CHAPTER 13

FUTURE FORECASTS

Air quality conformity regulations related to the latest planning assumptions require a consistent approach to estimate future population, household and employment data used in the regional transportation plan. This data is input into the regional transportation model to estimate future traffic volumes in the region which can in turn be used to analyze the effects of transportation improvement projects, identify areas where congestion could occur in the future, and perform an air quality conformity determination for the region.

The MassDOT Office of Transportation Planning (OTP) developed the forecasts for future population and employment for Massachusetts and each MPO region. Five data sources were used in developing the forecasts and are listed in Table 13-1. Procedures and preliminary estimates were reviewed by the Pioneer Valley Planning Commission (PVPC) and modifications were made. Control totals were allocated to the 43 communities in the Pioneer Valley region based on current trends and potential for future growth. Household projections were calculated based on population projections derived from the 2010 Census estimates of the five year American Community Survey (ACS).

Table 13-1 – Data Sources of Forecasts for the Pioneer Valley Region

UMass Donahue Institute Population Projections V2015 pre-release February 10, 2015
RPA inputs to MAPC's development database: December 2014 -February 2015
MAPC's land use allocation model results, March 2015
MassDOT Planning staff calculations, March 2015
PVPC Planning staff adjustments and calculations: April - May 2015
MassDOT Planning staff calculations of the Census 2010 ACS Five Year Estimates

Initial municipal population and employment projection estimates were provided by MassDOT. Thereafter, PVPC staff adjusted the values by reallocating growth differently among each community based on current trends and local staff knowledge of the opportunity for additional growth and major development planned through all forecast years 2010 through 2040. The resulting forecasts for population, households and employment completed in May 2015 are shown in Tables 13-2 – 13-4. A description of the forecast process and summary of the calculation methods follows.

A. POPULATION

Each community was reviewed in great detail with regards to population projections. Staff looked specifically at past trends, growth allocations in past projections, as well as recent building permit activity. A recent rise in building permit activity was viewed as an indicator for potential growth. Therefore, adjustments were made to projections based on past growth patterns, land use, economic development, and transportation trends while continuing to maintain the regional control total developed by MassDOT.

B. HOUSEHOLDS

Since there was only one year of household data provided by MassDOT, PVPC staff performed research to assist in developing regional household projections. The main assumption used in the household projection calculations is that between 2010 and 2040 communities will have the same change in the share of overall population and households as a percentage of the whole region. The basis for the calculations was the 2010 Census division of total number of households into the various Transportation Analysis Zones (TAZs) by planning staff at MassDOT. Thereafter, PVPC staff calculated the household projections for the model years 2020, 2030, and 2040. The value of household population is equal to the total population minus the group quarter (GQ) population. Regional and community totals for household numbers were calculated by using the following steps and assumptions:

- Calculate the average household size: The average household size was established by dividing the household population by number of households for each TAZ.
- Calculate group quarter (GQ) population projections: Established a ratio of GQ population compared to total population by TAZ for the model base year 2010. The GQ ratio was then multiplied by the previously projected total population of each TAZ to obtain the GQ population value for each future projection year. This assumed that the GQ ratio stays the same over the years.
- Calculate the household population per TAZ: GQ population was subtracted from the total population to obtain the household population by each TAZ for each future model year.
- Calculate the number of households per TAZ: The household population was divided by the average household size to obtain the number of households in a TAZ.
- Calculate household community totals: The number of households by TAZ were summed by community to arrive at community totals.
- Calculate regional community totals: Added the household community totals to provide regional projection totals for future model years 2020, 2030 and 2040.

C. EMPLOYMENT

Workplace-based employment data was used in the projections. The regional and community employment projections were provided by MassDOT staff and PVPC staff adjusted community totals while holding the regional projection estimates constant. The focus was on the 2040 totals as they compared to the 2010 total employment. The adjusted values assumed a potential positive impact on regional employment by a casino development in the City of Springfield. Community total employment values were divided using TAZ ratios according to a table received from MassDOT planning staff. The table contained adjusted employment by industry by TAZ for the Pioneer Valley Region. The sources of this data were the 2010 Census Transportation Planning Products (CTPP) and the Massachusetts Executive Office of Labor and Workforce Development (EOLWD). This data presented CTPP estimates adjusted to EOLWD totals at the community level. CTPP estimates were based on survey data collected between 2006 and 2010. TAZ ratios estimated for the 2010 model year were then applied to future model year employment projections by community while assuming that the TAZ ratios would remain the same for all years.

Table 13-2 – Population Forecast for the Pioneer Valley Region

	Population 2010	Population 2020	Population 2030	Population 2040
Agawam	28,438	29,176	29,712	30,002
Amherst	37,819	38,862	40,260	41,601
Belchertown	14,649	15,641	16,482	16,920
Blandford	1,233	1,230	1,225	1,219
Brimfield	3,609	3,692	3,768	3,807
Chester	1,337	1,318	1,297	1,270
Chesterfield	1,222	1,221	1,219	1,216
Chicopee	55,298	57,034	58,633	59,445
Cummington	872	846	819	785
East Longmeadow	15,720	16,719	17,706	18,707
Easthampton	16,053	16,811	17,438	17,642
Goshen	1,054	1,082	1,119	1,149
Granby	6,240	6,325	6,327	6,151
Granville	1,566	1,572	1,579	1,582
Hadley	5,250	5,497	5,679	5,723
Hampden	5,139	5,513	5,790	5,910
Hatfield	3,279	3,341	3,397	3,410
Holland	2,481	2,530	2,549	2,555
Holyoke	39,880	41,412	42,908	43,708
Huntington	2,180	2,151	2,114	2,006
Longmeadow	15,784	15,803	15,832	15,871
Ludlow	21,103	21,756	22,336	22,580
Middlefield	521	510	500	469
Monson	8,560	8,630	8,689	8,712
Montgomery	838	873	898	904
Northampton	28,549	28,702	28,832	28,834
Palmer	12,140	12,017	11,883	11,714
Pelham	1,321	1,337	1,348	1,337
Plainfield	648	678	700	704
Russell	1,775	1,777	1,781	1,782
South hadley	17,514	17,775	17,971	18,074
Southampton	5,792	6,109	6,330	6,429
Southwick	9,502	9,955	10,280	10,345
Springfield	153,060	158,284	164,120	167,987
Tolland	485	485	486	486
Wales	1,838	1,879	1,914	1,930
Ware	9,872	9,874	9,798	9,675
West Springfield	28,391	29,083	29,742	29,811
Westfield	41,094	42,099	43,064	43,285
Westhampton	1,607	1,700	1,781	1,792
Wilbraham	14,219	14,593	15,131	15,925
Williamsburg	2,482	2,507	2,526	2,532
Worthington	1,156	1,109	1,063	1,011
Pioneer Valley	**621,570**	**639,508**	**657,026**	**666,997**

Table 13-3 – Household Forecast for the Pioneer Valley Region

	Households 2010	Households 2020	Households 2030	Households 2040
Agawam	11,664	11,967	12,187	12,305
Amherst	9,259	9,514	9,857	10,185
Belchertown	5,595	5,974	6,295	6,462
Blandford	492	491	489	486
Brimfield	1,429	1,462	1,492	1,507
Chester	543	535	527	516
Chesterfield	511	511	510	508
Chicopee	23,739	24,484	25,171	25,519
Cummington	404	392	379	364
East Longmeadow	5,851	6,223	6,590	6,963
Easthampton	7,224	7,565	7,847	7,939
Goshen	416	427	442	453
Granby	2,374	2,406	2,407	2,340
Granville	608	610	613	614
Hadley	2,107	2,206	2,279	2,297
Hampden	1,898	2,036	2,138	2,183
Hatfield	1,483	1,511	1,536	1,542
Holland	994	1,014	1,021	1,024
Holyoke	15,361	15,951	16,527	16,835
Huntington	868	856	842	800
Longmeadow	5,741	5,748	5,758	5,773
Ludlow	8,080	8,330	8,552	8,646
Middlefield	218	225	221	207
Monson	3,279	3,306	3,328	3,337
Montgomery	330	344	354	356
Northampton	12,000	12,064	12,119	12,120
Palmer	5,099	5,047	4,991	4,920
Pelham	549	556	560	556
Plainfield	269	281	291	292
Russell	656	657	658	659
South hadley	6,793	6,894	6,970	7,010
Southampton	2,249	2,372	2,458	2,496
Southwick	3,710	3,887	4,014	4,039
Springfield	56,752	58,690	60,854	62,288
Tolland	197	197	197	197
Wales	736	752	766	773
Ware	4,120	4,121	4,089	4,038
West Springfield	12,124	12,420	12,701	12,730
Westfield	15,335	15,710	16,070	16,153
Westhampton	623	659	690	695
Wilbraham	5,309	5,449	5,650	5,946
Williamsburg	1,118	1,129	1,138	1,141
Worthington	522	490	470	446
Pioneer Valley	**238,630**	**245,463**	**252,048**	**255,660**

Table 13-4 – Employment Forecast for the Pioneer Valley Region

	Employment 2010	Employment 2020	Employment 2030	Employment 2040
Agawam	11,668	12,348	12,305	12,376
Amherst	14,733	15,226	15,143	15,175
Belchertown	2,619	2,725	2,752	2,776
Blandford	223	255	273	284
Brimfield	540	571	570	573
Chester	110	122	127	130
Chesterfield	123	130	130	130
Chicopee	19,003	20,065	20,228	20,428
Cummington	208	220	219	220
East Longmeadow	7,927	8,389	8,360	8,408
Easthampton	4,341	4,670	4,731	4,797
Goshen	158	172	177	180
Granby	753	815	829	842
Granville	157	166	166	167
Hadley	5,307	5,760	5,965	6,103
Hampden	821	870	867	871
Hatfield	1,965	2,098	2,110	2,132
Holland	147	156	155	156
Holyoke	21,164	22,408	22,539	22,751
Huntington	420	444	443	446
Longmeadow	3,376	3,493	3,401	3,381
Ludlow	6,431	6,678	6,662	6,688
Middlefield	39	42	42	42
Monson	1,295	1,370	1,366	1,373
Montgomery	26	27	28	28
Northampton	18,129	18,614	18,480	18,491
Palmer	4,986	5,116	5,100	5,111
Pelham	155	164	164	165
Plainfield	40	43	43	43
Russell	182	196	198	200
South hadley	4,441	4,484	4,481	4,486
Southampton	1,085	1,149	1,145	1,151
Southwick	2,533	2,668	2,645	2,655
Springfield	74,924	80,882	80,169	80,668
Tolland	37	40	40	40
Wales	150	159	158	159
Ware	2,728	2,887	2,876	2,893
West Springfield	16,922	17,812	17,653	17,707
Westfield	16,736	17,547	17,320	17,339
Westhampton	291	307	307	309
Wilbraham	4,510	4,773	4,756	4,784
Williamsburg	555	587	586	589
Worthington	194	205	204	205
Pioneer Valley	**252,156**	**266,854**	**265,913**	**267,456**

D. STATEWIDE TRAVEL SURVEY

The Statewide Travel Survey (MTS) is a multi-modal household travel survey conducted on behalf of the Massachusetts Department of Transportation (MassDOT) and the 13 Metropolitan Planning Organizations (MPOs) of the Commonwealth. The survey design, implementation, and results analyses were guided by MassDOT staff and a working group of transportation professionals from the MPOs. The survey was conducted in 2010-2011 to study the demographic and travel behavior characteristics of residents within the Commonwealth of Massachusetts. The survey data obtained through this effort provided substantially updated information on travel and mobility patterns to enable updates for state and regional travel demand models, and ultimately assist planners and decision makers in better understanding the needs of the traveling public – all of which will support making the best investments in transportation.

The MTS targets included demographic and trip data collected from a minimum of 15,000 households, including a sub-sample of at least 500 households that would also provide global positioning system (GPS) data. A total of 25,331 households were recruited for the full study. The total number of households surveyed in Massachusetts yielded information for 37,023 persons, 26,488 vehicles, and 190,215 places. The final data set contains information for 15,033 households, of which 611 households also provided GPS data. The project was conducted by NuStats, in association with GeoStats, with a portion of the Computer-Assisted-Telephone-Interviewing conducted by Wilkins Research Services.

The survey design employed a generally accepted research method for household travel surveys that included a subsample of households equipped with global positioning system (GPS) equipment to provide an independent measure of travel. Household members (age 14 and older) recorded all trips for a specified 24-hour period using a specially designed diary.

1. Pioneer Valley General Results

The statewide travel survey achieved 1,488 completed household surveys with a retrieval rate of 58.7 percent from the Pioneer Valley region. Households surveyed constituted 9.4 percent of out of 238,629 households in the Pioneer Valley Region. The 24-hour period travel diary of the Day of Survey was evenly distributed among each weekday: Monday (20.5 percent), Tuesday (19.9 percent), Wednesday (20.5 percent), Thursday (19.1 percent), and Friday (20.1 percent). Survey results related to household, person, and location related data are summarized below.

a) Household Data (n = 1,488)

- The average household size is 2.4 household members.
- On average, households reported 1.6 vehicles, with 35.7 percent of households reporting two vehicles and 36.3 percent of household reporting one vehicle.
- Households reported having an average of 1.1 household workers. Zero-worker households constituted 30.5 percent, one-worker households constituted 34.8 percent, and two-person households constituted 27.7 percent.
- The average household income category with the highest percentage of respondents (19.1 percent) was between $50,000 and $74,999.

b) Person Data

- Twenty-nine percent of respondents were aged 35 to 54 years of age; forty-three percent were younger than 35 years of age.
- Forty-three percent of respondents reported being unemployed.
- Workers in the study area average 1.46 jobs each.
- Eighty-two percent of respondents reported having a valid driver's license.
- Fifteen percent of respondents reported being a student.

c) Place Data

- Households reported an average of 10.2 daily household trips and 4.1 daily person trips.
- Sixty-nine percent of all trips were made by automobile, either as the driver or passenger.
- The non-motorized transportation mode for all trips included walk (14 percent) and bike (1.3 percent).
- Transit transportation mode for all trips included Public Bus (3.2 percent), Train (0.1 percent)

2. Pioneer Valley Detailed Results

The survey population represents all 2,547,075 households residing in the thirteen MPO regions in the Commonwealth of Massachusetts, however, according to the 2010 Census a total of 238,629 people, or 9.4%, live in the Pioneer Valley Region. While a total of 2,537 households were recruited from the Pioneer Valley Region to participate in the MTS survey, only 1,488 households actually completed surveys. This amounts to 9.9% of total survey responses statewide. As a result, survey results for the Pioneer Valley MPO were weighted. A selection of household, person, vehicle, and place characteristics along with their travel behavior descriptions are presented in the following tables.

a) Household Characteristics

As shown in Table 13-5, one-third of all households surveyed reported having two household members; another 30 percent of households reported only one household member.

Table 13-5 – Household Size

Household Size	Count	Percent
1	70763	29.9%
2	78501	33.2%
3	36836	15.6%
4	35826	15.2%
5	9826	4.2%
6	3046	1.3%
7	1398	0.6%
8 or More	140	0.1%
Total	236337	100.0%

The majority of households (84 percent) reported they do not use transit on a regular basis, as shown in Table 13-6.

Table 13-6 – Transit Used on Regular Basis

Transit Used on Regular Basis	Count	Percent
Yes	38743	16.4%
No	197326	83.5%
Don't Know	268	0.1%
Total	236337	100.0%

Overall, two thirds of all households (60 percent) reported having at least one household bicycle; of those, 17 percent reported having two bicycles available to the household, and 19 percent reported one bicycle. On the other hand, 40 percent of households reported not having a household bicycle. See Table 13-7 for more detail.

Table 13-7 – Household Bicycles

Household Bicycles	Count	Percent
0	95131	40.3%
1	40011	16.9%
2	45279	19.2%
3	23129	9.8%
4	17851	7.6%
5	8318	3.5%
6	4114	1.7%
7	950	0.4%
8	1431	0.6%
Don't Know	123	0.1%
Total	236337	100.0%

Thirty-six percent of households reported having two vehicles available to the household, 36 percent reported having one vehicle available, while 13 percent reported having no vehicles (see Table 13-8).

Table 13-8 – Household Number of Vehicles

Household Vehicles	Count	Percent
0	30459	12.9%
1	85891	36.3%
2	84407	35.7%
3	22615	9.6%
4	8796	3.7%
5	2750	1.2%
6	913	0.4%
7	412	0.2%
8 or More	93	0.0%
Total	236337	100.0%

Regarding ethnicity of the participating households (Table 13-9), the majority (83 percent) reported White Alone, 5 percent reported Black or African American Alone, while 7 percent reported Some Other Race Alone.

Table 13-9 – Household Ethnicity

Household Ethnicity	Count	Percent
White Alone	196969	83.3%
Black or African American Alone	12371	5.2%
American Indian or Alaskan Native Alone	87	0.0%
Asian Alone	2208	0.9%
Some Other Race Alone	16785	7.1%
Two or More Races	5919	2.5%
Refused	1997	0.8%
Total	236337	100.0%

Overall participation of Hispanic or Latino households in the survey was nearly 11 percent, as shown in Table 13-10.

Table 13-10 – Hispanic or Latino Households

Hispanic or Latino Household	Count	Percent
Yes	24952	10.6%
No	210020	88.9%
Refused	1365	0.6%
Total	236337	100.0%

As shown in Table 13-11, on their travel day, 29 percent of households made 6–10 trips, while 32 percent made 1–5 trips. Sixteen percent made 11–15 trips, 9 percent made 16–20 trips, and another 9 percent of households made at least 21 trips on their travel day. Nearly 5 percent of household reported making no trips.

Table 13-11 – Trips Made by Household on Travel Day

Trips Made by Household on Travel Day	Count	Percent
None	11824	5.0%
1 to 5	75176	31.8%
6 to 10	69556	29.4%
11 to 15	37080	15.7%
16 to 20	21830	9.2%
21 to 30	16482	7.0%
31 to 50	4253	1.8%
50+	135	0.1%
Total	236337	100.0%

As summarized in Table 13-12, the majority of households (64 percent) reported having no students in the household. Of those households that did, 17 percent reported 1 student, 13 percent reported 2 students, and 5 percent reported 3 students.

Table 13-12 – Household Students

Household Students	Count	Percent
0	151347	64.0%
1	39355	16.7%
2	30774	13.0%
3	11482	4.9%
4	1960	0.8%
5	1058	0.4%
6	360	0.2%
Total	236337	100.0%

Two-thirds of all households reported having one or two workers in the household, while 5.5 percent reported having three workers. A total of 30.5 percent of households reported having no workers within the household. See Table 13-13 for more information.

Table 13-13 – Household Workers

Household Workers	Count	Percent
0	72162	30.5%
1	82164	34.8%
2	65535	27.7%
3	13030	5.5%
4	2660	1.1%
5	693	0.3%
6	93	0.0%
Total	236337	100.0%

Nearly half of all households reported having two licensed drivers in the household, while 35 percent reported having one licensed driver. Nine percent reported having no licensed drivers (Table 13-14).

Table 13-14 – Licensed Drivers in Household

Licensed Drivers in Household	Count	Percent
0	20293	8.6%
1	82103	34.7%
2	106720	45.2%
3	21253	9.0%
4	4937	2.1%
5	847	0.4%
6	185	0.1%
Total	236337	100.0%

b) Person Characteristics

As indicated in Table 13-15, the majority of survey respondents (82 percent) reported having a valid driver's license.

Table 13-15 – Valid Driver's License

Valid Driver's License	Count	Percent
Yes	399552	81.8%
No	88833	18.2%
Refused	94	0.0%
Total	488478	100.0%

Only eight percent of all respondents reported having a transit pass; the remaining 91 percent reported not having a transit pass. The distribution is reported in Table 13-16.

Table 13-16 – Respondent has Transit Pass

Respondent has Transit Pass	Count	Percent
Yes	39862	8.2%
No	446286	91.4%
Don't Know	2236	0.5%
Refused	94	0.0%
Total	488478	100.0%

As shown in Table 13-17, the majority of respondents (66 percent) work a typical five-day work week, while 10 percent of respondents work four days a week. Seven percent work three days a week, and 8 percent work six days a week.

Table 13-17 – Respondent Average Number of Days Worked Per Week

Days Worked Per Week	Count	Percent
1	4910	1.8%
2	9422	3.4%
3	20515	7.3%
4	28624	10.2%
5	184868	66.1%
6	21933	7.8%
7	8682	3.1%
Don't Know	600	0.2%
Refused	147	0.1%
Total	279701	100.0%

Table 13-18 summarizes telecommute status of workers. Of the respondents who work, 16 percent telecommute.

Table 13-18 – Telecommute Status

Worker Telecommutes	Count	Percent
Yes	45485	16.3%
No	231256	82.7%
Don't Know	2866	1.0%
Refused	95	0.0%
Total	279701	100.0%

Table 13-19 summarizes whether workers participate in flexible work programs. For those who are offered a flexible work program at work, 87 percent participate in one of the programs offered to them; 10 percent do not participate.

Table 13-19 – Respondent Participates in Flexible Work Program

Respondent Participates in Flexible Work Program	Count	Percent
Yes	48500	86.5%
No	5729	10.2%
Don't Know	1827	3.3%
Total	56056	100.0%

Table 13-20 reports recent transit trips. The majority of respondents made no transit trips in the week prior to their survey travel day. Three percent reported making two transit trips, and three percent reported making ten transit trips.

Table 13-20 – Transit Trips Made in Past Week

Transit Trips Made in Past Week	Count	Percent
0	498010	82.0%
1	11562	1.9%
2	20329	3.3%
3	10675	1.8%
4	7908	1.3%
5	6081	1.0%
6	7410	1.2%
7	2879	0.5%
8	3936	0.6%
9	428	0.1%
10	17527	2.9%
11	222	0.0%
12	1486	0.2%
13	506	0.1%
14	6033	1.0%
15	895	0.1%
16	1553	0.3%
18	52	0.0%
20	294	0.0%
21	173	0.0%
25	523	0.1%
30	521	0.1%
34	152	0.0%
35	148	0.0%
75	162	0.0%
87	81	0.0%
Don't Know	7625	1.3%
Refused	94	0.0%
Total	607263	100.0%

c) Vehicle Characteristics

Table 13-21 presents distribution of vehicle fuel types. The vast majority of all respondents' vehicles (96 percent) run using the traditional gasoline engine; 2 percent of respondent vehicles are hybrid vehicles, while 1 percent use diesel fuel.

Table 13-21 – Vehicle Fuel Type

Vehicle Fuel Type	Count	Percent
Gas	365043	95.9%
Diesel	4205	1.1%
Hybrid	7716	2.0%
Flex Fuel	1211	0.3%
Other, SPECIFY	803	0.2%
Don't Know	134	0.0%
Refused	1480	0.4%
Total	380592	100.0%

d) Place Characteristics

Overall, 46 percent of all trips made were to return home for non-work-related activities, shown in Table 13-22. Other frequently reported reasons for traveling included change mode of transportation (6 percent), work/job (7 percent), and routine shopping (8 percent).

Table 13-22 – Primary Trip Purpose

Primary Trip Purpose	Count	Percent
All other home activities	1347859	45.3%
Routine shopping (groceries, clothing, convenience store, HH maintenance)	224937	7.6%
Work/Job	217829	7.3%
Changed type of transportation	173929	5.8%
Visit friends/relatives	102281	3.4%
Eat meal outside of home	96901	3.3%
Drop off passenger from car	96245	3.2%
Attending Class	93022	3.1%
Pick up passenger from car	86881	2.9%
Household errands (bank, dry cleaning, etc.)	80494	2.7%
Work Business Related	72342	2.4%
Outdoor recreation/entertainment	66402	2.2%
Personal business (visit government office, attorney, accountant)	65137	2.2%
Health care (doctor, dentist)	63334	2.1%
Indoor recreation/entertainment	62312	2.1%
Service private vehicle (gas, oil lube, etc.)	31030	1.0%
Civic/Religious activities	29006	1.0%
Working at home (for pay)	19926	0.7%
Shopping for major purchases or specialty items (appliance, electronics, new vehicle, major HH repairs)	17242	0.6%
All other School Activities	10515	0.4%
All other activities at work	9195	0.3%
Loop trip	5097	0.2%
Other, SPECIFY	1212	0.0%
Volunteer Work/Activities	567	0.0%
While Traveling -- Other, Specify	0	0.0%
Total	2973695	100.0%

Summarized in Table 13-23, the majority of trips (52 percent) were made with only one person in the travel party; 29 percent of trips were made with two people in the travel party, and another 12 percent of trips were made with three people in the travel party.

Table 13-23 – Total People Traveling in Travel Party, Including Respondent

Total People Traveling	Count	Percent
1 person	1184590	51.5%
2 persons	677414	29.4%
3 persons	277001	12.0%
4 persons	104867	4.6%
5 persons	56579	2.5%
Total	2300452	100.0%

As shown in Table 13-24, for the majority of trips (95 percent), a toll road was not used and only 2% used a toll road.

Table 13-24 – Toll Road Used on Trip

Use a Toll Road	Count	Percent
Yes	34428	1.9%
No	1771652	95.4%
Don't Know	49062	2.6%
Refused	2495	0.1%
Total	1857637	100.0%

e) Travel Behavior

The purpose of this section is to review the travel behavior reported by the 1,488 participating households in order to document the extent to which their travel behavior varies. This section includes summaries of trip rates by the different household and person characteristics in the total study area. As is shown in Table 13-25, the overall daily trip rate by households in the Pioneer Valley Region is 10.6 trips, whereas the overall trip rate per person is 4.1 trips.

Table 13-25 – Average Household and Person Trip Rates

	Average Trip Rate
Household	10.6
Person	4.1

As one may expect, the larger the household, the more trips they report. This trend is summarized in Table 13-26. The larger households (8 or more members) reported the highest trip rate—29.8. One-person households reported 4.5 trips, two-person households reported 8.3 trips, three-person households reported 13.6 trips, four-

person households reported 17.5 trips, five-person households reported 22.2 trips, while six person households reported 26.6 trips. Finally, seven-person households reported 24.8 trips.

Table 13-26 – Trip Rates by Household Size

Household Size	Trip Rate
1	4.5
2	8.3
3	13.6
4	17.5
5	22.2
6	26.6
7	24.8
8 or more	29.8
Total	10.6

Of all trips, 55 percent were reported as being made by auto/van/truck as a driver, 14 percent were reported as walk trips, while 24 percent were reported as being made in an auto/van/truck as a passenger. Nearly 4 percent of trips were made via some sort of transit and 3 percent made by school bus. See Table 13-27 for more information on travel mode.

Table 13-27 – All Trip Modes

Transportation Mode	Count	Percent
Walk	321837	13.6%
Bike	29757	1.3%
Auto/Van/Truck Driver	1295841	54.8%
Auto/Van/Truck Passenger	558839	23.6%
Public Bus	75832	3.2%
Train	3525	0.1%
Dial-A-Ride/Paratransit	8062	0.3%
Taxi	5094	0.2%
School bus	60887	2.6%
Motorcycle Driver	2280	0.1%
Motorcycle Passenger	678	0.0%
Other, SPECIFY	3802	0.2%
Total	2366432	100.0%

Table 13-28 summarizes mode to work information. For those trips made to work, 76 percent were reported as being made by auto/van/truck as a driver, 4 percent were reported as being made by bus/public transit, 5 percent were reported as walk trips, while 7 percent were reported as being made as an auto/van/truck passenger. Six percent of those who work do so from home and therefore require no transportation.

Table 13-28 – Mode to Work

Mode to Work	Count	Percent
Works from home	15493	5.5%
Walk	12485	4.5%
Bike	3726	1.3%
Auto/Van/Truck Driver	211362	75.6%
Auto/Van/Truck Passenger	20511	7.3%
Bus / Public Transit	10716	3.8%
Dial-A-Ride/Paratransit	644	0.2%
Motorcycle Driver	159	0.1%
Other, SPECIFY	2857	1.0%
Don't Know	1067	0.4%
Refused	682	0.2%
Total	279701	100.0%

Table 13-29 summarizes typical mode to school. For those trips made to school, 28 percent were reported as being made via school bus, 31 percent were reported as being made as an auto/van/truck passenger, 17 percent were reported as being made by auto/van/truck driver, while 11 percent of trips were reported as walk trips.

Table 13-29 – Mode to School

Mode to School	Count	Percent
Home schooled	5966	3.4%
Walk	18733	10.7%
Bike	3332	1.9%
Auto/Van/Truck Driver	30094	17.2%
Auto/Van/Truck Passenger	53940	30.8%
Bus / Public Transit	8625	4.9%
Dial-A-Ride/Paratransit	548	0.3%
School Bus	49247	28.1%
Other, SPECIFY	2706	1.5%
Don't Know	1823	1.0%
Refused	94	0.1%
Total	175107	100.0%

E. DEMOGRAPHIC SCENARIO PLANNING

The Metropolitan Area Planning Council (MAPC) in collaboration with MassDOT's Office of Transportation Planning and the University of Massachusetts Donahue Institute projected the potential for future growth and decline across the state over 30 years from 2010 to 2040. The study presented two alternative scenarios called "Status Quo" and "Stronger State" for statewide growth.

1. Regional Demographic Projections

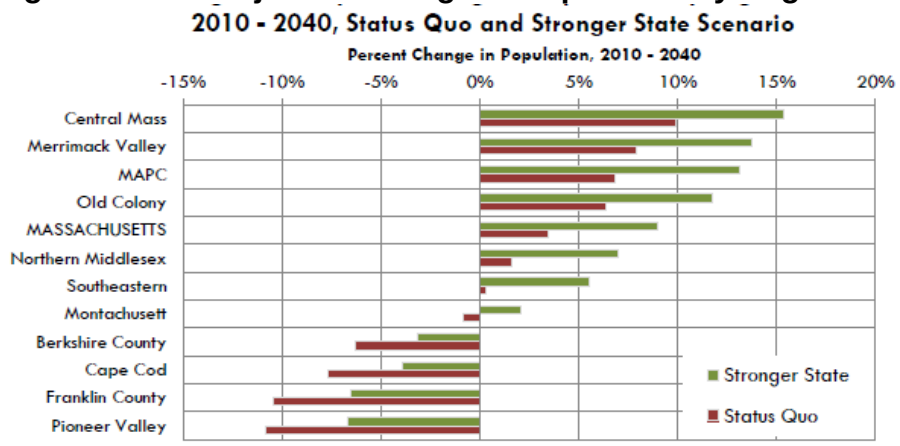
According to this study, the projections under both scenarios show a change in demographics in the Pioneer Valley region with an overall decline in population, households and employment. The details of this study as it pertains to the Pioneer Valley are presented below.

a) Population Change

The "Stronger State" scenario projects population to be 3% to 6% higher than "Status Quo" scenario across all regions of Massachusetts. However, the Pioneer Valley region, specifically, is expected to encounter a total population loss of about 7% under the "Stronger State" scenario and a 11% population loss under the "Status Quo" scenario. The varied demographics and migration patterns that exist in

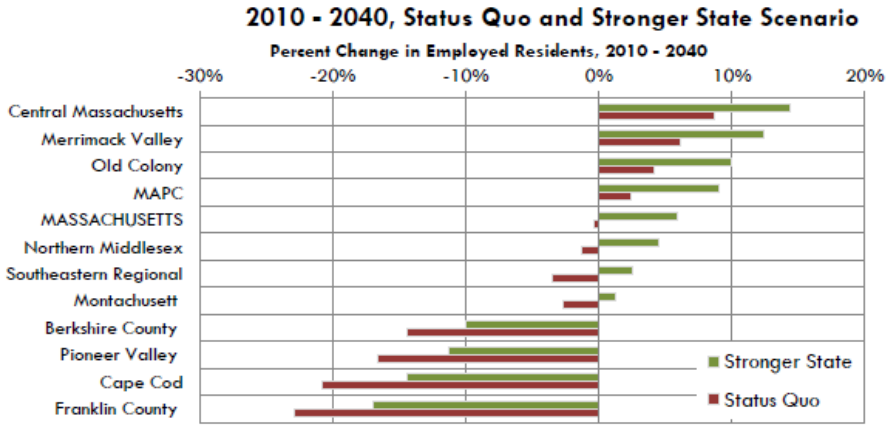
different regions means that population and labor force changes will not occur uniformly across the state.

Figure 13-1 – Projected Change in Population by Region



In the Pioneer Valley, the labor force is expected to decline about 17% even under the "Stronger State" scenario. The resident labor force is driven by the total population change as well as the age distribution of the population. The Pioneer Valley's decrease in labor force is likely due to the fact that the labor force may contract more quickly than the population overall.

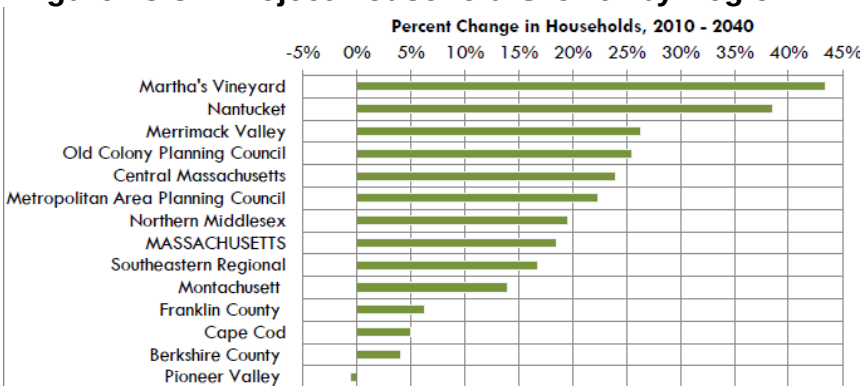
Figure 13-2 – Projected Change in Employed Residents by Region



b) Household Change

Despite modest population growth or even population declines in some regions, Massachusetts will still experience substantial growth in the number of households over the coming decades. However, as seen in Figure 13-3, the Pioneer Valley is projected to experience a loss of about 0.5% in household growth.

Figure 13-3 – Project Household Growth by Region



c) Regional Employment Change

As indicated in Table 13-30, The Pioneer Valley is projected to see labor force declines over the long term. Since the total non-Metro labor force is projected to decline, the initial totals regarding employment were adjusted slightly upward to match the non-Metro employment total derived from the shift-share method. The Pioneer Valley is projected to have an increase in employment between 2010 and 2020, but will rapidly decrease in the following two decades.

Table 13-30 – Projected Employment Change by Region

Forecast Region	Employment, 2010	Employment Change 2010-20	Employment Change 2020 - 2030	Employment Change 2030 - 2040
Berkshire County	60,200	2,400	-3,000	-5,400
Cape Cod	88,600	3,400	-5,300	-10,900
Central Massachusetts: Non Metro	180,100	25,500	-	300
Central Massachusetts: Metro	43,900	TBD	TBD	TBD
Franklin County	25,700	500	-2,000	-2,900
Martha's Vineyard	7,700	1,000	300	-300
Metro Boston (including all of MAPC, Old Colony, Northern Middlesex, and Merrimack Valley)	2,303,500	160,800	13,200	10,300
Montachusett: Non Metro	56,100	5,500	-3,200	-3,800
Montachusett: Metro	22,300	TBD	TBD	TBD
Nantucket	5,700	400	500	200
Pioneer Valley	252,200	9,200	-18,800	-19,000
Southeastern Regional: Non Metro	133,400	7,500	-1,900	-5,900
Southeastern Regional: Metro	94,400	TBD	TBD	TBD
MASSACHUSETTS	**3,113,200**	**196,700**	**-4,100**	**-8,000**

d) Summary

The findings presented here regarding the potential change in the Pioneer Valley region do not align with the regional projections presented earlier in this chapter.

This discrepancy is based in part on the regional projections placing a greater weight on major development such as the MGM casino development project in the center of Springfield on regional population and employment. The regional projections also assume a positive impact on population and employment as a result of expanded passenger rail service along the Knowledge Corridor line.

F. REGIONAL TRAVEL DEMAND MODEL

Travel demand forecasting is a major step in the transportation planning process. By simulating the current roadway conditions and the travel demand on those roadways, deficiencies in the system are identified. This is an important tool in planning future network enhancements and analyzing currently proposed projects.

Travel demand models are developed to simulate actual travel patterns and existing demand conditions. Networks are constructed using current roadway inventory files containing data for each roadway within the network. Travel demand is generated using socioeconomic data such as household size, automobile availability and employment data. Once the existing conditions are evaluated and adjusted to satisfactorily replicate actual travel patterns and vehicle roadway volumes, the model inputs are then altered to project future year conditions.

There are four basic steps in the traditional travel demand forecasting process: trip generation, trip distribution, modal choice, and trip assignment. There is also a preliminary step of network and zone development and a subsequent step of forecasting future conditions. The Pioneer Valley Planning Commission (PVPC) uses the TransCAD software to perform a 3-step process for forecasting near and future conditions including trip generation, trip distribution and trip assignment.

1. Network and Zone Development

a) Highway Network

The preliminary step in the development of a travel demand model is identifying the network and dividing the area into workable units. The highway network is composed of nodes and lines. Nodes represent intersections or centroids. Centroids are used to identify the center of activity within a zone and connect the zone to the highway network. Lines represent roadway segments or centroid connectors. Centroid connectors represent the path from a centroid to the highway network and typically represent the local roads and private driveways within the centroid. General information required for network developments include system length, demand, service conditions and connections to zones.

b) Transportation Analysis Zones

A Transportation Analysis Zone (TAZ) is the basic geographic unit representing tabulated data of individual households and business establishments aggregated for a region. The activity center of a zones is represented by a centroid. The centroid is

not necessarily the geographic center of a zone, but rather the point that best represents the average trip time in and out of a zone. A centroid connector links the zone with the roadway network. It often represents local streets that carry traffic out of or into a zone. Centroid connectors generally connect to adjacent collector or arterial roads.

1. Trip Generation

Trip generation is the first step in the modeling process. The goal of which is to identify the number of person trips that are made to and from traffic analysis areas (TAZ's). Trip generation analysis estimates the number of trips that are produced by each zone and the number of trips attracted to each zone for each of the three trip purposes:

- Home-Based Work (HBW) - trips from home to work;
- Home-Based Non-Work (HBNW) - trips from home to other destinations other than work; and
- Non-Home Based (NHB) - trips from a place other than home.

Households generally produce trips, while employment and other activity centers generally attract trips. Estimates of household based trips are affected by socioeconomic factors, such as auto ownership, and household size. Employment based trips depend on employment type and size. The trip generation model uses forecasted demographic and employment data associated with a zone to calculate person trips. Subsequently, total trips produced are balanced with the total trips attracted to reconcile inconsistencies between them. Consistency is reached by holding either trip productions or trip attractions constant an then redistributing the other category of tips.

2. Trip Distribution

Trip distribution determines the destination of the vehicle trips produced in each zone and how they are divided among all the other zones in the area. A relationship is developed between the number of trips produced by and attracted to zones and the accessibility of zones to other zones in terms of time and distance.

A basic trip distribution model is the gravity distribution model. In the gravity model, trips between zones are calculated based on the origin zone size; possible destinations size; as well as distance to neighboring zones. A friction factor is used in the gravity model to relate travel time to zone attractiveness. Travel time between two zones is based on the travel route selected and the speed on each road along the travel route. The following points list assumptions and inputs of the gravity model:

- Zone size is measured in terms of total population and total employment.
- Distance is measured in terms of travel time.

- A computerized assignment program designed to find the absolute shortest route between each pair of zones selects the travel route.

3. Mode Usage

This step in the development of the travel model estimates the distribution of previous trips to various alternative mode choices. Mode choices may include personal vehicle, transit, walking, bicycling, etc. Several factors affect a traveler's decision regarding the travel modes available. These include the characteristics of the person making the trip, the characteristics of the trip, and the characteristics of the transportation system.

4. Trip Assignment

Trip assignment is used to estimate the flow of traffic on a network. The trip assignment model takes as input a matrix of flows that indicate the volume of traffic between origin and destination pairs. The flows for each origin and destination pair are loaded on the network based upon the travel time or impedance of the alternative paths that could carry this traffic.

5. Forecasts

The preparation of a future year socioeconomic database is the last step in the travel demand forecast process. Forecasts of population and socioeconomic data as well as the attributes affecting travel are used to determine the number of trips that will be made in the future. The basic future year forecasts include total regional population, total number of households, and total number of jobs. The forecasted values are then divided by community in a region and subsequently divided into the various Transportation Analysis Zones. The zone-level estimates that forecasts provide are direct inputs in the travel demand forecasting model. Once travel demand is known and deficiencies identified, alternative transportation systems may be developed.

G. 2010 BASE YEAR MODEL

The regional travel demand model is made up of three major components: a roadway network, transportation analysis zones, and socioeconomic data. Each of these components add a critical contribution to the development of a working transportation simulation model. Initial 2010 base year model efforts included using 2010 socioeconomic data in a Quick Response trip generation model to calculate the home-based work trips (HBW), and the home-based non work trips (HBNW) productions per housing unit. As well as calculating the non home-based trips (NHB) production per retail employee, non-retail employee, and household. Standard vehicle occupancy rates were used to convert personal trips into vehicle trips before conducting the trip assignment process. This model continues to be updated according to the guidance of the MassDOT planning staff to a 2010 Base

Year Model using information from the 2010 Census as part of the Federal Fiscal Year 2015 Unified Planning Work Program for the Pioneer Valley MPO.

1. Network

A roadway network represents the regional transportation system in the regional travel demand model. A highway network was developed based on the federal functional classification of roadways. All roadways in the region classified as interstate, principal arterial and collector were included in this highway network. Local roads carrying minimal through traffic were represented only as centroid connectors to areas of traffic activity in a TAZ.

The characteristics of a roadway were coded as attributes and tabulated in a regional database for each line representing the roadway. Generally, speed and capacity attributes were based on the functional classification of a roadway and determined from the state roadway inventory files for the region. Adjustments were made to these attributes based on field observations, examination of aerial photographs, and review of regional and local traffic studies. Adjustments to these inputs were also made to better replicate regional travel activity in the model simulation. Out of the 45,722 roadway links in the Pioneer Valley regional network, a third (15,476) are included in the model. Local roadway links with a functional classification of zero are excluded from the model.

2. Transportation Analysis Zones

Transportation Analysis Zones are geographic divisions of a region into analysis units that allow linking tabulated data to a physical location serviced by the roadway network. Attributes of a TAZ include socioeconomic data which would impact the generation of trips in a zone either by spurring the production of trips or the attraction of trips to that zone. The current TAZ's size and location is based on the 2010 Census because it is the most comprehensive, current, and readily available source of socioeconomic and demographic information. The Pioneer Valley area is divided by the census into units of geographic areas called blocks containing the socioeconomic and demographic information and aggregated into block groups. The 2010 TAZ's geographic boundaries match the 2010 census block group boundaries for the most part except for certain urban areas warranting further detail due to a concentration of activity. On the other hand two block groups were aggregated in a rural area with minimal activity. The Pioneer Valley region 2010 base year model has 462 internal zones, and 62 external zones that represent external stations.

3. Socioeconomic Data

Basic socioeconomic data for the 2010 base year model came from the 2010 Census at the block level. Detailed socioeconomic data was obtained from the American Community Survey (ACS) 2009-2013 five year estimates at the tract level.

The socio economic data included the following list of variables: population, number of households, population in households, population in group quarters, auto availability, income, and number of workers.

The employment data was obtained from the department of labor for each of the communities in the region. The total number of workers in community was then distributed into the various zones in that community according to their ratios in the ACS survey. After breaking down of the number of jobs by job types they were aggregated into three categories: Basic, Retail, and Service.

To build the 2010 Census block / TAZ and 2010 Census tract / TAZ lookup tables used to generate the demographic tables, the following steps were performed by the MassDOT planning staff:

- The original TAZ shapefile based on the 2000 Census geographies was overlayed with 2010 Census block polygon features from the 2012 TIGER base map (ArcGIS identity tool). The quality of the 2012 TIGER is much better than that of earlier generations, and the features align quite well with those of other datasets in our spatial database as well as with aerial imagery.
- The resulting polygon attributes were edited to ensure that TAZs nest completely within a single town (except zone 10, which includes all of Middlefield and Worthington).
- Attributes were edited to ensure that 2010 Census blocks are not split among multiple TAZs. There is one exception to the no splits rule for Springfield tract 800900, block 1000 which is split between zones 245 and 246. For this block "Google Street View" was used to count the housing units in the zone 245 portion in order to estimate a factor for splitting the block data between the two zones.
- The resulting block / TAZ lookup table were used to estimate total population, household population and group quarters population by TAZ from 2010 Census Summary File 1 block level statistics. This block / TAZ lookup was also used to generate the various factors in the 2010 Census tract / TAZ lookup table.
- The tract / TAZ lookup table was used to generate the tables of household statistics (vehicles, workers, income) from the 2010 American Community Survey 5-year Summary File. Tract statistics were used to generate these tables due to high margins of error among block group estimates. The ACS household statistics were adjusted at the tract level to match 2010 Census total households before applying the tract / TAZ factors to generate the TAZ summaries.
- The employment data was extracted from the AASHTO Census Transportation Planning Products (CTPP) web query tool. This data is published at the tract level as well, and was allocated to TAZ based on the percentage of the land area of a tract that is contained in each of one or more TAZs. The CTPP employment estimates (collected between 2006 and 2010)

were then adjusted so that town totals match the ES-202 totals published by the Massachusetts Executive Office of Labor and Workforce Development.

4. Regionally Significant Projects

Only "regionally significant" projects are required to be included in travel demand modeling efforts. The final federal conformity regulations define regionally significant as follows:

> **Regionally significant:** a transportation project (other than an exempt project) that is on a facility which serves regional transportation needs (such as access to and from the area outside of the region, major activity centers in the region, major planned developments such as new retail malls, sport complexes, etc., or transportation terminals as well as most terminals themselves) and would be included in the modeling of a metropolitan area's transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel.

"Non-Exempt" projects add capacity to the existing transportation system and must be included as part of the air quality conformity determination for the RTP. Examples of "Non-Exempt" projects include those defined as regionally significant in addition to projects expected to widen roadways for the purpose of providing additional travel lanes.

Projects considered regionally significant were included as part of the 2010 Baseline model network and subsequent future model networks based on the project's expected construction date. These projects include non exempt system expansion projects that were financially constrained.

The 2010 base year roadway network includes all regionally significant TIP projects that were already included in the 2000 Baseline model network as well as projects that were completed by the end of 2010. Those projects include the following:

- Hadley: Widening Route 9 from two lanes to four lanes from West Street to Coolidge Bridge.
- Hadley/Northampton: Rehabilitation of the Coolidge Bridge with lane addition and widening from three lanes to four lanes.
- Springfield: Reverse the direction of four existing I-91 ramps.
- Westfield: Route 10/202 Great River Bridge - two bridges acting as one-way pairs.
- Holyoke: Commercial Street extension project from the I-391 ramp to Appleton Street.
- Chester: Maple Street Bridge one way northbound, connecting Route 20 to Main Street.

The 2020 model network will include the following regionally significant projects:

- Wilbraham: Boston Road reconstruction. Currently one lane in each direction, will become two lanes in each direction. Project starts at the Springfield City Line and continues east to Stony Hill Road (0.28 miles), but does not include Stony Hill Road. Expected in 2016.
- Through the region: New Commuter Rail Service from Hartford, CT to Greenfield, MA. (Currently not modeled)
- Hadley: Route 9 Phase 1 - Widens Route 9 from one lane to two lanes in each direction. Project starts west of Middle Street and continues till East Street. Expected in 2020.

The 2030 model network will include the following regionally significant projects:

- Hadley: Route 9 Phase 2 - Widens Route 9 from one lane to two lanes in each direction. Starts at East Street and continues to the Lowe's driveway. Expected in 2023
- Hadley: Route 9 Phase 3 - Widens Route 9 from one lane to two lanes in each direction. Project starts east of the Lowe's driveway and continues to the Home Depot driveway. Expected in 2026.