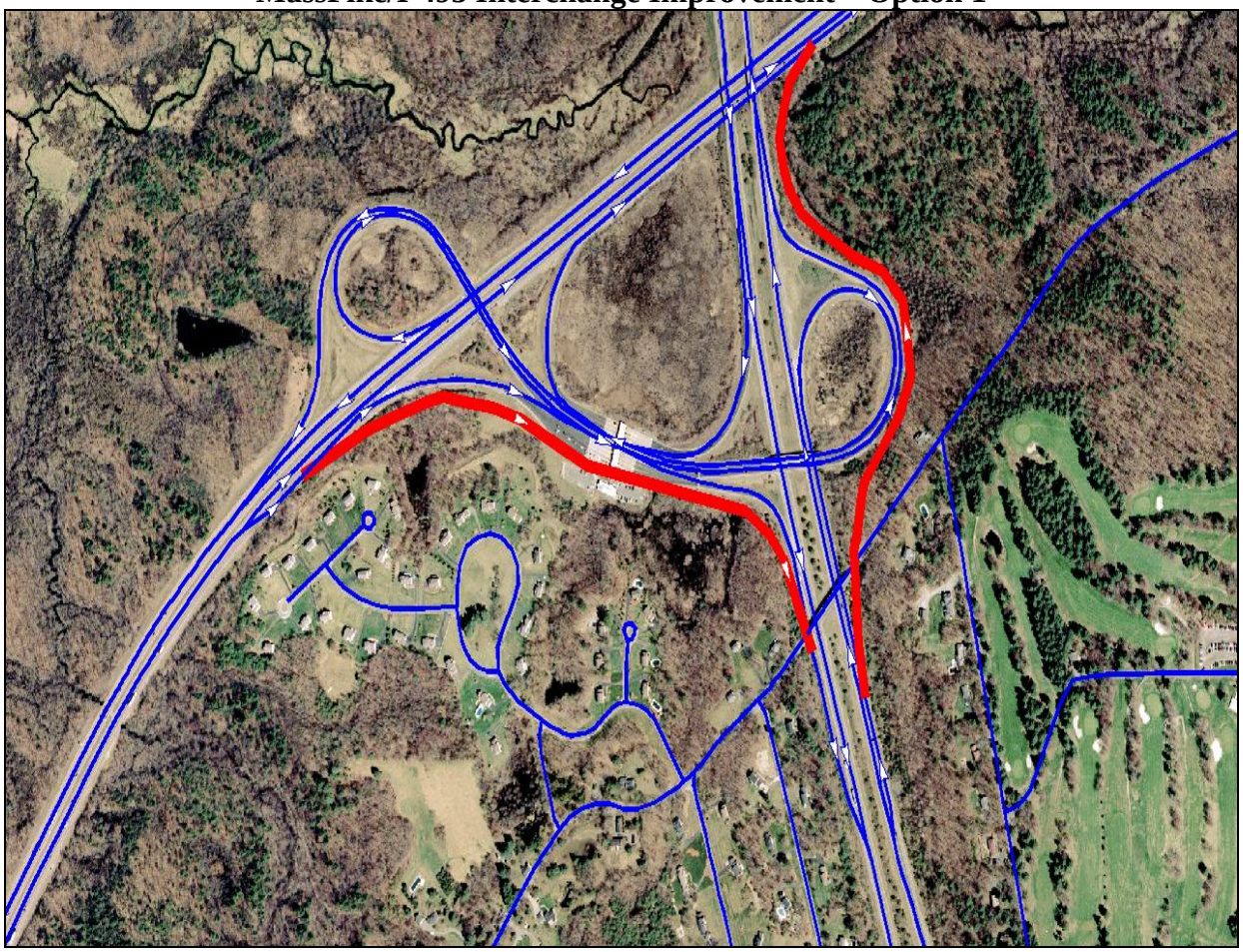
Figure 12
Route 9 to MassPike Collector-Distributor Road



6) *I-495/ MassPike Interchange Improvements:*

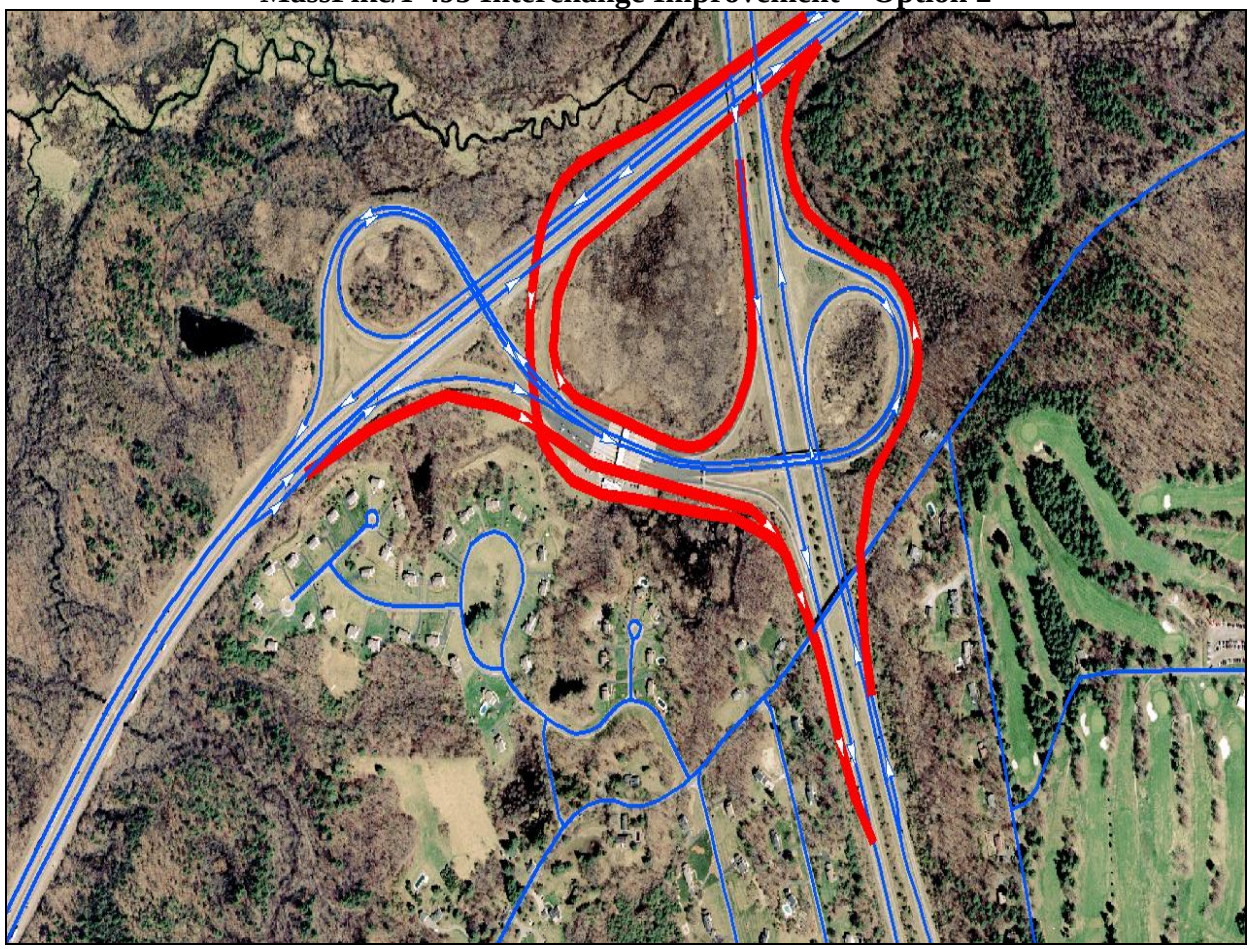
a) *Option 1:* The main constraints at this interchange are the presence of the physical toll plaza and environmental impacts of the wetlands. This improvement installs new ramps separated from the existing toll plaza from I-90 eastbound to I-495 southbound and I-495 northbound to I-90 eastbound. These new ramps reduce some of the weaving at the toll-plaza thereby reducing the delay at this interchange to a certain extent. Figure 13 depicts the proposed improvements in red. The blue lines show the existing infrastructure that will remain unchanged and the non-highlighted lines are the infrastructure that will be eliminated in the improvements.

Figure 13
MassPike/I-495 Interchange Improvement – Option 1



b) Option 2: This improvement reduces weaves at the interchange; however, merges would still occur. It creates new ramps from I-90 westbound and I-90 eastbound the merge together onto I-495 southbound. It also constructs new ramps from I-495 northbound and southbound to I-90 eastbound. Figure 14 depicts the proposed improvements in red. The blue lines show the existing infrastructure that will remain unchanged and the non-highlighted lines are the infrastructure that will be eliminated in the improvements.

Figure 14
MassPike/I-495 Interchange Improvement – Option 2



B) Land Use Scenarios/ Development Redistribution

With the reliance on automobiles as the primary means of travel between much of the existing development along and near I-495, an alternative future was developed, assuming a redistribution of future development through "smart growth" and "transit friendly" design patterns for the second strategy. It is assumed that if future development follows this type of development pattern, a number of other benefits would occur including:

- Higher density in land use; more efficient use of limited amounts of buildable land
- A decrease in associated infrastructure costs, such as sewer/water extensions
- A better balance between housing and employment locations, reducing the need for long-distance SOV travel

In order to develop a "smart growth" alternative, the study team decided that a concentrated development pattern clustered into mixed-use nodes with a split percentage of retail, residential and other uses. In order to determine a definition for "mixed-use," the study team researched two large mixed-use proposed developments in Worcester and Canton to see how the distribution of retail and non-retail jobs was attained. Based on this research, the team determined that a 50/30/20 split percentage, based on square footage, of office, residential and retail for mixed-use development was preferable baseline to follow. However, there is not a "standard" split for mixed-use development and it is understood that various zoning and infrastructure constraints will determine the incorporation of various mixed-use types in other future projects.

To develop suggested improvements and alternatives based on the data obtained and current growth trends, the travel demand model assumed for the year 2030 that land use and development patterns would continue the trend they have been following over the last 30 years. This "Trends Extended" land use scenario was input into the travel demand model to project what travel demand patterns may look like in the year 2030. Similarly, a second land use scenario was created that focused development in a mixed-use and concentrated pattern within existing town centers, along the I-495 corridor, and in some specific locations, such as Westborough's Transit-Oriented Development (TOD) district near the MBTA commuter rail station. Using the Trends Extended scenario as a base, this second "Smart Growth Plus" scenario was created and run in the model to see what changes in travel patterns and transportation modes might result if development occurred in a different way by 2030.

When mixed-use areas are created, many trips are often shortened because people stay more within the mixed-use zone. Trips that move within the zone are what is meant by daily internal capture rates as defined by the Institute for Transportation Engineers (ITE) *Trip Generation Manual* and shown in Table 10. The table below shows the percentage of trips captured within a mixed-use development by type. The largest percentage of trips captured internally was within the residential to retail land use category. It is assumed that the majority of these trips are made by either walking, bicycling or by transit.

Table 10
Multi-Use Development Internal Capture Rates

From Land Use	To Land Use	Daily Internal Capture
Office	Office	2%
Office	Retail	22%
Office	Residential	2%
Retail	Office	3%
Retail	Retail	30%
Retail	Residential	11%
Residential	Office	NA
Residential	Retail	38%
Residential	Residential	NA

Source: ITE Trip Generation Manual

Under this alternative Smart Growth Plus scenario, total population and employment growth in each of the eight communities remained the same as in the Trends Extended for 2030. However employment growth was concentrated mostly in the high growth areas where employment was expected to grow near I-495, the TOD district in Westborough and downtown areas. Population growth was projected to be concentrated in the high employment zones in an effort to achieve the best jobs/housing balance possible. Employment growth was assumed to occur in the following locations within each community:

- Berlin – Solomon Pond Road/River Road area and Route 62 near Highland Commons
- Bolton – Along I-495
- Hopkinton – West Main Street near South Street; Downtown
- Hudson – Near I-495/Route 85/I-290; Downtown; Highland Commons
- Marlborough – Downtown; I-495
- Northborough – Downtown; Southwest area
- Southborough – Along I-495
- Westborough – Along I-495; Downtown; TOD village area

Figures 15 through 18 show the changes in population and employment distribution within the study area based on a continued pattern of existing growth and a “Smart Growth” scenario in 2030. Projection numbers for both population and employment remained the same, however they were distributed based on the descriptions above.

Figure 15
Population Change in 2030 based on Current Growth Patterns

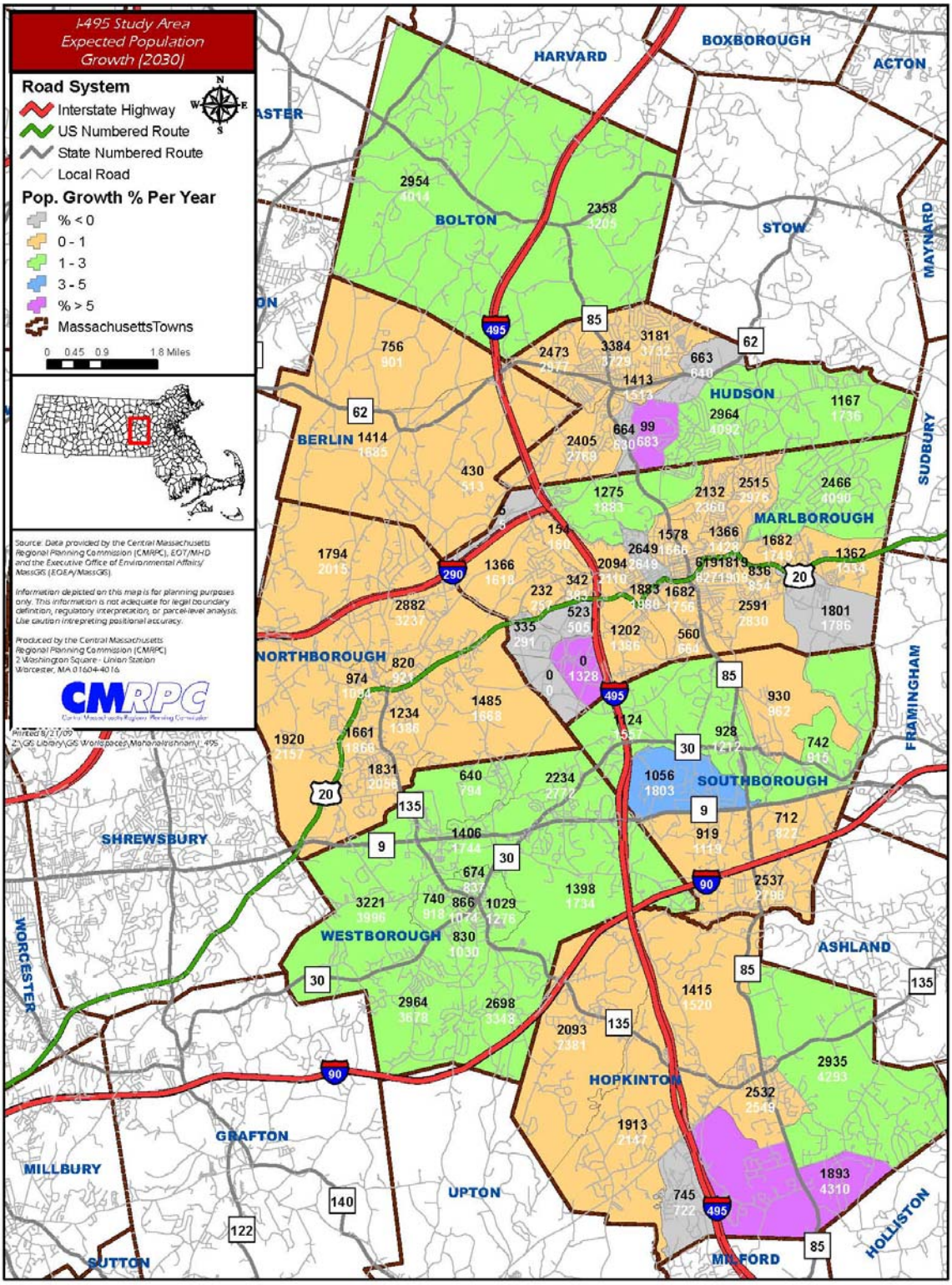


Figure 16
Population Change in 2030 based on "Smart Growth" Patterns

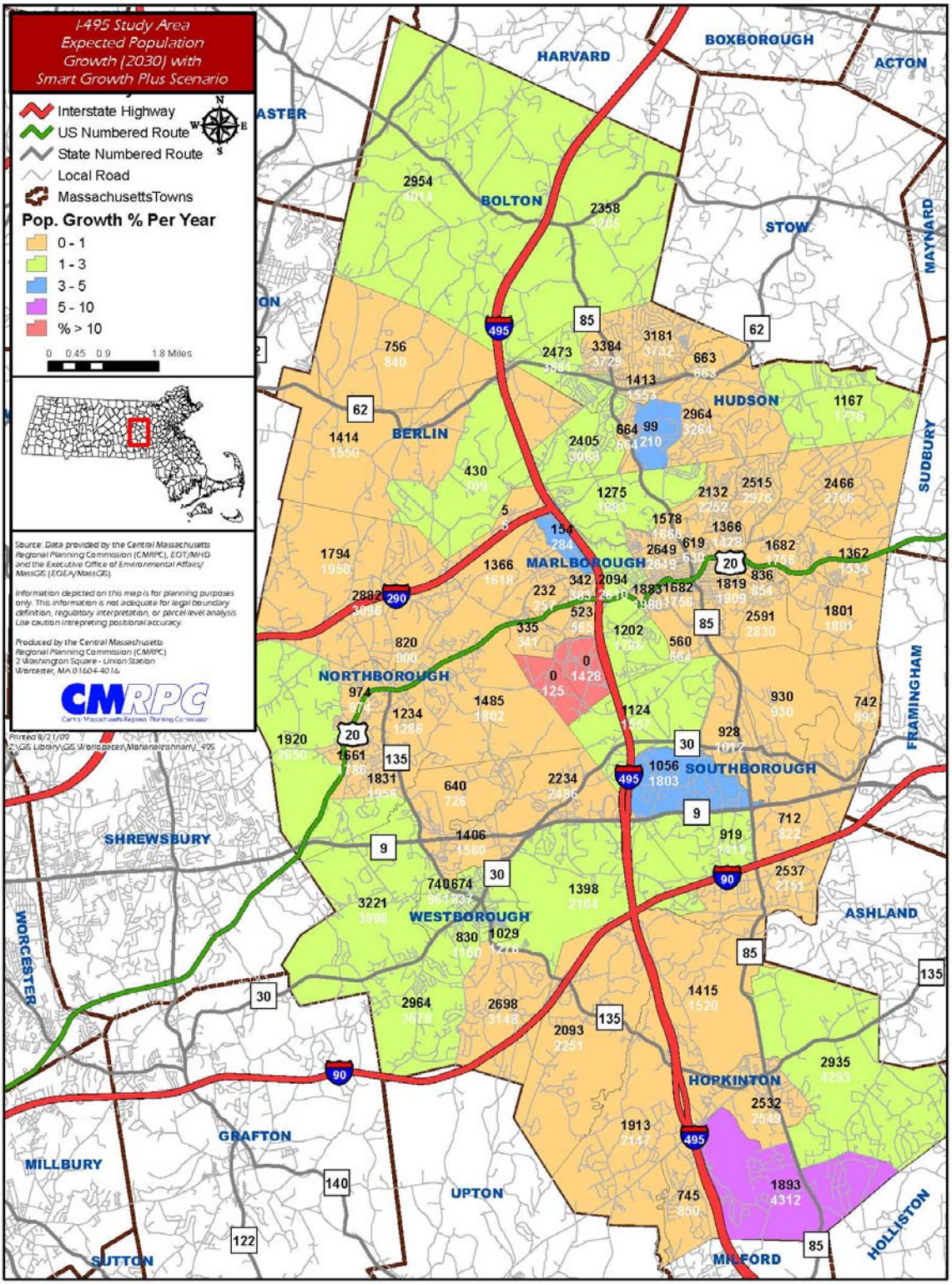


Figure 17
Employment Change in 2030 based on Current Growth Patterns

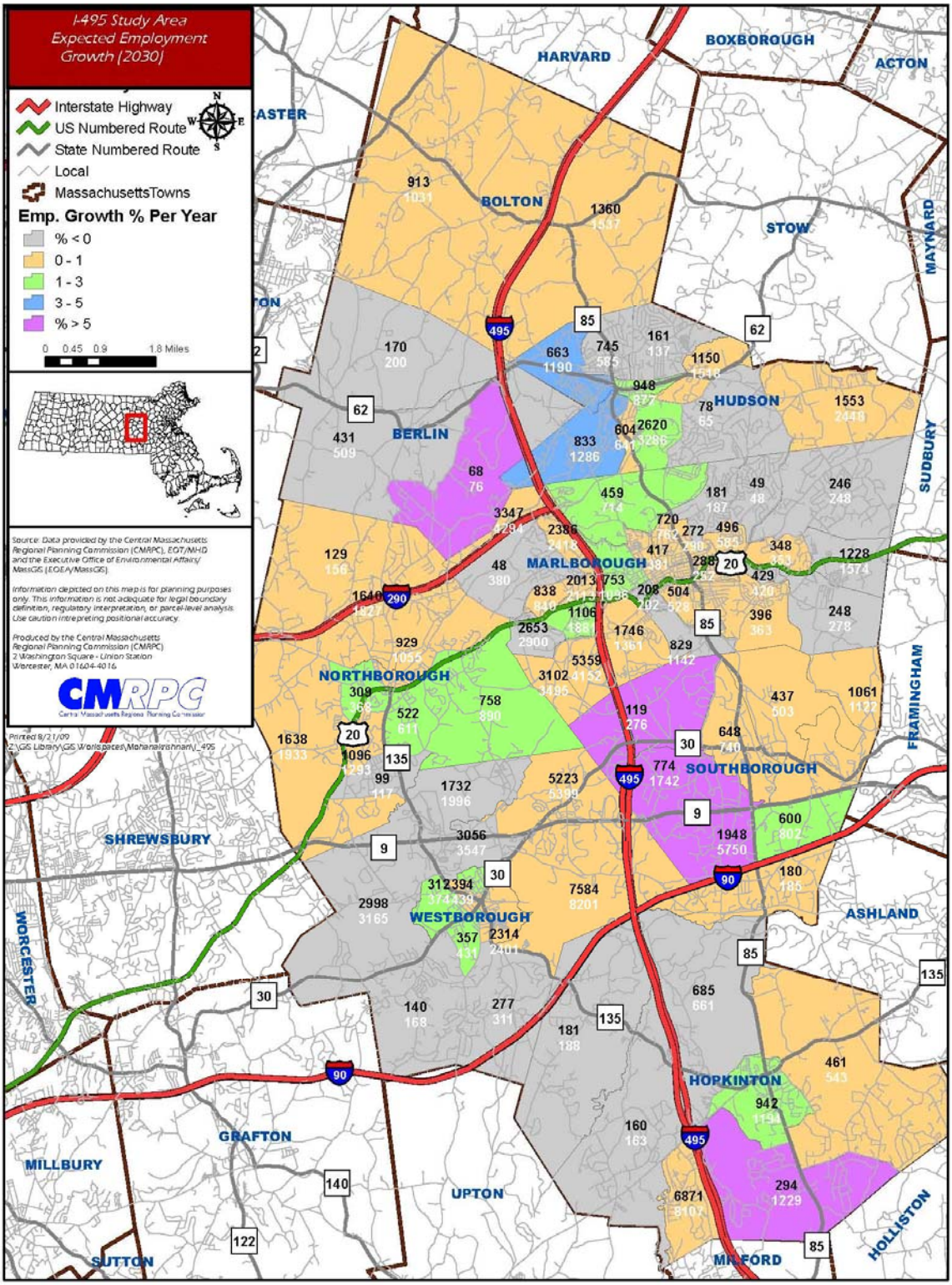
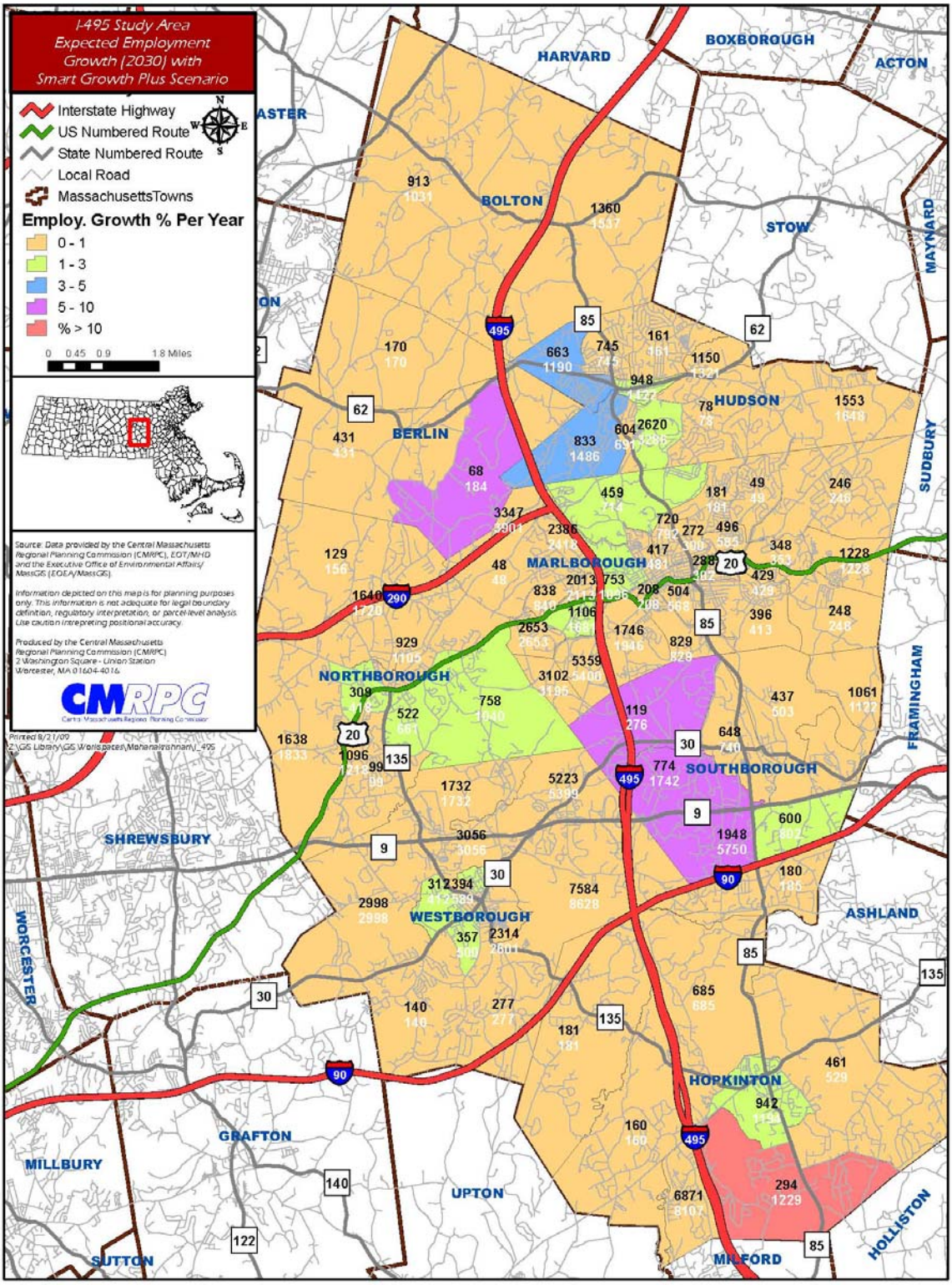


Figure 18
Employment Change in 2030 based on "Smart Growth" Patterns



C) Transit Alternatives

For the final strategy, transit alternatives that would reduce SOVs along the I-495 corridor and at the congested interchanges were also modeled and examined. These alternatives, some of them proposed in previous decades, were chosen for their potential effect in reducing SOVs. The Travel Demand Model was used to determine what these options would show for a mode shift based on the Smart Growth Plus land use alternative as well as potential ridership through new connections with existing infrastructure and transit services. These additional transit options included:

1. New local fixed-route bus service in Hudson, Marlborough, Northborough, Southborough, Westborough, and Hopkinton.
2. A new transit transfer/park and ride facility (a.k.a. "mega station") at the MassPike/
   I-495 interchange that would provide access to express buses and the Framingham/ Worcester commuter rail line
3. Option 2 plus connections to local fixed-route buses
4. Option 3 plus commuter rail connection to the Green Line at Riverside.

1) <u>New Local Fixed-Route Bus Service</u>

Two new potential bus routes were modeled that would provide local fixed-route transit service within the study area. They were designed to connect with the existing Routes 5 and 7 operated by the MetroWest Regional Transit Authority's (MWRTA) with transfer points in downtown Marlborough and downtown Hopkinton. The new routes were assumed to operate as follows and are shown graphically in Figure 19:

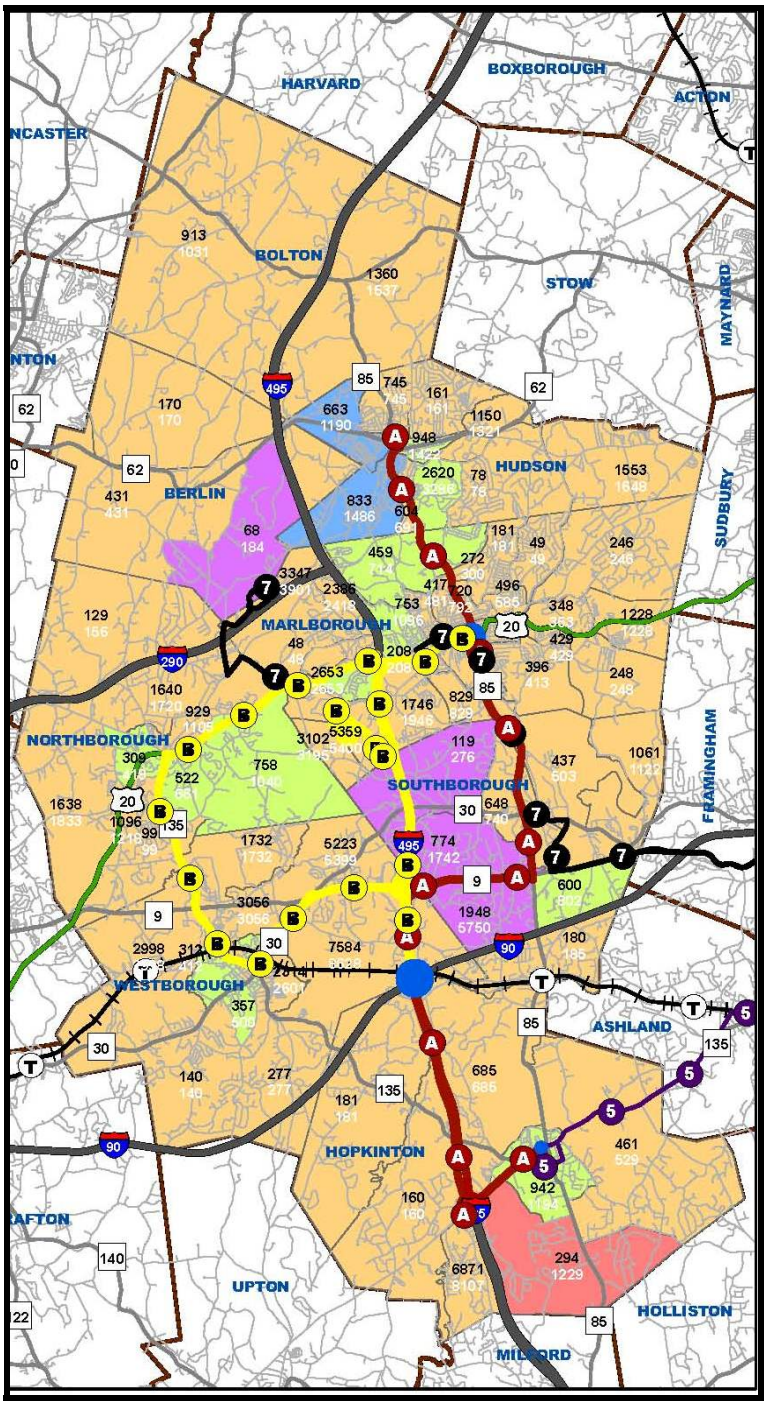
- Route A would operate between downtown Hudson and Downtown Hopkinton via Routes 85, 9 and I-495 to the proposed "mega station," as well as West Main Street in Hopkinton. It would run at opposite schedule times between Marlborough Center and Southborough Center with the MWRTA's Route 7 schedule and link up with the MWRTA's Route 5 in Hopkinton. There is also a transfer point in downtown Marlborough to link Route A with Route 7 and the new Route B, as well as the proposed "mega station" at I-90/I-495. The route would also run in the opposite direction concurrently.

- Route B would operate from the Marlborough transfer point along Route 20 West to Route 135 in downtown Northborough and then proceed down Route 135 to downtown Westborough. From there, it would operate along Route 30 East, with a diversion into the new Bay State Commons mixed-use development, to Route 9 East and the Westborough Office Parks. From there it would operate along I-495 South to the proposed "mega station." Thereafter it would follow I-495 North to Simarano Drive, make a loop within the industrial parks there and then head back I-495 North to Route 20 East and the Marlborough transfer point. Again, this route would also run in the opposite direction concurrently.

Based on these route alignments, the model was first run using both the Trends Extended and Smart Growth Plus land use scenarios, without the "mega station" as a base (see below). For the

Trends Extended 2030 land use scenario, approximately 2,900 weekday daily boardings were projected. For the Smart Growth Plus 2030 land use scenario, approximately 3,300 weekday daily boardings were projected. The Smart Growth Plus scenario exhibited a 14 percent increase in transit usage due to the mixed-use development and higher densities proposed under this scenario.

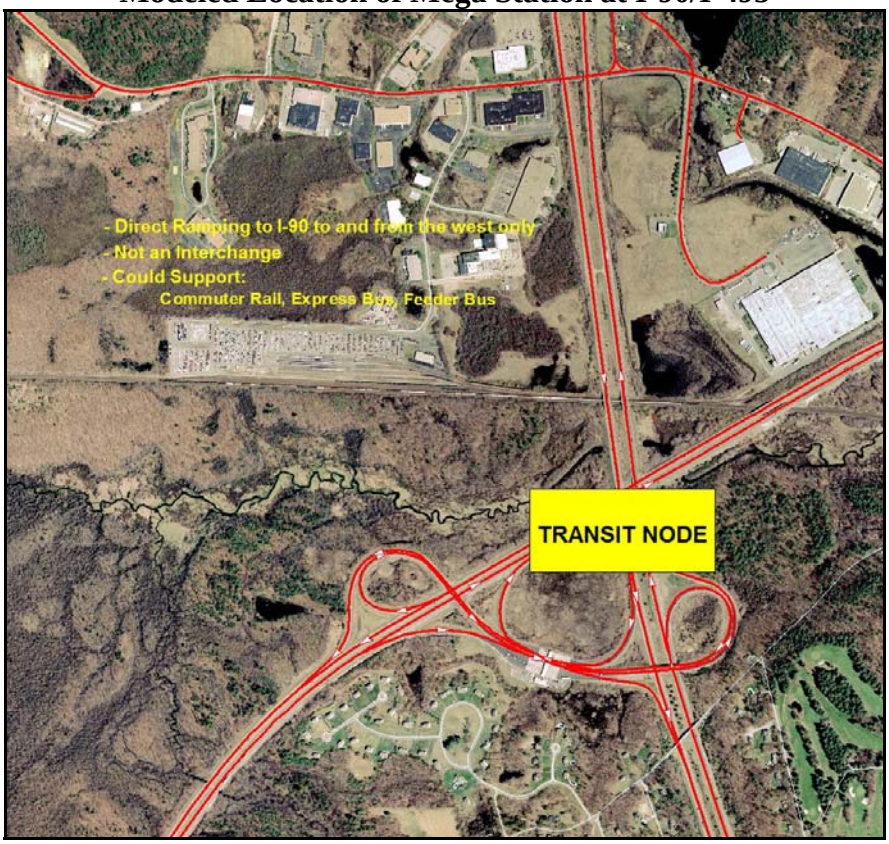
Figure 19
Proposed New Local Fixed-Route Bus Service Coordinated with MWRTA's Routes 5 and 7



2) Park and Ride Facility/"Mega Station"

As mentioned above, a "mega station" was modeled at the interchange of I-90 and I-495. The facility is assumed to provide a large number of parking spaces (approximately 2500+) and would be a transfer point for commuter/ express bus service to Boston, local transit buses and the MBTA commuter rail. Given the known environmental constraints in the area, the "mega station" was placed within the air rights over the 1-90/I-495 highway interchange, as well as the Framingham/Worcester commuter rail line with direct ramping to and from I-90 west and through existing interchanges ramps to I-90 east and I-495. While this was the modeled location, such a station should not be confined as an air rights development and could be located within the general area (Figure 20).

Figure 20
Modeled Location of Mega Station at I-90/I-495



The model projected that approximately 5,300 daily commuter rail boardings would occur at this new facility when implemented as a stand-alone transit station for commuter/express bus and commuter rail. However, only 600 of these are new users while 4,700 are diverted from other existing commuter rail stations within the area. With regional users diverted to the mega station from nearby stations, parking availability would increase for local users who may wish to commute to Boston at the local stations.

3) "Mega Station" with connection to local fixed-route bus service

When the model was run to combine the local fixed-route bus service and the services operated at the "mega station", a total of 6,800 daily commuter rail boardings occurred, an increase of

approximately 1,500 boardings over stand alone Commuter Rail Station. In addition, local fixed route bus ridership increased from 3,300 to 4,800 daily riders.

4) "Mega Station" with commuter rail connection with Green Line at Riverside

Lastly, the model examined the potential ridership at the "mega station" should a connection be made between the MBTA commuter rail and the Green Line at Riverside. With this potential connection, daily boardings increased to 7,200 riders, showing an increase of 400 boardings due to this connection along with the other services described above.

D) Summary of Results

Roadway

The following two tables (Tables 11 and 12) compare travel demand model results for the different alternatives to the Trends Extended scenario. In Table 11, the alternatives are ranked from smallest congestion and VMT reductions (and even increases) to greatest reductions. Table 11 shows that the greatest benefit in terms of reduction in delay (VHT) would be achieved by the I-90/I-495 Interchange improvement options and the CD roads. VMT reductions will also yield reductions in greenhouse gases. Even with minor changes in the overall figures presented below, the eight town study area would experience a significant change in congestion.

Table 11
Comparison of Highway Alternatives

HIGHWAY ALTERNATIVES	Total Regional Vehicle Miles Travelled (VMT)	Total Regional Vehicle Hours Travelled (VHT)	VMT change from Trends Extended	VHT change from Trends Extended
Trends Extended with No Build	7,043,704	184,042	n/a	n/a
I-290/I-495 Interchange Improvement	7,051,185	184,419	7,481	377
RTE 20/I-495 Interchange Improvement Option 1	7,045,628	184,125	1,924	83
RTE 20/I-495 Interchange Improvement Option 2	7,045,280	184,073	1,576	31
RTE 9/I-495 Interchange Improvement	7,042,202	183,950	-1,502	-92
CD Road From RTE 20 To RTE 9	7,039,152	183,836	-4,552	-206
CD Road From RTE 9 To I-90	7,035,068	183,483	-8,636	-559
I-90/I-495 Interchange Improvement Option 1	7,020,082	183,096	-23,622	-946
I-90/I-495 Interchange Improvement Option 2	6,948,745	181,021	-94,959	-3,021

Table 12 shows a comparison between the modeled volume of traffic using I-495 and its interchanges at various points before and after each improvement was made. The two alternatives where C/D roads were added to the I-495 mainline reduce the traffic volume because a C/D road separates the through traffic from the traffic trying to use the interchanges. All improvements to the interchanges keep traffic flow the same or increase it because the improvements reduce the weaving movements thereby improving the capacity and facilitating more people to use the roadway.

Table 12
I-495 Projected Volume

Interchange Improvement Options	***2030 Trends Extended at option locations***	***2030 Build at option locations***
I-290	59,700 vpd	67,800 vpd
Route 20 Option 1	68,300 vpd	64,500 vpd
Route 20 Option 2	68,300 vpd	67,781 vpd
CD Road Rte 20 to Rte 9	131,600 vpd	111,000 vpd
Route 9	78,600 vpd	73,100 vpd
CD Road Rte 9 to MassPike	150,200 vpd	103,600 vpd
I-90/MassPike Option 1	76,400 vpd	83,500 vpd
I-90/MassPike Option 2	76,400 vpd	91,500 vpd

Transit

Table 13 summarizes the usage for the four transit options modeled under the smart growth land use scenario in 2030. As transit modes are connected to each other at various locations, ridership also increases. With this mode shift from single occupancy vehicle trips to transit trips, reduction in vehicle congestion on I-495 would occur or increase at a lower rate.

Table 13
Summary of Transit Use Projections by Transit Option

	Local Fixed-Route Bus Service	**Park and Ride Facility/"Mega Station" to existing commuter rail service**	**Mega Station with Local Fixed-Route Bus Connection**	**Mega Station with commuter rail connection to Green Line at Riverside**
Local Bus Ridership	**3,300**	**--**	**4,800**	**4,800**
Commuter Rail Ridership	**--**	**5,300**	**6,800**	**7,200**

V. Conclusions and Recommendations

As noted earlier, this is a generalized planning study and it is assumed that a more detailed study would be completed for this portion of the I-495 corridor. This study does provide valuable information for the future, including a comparison of highway alternatives and their relative merit to each other. It also attempts to quantify the potential effects of land use and transit alternatives which would limit sprawl development and reduce single occupancy vehicle trips thereby maximizing the efficiency of the highway infrastructure.

i. *Highway Conclusions*

- The greatest benefit in terms of reduction in delay would be achieved by the I-90/I-495 Interchange improvement options
- Reduction in volume and congestion on Mainline I-495 would be achieved by the collector-distributor options, which would separate the through traffic from traffic using various interchanges

ii. *Transit/Land Use Conclusions*

- Transit service has the potential to reduce single-occupancy vehicles under both land use scenarios by 2030, however a "Smart Growth Plus " scenario provides higher transit ridership as well
- Projections show that an intermodal center with access to multiple transportation options provides the highest transit ridership increase and a decreased dependence upon single-occupancy vehicles
- Reduced single-occupancy vehicles would likely have a positive impact on congestion in the study area

VI. Next Steps

In addition to this final report, a survey is being prepared to determine how much support and/or interest local community officials within the study area have regarding smart growth, housing, and economic development concerns within this section of I-495. The results of the survey would provide additional information for other ongoing planning studies in the region along the Route 9 corridor and would help continue a regional dialogue begun among community planners and officials regarding land use changes, regulatory changes and regional development begun with this study through the 495/MetroWest Partnership.

As mentioned in Section V, it is assumed that a more detailed study would be completed for this portion of the I-495 corridor. The study would pay particularly attention to land use and zoning issues at key interchanges through the corridor. The study should have a full range of analyzed and developed alternatives, including interchange, highway, non-highway improvements, and multimodal options. A recommended prioritization "package" of future scheduled transportation improvements (short- and long-term), based on alternatives analysis, would be the end product of this project with preliminary cost estimates as well as action steps for municipalities and the state to take to address land use planning challenges along the corridor.