

# MUTCD Traffic Signal Warrant Analysis

MassDOT District 3 Traffic section provided HSH with traffic signal warrant analysis conducted at three intersections within the Route 20 study corridor:

- Route 20/South Street;
- Route 20/Walnut Street; and
- Route 20/Shrewsbury Village/Valente Drive.

In addition, HSH conducted traffic signal warrant analyses for the Stoney Hill Road intersections with Route 20, as there were requests by the residents, Town, and State officials to look into a signal as a way to mitigate the safety issues at these intersections. HSH's warrant analysis work can be found in **Appendix D**.

Per the Manual of Uniform Traffic Control Devices (MUTCD), to determine whether a traffic signal is warranted at a location, an engineering study must be completed that reviews vehicular and pedestrian conditions as well as physical characteristics at an intersection. The MUTCD outlines nine warrants that could justify the installation of a traffic signal:

- Warrant 1 – Eight-Hour Vehicular Volume
- Warrant 2 – Four-Hour Vehicular Volume
- Warrant 3 – Peak hour
- Warrant 4 – Pedestrian Volume
- Warrant 5 – School Crossing
- Warrant 6 – Coordinated Signal System
- Warrant 7 – Crash Experience
- Warrant 8 – Roadway Network
- Warrant 9 – Intersection Near a Grade Crossing

District 3's study and HSH's work focused on Warrants 1, 2, and 3, as the other warrants weren't applicable (no pedestrian accommodations along the study area corridor, no schools in the immediate vicinity, signals aren't coordinated, etc.). and it found that Route 20/Walnut Street met all warrants; Route 20/Old Shrewsbury Village/Valente Drive met Warrants 2 and 3; and Route 20/Stoney Hill Road West, Route 20/Stoney Hill Road East, and Route 20/South Street didn't meet any warrants. The results are shown in **Table 14**.

**Table 14. Traffic Signal Warrant Analysis Summary**

Warrant No.	Warrant Name	Does it meet Warrant?				
		Route 20/ Stoney Hill Road West	Route 20/ Stoney Hill Road East	Route 20/ South Street	Route 20/ Walnut Street	Route 20/ Valente Drive/Old Shrewsbury Village
1	8-hr Vehicular Volume	No	No	No	Yes	No
2	4-hr Vehicular	No	No	No	Yes	Yes
3	Peak hour	No	No	No	Yes	Yes



MassDOT requires Warrant 1 to be satisfied before it considers signaling an intersection. However, due to the proximity of the Route 20/Walnut Street South intersection to the Route 20/Old Shrewsbury Village/Valente Drive intersection and the significant grade change (west of Route 20/Old Shrewsbury Village/Valente Drive intersection, Route 20 drops down), a signal at Walnut Street South may not be the safest option. Therefore, two different concepts will be discussed in the sections that follow.

## Future (2037) Conditions

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This section provides information on future developments, and their impacts, planned on Route 20 within and adjacent to the study area.

### Background Growth and Future Developments

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HSH studied historical and projected population growth in Shrewsbury and Northborough, available traffic counts along the corridor, and worked with CMRPC and determined that a background growth rate of 1.5% can be applied to the traffic volumes of the study area network. However, as there are 15 developments approved and/or planned to be built within and adjacent to the study area, applying the 1.5% growth rate to every movement in the study area is not reasonable. For this reason, the following was done:

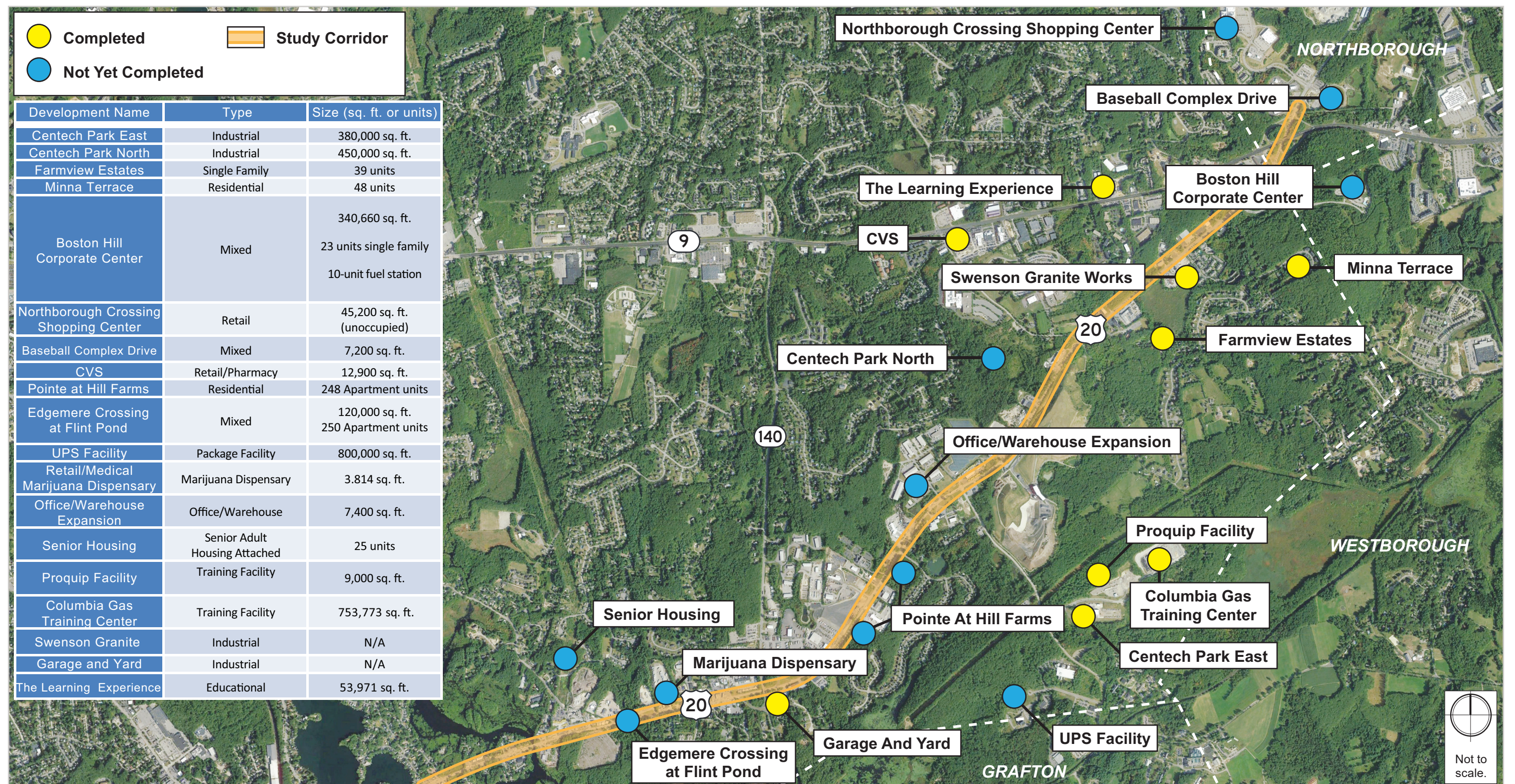
- Existing volumes of movements **impacted** by the trips generated from the proposed developments will be increased by 0.5% over 20 years, in order to include general background growth. Trips generated by the developments will also be added to these movements; and
- Existing volumes of movements **not impacted** by the developments will be increased by 1.5% over 20 years, in order to include general background growth and increased cut-through traffic on these movements.

**Figure 31** provides a list of the 19 planned and approved developments, including their location, type, and size (square footage, units, fuel stations, etc.) Types of developments include, but are not limited to, industrial, commercial, office, and residential developments. It includes six developments at the bottom of the table, two of which (547 Hartford Turnpike and 14 Fortune Boulevard) have been approved for construction recently by the Shrewsbury Planning Board, and another four which were built in 2018. As these businesses are small traffic generators, it is assumed that the general background growth rates applied to the network include their generated trips.

This information was used to create **Figure 32**, shows the location of each proposed development and the number of vehicles they are expected to add to Route 20, and **Figure 33**, which shows the future (2037) traffic volumes which include the development volumes, the 0.5% per year background growth applied to movements impacted by development-related traffic, and the 1.5% per year background growth applied to movements not impacted by development-related traffic. Trip generation and distribution details are provided in **Appendix E**.



Figure 31. Proposed Developments and Locations



Shrewsbury – Route 20 Corridor Improvements



Figure 32. Route 20 Proposed Developments Trip Generation, a.m., and p.m. Peak Hours

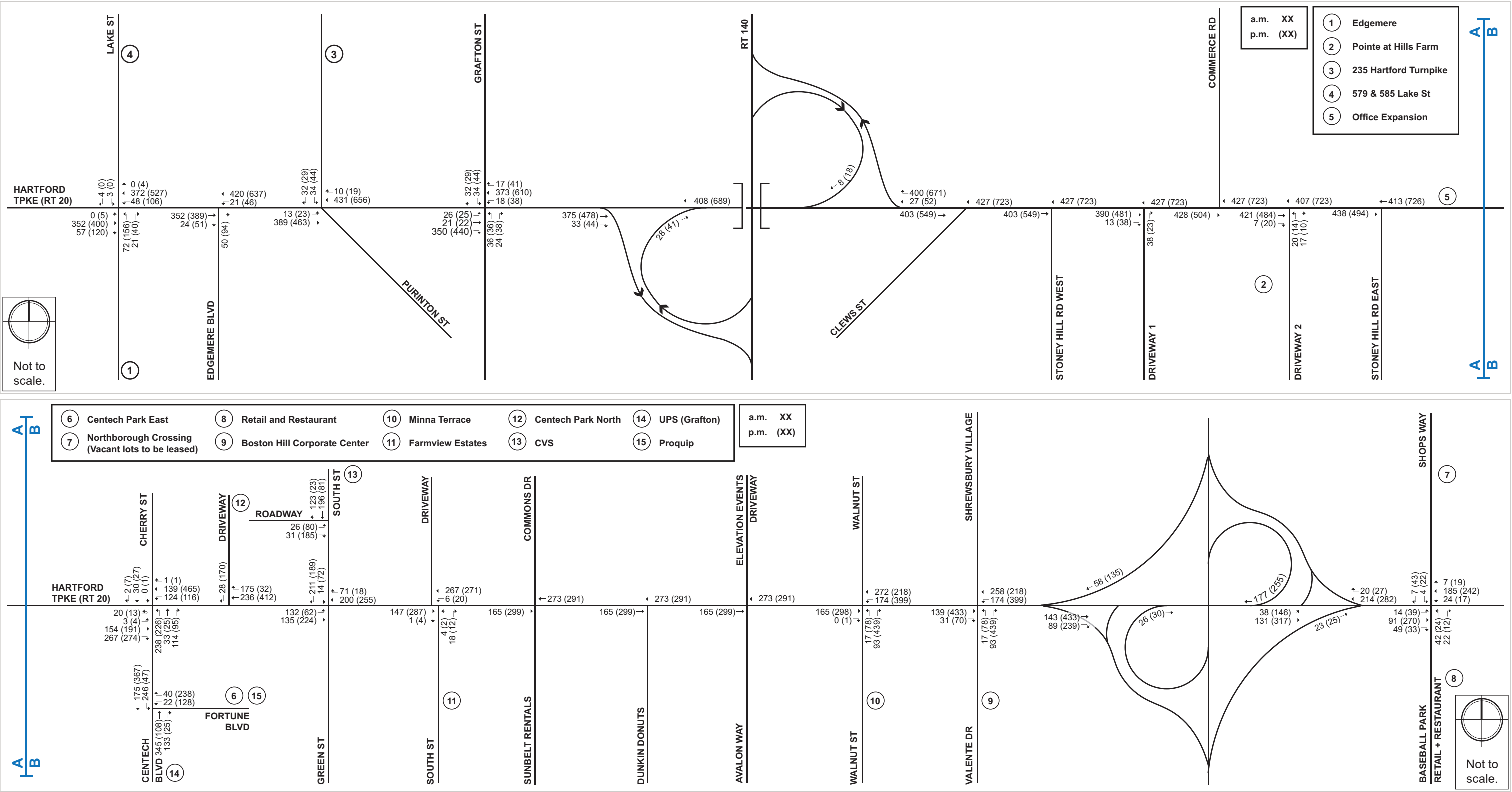
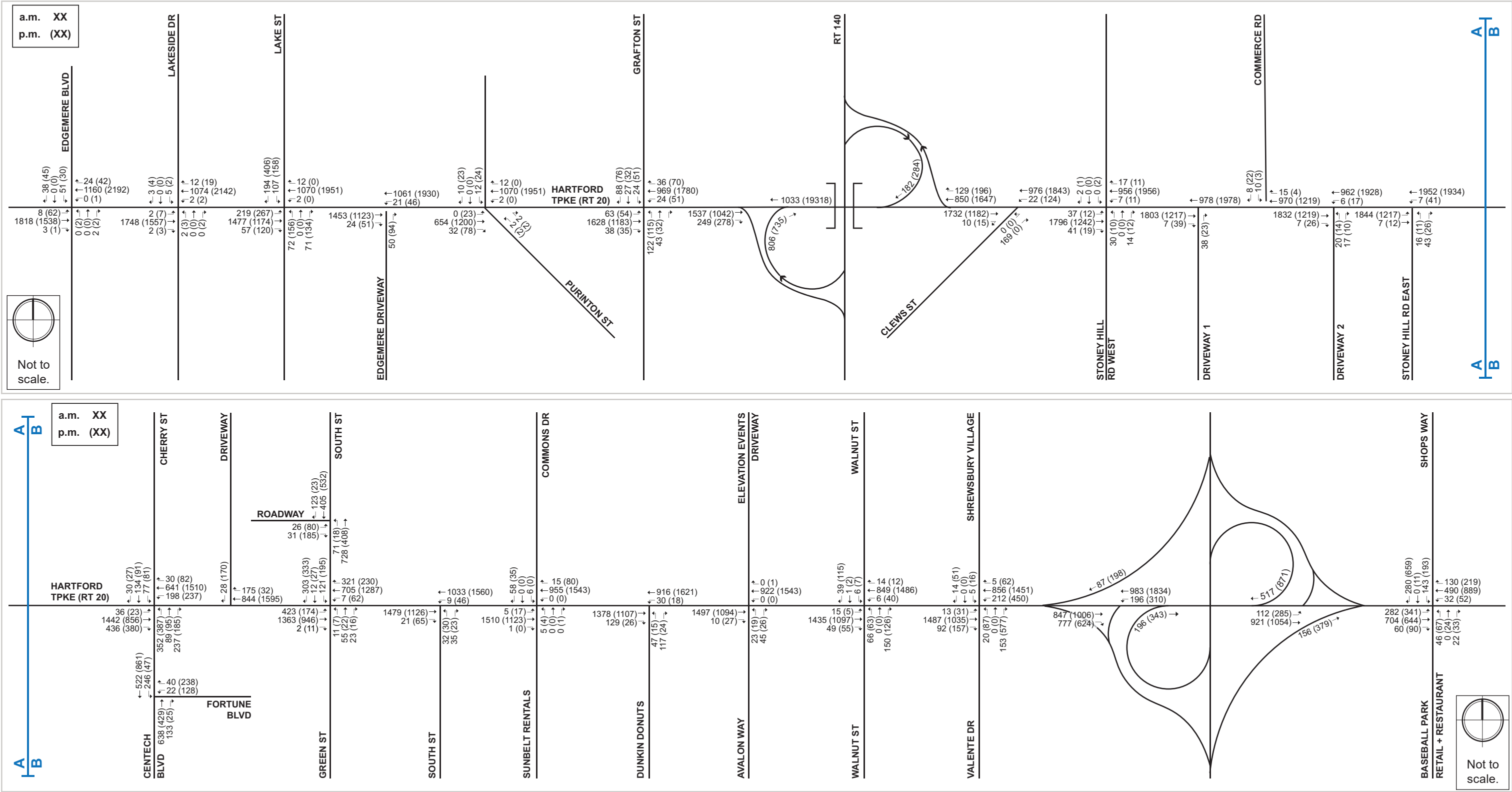




Figure 33. Future (2037) Conditions Traffic Volumes, Weekday a.m. and p.m. Peak Hours







## UPS FACILITY

One of the proposed developments is a new UPS facility on Centech Boulevard. In November 2018, UPS finalized the purchase of several land parcels, totaling 200 acres spanning Shrewsbury and Grafton, and is planning to construct an 800,000-sq. ft. distribution facility. The subset of the site within Shrewsbury is zoned as Limited Industrial and abuts Residential zoned parcels and the subset within Grafton is zoned as Office/Light Industrial.

Because the UPS plan is still in the early stages, the Town of Shrewsbury and MassDOT requested that the HSH team examine the trip generation associated with an alternative as-of-right (allowable by zoning) development on the 200-acre site. Defining a hypothetical as-of-right program is difficult for such a large parcel in the absence of understanding constraints related to environmental conditions, utility services, vehicle access, and setbacks. Instead, HSH estimated the trip generation associated with an office development, which is an allowed use under existing zoning.

Peak hour vehicle trip generation forecasts for UPS' proposed 800,000 sq. ft. facility were obtained from the UPS development team. The HSH team estimated vehicle trips associated with two office alternatives:

- **Alternative 1:** an 800,000 sq. ft. office development, which is the same size as the proposed UPS facility.
- **Alternative 2:** a 512,000 sq. ft. office development, which would generate a similar number of peak hour vehicle trips as the proposed UPS facility.

**Table 15** presents the trip generation for these developments.

**Table 15. Vehicle Trip Generation - UPS vs. Office Alternatives**

Development	Size (sq. ft.)	Vehicles per Hour					
		a.m. peak hour			p.m. peak hour		
		Entering	Exiting	Total	Entering	Exiting	Total
<b>UPS</b>	800,000	248	450	698	467	122	589
<b>Office Alternative 1</b>	800,000	798	130	928	147	773	920
<b>Office Alternative 2</b>	512,000	511	83	594	94	495	589





As shown, the number of a.m./p.m. peak hour entering and exiting trips for the proposed UPS facility, with multiple employee shifts covering 24/7, are not equal to an office development, where most employees arrive in the morning and leave in the evening, reflecting typical commuting patterns.

The UPS facility would generate about 698 vehicle trips in the a.m. peak hour and about 589 vehicle trips during the p.m. peak hour. Under Alternative 1, a general office building of 800,000 sq. ft. would generate 35 – 40% more peak hour vehicle trips than the UPS facility, reflecting the differences in the nature of the workspace, number of employees, and commuting patterns. An office development of this size, with almost 800 vehicle trips entering in the morning and exiting in the evening, would likely cause traffic impacts to key nearby intersections of Route 30/Pine Street and Route 30/Centech Boulevard/Cherry Street. (If the

UPS facility is ultimately not constructed, the next developer would be responsible for preparing, among other studies, a traffic report that would present the associated impacts from the re-defined development.)

The size of the office program under Alternative 2 was determined by matching the p.m. peak hour trip generation to the UPS facility. A 512,000 sq. ft. office development would generate about 594 vehicle trips in the a.m. peak hour and about 589 vehicle trips in the p.m. hour, resulting in similar area traffic impacts as expected with the UPS facility. Therefore, any intersection improvements proposed for the 800,000 sq. ft. UPS facility would likely be enough for a 512,000 sq. ft. office development.

Detailed vehicle trip generation calculations for the alternatives are shown in **Appendix E**.

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## Future (2037) Operations Analysis without Roadway Improvements

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This section will analyze the impact that the development-generated traffic, general background growth, and increased cut-through traffic, is anticipated to have on the Route 20 corridor, while assuming no roadway and intersection improvements in the project area.

The Future (2037) Conditions a.m. and p.m. peak hour Level of Service for each of the nine (9) signalized and the 16 unsignalized intersections within the study area are shown graphically in **Figure 34. Table 16 through Table 19** show the a.m. and p.m. peak hour capacity analyses in detail.



Figure 34. Future (2037) Conditions, Level of Service a.m. and p.m. Peak Hours

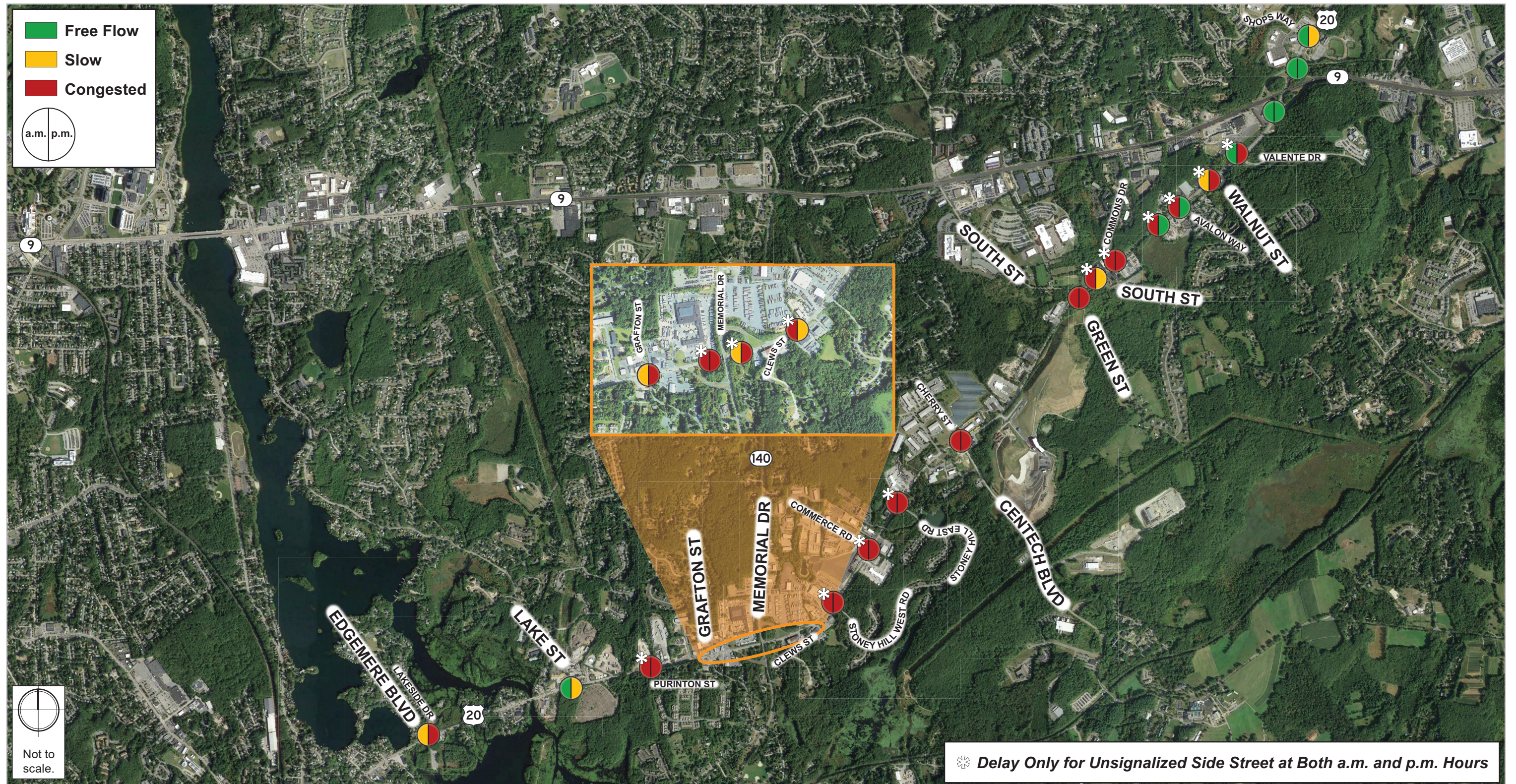




Table 16. No-Build (2037) Conditions Signalized Intersection Capacity Analysis Summary, a.m. Peak Hour

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
<b>Route 20/Edgemere Boulevard/Oak Island Driveway</b>	<b>E</b>	<b>67.2</b>	-	-	-
Route 20 EB left/thru thru/right	F	>80.0	1.17	~494	#930
Route 20 WB left/thru thru/right	C	31.6	0.99	170	#600
Oak Island NB left/thru/right	C	29.6	0.00	0	0
Edgemere SB left/thru/right	C	30.1	0.07	0	43
<b>Route 20/Lake Street/Edgemere Driveway</b>	<b>B</b>	<b>19.9</b>	-	-	-
Route 20 EB left	B	13.1	0.64	46	114
Route 20 EB lthru thru/right	B	16.3	0.79	455	666
Route 20 WB left	B	14.9	0.48	13	45
Route 20 WB thru thru/right	B	15.6	0.64	267	462
Edgemere NB left	D	45.6	0.58	48	92
Edgemere NB thru/right	D	37.9	0.05	0	2
Lake SB left/thru thru/right	D	49.9	0.54	42	91
<b>Route 20/Grafton Street</b>	<b>D</b>	<b>47.2</b>	-	-	-
Route 20 EB left	E	65.8	0.72	34	#118
Route 20 EB thru thru/right	B	19.0	0.87	316	#877
Route 20 WB left/thru thru/right	C	31.5	0.91	256	#624
Grafton NB left/thru/right	F	>80.0	1.28	~144	#387
Grafton SB left/thru/right	F	>80.0	1.20	~132	#373
<b>Route 20/Cherry Street/Centech Boulevard</b>	<b>F</b>	<b>&gt;80.0</b>	-	-	-
Route 20 EB left	A	9.6	0.19	8	19
Route 20 EB thru thru/right	F	>80.0	1.17	~613	#752
Route 20 WB left	D	44.8	0.86	54	#175
Route 20 WB thru/right	B	19.8	0.81	280	#518
Centech Boulevard NB left/thru	F	>80.0	2.67	~400	#578
Centech Boulevard NB right	C	22.2	0.47	74	136

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
Cherry Street SB left/thru	F	>80.0	3.83	~205	#320
Cherry Street SB right	C	20.3	0.02	0	14
<b>Route 20/South Street/Green Street</b>	<b>F</b>	<b>&gt;80.0</b>	-	-	-
Route 20 EB left	F	>80.0	1.11	~218	#406
Route 20 EB thru/right	F	>80.0	1.20	~949	#1199
Route 20 WB left/thru thru/right	D	41.5	0.96	271	#425
Green Street NB left/thru/right	C	27.9	0.24	36	79
South Street SB left/thru/right	F	>80.0	1.16	~252	#442
<b>Route 20/Shrewsbury Village/ Valente Drive</b>	<b>C</b>	<b>23.5</b>	-	-	-
Route 20 EB left	D	54.3	0.29	10	30
Route 20 EB thru thru/right	B	14.9	0.75	150	#830
Route 20 WB left left	F	>80.0	1.02	~112	#198
Route 20 WB thru thru/right	A	9.5	0.40	46	365
Valente Drive NB left/thru	E	66.1	0.54	15	41
Valente Drive NB right	D	46.3	0.10	0	39
Shrewsbury Village SB left/thru	E	56.4	0.19	3	16
Shrewsbury Village SB right	D	48.3	0.01	0	0
<b>Route 20 WB/Route 9 EB on ramp</b>	<b>A</b>	<b>4.8</b>	-	-	-
Route 20 EB thru	B	10.5	0.69	162	405
Route 20 WB left	A	4.5	0.36	0	7
Route 20 WB thru thru	A	0.3	0.33	0	0
<b>Route 20/Route 9 WB on/off ramp</b>	<b>B</b>	<b>10.2</b>	-	-	-
Route 20 EB left	B	12.8	0.28	33	m46
Route 20 EB thru	A	7.1	0.72	187	208





**Table 16. No-Build (2037) Conditions Signalized Intersection Capacity Analysis Summary, a.m. Peak Hour (cont'd)**

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
Route 20 WB thru thru/right	B	10.5	0.51	152	154
Route 9 WB off ramp NB right	C	24.0	0.11	0	42
<b>Route 20/Shops Way/Baseball Complex Drive</b>	<b>C</b>	<b>30.4</b>	-	-	-
Route 20 EB left left	D	49.0	0.64	118	150
Route 20 EB thru/right	C	20.1	0.80	274	#627
Route 20 WB left	D	53.5	0.40	24	58
Route 20 WB thru thru/right	C	20.1	0.44	156	226
Baseball Complex NB left	E	58.8	0.47	17	48
Baseball Complex NB left/thru	E	58.8	0.47	17	48
Baseball Complex NB right	D	46.2	0.01	0	0
Shops Way SB left/thru	E	77.3	0.86	109	#233
Shops Way SB right right	C	30.0	0.11	0	30

# = 95th percentile volume exceeds capacity, queue may be longer.

~ = Volume exceeds capacity, queue is theoretically infinite.

m = Volume of 95th percentile queue is metered by upstream signal

Table 17. No-Build (2037) Conditions Unsignalized Intersection Capacity Analysis Summary, a.m. Peak Hour

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
<b>Route 20/Purinton Street</b>	-	-	-	-	-
Route 20 EB thru thru/right	A	0.0	0.98	-	0
Route 20 WB left/thru	C	15.8	0.01	--	0
Purinton St NB left/right	F	>50.0	0.09	-	6
<b>Route 20/Route 140 West Off-Ramp</b>	-	-	-	-	-
Route 20 EB thru	A	0.0	0.00	-	0
Route 20 WB thru/thru	A	0.0	0.00	-	0
Route 140 West NB right	F	>50.0	10.66	-	>2000
<b>Route 20/Route 140 East Off-Ramp</b>	-	-	-	-	-
Route 20 EB thru	A	0.0	0.00	-	0
Route 20 WB thru	A	0.0	0.00	-	0
Route 140 East SB right	E	38.3	0.67	-	110
<b>Route 20/Clews Street</b>	-	-	-	-	-
Route 20 EB thru/right	A	0	0.00	-	0
Route 20 WB left/thru	C	17.2	0.08	-	5
Clews St NB left/right	F	>50.0	2.09	-	405
<b>Route 20/Stoney Hill Road (West)/Driveway</b>	-	-	-	-	-
Route 20 EB left/thru thru/right	B	11	0.06	-	5
Route 20 WB left/thru	C	17.7	0.03	-	3
Route 20 WB right	A	0	0.00	-	0
Stoney Hill Rd NB left/thru/right	F	>50.0	6.83	-	188
Driveway SB left/thru/right	C	22.2	0.01	-	0
<b>Route 20/Commerce Road</b>	-	-	-	-	-
Route 20 EB left/thru	B	11.3	0.04	-	3
Route 20 WB thru/right	A	0	0.00	-	0
Commerce Rd SB left/right	F	>50.0	1.03	-	68

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
<b>Route 20/Stoney Hill Road (East)</b>	-	-	-	-	-
Route 20 EB thru/right	A	0	0.00	-	0
Route 20 WB left/thru	C	20.0	0.03	-	3
Stoney Hill Rd NB left/right	F	>50.0	1.94	-	180
<b>Route 20/South Street</b>	-	-	-	-	-
Route 20 EB thru/right	A	0.0	0.00	-	0
Route 20 WB left/thru thru	C	16.6	0.03	-	3
South St NB left/right	F	>50.0	1.12	-	143
<b>Route 20/Commons Drive/Sunbelt Rentals Driveway</b>	-	-	-	-	-
Route 20 EB left/thru/right	B	10.2	0.01	-	0
Route 20 WB left/thru thru/right	A	0.0	0.00	-	0
Sunbelt Rentals NB left/thru/right	F	>50.0	0.32	-	23
Commons Drive SB left/right	F	>50.0	0.59	-	73
<b>Route 20/Dunkin Donuts Driveway</b>	-	-	-	-	-
Route 20 EB thru thru/right	A	0.0	0.00	-	0
Route 20 WB left/thru thru	B	14.7	0.08	-	7
Dunkin Donuts NB left/right	F	>50.0	1.77	-	358
<b>Route 20/Avalon Way</b>	-	-	-	-	-
Route 20 EB thru/thru right	A	0.0	0.00	-	0
Route 20 WB left/thru thru	C	17.3	0.02	-	3
Avalon NB left/right	F	>50.0	0.70	-	93
<b>Route 20/Walnut Street N</b>	-	-	-	-	-
Route 20 EB left/thru thru	B	10.3	0.02	-	3
Route 20 WB thru thru right	A	0.0	0.00	-	0
Walnut Street SB left/thru/right	C	23.1	0.20	-	18





**Table 17. No-Build (2037) Conditions Unsignalized Intersection Capacity Analysis Summary, a.m. Peak Hour (cont'd)**

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
<b>Route 20/Walnut Street S</b>	-	-	-	-	-
Route 20 EB thru thru/right	A	0.0	0.00	-	0
Route 20 WB left	B	13.7	0.07	-	5
Route 20 WB thru thru	A	0.0	0.00	-	0
Walnut Street NB left	F	>50.0	1.71	-	200
Walnut Street NB right	C	23.6	0.46	-	58
<b>Route 20 WB/Route 9 EB off ramp</b>	-	-	-	-	-
Route 20 EB thru	A	0.0	0.00	-	0
Route 20 WB thru thru	A	0.0	0.00	-	0
Route 9 EB off ramp WB right	B	14.4	0.20	-	18
<b>Route 20 EB/Route 9 EB off ramp</b>	-	-	-	-	-
Route 20 EB thru	A	0.0	0.00	-	0
Route 20 WB thru thru	A	0.0	0.00	-	0
Route 9 EB off ramp EB right	D	28.9	0.60	-	93
<b>Route 20 WB/Route 9 WB off ramp</b>	-	-	-	-	-
Route 20 EB thru	A	0.0	0.00	-	0
Route 20 WB thru thru	A	0.0	0.00	-	0
Route 9 WB off ramp SB right	E	40.7	0.89	-	265

Table 18. No-Build (2037) Conditions Signalized Intersection Capacity Analysis Summary, p.m. Peak Hour

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
<b>Route 20/Edgemere Boulevard/Oak Island Driveway</b>	<b>F</b>	<b>&gt;80.0</b>	-	-	-
Route 20 EB left/thru thru/right	F	>80.0	2.19	~586	#980
Route 20 WB left/thru thru/right	F	>80.0	1.69	~746	#1248
Oak Island NB left/thru/right	C	29.7	0.00	0	0
Edgemere SB left/thru/right	C	31.7	0.29	12	60
<b>Route 20/Lake Street/Edgemere Driveway</b>	<b>E</b>	<b>69.0</b>	-	-	-
Route 20 EB left	F	>80.0	1.15	~206	#383
Route 20 EB lthru thru/right	B	11.9	0.62	286	351
Route 20 WB left	E	78.1	0.94	116	#267
Route 20 WB thru thru/right	E	74.1	1.08	~878	#1018
Edgemere NB left	F	>80.0	0.91	108	#213
Edgemere NB thru/right	C	34.5	0.15	19	73
Lake SB left/thru thru/right	F	>80.0	1.16	~216	#336
<b>Route 20/Grafton Street</b>	<b>F</b>	<b>&gt;80.0</b>	-	-	-
Route 20 EB left	D	53.1	0.62	30	#101
Route 20 EB thru thru/right	B	12.3	0.66	184	495
Route 20 WB left/thru thru/right	F	>80.0	1.54	~796	#1345
Grafton NB left/thru/right	F	>80.0	1.05	107	#342
Grafton SB left/thru/right	E	70.5	0.89	95	#306
<b>Route 20/Cherry Street/Centech Boulevard</b>	<b>F</b>	<b>&gt;80.0</b>	-	-	-
Route 20 EB left	C	26.0	0.26	5	12
Route 20 EB thru thru/right	B	13.0	0.62	245	365
Route 20 WB left	C	20.4	0.75	39	128
Route 20 WB thru/right	F	>80.0	1.35	~1564	#1853
Centech Boulevard NB left/thru	F	>80.0	4.76	~691	#906
Centech Boulevard NB right	C	32.8	0.22	24	77

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
Cherry Street SB left/thru	F	>80.0	3.82	~240	#386
Cherry Street SB right	D	35.1	0.02	0	23
<b>Route 20/South Street/Green Street</b>	<b>F</b>	<b>&gt;80.0</b>	-	-	-
Route 20 EB left	C	24.1	0.67	44	110
Route 20 EB thru/right	C	21.6	0.90	405	#760
Route 20 WB left/thru thru/right	F	>80.0	1.44	~653	#857
Green Street NB left/thru/right	C	25.1	0.10	13	43
South Street SB left/thru/right	F	>80.0	1.55	~418	#646
<b>Route 20/Old Shrewsbury Village/ Valente Drive</b>	<b>F</b>	<b>&gt;80.0</b>	-	-	-
Route 20 EB left	D	45.2	0.34	20	51
Route 20 EB thru thru/right	F	>80.0	1.39	376	#746
Route 20 WB left left	D	35.9	0.53	149	#321
Route 20 WB thru thru/right	C	31.2	0.93	246	#897
Valente Drive NB left/thru	D	48.2	0.61	54	#149
Valente Drive NB right	C	23.4	0.40	3	#128
Shrewsbury Village SB left/thru	D	50.0	0.35	10	31
Shrewsbury Village SB right	D	40.2	0.03	0	0
<b>Route 20 WB/Route 9 EB on ramp</b>	<b>B</b>	<b>10.7</b>	-	-	-
Route 20 EB thru	B	19.1	0.80	317	m535
Route 20 WB left	D	42.4	0.71	87	m161
Route 20 WB thru thru	A	0.5	0.54	0	0
<b>Route 20/Route 9 WB on/off ramp</b>	<b>C</b>	<b>22.7</b>	-	-	-
Route 20 EB left	D	39.7	0.77	186	m195
Route 20 EB thru	C	23.3	0.89	517	#889
Route 20 WB thru thru/right	B	12.4	0.81	290	m#379





**Table 18.** *No-Build (2037) Conditions Signalized Intersection Capacity Analysis Summary, p.m. Peak Hour (cont'd)*

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
Route 9 WB off ramp NB right	D	51.5	0.85	176	#324
<b>Route 20/Shops Way/Baseball Complex Drive</b>	<b>D</b>	<b>42.3</b>	-	-	-
Route 20 EB left left	D	44.5	0.88	205	m240
Route 20 EB thru/right	C	22.1	0.81	290	m438
Route 20 WB left	D	50.0	.56	34	73
Route 20 WB thru thru/right	D	49.6	0.97	347	#492
Baseball Complex NB left	E	58.4	0.62	30	#77
Baseball Complex NB left/thru	E	56.4	0.61	31	#77
Baseball Complex NB right	D	37.7	0.01	0	0
Shops Way SB left/thru	F	>80.0	1.02	~172	#316
Shops Way SB right right	C	26.8	0.60	136	199

# = 95th percentile exceeds capacity, queue may be longer.

~ = Volume exceeds capacity, queue is theoretically infinite.

m = Volume of 95th percentile queue is metered by upstream signal.

Table 19. No-Build (2037) Conditions Unsignalized Intersection Capacity Analysis Summary, p.m. Peak Hour

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
<b>Route 20/Purinton Street</b>	-	-	-	-	-
Route 20 EB thru thru/right	A	0	0.00	-	0
Route 20 WB left thru thru	A	0	0.00	-	0
Purinton St NB left/right	F	77.4	0.08	-	7
<b>Route 20/Route 140 West Off-Ramp</b>	-	-	-	-	-
Route 20 EB thru	A	0.0	0.00	-	0
Route 20 WB thru thru	A	0.0	0.00	-	0
Route 140 West NB right	F	>50.0	0.87	-	154
<b>Route 20/Route 140 East Off-Ramp</b>	-	-	-	-	-
Route 20 EB thru	A	0.0	0.00	-	0
Route 20 WB thru	A	0.0	0.00	-	0
Route 140 East SB right	F	>50.0	3.12	-	>2000
<b>Route 20/Clews Street</b>	-	-	-	-	-
Route 20 EB thru/right	A	0.0	0.00	-	0
Route 20 WB left thru	B	13.4	0.24	-	23
Clews St NB left/right	E	42.6	0.57	-	78
<b>Route 20/Stoney Hill Road (West)/Driveway</b>	-	-	-	-	-
Route 20 EB left thru thru/right	C	24.7	0.07	-	5
Route 20 westbound left thru	B	12.2	0.02	-	3
Route 20 westbound right	A	0	0.00	-	0
Stoney Hill Rd NB left thru right	F	>50.0	5.98	-	113
Driveway SB left thru right	F	>50.0	0.30	-	18
<b>Route 20/Commerce Road</b>	-	-	-	-	-
Route 20 EB left thru	D	27.4	0.02	-	3
Route 20 WB thru right	A	0	0.00	-	0
Commerce Rd SB left right	F	>50.0	0.82	-	70

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
<b>Route 20/Stoney Hill Road East</b>	-	-	-	-	-
Route 20 EB thru/right	A	0.0	0.00	-	0
Route 20 WB left thru	B	12.4	0.08	-	7
Stoney Hill Rd NB left/right	F	>50.0	1.61	-	123
<b>Route 20/South Street</b>	-	-	-	-	-
Route 20 EB thru/right	A	0.0	0.00	-	0
Route 20 WB left thru thru	B	12.3	0.09	-	7
South St NB left/right	D	28.5	0.27	-	28
<b>Route 20/Commons Drive/Sunbelt Rentals Driveway</b>	-	-	-	-	-
Route 20 EB eft thru right	C	15.6	0.05	-	5
Route 20 WB left thru thru/right	A	0.0	0.00	-	0
Sunbelt Rentals NB left thru right	F	>50.0	0.17	-	13
Commons Drive SB left right	C	19.3	0.13	-	10
<b>Route 20/Dunkin Donuts Driveway</b>	-	-	-	-	-
Route 20 EB thru thru right	A	0.0	0.00	-	0
Route 20 WB left thru thru	B	11.4	0.03	-	3
Dunkin Donuts NB left right	B	14.0	0.10	-	7
<b>Route 20/Avalon Way</b>	-	-	-	-	-
Route 20 EB thru thru right	A	0.0	0.00	-	0
Route 20 WB left thru thru	B	11.7	0.08	-	5
Avalon NB left right	B	14.1	0.11	-	10
<b>Route 20/Walnut Street N</b>	-	-	-	-	-
Route 20 EB left thru thru	B	14.5	0.01	-	0
Route 20 WB thru thru right	A	0.0	0.00	-	0
Walnut Street SB left thru right	F	>50.0	0.70	-	108





**Table 19. No-Build (2037) Conditions Unsignalized Intersection Capacity Analysis Summary, p.m. Peak Hour (cont'd)**

Intersection/Movement	LOS	Delay (Seconds)	V/C Ratio	50th Percentile Queue Length (feet)	95th Percentile Queue Length (feet)
<b>Route 20/Walnut Street S</b>	-	-	-	-	-
Route 20 EB thru thru/right	A	0.0	0.00	-	0
Route 20 WB left	B	13.1	0.20	-	18
Route 20 WB thru/thru	A	0.0	0.00	-	0
Walnut Street NB left	F	>50.0	2.36	-	203
Walnut Street NB right	C	17.4	0.32	-	35
<b>Route 20 WB/Route 9 EB off ramp</b>	-	-	-	-	-
Route 20 EB thru	A	0.0	0.00	-	0
Route 20 WB thru thru	A	0.0	0.00	-	0
Route 9 EB off ramp WB right	F	>50.0	0.84	-	168
<b>Route 20 EB/Route 9 EB off ramp</b>	-	-	-	-	-
Route 20 EB thru	A	0.0	0.00	-	0
Route 20 WB thru thru	A	0.0	0.00	-	0
Route 9 EB off ramp EB right	F	>50.0	1.43	-	518
<b>Route 20 WB/Route 9 WB off ramp</b>	-	-	-	-	-
Route 20 EB thru	A	0.0	0.00	-	0
Route 20 WB thru thru	A	0.0	0.00	-	0
Route 9 WB off ramp SB right	F	>50.0	2.32	-	1362

Under future (2037) conditions, and during the a.m. peak hour, six of the nine signalized intersections are expected to operate at LOS D or better, and the remaining six intersections are expected to operate at either LOS E or LOS F. During the p.m. peak hour, three of the nine signalized intersections are expected to operate at LOS D or better, and the remaining six intersections are expected to operate at either LOS E or LOS F.

It should be noted that existing signal timings and phases at the Route 20/Cherry Street/Centech Boulevard and Route 20/South Street/Green Street intersections were not changed for the no-build analysis. Details of the Synchro analyses are provided in **Appendix B**.