TRAFFIC IMPACT AND ACCESS STUDY

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PROPOSED FISHERVILLE TERRACE 40B DEVELOPMENT

119 Main Street
Grafton, Massachusetts

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Zoning Board of Appeals

Prepared for:
Fisherville Terrace, LLC

October 2020

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

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TRAFFIC IMPACT AND ACCESS STUDY

PROPOSED FISHERVILLE TERRACE 40B DEVELOPMENT

119 Main Street
Grafton, Massachusetts

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Arlington, Massachusetts

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October 2020

MDM

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EXECUTIVE SUMMARY

MDM Transportation Consultants, Inc. (MDM) has prepared a Traffic Impact and Access Study (TIAS) for a proposed 100-unit residential development to be located at 119 Main Street in Grafton, Massachusetts. The location of the site relative to adjacent roadways is shown in **Figure 1**. This report documents existing operational and safety-related characteristics of roadways serving the development Site, estimates development-related trip generation and operational impacts, and identifies potential mitigation actions to support the development.

This TIAS has been developed in conformance with guidelines for preparation of traffic studies as jointly issued by the Commonwealth of Massachusetts Executive Office of Energy & Environmental Affairs/Massachusetts Department of Transportation (EEA/MassDOT).

The TIAS updates and supersedes prior studies and analysis conducted for a previously approved 72-unit Fisherville Terrace 40B development as documented in a Traffic Impact Assessment (TIA) prepared by Abend Associates in December 2008 and supplemental traffic evaluation prepared by MDM dated February 15, 2010 (incorporated herein by reference). MDM concludes that analysis of the currently proposed 100 unit plan for Fisherville Terrace presents no material differences in impact relative to the prior approved plan: ample capacity exists to accommodate projected traffic volumes, applicable safety criteria are met for sight lines at the proposed Fisherville Terrace driveway; and proposed access and circulation elements of the plan properly accommodate Town emergency apparatus and service vehicles.

E.1 PROJECT DESCRIPTION

The Site comprises approximately 26.2± acres and includes undeveloped land along Main Street. Under the proposed residential development program, the Site will include 100 residential homes. On-site parking will include approximately 200 parking spaces within individual driveways and 19 supplemental visitor spaces along Fisherville Terrace. Site access/egress is proposed a single boulevard style full access/egress driveway along Main Street.

E.2 STUDY AREA

This TIAS evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the Site, and that are likely to sustain a measurable level of traffic impact from the proposed development.

- Main Street (Route 122A) at Pleasant Street/Leland Hill Road
- Main Street at Proposed Site Driveway
- Main Street at Ferry Street
- Main Street at Cross Street
- Main Street at Providence Road (Route 122)

E.3 SUMMARY OF ANALYSIS AND FINDINGS

Capacity analyses were conducted for each study area intersection to quantify Baseline and future year traffic operations with and without the development for the weekday morning and weekday evening peak hours. These time periods represent the highest activity periods of the proposed project and the adjacent roadway system.

The analyses presented in this TIAS are based on industry-standard trip rates and methodology published by the Institute of Transportation Engineers (ITE). Based on industry-standard trip rates the proposed development is estimated to generate approximately 76 trips during the weekday morning peak hour (19 entering and 57 exiting), 102 trips during the weekday evening peak hour (64 entering and 38 exiting), and approximately 1,040 daily trips on a weekday. Journey to work data for the Town of Grafton served as the primary basis for distribution for the apartment trips to/from the Site.

Capacity analyses indicates that the proposed residential development will be accommodated well within capacity of Main Street and the area study intersections with no discernable impact to traffic flow and at operating levels that are considered acceptable for suburban locations. The proposed development is not expected to materially impact study area intersections and will not result in any material changes in traffic operations in the study area between future No-Build and Build conditions. The study intersection will continue to operate at LOS D or better and the site driveway will operate at LOS B or better during the peak hours. Mainline traffic along Main Street will continue to operate unimpeded with minimal delay.

E.4 RECOMMENDATIONS

MDM finds Main Street and roadways within the site vicinity can accommodate modest traffic increases of the project. The proposed development is not expected to materially impact study area intersections and will not result in any material changes in traffic operations in the study area between future No-Build and Build conditions. Accordingly, no roadway improvements are warranted to accommodate the project. However, several mitigation actions are identified to support the project which include (a) access/egress improvements and (b) pedestrian accommodations as summarized below.

Access/Egress Improvements

- *Driveway Design.* The driveway width and curb radii between the proposed Site Driveway and Main Street has been designed to accommodate the Town's largest fire apparatus (ladder truck) and single unit delivery vehicles. AutoTurn graphics for the ladder truck are provided in the **Appendix**. Signs and pavement markings that are compliant with the Manual on Uniform Traffic Control Devices (MUTCD) are shown on the approach to Main Street including a STOP sign (R1-1) and STOP line pavement markings.

- *Sight Line Triangles.* With selective clearing and grading as part of the installation of the Site driveway the available sight lines will satisfy the recommended sight line requirements from AASHTO. Plantings (shrubs, bushes) and structures (walls, fences, etc.) shall be maintained at a height of 2 feet or less within the sight lines in vicinity of the Site Driveway intersection with Main Street and at all internal intersections to provide unobstructed sight lines.

Pedestrian Accommodations

- *Pedestrian Connections.* The Site Plan incorporates sidewalks along Fisherville Terrace that connect the proposed homes to the existing sidewalk system along Main Street.

- *Crosswalk Design.* All on-site crosswalks should be installed 4 feet after any proposed STOP line pavement markings. This includes the two crosswalks at the internal 4-way STOP location and the crosswalk on the Fisherville Terrace approach to Main Street. Furthermore, all crosswalks shall be designed to be a minimum of 6-feet wide to be compliant with the MUTCD and shall include the appropriate pedestrian crossing signs.

- *Main Street at Fisherville Terrace Pedestrian Crossing.* MassDOT is currently designing the reconstruction of Main Street (Project 607903) between Providence Road and the Sutton Town Line that is scheduled to begin in the spring/summer of 2021. The project will include pavement reclamation, sidewalk reconstruction, new sidewalk construction, minor geometric intersection improvements, and related work. To complement the existing sidewalk sections in the area that currently end along the southern side of Main Street near the Site and pending MassDOT improvements, the Proponent will work with the Town to provide a new ADA compliant pedestrian crossing at the intersection of Main Street and the proposed Fisherville Terrace. MDM recommends that design of the crosswalk include appropriate controls, signs and markings that comply with current guidance under the Manual on Uniform Traffic Control Devices (MUTCD).

E.5 CONCLUSIONS

In summary, the proposed residential development will be accommodated well within capacity of Main Street and the area study intersections with no discernable impact to traffic flow and at operating levels that are considered acceptable for suburban locations. The proposed development is not expected to materially impact study area intersections and will not result in any material changes in traffic operations in the study area between future No-Build and Build conditions. Accordingly, no roadway improvements are warranted to accommodate the project. Proposed access access/egress improvements and pedestrian accommodations as outlined in the *Conclusions and Recommendations* section of this report will adequately mitigate the project impacts.

1.0 INTRODUCTION

MDM Transportation Consultants, Inc. (MDM) has prepared a Traffic Impact and Access Study (TIAS) for a proposed 100-unit residential development to be located at 119 Main Street in Grafton, Massachusetts. The location of the site relative to adjacent roadways is shown in **Figure 1**. This report documents existing operational and safety-related characteristics of roadways serving the development Site, estimates development-related trip generation and operational impacts, and identifies potential mitigation actions to support the development.

This TIAS has been developed in conformance with guidelines for preparation of traffic studies as jointly issued by the Commonwealth of Massachusetts Executive Office of Energy & Environmental Affairs/Massachusetts Department of Transportation (EEA/MassDOT).

1.1 PROPOSED DEVELOPMENT

The Site comprises approximately 26.2± acres and includes undeveloped land along Main Street. Under the proposed residential development program, the Site will include 100 residential homes. On-site parking will include approximately 200 parking spaces within individual driveways and 19 supplemental visitor spaces along Fisherville Terrace. Site access/egress is proposed a single boulevard style full access/egress driveway along Main Street. The preliminary Site layout plan prepared by Turning Point Engineering is presented in **Figure 2**.

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Figure 1

Site Location

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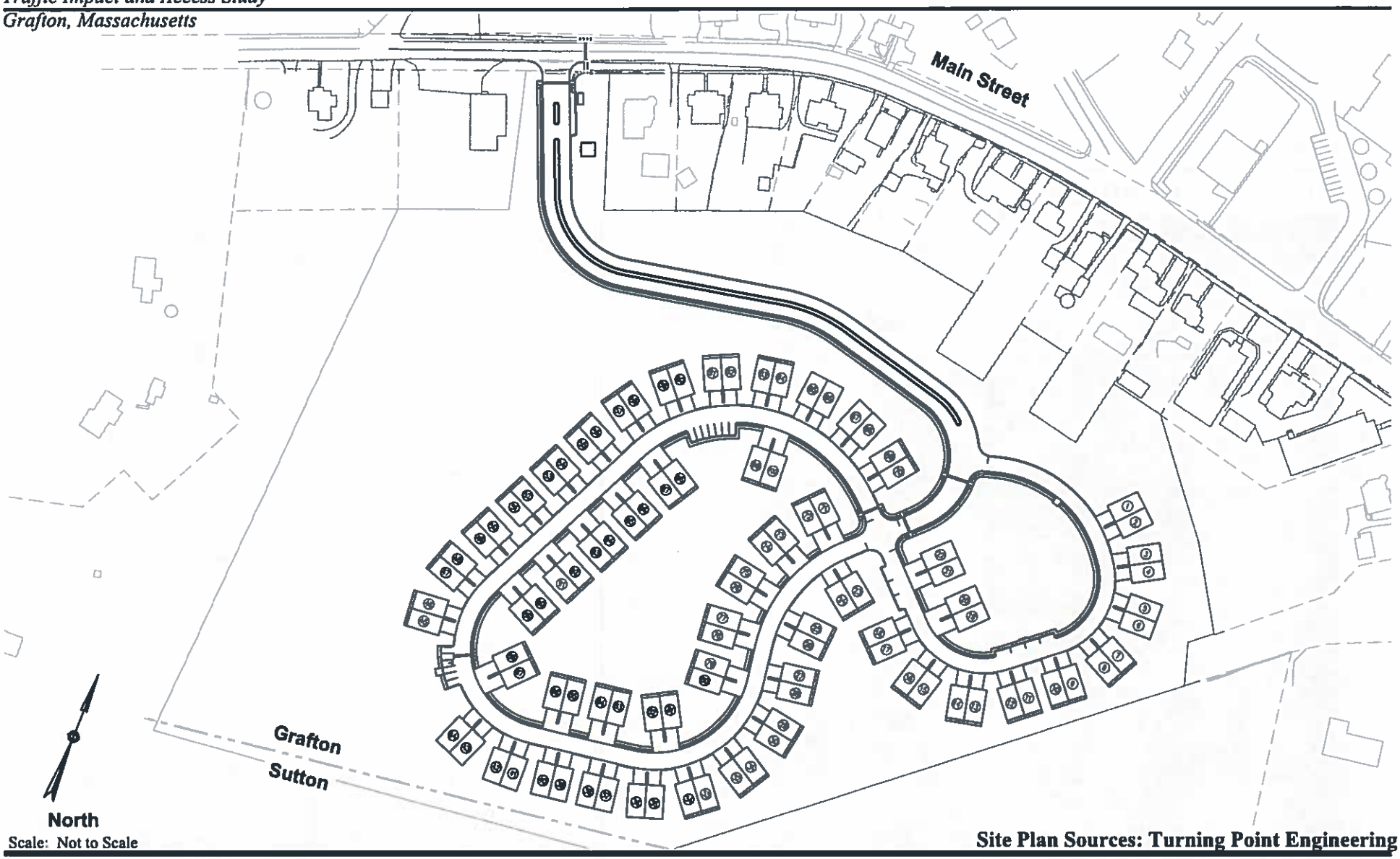

Scale: Not to Scale

Site Plan Sources: Turning Point Engineering

MDM TRANSPORTATION CONSULTANTS, INC.
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Figure 2

Preliminary Site Layout

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1.2 STUDY METHODOLOGY

This transportation impact and access evaluation is conducted in accordance with EEA/MassDOT guidelines and consists of several steps. The first step documents existing conditions in the transportation study area including an inventory of roadway geometry, observed traffic volumes, public transportation, and safety characteristics. Next, future year traffic conditions are forecast that account for other planned area developments, normal area growth, and development-related traffic increases. The third step quantifies operating characteristics of the study intersection. Specific attention is given to the incremental impacts of the proposed development. Finally, improvements are identified to address specific development-related requirements as needed.

1.3 STUDY AREA

This TIAS evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the Site, and that are likely to sustain a measurable level of traffic impact from the proposed development. The study area includes the following intersections, as shown on **Figure 1**:

- Main Street (Route 122A) at Pleasant Street/Leland Hill Road
- Main Street at Proposed Site Driveway
- Main Street at Ferry Street
- Main Street at Cross Street
- Main Street at Providence Road (Route 122)

2.0 BASELINE CONDITIONS

In order to provide a basis for quantifying the transportation impacts of the development, the Baseline roadway system and the baseline traffic operations of study area roadways were reviewed. This section describes the existing traffic characteristics and operations of roadways and intersection within the study area. Specifically, this section presents an overview of baseline traffic volumes, an inventory of crash data and accounting of public transportation systems serving the area.

2.1 STUDY AREA ROADWAY NETWORK

The study area roadways, intersection, and pedestrian facilities are described briefly in this section along with area roadway commitments by others. A general description of the physical roadway, intersection features, and pedestrian accommodations is provided. The study area and intersection are depicted in **Figure 1**.

2.1.1 Roadways

Main Street (Route 122A)

Main Street (Route 122A) is generally an east-west roadway under local (Town) jurisdiction within the study area. Main Street is classified by the MassDOT as an Urban Minor Arterial roadway, and it provides a connection between Providence Street and the town of Millbury to the west and Providence Road (Route 122) to the east. Main Street provides one travel lane in each direction separated by a double yellow centerline and paved shoulders within the study area. The posted (regulatory) speed limit on Main Street in the study area is 30 mph in both travel directions. Sidewalks are provided along both sides of Main Street through the Site. Land uses along Main Street in the study area are primarily residential uses, several commercial properties, and South Grafton Elementary School.

Providence Road (Route 122)

Providence Road (Route 122) is generally north-south roadway under State jurisdiction within the study area and provides a connection between Route 140 to the north and the town of Northbridge to the south. Providence Road is classified as an Urban Principal Arterial Roadway, and it provides one travel lanes in each direction separated by a double yellow centerline. Land uses along Providence Road in the study area includes residential uses and commercial properties.

Cross Street

Cross Street is generally northeast-southwest roadway under local jurisdiction within the study and provides a connection between Providence Road (Route 122) to the north to Main Street (Route 122A) to the south. Cross Street provides a single travel lane in each direction separated by a double yellow centerline. Land uses along Cross Street in the study area are primarily residential uses.

Pleasant Street

Pleasant Street is generally a north-south roadway under local jurisdiction within the study area that provides a connection from Route 122 to the north and Main Street (Route 122A) to the south. Pleasant Street is classified as a Major Collector Roadway, and it provides one travel lane in each direction separated by a double yellow centerline. Land uses along Pleasant Street are primarily residential uses.

2.1.2 Intersections

Main Street at Pleasant Street/Leland Hill Road

Main Street meets Pleasant Street and Leland Hill Road to form a four-legged, unsignalized intersection under local jurisdiction. The Leland Hill and Pleasant Street approaches provide a single lane and operate under "STOP" sign control. The Main Street approaches to the intersection provide a single travel lane. Sidewalks and a crosswalk are provided along the northern side of the intersection. Uses at the intersection include residential homes and a small retail plaza.

Main Street at Ferry Street

Ferry Street meets Main Street to form a three-legged, unsignalized intersection under local jurisdiction. The Ferry Street northbound approach provides a single turn lane and operates under "STOP" sign control. The Main Street approaches to the intersection provide a single travel lane. Sidewalks are provided along both sides of Main Street and a crosswalk is provided across the Main Street westbound approach. Uses at the intersection include residential homes, a local church, and South Grafton Elementary School.

Main Street at Cross Street

Cross Street meets Main Street to form a three-legged, unsignalized intersection under local jurisdiction. The Cross-Streetprovides a single turn lane and operates under "STOP" sign control. The Main Street approaches to the intersection provide a single travel lane. Sidewalks are provided along the northern side of Main Street and crosswalks are provided. Uses at the intersection include a residential home and a small retail plaza.

Providence Road (Route 122) at Main Street

Main Street meets Providence Road to form a three-legged, unsignalized intersection under local jurisdiction. The Main Street approach provides a separate left and right turn lane and operates under "STOP" sign control. The Providence Road approaches to the intersection provide a single travel lane. Sidewalks are provided along the eastern side of Providence Road and the northern side of Main Street, but crosswalks are not provided. Uses at the intersection include residential homes and a gas station with convenience market.

2.2 BASELINE TRAFFIC VOLUMES

Traffic-volume data used in this study were obtained by mechanical and manual methods in October 2020. Automatic traffic recorder counts (ATRs) were conducted along Main Street while manual turning movement counts (TMCs) were conducted at the study intersections. Traffic data were collected during the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) peak periods. These hours represent the combination of busiest activity periods for the proposed use and the adjacent roadway network.

2.2.1 Daily Traffic

In addition to TMC data described above, daily traffic volumes were obtained along Main Street adjacent to 119 Main Street (Site). This data is summarized in **Table 1** and are discussed below.

TABLE 1
BASELINE TRAFFIC VOLUME SUMMARY
MAIN STREET ADJACENT TO SITE

Time Period	Daily Volume (vpd)[1]	Percent Daily Traffic[2]	Peak Hour Volume (vph)[3]	Peak Flow Direction[4]	Peak Hour Directional Volume (vph)
Weekday Morning Peak Hour	6,410	7%	450	51% EB	230
Weekday Evening Peak Hour	6,410	9%	580	50% EB/WB	293

[1]Two-way daily traffic expressed in vehicles per day adjusted for pre-Covid 19 pandemic by 23% AM, 17% PM, and 16% Daily.
[2]The percent of daily traffic that occurs during the peak hour.
[3]Two-way peak-hour volume expressed in vehicles per hour.
[4]EB = Eastbound, WB = Westbound

As summarized in **Table 1**, the weekday daily traffic volume on Main Street adjacent to the Site is approximately 6,410 vehicles per day (vpd) on a weekday with travel patterns slightly directional eastbound during the weekday morning peak hour and split 50/50 during the weekday evening peak hour. Peak hour traffic flow on Main Street is between 450 and 580 vehicles per hour (vph) during the weekday morning and weekday evening peak hours representing approximately 8 percent of the daily traffic flow.

2.2.2 Peak-Hour Volumes

Peak-hour traffic volumes at the study area intersections were collected in October 2020. A review of historical traffic data indicates that peak hour traffic volumes collected in October 2020 remain below normal average conditions due to the Covid-19 pandemic. Accordingly, the weekday morning traffic volumes have been adjusted by 23%, the weekday evening peak hour have been adjusted by 17% to represent average traffic volume conditions. The weekday morning and weekday evening peak hour traffic volumes for the study intersections are shown in **Figure 3**. Traffic count data, and MassDOT permanent count station data are provided in the **Appendix**.

2.3 MEASURED TRAVEL SPEEDS

Vehicle speeds were obtained for the Route 122A (Main Street) eastbound and westbound travel directions using an ATR equipped with radar. **Table 2** summarizes the average and 85th percentile speeds for Route 122A located adjacent to the Site. Field data are provided in the **Attachments**. These speed data provide a basis for determining appropriate sight lines for the proposed driveway.

TABLE 2
SPEED STUDY RESULTS – Route 122A

Travel Direction	Posted Speed Limit	Travel Speed	
		Average[1]	85th Percentile[2]
Eastbound	30	33	37
Westbound	30	32	34

[1] Arithmetic Mean.
[2] The speed at or below which 85 percent of the vehicles are traveling.

As summarized in **Table 2**, the mean (average) travel speed on Route 122A eastbound and westbound was observed to be 33 mph and 32 mph respectively; the 85th percentile travel speed eastbound and westbound was observed to be 37 mph and 34 mph respectively. The speed data sets the basis for the sight line review in the subsequent section of this report.

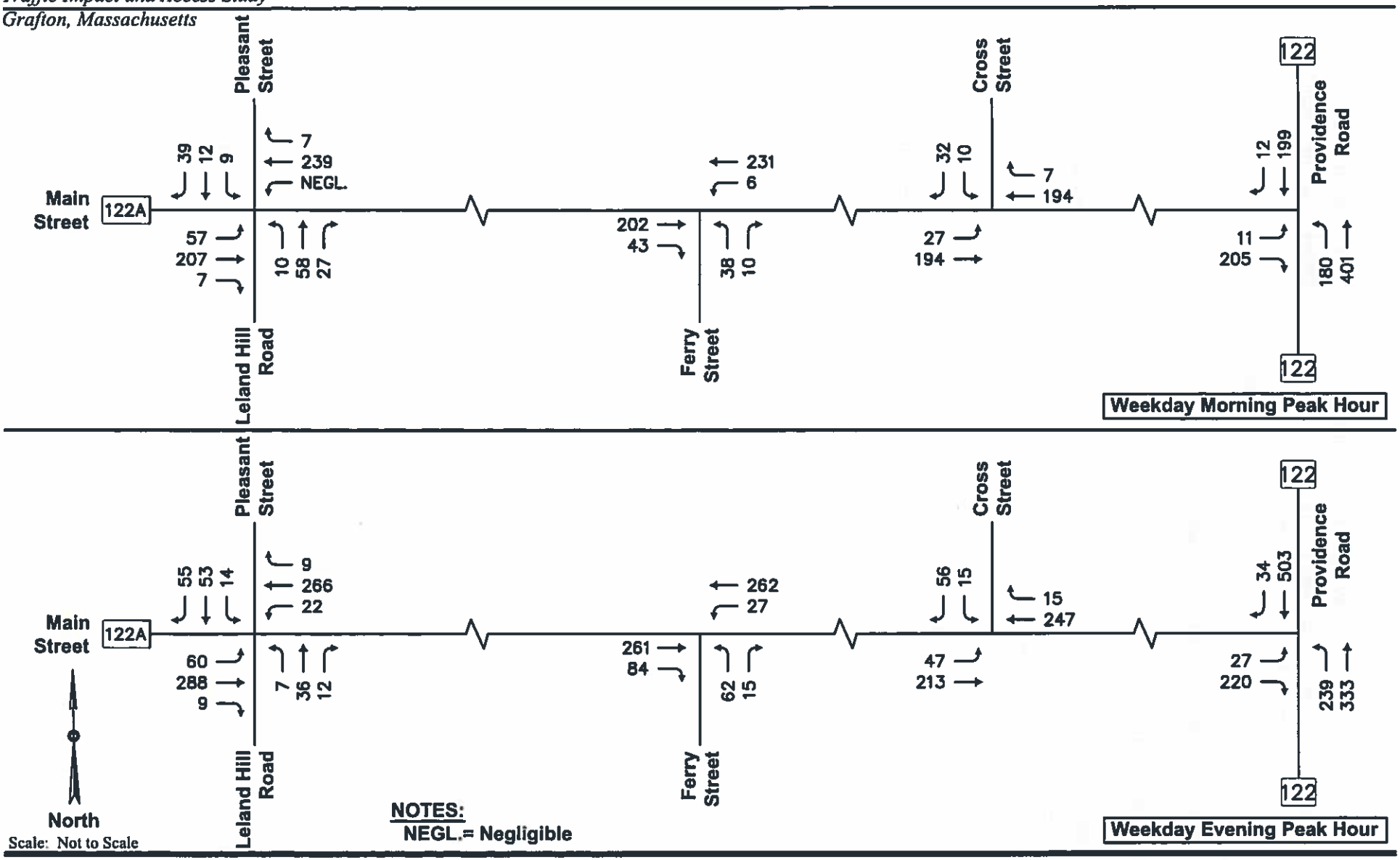

Figure 3

MDM TRANSPORTATION CONSULTANTS, INC.
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2020 Baseline Conditions
Peak Hour Traffic Volumes

Date: October 2020
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2.4 SAFETY

Crash data were obtained from the MassDOT Online Crash Portal for the five-year period 2015 through 2019 to identify crash trends and safety characteristics for study area intersections. In addition, review of the MassDOT high crash cluster mapping was conducted to determine locations listed as eligible for Highway Safety Improvement Program (HSIP) evaluation and funding. Crash data for the study intersections is summarized in **Table 3** with detailed data provided in the **Appendix.**

Crash rates were calculated for the study area intersections as reported in **Table 3.** This rate quantifies the number of crashes per million entering vehicles. MassDOT has determined the official District 3 (which includes the town of Grafton) crash rate to be 0.61 for unsignalized intersections. This rate represents MassDOT's "average" crash experience for District 3 communities and serves as a basis for comparing reported crash rates for the study intersections. Where calculated crash rates notably exceed the District average, some form of safety countermeasures may be warranted.

TABLE 3
INTERSECTION CRASH SUMMARY – 2015 THROUGH 2019[1]

	INTERSECTION			
Data Category	Providence Rd at Main St	Main Street at Pleasant St/ Leland Hill Rd	Main Street at Cross Street	Main Street at Ferry Street
Traffic Control	Unsignalized	Unsignalized	Unsignalized	Unsignalized
Crash Rate[2]	**0.29**	**0.58**	**0.12**	**0.06**
District 3 Avg[3]	0.61	0.61	0.61	0.61
Year:				
2015	2	1	0	0
2016	2	4	0	0
2017	3	2	1	0
2018	2	3	0	0
2019	0	1	0	1
Total	9	11	1	1
Type:				
Angle	2	8	0	0
Rear-End	2	3	1	1
Head-On	1	0	0	0
Sideswipe	1	0	0	0
Single Vehicle	3	0	0	0
Other/Unknown	0	0	0	0
Severity:				
P. Damage Only	4	5	0	1
Personal Injury	5	6	1	0
Fatality	0	0	0	0
Conditions:				
Dry	9	9	1	1
Wet	0	1	0	0
Snow	0	1	0	0
Other	0	0	0	0
Time:				
7:00 to 9:00 AM	1	1	0	0
4:00 to 6:00 PM	3	1	0	0
Rest of Day	5	9	1	1

[1] Source: MassDOT Crash Database
[2] Crashes per million entering vehicles
[3] District 3 averages = 0.61 (unsignalized)

As summarized in **Table 3**:

- *Providence Road at Main Street.* Nine (9) crashes were reported for the intersection resulting crash rate of 0.29 which is below the District 3 average crash rate for unsignalized intersections. The majority of the reported crashes at the intersection were single vehicle type (33%) three (3) crashes were rear-end/sideswipe type, two (2) of the crashed were angle type, and the remaining crash was a head-on type collision. The majority resulted in injury type accidents (56%) with approximately all of the crashes occurring under dry roadway conditions and 44 percent occurring during the peak hours. There were no reported fatalities or pedestrian related crashes at this location.

- *Main Street at Pleasant Street/Leland Hill Road.* Eleven (11) crashes were reported for intersection resulting crash rate of 0.58 which is just below the District 3 average crash rate for unsignalized intersections. The reported crashes at the intersection included eight (8) angle type and three (3) rear-end type collisions. The majority resulted in injury type accidents (55%) with approximately 18 percent occurring during the peak hours. There were no reported fatalities or pedestrian related crashes at this location.

- *Main Street at Cross Street.* One (1) crash was reported for the intersection. The crash was a rear-end on type crash under dry roadway conditions outside the peak hours which resulted in an injury type crash.

- *Main Street at Ferry Street.* One (1) crash was reported for the intersection. The crash was a rear-end on type crash under dry roadway conditions outside the peak hours which resulted in property damage only.

In summary, based on extensive review of Local crash data and MassDOT crash data, the study intersections all experienced crash rates at or below the District 3 averages and none of the intersection are listed as HSIP locations; therefore, no immediate safety countermeasures are warranted based on the crash history at the study intersections.

2.5 SIGHT LINE ANALYSIS

The evaluation documents existing sight distances for vehicles entering or exiting the proposed Site driveway at its intersection with Main Street with comparison to American Association of State Highway and Transportation Officials' (AASHTO)[1] recommended guidelines for the regulatory (posted) speed limit and observed 85th percentile travel speeds.

The AASHTO standards reference two types of sight distance that are relevant at the proposed site driveway intersection with Main Street: stopping sight distance (SSD) and intersection sight distance (ISD). Sight lines for critical vehicle movements at the Main Street and site driveway intersection were compared to minimum SSD and ISD recommended for the posted and observed travel speeds along Main Street.

[1] *A policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials (AASHTO), 2018.

Stopping Sight Distance

Sight distance is the length of roadway visible to the motorist to a fixed object. The minimum sight distance available on a roadway should be sufficiently long enough to enable a below-average operator, traveling at or near a regulatory speed limit, to stop safely before reaching a stationary object in its path, in this case, a vehicle exiting from the site driveway onto Main Street or a vehicle on Main Street slowing to turn into the site driveway. The SSD criteria are defined by AASHTO based on design and operating speeds, anticipated driver behavior and vehicle performance, as well as physical roadway conditions. SSD includes the length of roadway traveled during the perception and reaction time of a driver to an object, and the distance traveled during brake application on wet, level pavements. Adjustment factors are applied to account for roadway grades.

SSD was estimated in the field using AASHTO standards for driver's eye (3.5 feet) and object height equivalent to the taillight height of a passenger car (2.0 feet) for the eastbound and westbound Main Street approaches to the proposed primary site driveway. **Table 4** presents a summary of the available SSD for the Main Street segments approaching the proposed site driveway and AASHTO's recommended SSD for the regulatory (posted) speed limit and observed travel speeds.

TABLE 4
STOPPING SIGHT DISTANCE SUMMARY
MAIN STREET APPROACHES TO SITE DRIVEWAY

Approach/ Travel Direction	Available SSD	AASHTO Recommended[1]	
		Regulatory Speed Limit[2]	85th Percentile Travel Speed[3]
Eastbound	800+ Feet	200 Feet	270 Feet
Westbound	450± Feet	200 Feet	240 Feet

[1] Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet to object height of 2.0 feet and adjustments for roadway grade were applicable.
[2] Regulatory Speed Limit is 30 mph EB and WB.
[3] 85th Percentile travel speed is 37 mph EB and 34 mph WB.

As summarized in **Table 4,** analysis results indicate that the available sight lines at the approaches to the Site Driveway will exceed AASHTO's recommended SSD criteria for the eastbound and westbound travel directions along Main Street based on the regulatory (posted) speed limit and observed 85th percentile travel speeds.

Intersection Sight Distance

Clear sight lines provide sufficient sight distance for a stopped driver on a minor-road approach to depart from the intersection and enter or cross the major road. As stated under AASHTO's Intersection Sight Distance (ISD) considerations, "*...If the available sight distance for an entering ...vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to avoid collisions...To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road.*" AASHTO's ISD criteria are defined into several "cases". In this case, the proposed site driveway approach to the intersection will be under "STOP" control and the ISD in question relates to the ability to turn left or right onto Main Street.

Available ISD was estimated in the field using AASHTO standards for driver's eye (3.5 feet), object height (3.5 feet) and decision point (8 to 14.5 feet from edge of travel way) looking east and west from the proposed driveway onto Main Street. **Table 5** presents a summary of the available ISD for the departures from the proposed site driveway and AASHTO's recommended ISD.

TABLE 5
INTERSECTION SIGHT DISTANCE SUMMARY
SITE DRIVEWAY DEPARTURE TO MAIN STREET

Approach/ Travel Direction	Available ISD	AASHTO Minimum[1] 85th Percentile Travel Speed[2]	AASHTO Ideal[1] Regulatory Speed Limit[3]
Looking East	410± Feet	240 Feet	335 Feet
Looking West	800+ Feet	270 Feet	290 Feet

[1]Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet and an object height of 3.5 feet. Minimum value as noted represents SSD per AASHTO guidance. Adjustments for driveway grade have been made as needed.
[2]85th Percentile travel speed is 37 mph EB and 34 mph WB.
[3]Regulatory (posted) speed limit is 35 mph.

The results of the ISD analysis presented in **Table 5** indicates that the with selective clearing and grading as part of the installation of the site driveway the available sight lines will satisfy the recommended sight line requirements from AASHTO. MDM recommends that any new plantings (shrubs, bushes) or physical landscape features to be located within driveway sight lines should also be maintained at a height of 2 feet or less above the adjacent existing roadway grade to ensure unobstructed lines of sight.

3.0 FUTURE CONDITIONS

Evaluation of the proposed development impacts requires the establishment of a future baseline analysis condition. This section estimates future roadway and traffic conditions with and without the proposed development. To be consistent with EEA/MassDOT guidelines, a seven-year planning horizon was selected.

To determine the impact of Site-generated traffic volumes on the roadway network under future conditions, baseline traffic volumes in the study area were projected to a future year condition. Traffic volumes on the roadway network at that time, in the absence of the development (that is, the No-Build condition), would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific development by others that is currently under review at the local and/or state level. Consideration of these factors resulted in the development of No-Build traffic volumes. Anticipated Site-generated traffic volumes were then superimposed upon these No-Build traffic-flow networks to develop future Build conditions.

The following sections provide an overview of future No-Build traffic volumes, and projected Build traffic volumes.

3.1 BACKGROUND TRAFFIC GROWTH

Background traffic includes demand generated by other planned developments in the area as well as demand increases caused by external factors. External factors are general increases in traffic not attributable to a specific development and are determined using historical data.

3.1.1 Historical Area Growth

Nearby permanent count station data published by MassDOT indicates a 0.8 percent per year growth rate. For purposes of this evaluation, a 1-percent compounded annual growth rate was used (7.2 percent increase over a 7-year horizon). This growth rate is consistent with historic rates and is also expected to account for any small fluctuation in hourly traffic as may occur from time to time in the study area and traffic associated with other potential small developments or vacancies in the area. MassDOT permanent count station data and background growth calculations are provided in the **Appendix.**

3.1.2 Background Development-Related Growth

Development of future No-Build traffic volumes considers traffic generated through the study area from other specific area developments. A review of the areas projects and the MEPA project database indicates that there is no development project in the area that may increase baseline traffic at the study intersections.

3.2 NO-BUILD TRAFFIC VOLUMES

To account for future traffic growth along the corridor, the 1-percent annual growth rate was applied to Baseline traffic volumes over a seven-year period. Future 2027 No-Build traffic volumes are displayed in **Figure 4**.

3.3 SITE-GENERATED TRAFFIC – ITE BASIS

Future Build condition traffic volumes were developed by estimating the number of peak-hour trips expected to be generated by the proposed development and distributing this additional traffic onto the local roadway network. These future development-related trips were added to future No-Build traffic volumes to evaluate future traffic operations with the proposed residential development in place. The methodology utilized to estimate the future trip-generation characteristics of the proposed development are summarized below.

In accordance with EEA/MassDOT guidelines, the traffic generated by the proposed development was estimated using trip rates published in ITE's *Trip Generation* for the Land Use Code (LUC) based on trip rates for the closest land use code Single Family Detached Housing – (LUC 210). **Table 6** presents the trip-generation estimates for the proposed development based on ITE methodology with appropriate adjustments to reflect net new trip activity. Detailed trip generation calculations are provided in the **Appendix**.

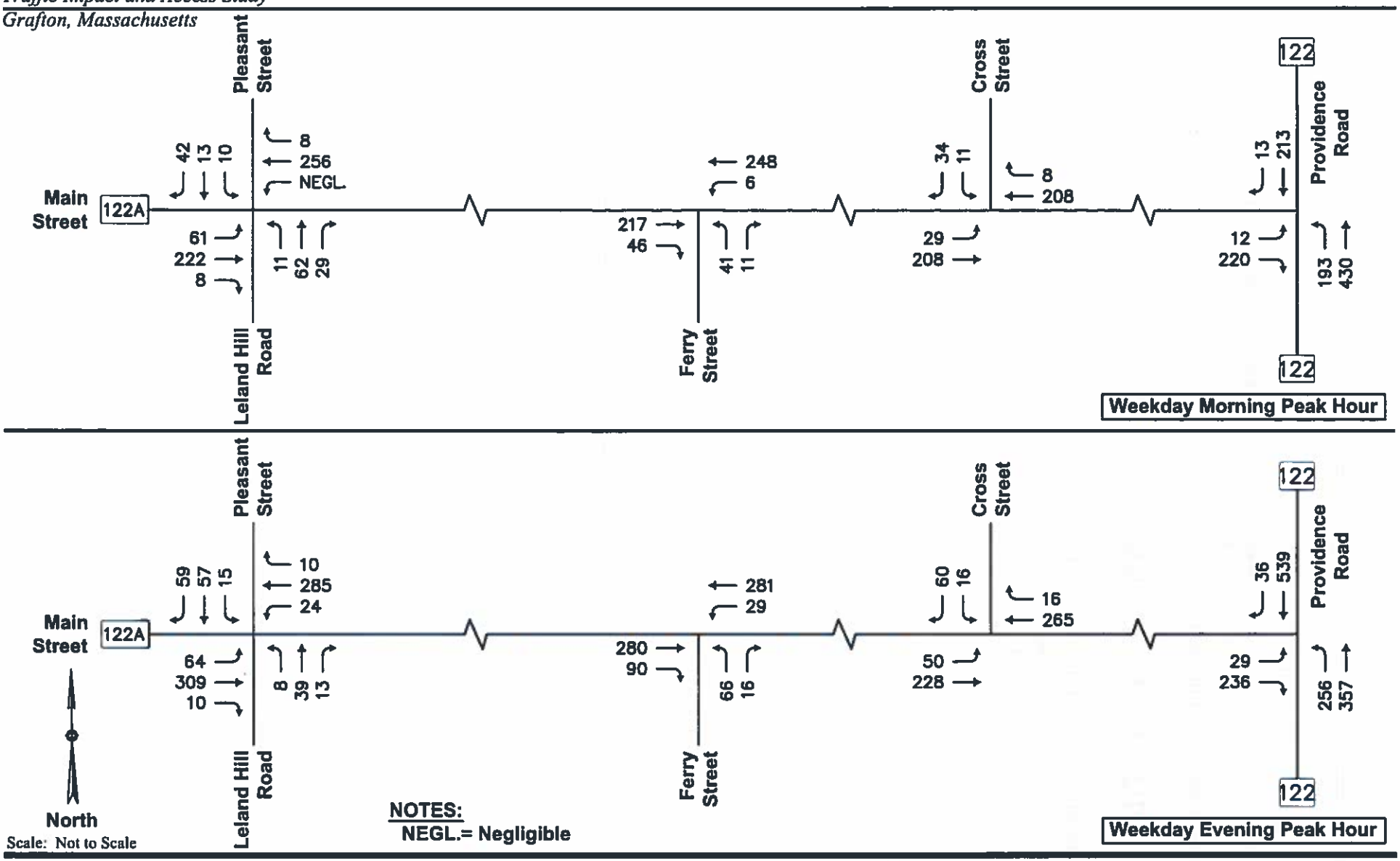

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Figure 4

2027 No-Build Conditions
Peak Hour Traffic Volumes

Date: October 2020
Dwg No. 527 TIAS02.dwg
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TABLE 6
TRIP-GENERATION SUMMARY

Peak Hour/Direction	Single Family Duplex (100 Homes)[1]
Weekday Morning Peak Hour:	
Entering	19
Exiting	57
Total	76
Weekday Evening Peak Hour:	
Entering	64
Exiting	38
Total	102
Daily (24 Hours):	1,040

Source: ITE *Trip Generation*, Tenth Edition; 2017.
[1]ITE LUC 210 – Single Family Detached Housing applied to 100 homes.

As summarized in **Table 6**, based on industry-standard trip rates the proposed development is estimated to generate approximately 76 trips during the weekday morning peak hour (19 entering and 57 exiting), 102 trips during the weekday evening peak hour (64 entering and 38 exiting), and approximately 1,040 daily trips on a weekday.

3.4 TRIP DISTRIBUTION AND ASSIGNMENT

The directional distribution of development-generated trips on the roadway network is a function of a number of variables including local area populations and the efficiency of the roadways leading to the Site. Journey to work census data served as the primary basis for determining the trip distribution pattern for the proposed development. Trip distribution is quantified in **Figure 5** and the accompanying calculations are provided in the **Appendix.**

Development-related trips for the proposed Site are assigned to the roadway network using the ITE trip-generation estimates shown in **Table 6** and the distribution patterns for the Site. Development-related trip tracings at each intersection approach for the weekday morning and weekday evening peak hours are quantified in **Figure 6.**

3.5 BUILD TRAFFIC VOLUMES

Future Build condition traffic volumes were arrived at by adding development-specific traffic volumes to the 2027 No-Build conditions. The resulting 2027 Build condition traffic-volume networks for the weekday morning and weekday evening peak hours are displayed in **Figure 7**.

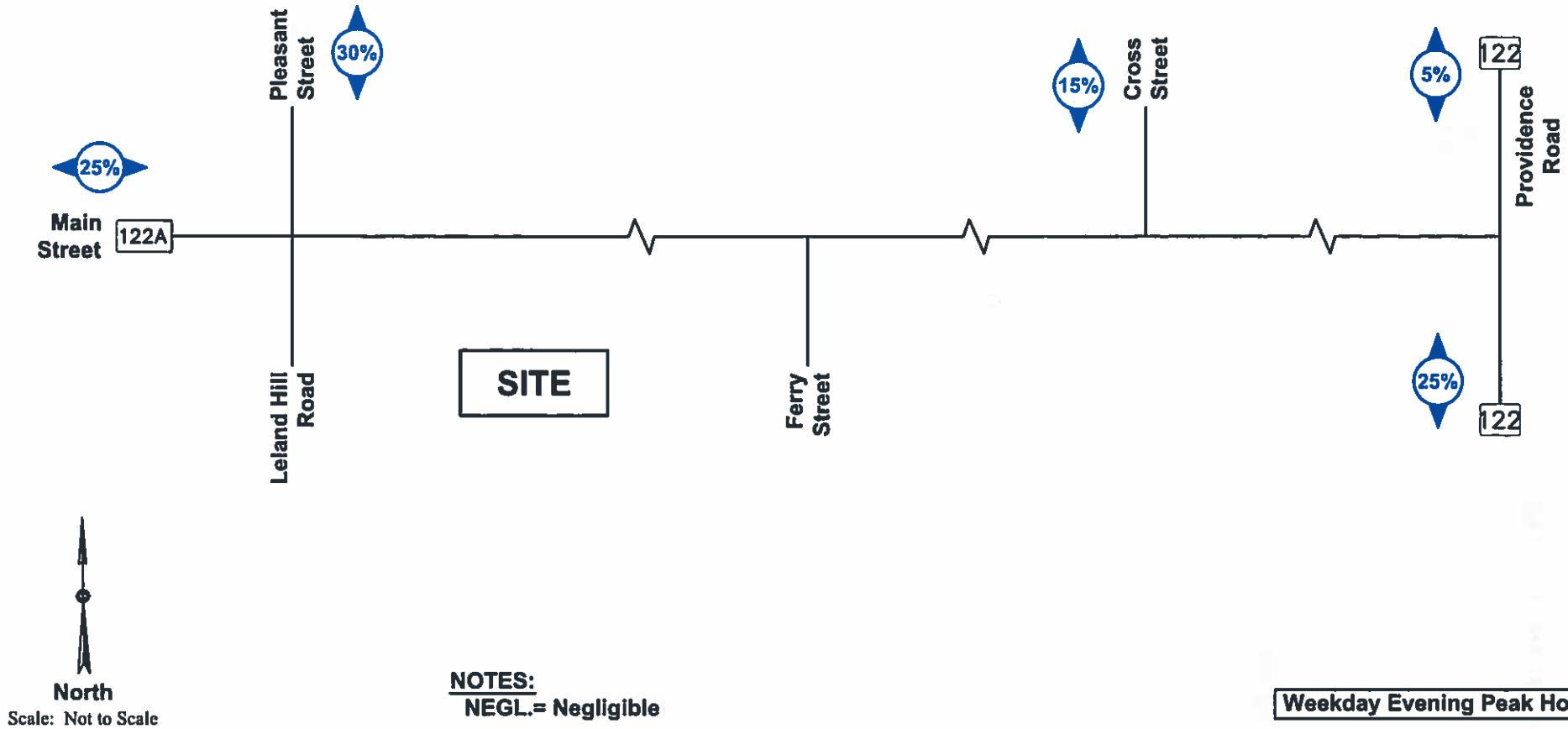

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Figure 5

Trip Distribution

Date: October 2020
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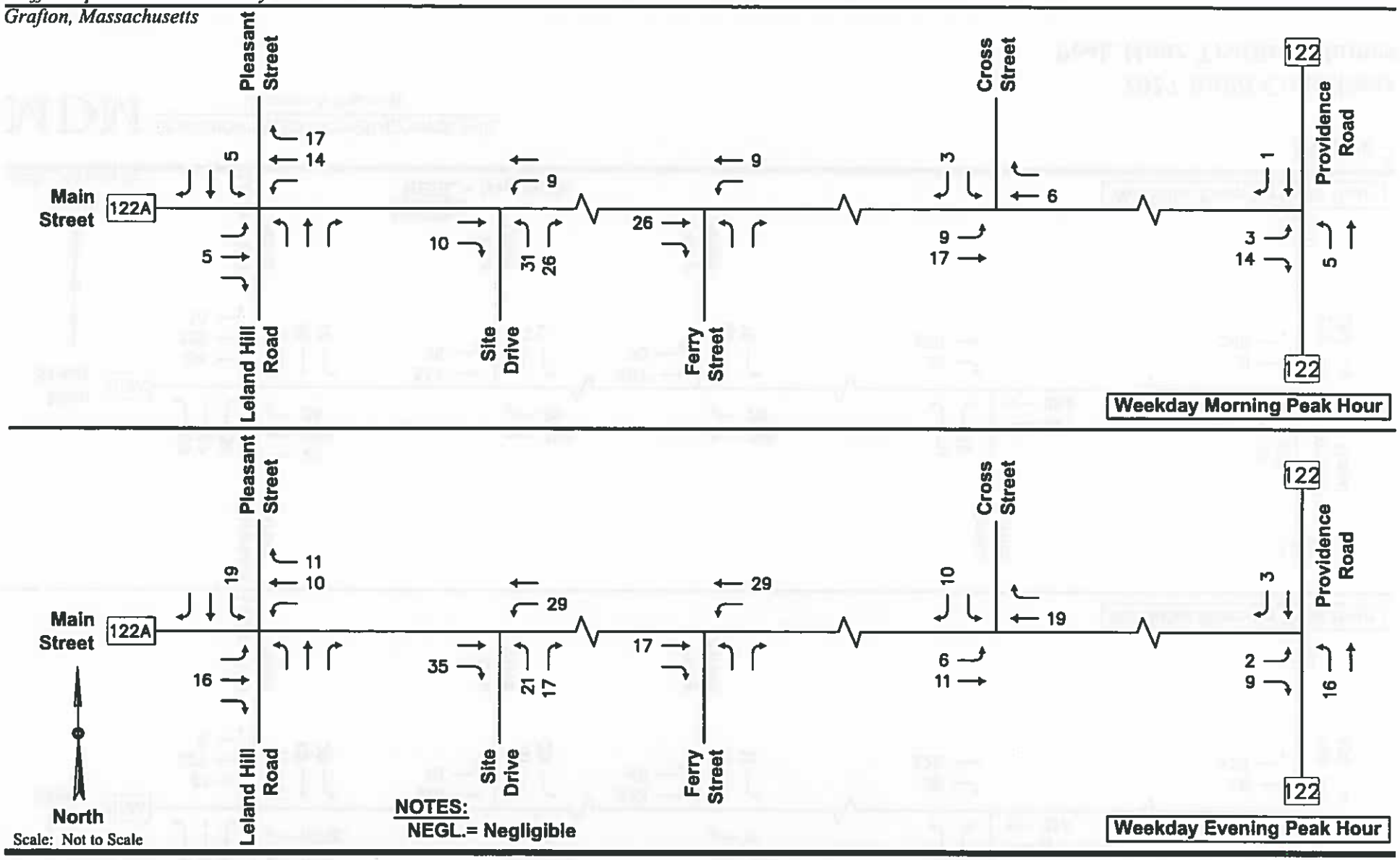

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Figure 6

Weekday Peak Hour Trip Tracings (100-Unit Housing Development)

Date: October 2020
Dwg No. 527 TIAS02.dwg
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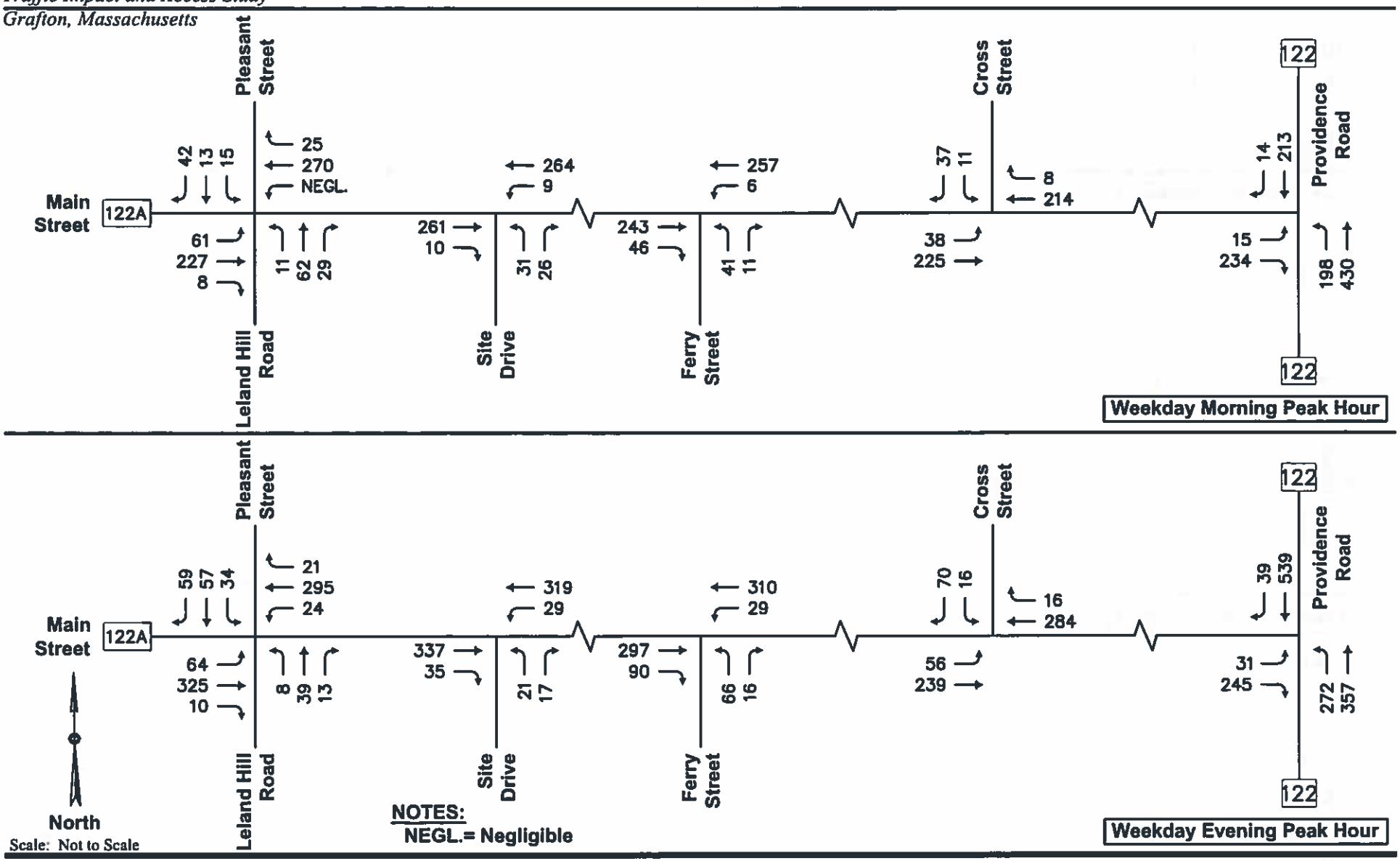

Figure 7

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2027 Build Conditions
Peak Hour Traffic Volumes

Date: October 2020
Dwg No. 527 TIAS02.dwg
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4.0 TRAFFIC OPERATIONS ANALYSIS

Intersection capacity analyses for the primary study intersections are presented in this section for the Baseline, No-Build, and Build traffic-volume conditions. Capacity analyses, conducted in accordance with EEA/MassDOT guidelines, provide an index of how well the roadway facilities serve the traffic demands placed upon them. The operational results provide the basis for recommended access and roadway improvements in the following section.

4.1 CAPACITY ANALYSIS PROCEDURES

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the Highway Capacity Manual 6th Edition (HCM). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements). The specific control delays and associated LOS designations are presented in the **Appendix.**

4.2 INTERSECTION CAPACITY ANALYSIS RESULTS

Capacity analysis results for the weekday morning and weekday evening peak hours for the study intersections are described below, with detailed analysis results presented in the **Appendix.**

4.2.1 Level of Service Analysis

The capacity analysis results for the intersections in the study area are summarized in **Table 7** and **Table 8** for the weekday morning and weekday evening peak hours, respectively.

TABLE 7
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY MORNING PEAK HOUR

		2020 Baseline			2027 No-Build			2027 Build		
Period	Approach	v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Main Street at	Eastbound	0.05	<5	A	0.06	<5	A	0.06	<5	A
Pleasant Street/	Westbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
Leland Hill Road	NB Exit	0.25	16	C	0.29	18	C	0.31	19	C
	SB Exit	0.13	13	B	0.15	14	B	0.19	15	C
Main Street at	Eastbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
Ferry Street	Westbound	0.01	<5	A	0.01	<5	A	0.01	<5	A
	NB Exit	0.09	12	B	0.10	12	B	0.11	13	B
Main Street at	Eastbound	0.02	<5	A	0.03	<5	A	0.03	<5	A
Cross Street	Westbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	SB Exit	0.07	10	B	0.07	11	B	0.08	11	B
Providence Road at	Northbound	0.15	<5	A	0.16	<5	A	0.16	<5	A
Main Street	Southbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	EB L Exit	0.06	23	C	0.07	26	D	0.09	27	C
	EB R Exit	0.27	11	B	0.30	12	B	0.32	12	B
Main Street at	NB Exit	n/a[4]	n/a	n/a	n/a	n/a	n/a	0.11	12	B
Site Driveway	Eastbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	Westbound	n/a	n/a	n/a	n/a	n/a	n/a	0.01	<5	A

[1]Volume-to-capacity ratio
[2]Average control delay per vehicle (in seconds)
[3]Level of service
[4]n/a = not applicable

TABLE 8
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY EVENING PEAK HOUR

		2020 Baseline			2027 No-Build			2027 Build		
Period	Approach	v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Main Street at	Eastbound	0.05	<5	A	0.06	<5	A	0.06	<5	A
Pleasant Street/	Westbound	0.02	<5	A	0.02	<5	A	0.02	<5	A
Leland Hill Road	NB Exit	0.20	20	C	0.24	22	C	0.25	23	C
	SB Exit	0.35	20	C	0.41	22	C	0.55	30	D
Main Street at	Eastbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
Ferry Street	Westbound	0.02	<5	A	0.03	<5	A	0.03	<5	A
	NB Exit	0.18	15	B	0.21	16	C	0.22	17	C
Main Street at	Eastbound	0.05	<5	A	0.05	<5	A	0.06	<5	A
Cross Street	Westbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	SB Exit	0.14	12	B	0.15	12	B	0.18	12	B
Providence Road at	Northbound	0.24	<5	A	0.27	<5	A	0.29	<5	A
Main Street	Southbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	EB L Exit[5]	0.10	20	B	0.13	22	C	0.14	24	C
	EB R Exit	0.42	16	C	0.47	18	C	0.49	18	C
Main Street at	SB Exit	n/a[4]	n/a	n/a	n/a	n/a	n/a	0.09	14	B
Site Driveway	Eastbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	Westbound	n/a	n/a	n/a	n/a	n/a	n/a	0.03	<5	A

[1]Volume-to-capacity ratio
[2]Average control delay per vehicle (in seconds)
[3]Level of service
[4]n/a = not applicable
[4]Calibrated based on a delay study conducted for the weekday evening peak hour.

As summarized in **Table 7** and **Table 8**:

- *Main Street at Pleasant Street/Leland Road.* Under future Build conditions, the Pleasant Street and Leland Hill Road approaches to Main Street will operate below capacity at LOS D or better during the weekday morning and evening peak hours. Mainline movement along Main Street will continue to operate unimpeded at LOS A during the weekday morning and evening peak hours.

- *Main Street at Ferry Street.* Under future No-Build conditions, the northbound Ferry Street approach to Main Street will operate below capacity at LOS C or better during the weekday morning and evening peak hours. The project will have a nominal impact on operations this intersection under Build condition. Mainline movement along Main Street will continue to operate unimpeded at LOS A during the weekday morning and evening peak hours.

- *Main Street at Cross Street.* Under future No-Build conditions, the southbound Cross Street approach to Main Street has been calculated to operate at LOS B or better during the weekday morning and evening peak hours. The project will have a nominal impact on operations this intersection under Build condition. Mainline movement along Main Street will continue to operate unimpeded at LOS A during the weekday morning and evening peak hours.

- *Providence Road at Main Street.* Under future No-Build conditions, left and right turn movements from Main Street onto Providence Road have been calculated to operate at LOS C or better during the weekday morning and evening peak hour. The project will have a nominal impact on operations this intersection under Build condition. Mainline movement along Providence Road will continue to operate unimpeded at LOS A during the weekday morning and evening peak hours.

- *Main Street at Site Driveway.* Under Build conditions, the proposed Site Driveway approach to Main Street will operate below capacity at LOS B or better during the peak hours. Mainline movement along MainStreet will continue to operate unimpeded at LOS A during the weekday morning and evening peak hours.

In summary, the proposed development is not expected to materially impact study area intersections and will not result in any material changes in traffic operations in the study area between future No-Build and Build conditions. Accordingly, no roadway improvements are warranted to accommodate the project. Proposed access access/egress improvements and pedestrian accommodations as outlined in the *Conclusions and Recommendations* section of this report will adequately mitigate the project impacts.

5.0 RECOMMENDATIONS AND CONCLUSIONS

5.1 RECOMMENDATIONS

MDM finds Main Street and roadways within the site vicinity can accommodate modest traffic increases of the project. The proposed development is not expected to materially impact study area intersections and will not result in any material changes in traffic operations in the study area between future No-Build and Build conditions. Accordingly, no roadway improvements are warranted to accommodate the project. However, several mitigation actions are identified to support the project which include (a) access/egress improvements and (b) pedestrian accommodations as summarized below.

Access/Egress Improvements

- *Driveway Design.* The driveway width and curb radii between the proposed Site Driveway and Main Street has been designed to accommodate the Town's largest fire apparatus (ladder truck) and single unit delivery vehicles. AutoTurn graphics for the ladder truck are provided in the **Appendix**. Signs and pavement markings that are compliant with the Manual on Uniform Traffic Control Devices (MUTCD) are shown on the approach to Main Street including a STOP sign (R1-1) and STOP line pavement markings.
- *Sight Line Triangles.* With selective clearing and grading as part of the installation of the Site driveway the available sight lines will satisfy the recommended sight line requirements from AASHTO. Plantings (shrubs, bushes) and structures (walls, fences, etc.) shall be maintained at a height of 2 feet or less within the sight lines in vicinity of the Site Driveway intersection with Main Street and at all internal intersections to provide unobstructed sight lines.

Pedestrian Accommodations

- *Pedestrian Connections.* The Site Plan incorporates sidewalks along Fisherville Terrace that connect the proposed homes to the existing sidewalk system along Main Street.

- *Crosswalk Design.* All on-site crosswalks should be installed 4 feet after any proposed STOP line pavement markings. This includes the two crosswalks at the internal 4-way STOP location and the crosswalk on the Fisherville Terrace approach to Main Street. Furthermore, all crosswalks shall be designed to be a minimum of 6-feet wide to be compliant with the MUTCD and shall include the appropriate pedestrian crossing signs.

- *Main Street at Fisherville Terrace Pedestrian Crossing.* MassDOT is currently designing the reconstruction of Main Street (Project 607903) between Providence Road and the Sutton Town Line that is scheduled to begin in the spring/summer of 2021. The project will include pavement reclamation, sidewalk reconstruction, new sidewalk construction, minor geometric intersection improvements, and related work. To compliment the existing sidewalk sections in the area that currently end along the southern side of Main Street near the Site and pending MassDOT improvements, the Proponent will work with the Town to provide a new ADA compliant pedestrian crossing at the intersection of Main Street and the proposed Fisherville Terrace. MDM recommends that design of the crosswalk include appropriate controls, signs and markings that comply with current guidance under the Manual on Uniform Traffic Control Devices (MUTCD).

5.2 CONCLUSIONS

In summary, the proposed residential development will be accommodated well within capacity of Main Street and the area study intersections with no discernable impact to traffic flow and at operating levels that are considered acceptable for suburban locations. The proposed development is not expected to materially impact study area intersections and will not result in any material changes in traffic operations in the study area between future No-Build and Build conditions. Accordingly, no roadway improvements are warranted to accommodate the project. Proposed access access/egress improvements and pedestrian accommodations as outlined in the *Conclusions and Recommendations* section of this report will adequately mitigate the project impacts.

ATTACHMENTS

- Traffic Volume Data
- Seasonal/Yearly Growth Data
- Speed Data
- Crash Data
- Sight Distance Calculations
- Trip Generation
- Trip Distribution
- Delay Study
- Capacity Analysis
- AutoTURN® Analysis

- Traffic Volume Data

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28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Main Street (Route 122A)
East of Pleasant Street
Grafton, MA

Site Code: 527
Station ID:

Start Time	01-Oct-20 Thu	Westbound Morning	Westbound Afternoon	Hour Totals Morning	Hour Totals Afternoon	Eastbound Morning	Eastbound Afternoon	Hour Totals Morning	Hour Totals Afternoon	Combined Totals Morning	Combined Totals Afternoon
12:00		5	36			2	51				
12:15		0	47			2	50				
12:30		1	52			3	54				
12:45		5	43	11	178	2	45	9	200	20	378
01:00		2	41			1	40				
01:15		0	33			1	54				
01:30		0	49			2	42				
01:45		0	41	2	164	1	56	5	192	7	356
02:00		0	39			1	60				
02:15		3	50			4	43				
02:30		0	55			1	56				
02:45		2	52	5	196	2	54	8	213	13	409
03:00		0	59			0	58				
03:15		1	60			1	56				
03:30		0	67			0	54				
03:45		2	77	3	263	1	53	2	221	5	484
04:00		0	63			5	63				
04:15		2	74			4	62				
04:30		0	48			4	57				
04:45		0	60	2	245	9	68	22	250	24	495
05:00		7	65			6	70				
05:15		11	65			9	74				
05:30		19	54			18	59				
05:45		9	53	46	237	9	53	42	256	88	493
06:00		15	63			21	51				
06:15		17	48			28	37				
06:30		35	35			35	48				
06:45		31	35	98	181	32	28	116	164	214	345
07:00		25	32			38	46				
07:15		48	37			40	37				
07:30		47	30			54	28				
07:45		60	24	180	123	55	39	187	150	367	273
08:00		45	18			48	13				
08:15		42	12			44	17				
08:30		37	17			43	21				
08:45		59	9	183	56	36	14	171	65	354	121
09:00		24	20			36	17				
09:15		34	6			36	16				
09:30		38	11			30	6				
09:45		47	9	143	46	36	13	138	52	281	98
10:00		28	10			30	17				
10:15		33	5			32	5				
10:30		36	5			30	10				
10:45		31	5	128	25	41	6	133	38	261	63
11:00		47	5			32	10				
11:15		34	8			63	4				
11:30		36	7			38	8				
11:45		36	5	153	25	38	3	171	25	324	50
Total		954	1739			1004	1826			1958	3565
Percent		35.4%	64.6%			35.5%	64.5%			35.5%	64.5%
Total		954	1739			1004	1826			1958	3565
Percent		35.4%	64.6%			35.5%	64.5%			35.5%	64.5%
Combined Total		2693				2830				5523	

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Marlborough, MA, 01752

N/S: Providence Road (Rt 122)
EB: Main Street (Route 122A)
Grafton, MA

File Name : 527_Route_122_at_122A_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 1

Groups Printed- Lights - Mediums - Articulated Trucks

	Providence Road From North				Providence Road From South				Main Street From West				
Start Time	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Int. Total
07:00 AM	2	38	0	40	83	19	0	102	33	3	0	36	178
07:15 AM	2	47	0	49	82	26	0	108	42	1	0	43	200
07:30 AM	1	43	0	44	81	46	0	127	47	2	0	49	220
07:45 AM	3	30	0	33	78	39	0	117	38	3	0	41	191
Total	8	158	0	166	324	130	0	454	160	9	0	169	789
08:00 AM	4	42	0	46	85	35	0	120	40	3	0	43	209
08:15 AM	9	99	0	108	48	26	0	74	11	2	0	13	195
08:30 AM	8	57	0	65	72	35	0	107	8	1	0	9	181
08:45 AM	3	59	0	62	54	34	0	88	7	3	0	10	160
Total	24	257	0	281	259	130	0	389	66	9	0	75	745
04:00 PM	6	117	0	123	58	51	0	109	51	2	0	53	285
04:15 PM	4	86	0	90	62	53	0	115	43	9	0	52	257
04:30 PM	8	82	0	90	56	44	0	100	47	4	0	51	241
04:45 PM	8	99	0	107	70	62	0	132	50	3	0	53	292
Total	26	384	0	410	246	210	0	456	191	18	0	209	1075
05:00 PM	7	115	0	122	76	45	0	121	49	6	0	55	298
05:15 PM	4	116	0	120	60	48	0	108	37	10	0	47	275
05:30 PM	10	100	0	110	79	49	0	128	52	4	0	56	294
05:45 PM	0	98	0	98	56	57	0	113	32	5	0	37	248
Total	21	429	0	450	271	199	0	470	170	25	0	195	1115
Grand Total	79	1228	0	1307	1100	669	0	1769	587	61	0	648	3724
Apprch %	6	94	0		62.2	37.8	0		90.6	9.4	0		
Total %	2.1	33	0	35.1	29.5	18	0	47.5	15.8	1.6	0	17.4	
Lights	74	1179	0	1253	1057	646	0	1703	569	61	0	630	3586
% Lights	93.7	96	0	95.9	96.1	96.6	0	96.3	96.9	100	0	97.2	96.3
Mediums	4	40	0	44	38	18	0	56	11	0	0	11	111
% Mediums	5.1	3.3	0	3.4	3.5	2.7	0	3.2	1.9	0	0	1.7	3
Articulated Trucks	1	9	0	10	5	5	0	10	7	0	0	7	27
% Articulated Trucks	1.3	0.7	0	0.8	0.5	0.7	0	0.6	1.2	0	0	1.1	0.7

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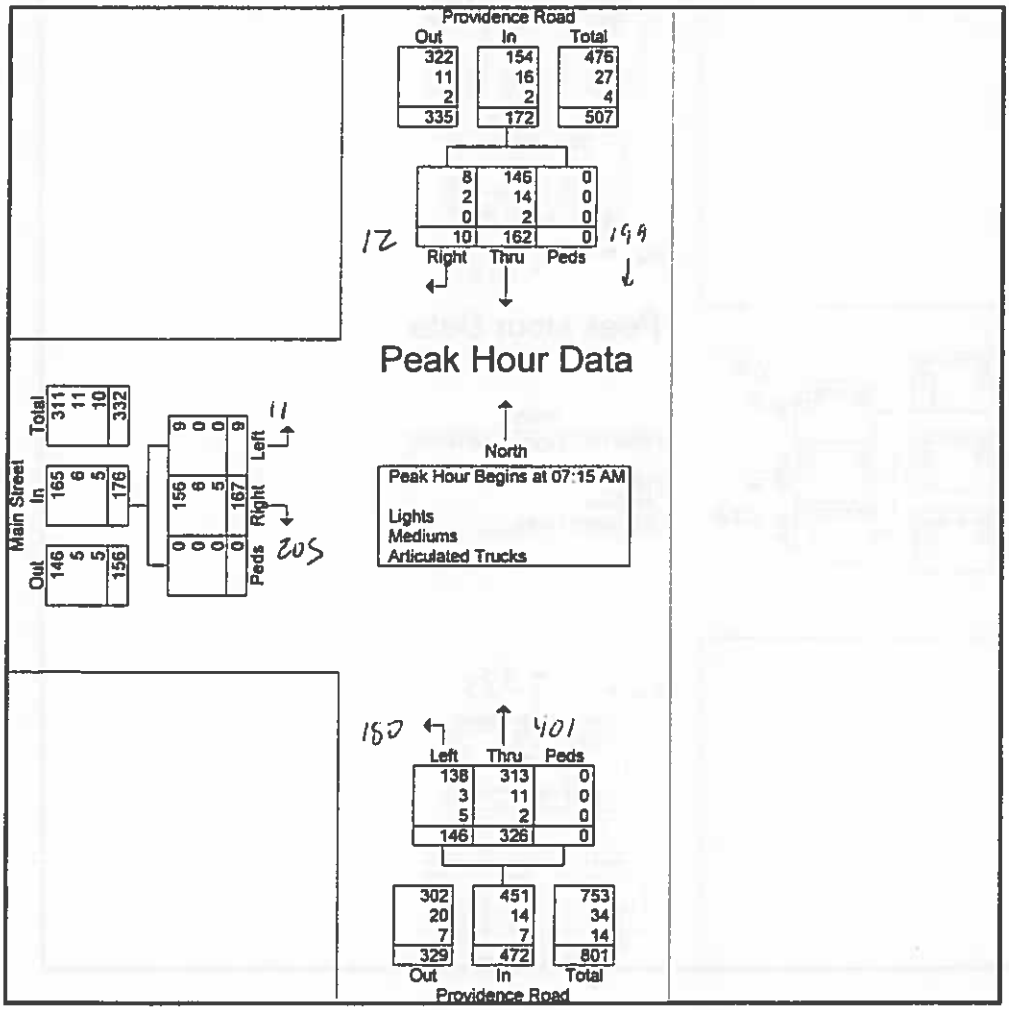
28 Lord Road, Suite 280
Marlborough, MA, 01752

N/S: Providence Road (Rt 122)
EB: Main Street (Route 122A)
Grafton, MA

File Name : 527_Route_122_at_122A_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 2

	Providence Road From North				Providence Road From South				Main Street From West				
Start Time	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:15 AM													
07:15 AM	2	47	0	49	82	26	0	108	42	1	0	43	200
07:30 AM	1	43	0	44	81	46	0	127	47	2	0	49	220
07:45 AM	3	30	0	33	78	39	0	117	38	3	0	41	191
08:00 AM	4	42	0	46	85	35	0	120	40	3	0	43	209
Total Volume	10	162	0	172	326	146	0	472	167	9	0	176	820
% App. Total	5.8	94.2	0		69.1	30.9	0		94.9	5.1	0		
PHF	.625	.862	.000	.878	.959	.793	.000	.929	.888	.750	.000	.898	.932
Lights	8	146	0	154	313	138	0	451	156	9	0	165	770
% Lights	80.0	90.1	0	89.5	96.0	94.5	0	95.6	93.4	100	0	93.8	93.9
Mediums	2	14	0	16	11	3	0	14	6	0	0	6	36
% Mediums	20.0	8.6	0	9.3	3.4	2.1	0	3.0	3.6	0	0	3.4	4.4
Articulated Trucks	0	2	0	2	2	5	0	7	5	0	0	5	14
% Articulated Trucks	0	1.2	0	1.2	0.6	3.4	0	1.5	3.0	0	0	2.8	1.7



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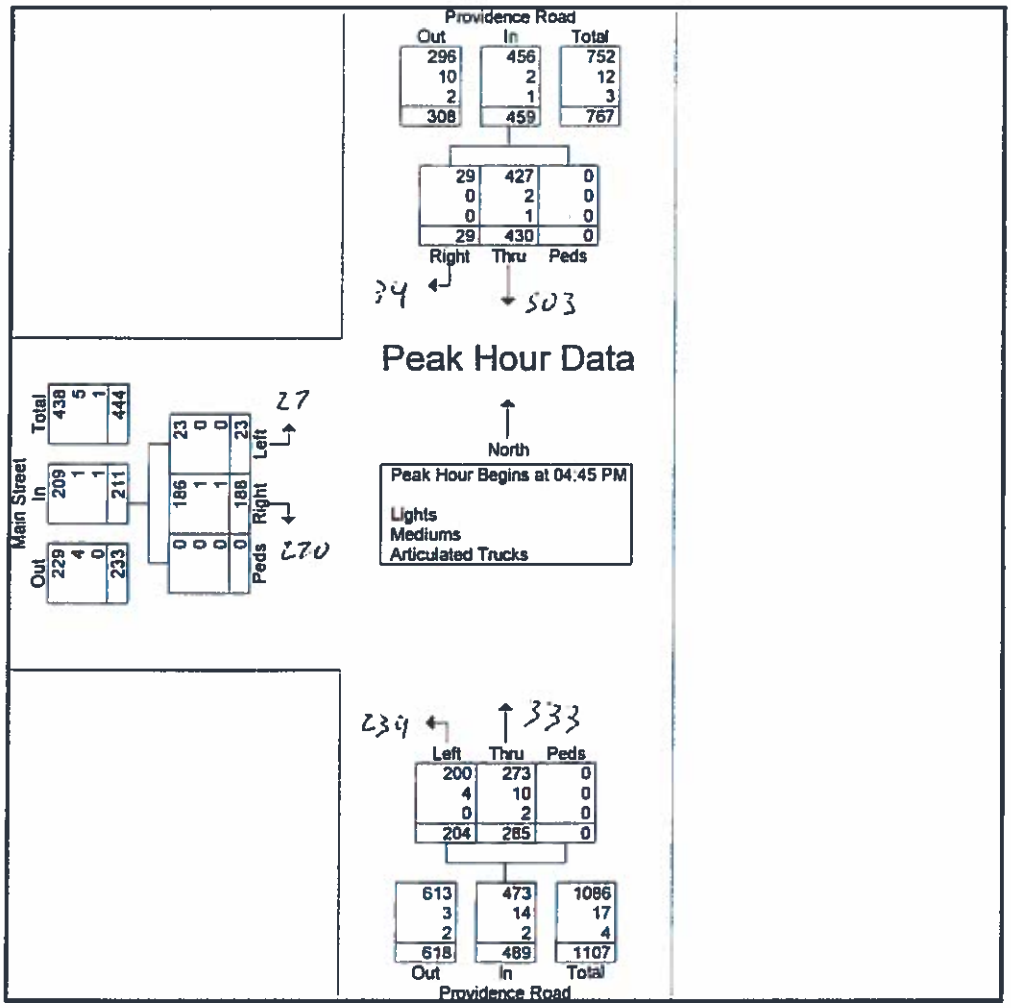
EB: Main Street (Route 122A)
Grafton, MA

File Name : 527_Route_122_at_122A_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 3

	Providence Road From North				Providence Road From South				Main Street From West				
Start Time	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:45 PM													
04:45 PM	8	99	0	107	70	62	0	132	50	3	0	53	292
05:00 PM	7	115	0	122	76	45	0	121	49	6	0	55	298
05:15 PM	4	116	0	120	60	48	0	108	37	10	0	47	275
05:30 PM	10	100	0	110	79	49	0	128	52	4	0	56	294
Total Volume	29	430	0	459	285	204	0	489	188	23	0	211	1159
% App. Total	6.3	93.7	0		58.3	41.7	0		89.1	10.9	0		
PHF	.725	.927	.000	.941	.902	.823	.000	.926	.904	.575	.000	.942	.972
Lights	29	427	0	456	273	200	0	473	186	23	0	209	1138
% Lights	100	99.3	0	99.3	95.8	98.0	0	96.7	98.9	100	0	99.1	98.2
Mediums	0	2	0	2	10	4	0	14	1	0	0	1	17
% Mediums	0	0.5	0	0.4	3.5	2.0	0	2.9	0.5	0	0	0.5	1.5
Articulated Trucks	0	1	0	1	2	0	0	2	1	0	0	1	4
% Articulated Trucks	0	0.2	0	0.2	0.7	0	0	0.4	0.5	0	0	0.5	0.3



MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Main Street (Route 122A)
SB: Cross Street
Grafton, MA

File Name : 527_122A_at_Cross_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 1

Groups Printed- Lights - Mediums - Articulated Trucks

	Cross Street From North					Route 122A From East					Plaza Lot From South					Route 122A From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	5	0	1	0	6	1	21	0	0	22	0	0	0	0	0	0	40	7	0	47	75
07:15 AM	4	0	0	0	4	1	35	0	0	36	0	0	0	0	0	0	38	4	0	42	82
07:30 AM	8	0	2	0	10	2	44	0	0	46	0	0	0	0	0	1	45	7	0	53	109
07:45 AM	8	1	3	0	12	1	40	0	0	41	0	1	1	0	2	1	39	2	0	42	97
Total	25	1	6	0	32	5	140	0	0	145	0	1	1	0	2	2	162	20	0	184	363
08:00 AM	6	0	3	0	9	2	39	0	0	41	0	0	0	0	0	0	36	9	0	45	95
08:15 AM	37	2	3	0	42	5	4	0	0	9	0	0	1	0	1	1	1	45	0	47	99
08:30 AM	46	2	1	0	49	3	5	0	0	8	0	0	0	0	0	1	3	36	0	40	97
08:45 AM	39	2	0	0	41	1	14	0	0	15	0	1	0	0	1	1	0	43	0	44	101
Total	128	6	7	0	141	11	62	0	0	73	0	1	1	0	2	3	40	133	0	176	392
04:00 PM	7	1	1	0	9	4	53	2	0	59	0	1	3	0	4	1	45	10	0	56	128
04:15 PM	8	4	2	0	14	1	55	2	0	58	1	2	3	0	6	7	52	7	0	66	144
04:30 PM	10	5	1	0	16	4	39	3	0	46	0	3	2	0	5	2	49	8	0	59	126
04:45 PM	14	2	5	0	21	7	60	7	0	74	0	4	7	0	11	2	48	13	0	63	169
Total	39	12	9	0	60	16	207	14	0	237	1	10	15	0	26	12	194	38	0	244	567
05:00 PM	15	0	2	0	17	1	52	5	0	58	0	1	3	0	4	3	52	9	0	64	143
05:15 PM	9	1	5	0	15	3	49	2	0	54	0	2	6	0	8	5	34	9	0	48	125
05:30 PM	10	2	1	0	13	2	50	2	0	54	0	2	1	0	3	6	48	9	0	63	133
05:45 PM	7	4	2	0	13	2	48	3	0	53	0	2	4	0	6	4	38	10	0	52	124
Total	41	7	10	0	58	8	199	12	0	219	0	7	14	0	21	18	172	37	0	227	525
Grand Total	233	26	32	0	291	40	608	26	0	674	1	19	31	0	51	35	568	228	0	831	1847
Apprch %	80.1	8.9	11	0		5.9	90.2	3.9	0		2	37.3	60.8	0		4.2	68.4	27.4	0		
Total %	12.6	1.4	1.7	0	15.8	2.2	32.9	1.4	0	36.5	0.1	1	1.7	0	2.8	1.9	30.8	12.3	0	45	
Lights	221	24	32	0	277	39	589	26	0	654	0	19	31	0	50	34	550	218	0	802	1783
% Lights	94.8	92.3	100	0	95.2	97.5	96.9	100	0	97	0	100	100	0	98	97.1	96.8	95.6	0	96.5	96.5
Mediums	11	2	0	0	13	1	13	0	0	14	1	0	0	0	1	1	11	10	0	22	50
% Mediums	4.7	7.7	0	0	4.5	2.5	2.1	0	0	2.1	100	0	0	0	2	2.9	1.9	4.4	0	2.6	2.7
Articulated Trucks	1	0	0	0	1	0	6	0	0	6	0	0	0	0	0	0	7	0	0	7	14
% Articulated Trucks	0.4	0	0	0	0.3	0	1	0	0	0.9	0	0	0	0	0	0	1.2	0	0	0.8	0.8

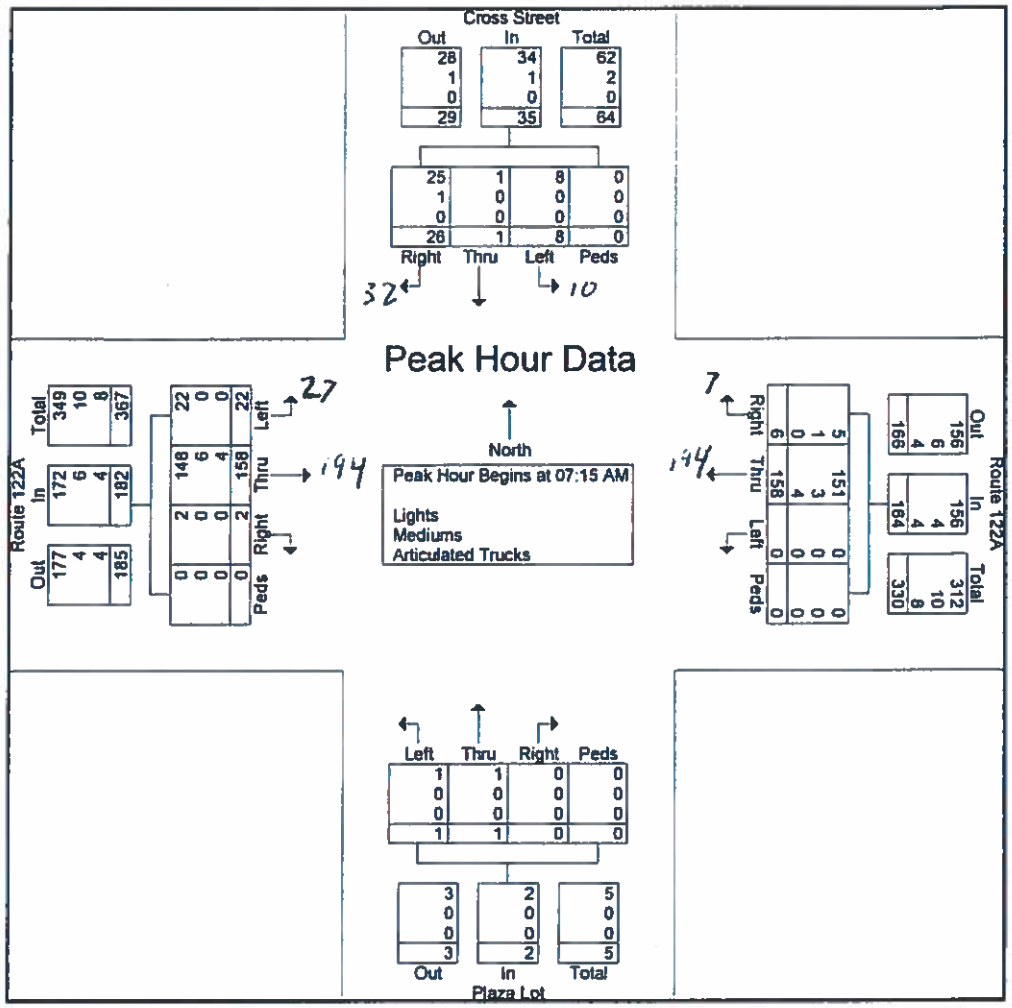
MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Main Street (Route 122A)
SB: Cross Street
Grafton, MA

File Name : 527_122A_at_Cross_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 2

	Cross Street From North					Route 122A From East					Plaza Lot From South					Route 122A From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:00 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	4	0	0	0	4	1	35	0	0	36	0	0	0	0	0	0	38	4	0	42	82
07:30 AM	8	0	2	0	10	2	44	0	0	46	0	0	0	0	0	1	45	7	0	53	109
07:45 AM	8	1	3	0	12	1	40	0	0	41	0	1	1	0	2	1	39	2	0	42	97
08:00 AM	6	0	3	0	9	2	39	0	0	41	0	0	0	0	0	0	36	9	0	45	95
Total Volume	26	1	8	0	35	6	158	0	0	164	0	1	1	0	2	2	158	22	0	182	383
% App. Total	74.3	2.9	22.9	0		3.7	96.3	0	0		0	50	50	0		1.1	86.8	12.1	0		
PHF	.813	.250	.667	.000	.729	.750	.898	.000	.000	.891	.000	.250	.250	.000	.250	.500	.878	.611	.000	.858	.878
Lights	25	1	8	0	34	5	151	0	0	156	0	1	1	0	2	2	148	22	0	172	364
% Lights	96.2	100	100	0	97.1	83.3	95.6	0	0	95.1	0	100	100	0	100	100	93.7	100	0	94.5	95.0
Mediums	1	0	0	0	1	1	3	0	0	4	0	0	0	0	0	0	6	0	0	6	11
% Mediums	3.8	0	0	0	2.9	16.7	1.9	0	0	2.4	0	0	0	0	0	0	3.8	0	0	3.3	2.9
Articulated Trucks	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	0	4	0	0	4	8
% Articulated Trucks	0	0	0	0	0	0	2.5	0	0	2.4	0	0	0	0	0	0	2.5	0	0	2.2	2.1



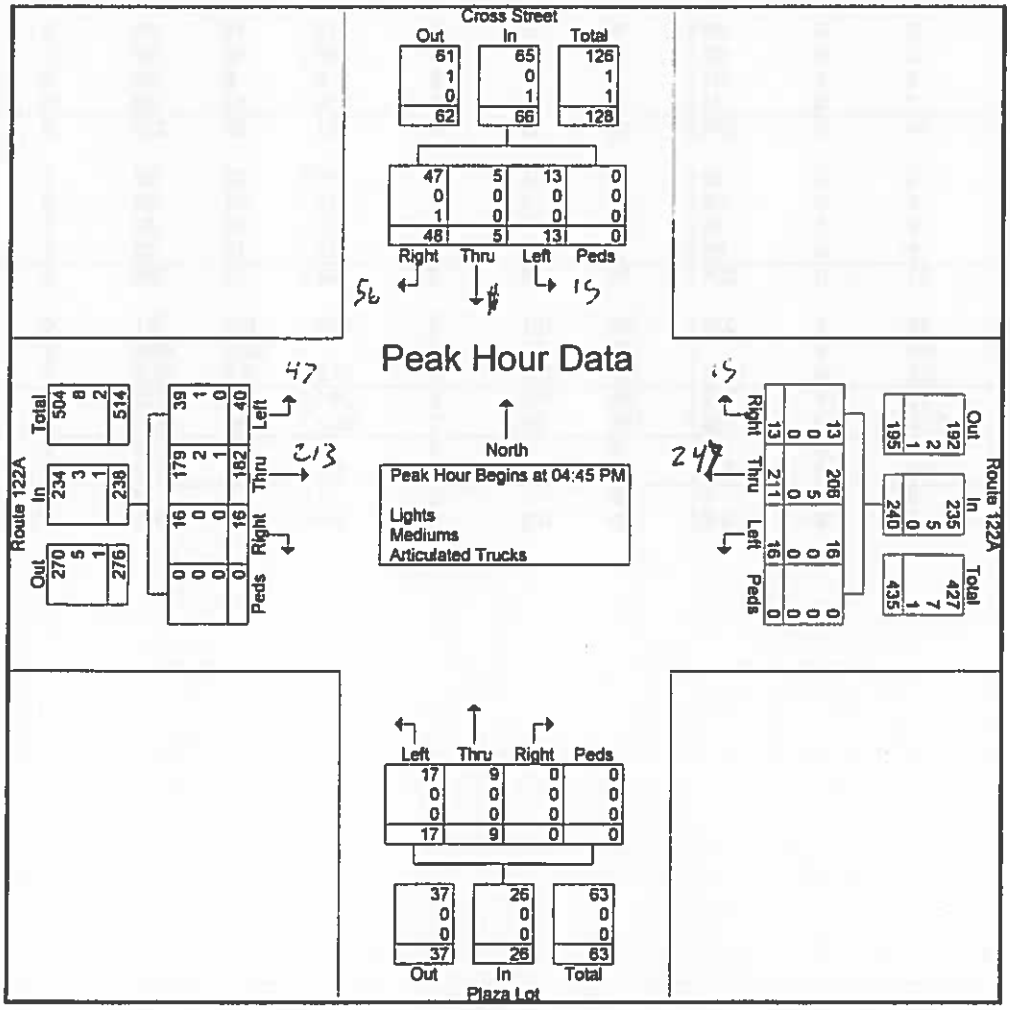
MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Main Street (Route 122A)
SB: Cross Street
Grafton, MA

File Name : 527_122A_at_Cross_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 3

	Cross Street From North					Route 122A From East					Plaza Lot From South					Route 122A From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:45 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	14	2	5	0	21	7	60	7	0	74	0	4	7	0	11	2	48	13	0	63	169
05:00 PM	15	0	2	0	17	1	52	5	0	58	0	1	3	0	4	3	52	9	0	64	143
05:15 PM	9	1	5	0	15	3	49	2	0	54	0	2	6	0	8	5	34	9	0	48	125
05:30 PM	10	2	1	0	13	2	50	2	0	54	0	2	1	0	3	6	48	9	0	63	133
Total Volume	48	5	13	0	66	13	211	16	0	240	0	9	17	0	26	16	182	40	0	238	570
% App. Total	72.7	7.6	19.7	0		5.4	87.9	6.7	0		0	34.6	65.4	0		6.7	76.5	16.8	0		
PHF	.800	.625	.650	.000	.786	.464	.879	.571	.000	.811	.000	.563	.607	.000	.591	.667	.875	.769	.000	.930	.843
Lights	47	5	13	0	65	13	206	16	0	235	0	9	17	0	26	16	179	39	0	234	560
% Lights	97.9	100	100	0	98.5	100	97.6	100	0	97.9	0	100	100	0	100	100	98.4	97.5	0	98.3	98.2
Mediums	0	0	0	0	0	0	5	0	0	5	0	0	0	0	0	0	2	1	0	3	8
% Mediums	0	0	0	0	0	0	2.4	0	0	2.1	0	0	0	0	0	0	1.1	2.5	0	1.3	1.4
Articulated Trucks	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2
% Articulated Trucks	2.1	0	0	0	1.5	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0.4	0.4



MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Main Street (Route 122A)
NB: Ferry Street
Grafton, MA

File Name : 527_122A_at_Ferry_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 1

Groups Printed- Lights - Mediums - Articulated Trucks

	Route 122A From East				Ferry Street From South				Route 122A From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
07:00 AM	22	1	0	23	4	3	0	7	4	42	0	46	76
07:15 AM	45	0	0	45	1	7	0	8	9	36	0	45	98
07:30 AM	47	2	0	49	3	8	0	11	8	48	0	56	116
07:45 AM	53	0	0	53	1	5	0	6	12	35	0	47	106
Total	167	3	0	170	9	23	0	32	33	161	0	194	396
08:00 AM	43	3	0	46	3	11	0	14	6	45	0	51	111
08:15 AM	38	2	0	40	2	8	0	10	7	40	0	47	97
08:30 AM	45	1	0	46	2	14	0	16	7	32	0	39	101
08:45 AM	49	2	0	51	2	12	0	14	9	40	0	49	114
Total	175	8	0	183	9	45	0	54	29	157	0	186	423
04:00 PM	58	0	0	58	0	10	0	10	18	54	0	72	140
04:15 PM	63	2	0	65	9	17	0	26	16	57	0	73	164
04:30 PM	42	5	0	47	2	7	0	9	9	56	0	65	121
04:45 PM	67	7	0	74	5	11	0	16	14	58	0	72	162
Total	230	14	0	244	16	45	0	61	57	225	0	282	587
05:00 PM	57	3	0	60	1	15	0	16	20	62	0	82	158
05:15 PM	50	5	0	55	2	15	0	17	24	46	0	70	142
05:30 PM	50	8	0	58	5	12	0	17	14	57	0	71	146
05:45 PM	56	5	0	61	6	6	0	12	15	43	0	58	131
Total	213	21	0	234	14	48	0	62	73	208	0	281	577
Grand Total	785	46	0	831	48	161	0	209	192	751	0	943	1983
Apprch %	94.5	5.5	0		23	77	0		20.4	79.6	0		
Total %	39.6	2.3	0	41.9	2.4	8.1	0	10.5	9.7	37.9	0	47.6	
Lights	755	43	0	798	48	153	0	201	190	723	0	913	1912
% Lights	96.2	93.5	0	96	100	95	0	96.2	99	96.3	0	96.8	96.4
Mediums	23	3	0	26	0	7	0	7	2	20	0	22	55
% Mediums	2.9	6.5	0	3.1	0	4.3	0	3.3	1	2.7	0	2.3	2.8
Articulated Trucks	7	0	0	7	0	1	0	1	0	8	0	8	16
% Articulated Trucks	0.9	0	0	0.8	0	0.6	0	0.5	0	1.1	0	0.8	0.8

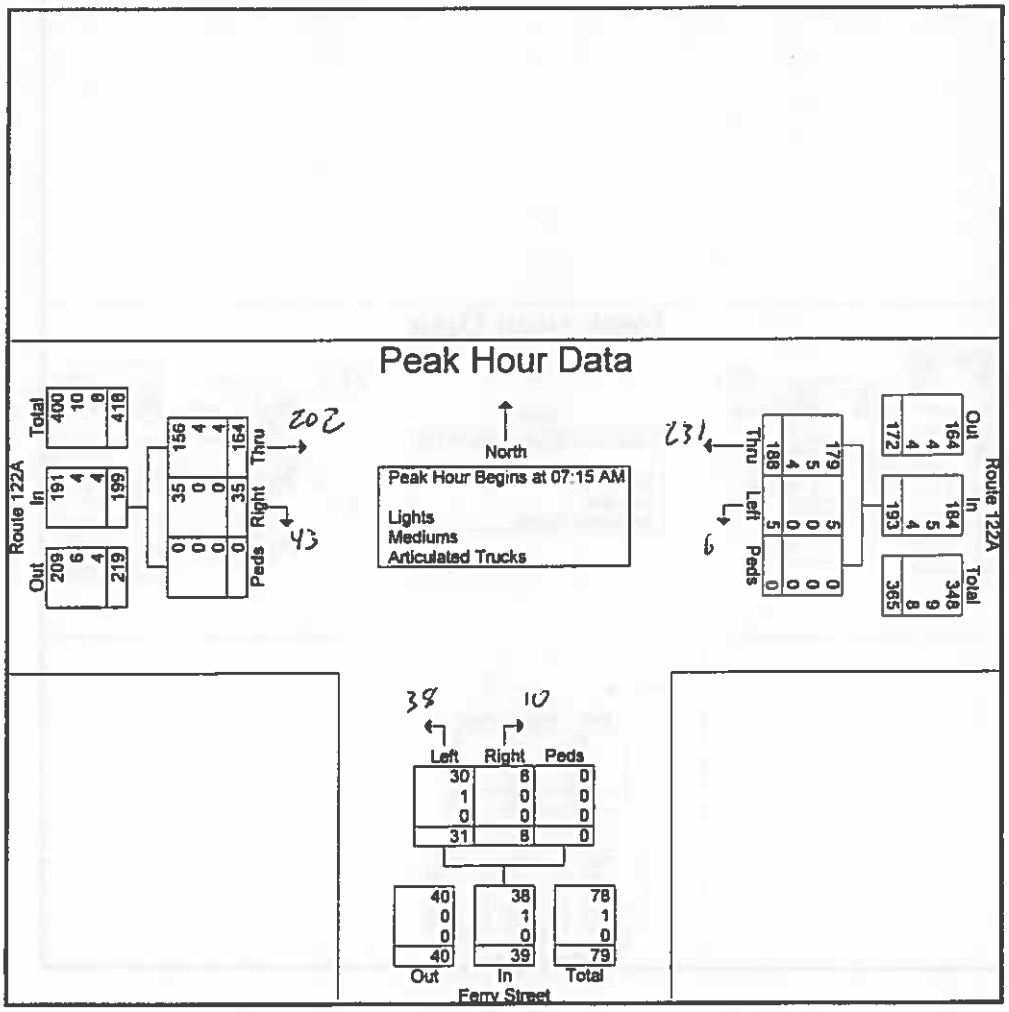
MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Main Street (Route 122A)
NB: Ferry Street
Grafton, MA

File Name : 527_122A_at_Ferry_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 2

	Route 122A From East				Ferry Street From South				Route 122A From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:15 AM													
07:15 AM	45	0	0	45	1	7	0	8	9	36	0	45	98
07:30 AM	47	2	0	49	3	8	0	11	8	48	0	56	116
07:45 AM	53	0	0	53	1	5	0	6	12	35	0	47	106
08:00 AM	43	3	0	46	3	11	0	14	6	45	0	51	111
Total Volume	188	5	0	193	8	31	0	39	35	164	0	199	431
% App. Total	97.4	2.6	0		20.5	79.5	0		17.6	82.4	0		
PHF	.887	.417	.000	.910	.667	.705	.000	.696	.729	.854	.000	.888	.929
Lights	179	5	0	184	8	30	0	38	35	156	0	191	413
% Lights	95.2	100	0	95.3	100	96.8	0	97.4	100	95.1	0	96.0	95.8
Mediums	5	0	0	5	0	1	0	1	0	4	0	4	10
% Mediums	2.7	0	0	2.6	0	3.2	0	2.6	0	2.4	0	2.0	2.3
Articulated Trucks	4	0	0	4	0	0	0	0	0	4	0	4	8
% Articulated Trucks	2.1	0	0	2.1	0	0	0	0	0	2.4	0	2.0	1.9



MDM Transportation Consultants, Inc.

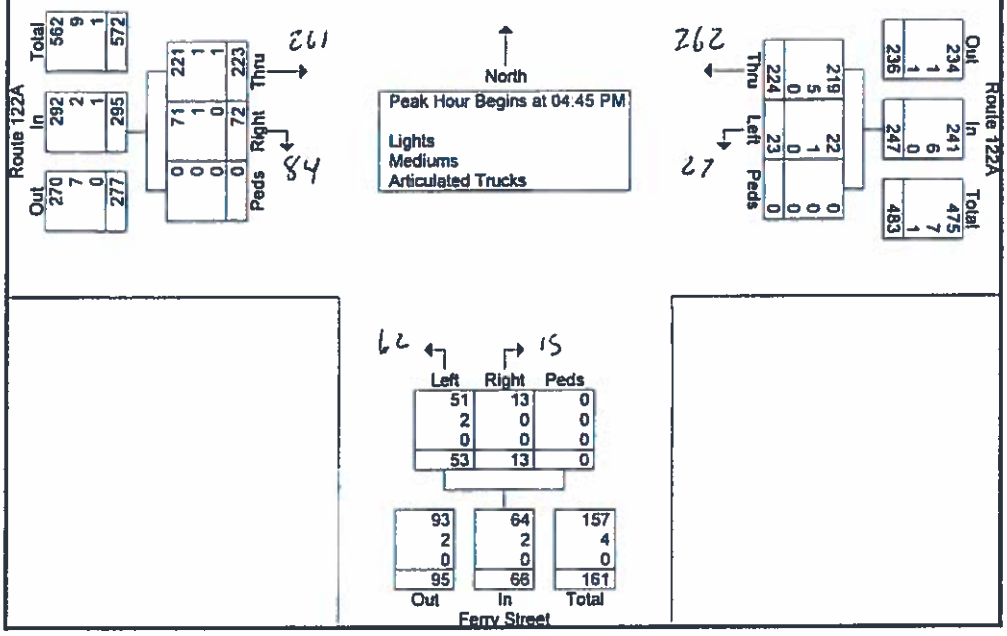
28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Main Street (Route 122A)
NB: Ferry Street
Grafton, MA

File Name : 527_122A_at_Ferry_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 3

	Route 122A From East				Ferry Street From South				Route 122A From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:45 PM													
04:45 PM	67	7	0	74	5	11	0	16	14	58	0	72	162
05:00 PM	57	3	0	60	1	15	0	16	20	62	0	82	158
05:15 PM	50	5	0	55	2	15	0	17	24	46	0	70	142
05:30 PM	50	8	0	58	5	12	0	17	14	57	0	71	146
Total Volume	224	23	0	247	13	53	0	66	72	223	0	295	608
% App. Total	90.7	9.3	0		19.7	80.3	0		24.4	75.6	0		
PHF	.836	.719	.000	.834	.650	.883	.000	.971	.750	.899	.000	.899	.938
Lights	219	22	0	241	13	51	0	64	71	221	0	292	597
% Lights	97.8	95.7	0	97.6	100	96.2	0	97.0	98.6	99.1	0	99.0	98.2
Mediums	5	1	0	6	0	2	0	2	1	1	0	2	10
% Mediums	2.2	4.3	0	2.4	0	3.8	0	3.0	1.4	0.4	0	0.7	1.6
Articulated Trucks	0	0	0	0	0	0	0	0	0	1	0	1	1
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0.4	0	0.3	0.2

Peak Hour Data



MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Main Street (Route 122A)
SB: Pleasant Street
Grafton, MA

File Name : 527_122A_at_Pleasant_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 1

Groups Printed- Lights - Mediums - Articulated Trucks

	Pleasant Street From North					Route 122A From East					Leland Hill Road From South					Route 122A From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	14	2	2	0	18	1	24	0	0	25	1	10	3	0	14	1	35	9	0	45	102
07:15 AM	8	1	0	0	9	1	47	0	0	48	4	10	0	0	14	2	36	8	0	46	117
07:30 AM	11	5	3	0	19	0	47	0	0	47	8	17	2	0	27	3	44	15	0	62	155
07:45 AM	4	2	3	0	9	5	55	0	0	60	5	11	4	0	20	0	47	13	0	60	149
Total	37	10	8	0	55	7	173	0	0	180	18	48	9	0	75	6	162	45	0	213	523
08:00 AM	9	2	1	0	12	0	45	0	0	45	5	9	2	0	16	1	41	10	0	52	125
08:15 AM	14	3	2	0	19	1	40	1	0	42	1	4	1	0	6	1	42	8	0	51	118
08:30 AM	6	6	1	0	13	0	35	3	0	38	1	5	3	0	9	3	41	16	0	60	120
08:45 AM	6	5	0	0	11	0	58	1	0	59	0	3	5	0	8	2	36	15	0	53	131
Total	35	16	4	0	55	1	178	5	0	184	7	21	11	0	39	7	160	49	0	216	494
04:00 PM	22	9	6	0	37	1	59	4	0	64	1	2	3	0	6	2	56	15	0	73	180
04:15 PM	18	18	5	0	41	3	70	2	0	75	6	8	2	0	16	2	50	16	0	68	200
04:30 PM	16	13	3	0	32	4	38	6	0	48	4	12	0	0	16	3	51	12	0	66	162
04:45 PM	10	7	5	0	22	0	56	8	0	64	2	8	3	0	13	1	59	9	0	69	168
Total	66	47	19	0	132	8	223	20	0	251	13	30	8	0	51	8	216	52	0	276	710
05:00 PM	15	11	4	0	30	1	60	5	0	66	4	10	0	0	14	2	61	15	0	78	188
05:15 PM	14	14	1	0	29	3	59	6	0	68	2	9	3	0	14	2	72	13	0	87	198
05:30 PM	8	13	2	0	23	4	52	0	0	56	2	4	0	0	6	3	54	14	0	71	156
05:45 PM	19	3	4	0	26	1	50	4	0	55	0	6	1	0	7	3	49	13	0	65	153
Total	56	41	11	0	108	9	221	15	0	245	8	29	4	0	41	10	236	55	0	301	695
Grand Total	194	114	42	0	350	25	795	40	0	860	46	128	32	0	206	31	774	201	0	1006	2422
Apprch %	55.4	32.6	12	0		2.9	92.4	4.7	0		22.3	62.1	15.5	0		3.1	76.9	20	0		
Total %	8	4.7	1.7	0	14.5	1	32.8	1.7	0	35.5	1.9	5.3	1.3	0	8.5	1.3	32	8.3	0	41.5	
Lights	190	113	38	0	341	24	768	39	0	831	45	126	32	0	203	31	751	195	0	977	2352
% Lights	97.9	99.1	90.5	0	97.4	96	96.6	97.5	0	96.6	97.8	98.4	100	0	98.5	100	97	97	0	97.1	97.1
Mediums	3	1	4	0	8	1	22	1	0	24	1	2	0	0	3	0	19	6	0	25	60
% Mediums	1.5	0.9	9.5	0	2.3	4	2.8	2.5	0	2.8	2.2	1.6	0	0	1.5	0	2.5	3	0	2.5	2.5
Articulated Trucks	1	0	0	0	1	0	5	0	0	5	0	0	0	0	0	0	4	0	0	4	10
% Articulated Trucks	0.5	0	0	0	0.3	0	0.6	0	0	0.6	0	0	0	0	0	0	0.5	0	0	0.4	0.4

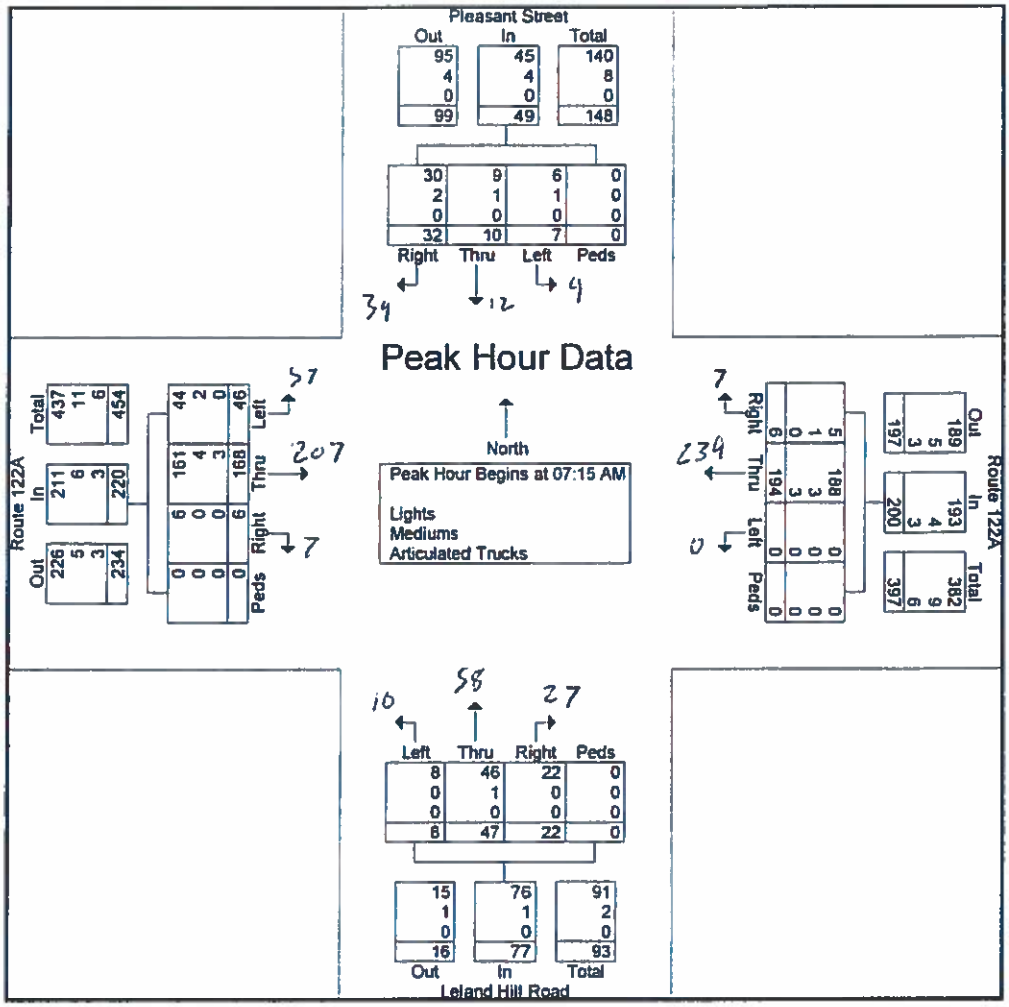
MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Main Street (Route 122A)
SB: Pleasant Street
Grafton, MA

File Name : 527_122A_at_Pleasant_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 2

	Pleasant Street From North					Route 122A From East					Leland Hill Road From South					Route 122A From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:00 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	8	1	0	0	9	1	47	0	0	48	4	10	0	0	14	2	36	8	0	46	117
07:30 AM	11	5	3	0	19	0	47	0	0	47	8	17	2	0	27	3	44	15	0	62	155
07:45 AM	4	2	3	0	9	5	55	0	0	60	5	11	4	0	20	0	47	13	0	60	149
08:00 AM	9	2	1	0	12	0	45	0	0	45	5	9	2	0	16	1	41	10	0	52	125
Total Volume	32	10	7	0	49	6	194	0	0	200	22	47	8	0	77	6	168	46	0	220	546
% App. Total	65.3	20.4	14.3	0		3	97	0	0		28.6	61	10.4	0		2.7	76.4	20.9	0		
PHF	.727	.500	.583	.000	.645	.300	.882	.000	.000	.833	.688	.691	.500	.000	.713	.500	.894	.767	.000	.887	.881
Lights	30	9	6	0	45	5	188	0	0	193	22	46	8	0	76	6	161	44	0	211	525
% Lights	93.8	90.0	85.7	0	91.8	83.3	96.9	0	0	96.5	100	97.9	100	0	98.7	100	95.8	95.7	0	95.9	96.2
Mediums	2	1	1	0	4	1	3	0	0	4	0	1	0	0	1	0	4	2	0	6	15
% Mediums	6.3	10.0	14.3	0	8.2	16.7	1.5	0	0	2.0	0	2.1	0	0	1.3	0	2.4	4.3	0	2.7	2.7
Articulated Trucks	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	3	0	0	3	6
% Articulated Trucks	0	0	0	0	0	0	1.5	0	0	1.5	0	0	0	0	0	0	1.8	0	0	1.4	1.1



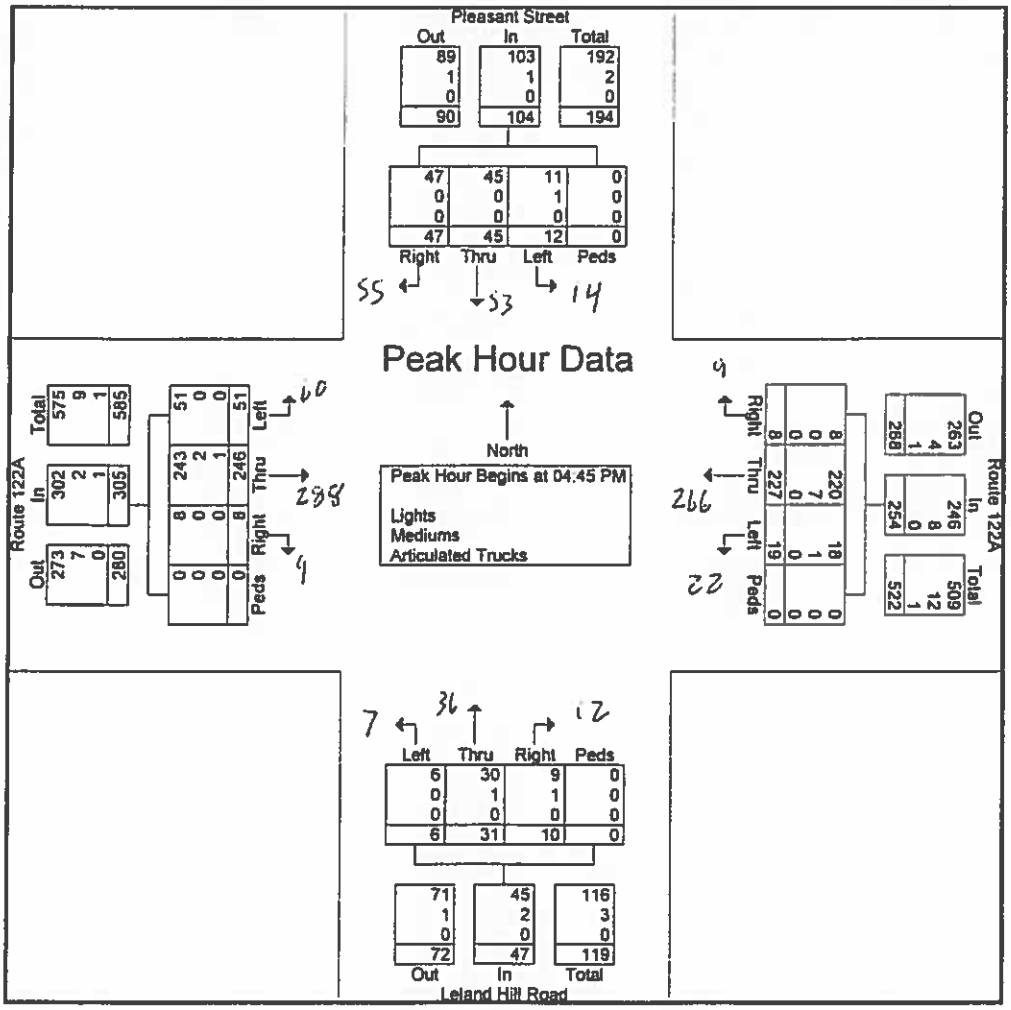
MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Main Street (Route 122A)
SB: Pleasant Street
Grafton, MA

File Name : 527_122A_at_Pleasant_10-01-2020
Site Code : 527
Start Date : 10/1/2020
Page No : 3

	Pleasant Street From North					Route 122A From East					Leland Hill Road From South					Route 122A From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:45 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	10	7	5	0	22	0	56	8	0	64	2	8	3	0	13	1	59	9	0	69	168
05:00 PM	15	11	4	0	30	1	60	5	0	66	4	10	0	0	14	2	61	15	0	78	188
05:15 PM	14	14	1	0	29	3	59	6	0	68	2	9	3	0	14	2	72	13	0	87	198
05:30 PM	8	13	2	0	23	4	52	0	0	56	2	4	0	0	6	3	54	14	0	71	156
Total Volume	47	45	12	0	104	8	227	19	0	254	10	31	6	0	47	8	246	51	0	305	710
% App. Total	45.2	43.3	11.5	0		3.1	89.4	7.5	0		21.3	66	12.8	0		2.6	80.7	16.7	0		
PHF	.783	.804	.600	.000	.867	.500	.946	.594	.000	.934	.625	.775	.500	.000	.839	.667	.854	.850	.000	.876	.896
Lights	47	45	11	0	103	8	220	18	0	246	9	30	6	0	45	8	243	51	0	302	696
% Lights	100	100	91.7	0	99.0	100	96.9	94.7	0	96.9	90.0	96.8	100	0	95.7	100	98.8	100	0	99.0	98.0
Mediums	0	0	1	0	1	0	7	1	0	8	1	1	0	0	2	0	2	0	0	2	13
% Mediums	0	0	8.3	0	1.0	0	3.1	5.3	0	3.1	10.0	3.2	0	0	4.3	0	0.8	0	0	0.7	1.8
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0	0	0.3	0.1



- Seasonal/Yearly Growth Data

STATION 310 - SUTTON - RTE.146 - SOUTH OF PURGATORY ROAD

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	29,600	29,800	30,000	30,091	30,571	32,009	31,477	32,505	30,362	30,000	29,000	27,000	30,201
	-6%	-4%	0%	2%	3%	1%	2%	1%	6%	2%	7%	6%	1.6%
06	27,942	28,570	29,913	30,757	31,353	32,274	32,010	32,876	32,157	30,715	30,961	28,654	30,682
	-3%	-2%	3%	4%	6%	5%	5%	8%	-3%	-11%	3%	3%	1.5%
07	*26,982*	27,863	30,788	31,934	33,297	33,965	33,481	35,503	31,235	27,268	31,910	29,582	31,151
	11%	8%	1%	1%	-2%	-4%	-2%	-4%	4%	22%	0%	-6%	1.9%
08	*30,000*	30,102	31,021	32,235	32,718	32,715	32,707	34,088	32,529	33,273	31,779	27,892	31,755
	4%	3%	9%	11%	11%	14%	13%	12%	13%	10%	8%	18%	10.4%
14	31,108	31,099	33,880	35,630	*36,190*	*37,328*	*36,856*	38,220	36,831	36,492	34,166	32,866	35,056
	-2%	-11%	0%	1%	1%	2%	3%	1%	1%	1%	6%	5%	0.8%
15	30,546	27,602	34,036	36,009	*36,718*	*37,949*	*37,910*	38,462	37,241	37,028	36,107	34,393	35,333
	8%	22%	7%	2%	5%	6%	5%	5%	6%	5%	4%	4%	6.3%
16	32,944	33,785	36,279	36,892	*38,644*	*40,200*	*39,738*	40,293	39,439	39,028	37,572	35,808	37,552
Seasonal Adjustment Factor (to average month)	1.11	1.11	1.03	0.99	0.97	0.94	0.95	0.92	0.97	1.00	1.00	1.07	
												Growth	2.3%

STATION 3180 - MILFORD - RTE.I-495 - AT MEDWAY T.L.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	67,586	71,945	74,150	79,123	84,600	90,062	88,165	91,494	83,189	79,428	78,746	75,126	80,301
	7%	-1%	3%	-1%	-5%	-5%	-4%	-2%	1%	1%	1%	2%	0%
06	72,492	71,145	76,347	78,305	80,480	85,728	84,957	89,595	83,740	80,518	79,468	76,386	79,930
	-2%	-1%	-4%	-2%	6%	3%	4%	2%	-1%	2%	-2%	-5%	0%
07	70,749	70,432	73,596	76,751	85,024	88,000	88,401	91,080	83,309	82,221	77,941	72,362	79,989
	-2%	-3%	3%	-1%	-7%	-8%	-4%	-5%	-5%	-3%	-5%	-2%	-4%
08	69,200	68,456	76,000	75,934	79,352	81,166	84,701	86,189	78,778	79,645	73,861	70,747	77,002
	-5%	1%	-8%	1%	-1%	-1%	-1%	1%	6%	0%	2%	3%	0%
09	65,444	69,136	69,739	76,913	78,876	80,700	84,000	86,829	83,273	79,419	75,486	73,169	76,915
	3%	-1%	5%	1%	-1%	7%	4%	4%	0%	4%	3%	3%	3%
10	67,428	68,595	73,544	77,906	77,940	86,167	87,728	90,295	83,483	82,244	77,516	75,273	79,010
	-3%	2%	1%	-1%	3%	1%	-1%	-4%	1%	-2%	2%	2%	0%
11	65,217	69,804	73,992	77,115	80,458	87,344	86,859	87,108	84,288	80,223	78,698	76,729	78,986
	8%	2%	1%	1%	2%	0%	-1%	4%	-1%	3%	1%	-2%	1%
12	70,333	71,280	74,372	78,117	81,707	87,015	85,909	90,589	83,100	82,647	79,543	74,989	79,967
	7%	7%	8%	9%	12%	11%	9%	7%	11%	12%	10%	9%	9%
17	75,101	76,457	80,500	85,524	91,188	96,164	93,860	97,247	92,026	92,357	87,401	81,383	87,434
	2%	5%	4%	2%	1%	1%	2%	4%	2%	-1%	-1%	2%	2%
18	76,814	80,442	84,070	87,135	92,456	96,848	96,198	101,076	93,917	91,662	86,684	82,734	89,186
	1%	-3%	-2%	0%	0%	1%	-1%	-1%	1%	1%	0%	-3%	0%
19	77,652	77,922	82,325	87,537	92,344	97,773	95,052	100,174	94,796	92,437	86,606	80,298	88,743
Seasonal Adjustment Factor (to average month)	1.16	1.13	1.07	1.02	0.96	0.91	0.93	0.89	0.95	0.96	1.02	1.09	
												Growth	0.3%

STATION 307 - WESTBOROUGH - RTE.9 - EAST OF NORTHBOROUGH T.L.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
06	44,301	44,854	50,326	51,170	51,729	52,438	48,052	50,270	50,998	50,194	50,043	*50,032*	49,534
	7%	5%	-2%	-4%	-3%	-1%	10%	4%	-4%	1%	-1%	-6%	0%
07	47,505	47,283	49,268	49,136	*50,000*	*52,000*	*53,000*	52,322	49,031	50,571	49,662	47,007	49,732
	-4%	-2%	-3%	1%	1%	-4%	-8%	-7%	-1%	-3%	-4%	-1%	-3%
08	45,614	46,112	47,829	49,816	*50,518*	*49,936*	*48,629*	48,759	48,531	49,009	47,490	46,696	48,245
	-3%	1%	-3%	-2%	-2%	0%	-2%	-3%	-2%	-1%	0%	2%	-1%
09	44,103	46,434	46,455	49,049	*49,474*	*49,934*	*47,638*	47,056	47,762	48,663	47,379	47,564	47,626
	-1%	0%	2%	0%	0%	1%	-1%	1%	1%	1%	2%	2%	1%
11	43,244	46,150	48,016	48,943	*49,781*	*50,525*	*46,812*	48,234	48,825	49,198	49,151	49,888	48,231
	7%	2%	1%	-1%	1%	-1%	3%	4%	0%	2%	2%	-5%	1%
12	46,381	46,883	48,608	48,662	*50,126*	*49,961*	*48,380*	49,941	48,882	50,056	50,015	47,600	48,791
	0%	-1%	-2%	1%	1%	-9%	3%	-1%	2%	0%	-1%	2%	0%
13	46,393	46,220	47,421	49,359	*50,657*	*45,623*	*49,797*	49,223	49,935	50,021	49,651	48,441	48,562
	2%	3%	6%	3%	3%	17%	0%	3%	0%	2%	4%	4%	4%
16	47,447	47,570	50,342	50,977	52,259	53,476	49,724	50,789	50,057	51,035	51,749	50,442	50,489
Seasonal Adjustment Factor (to average month)	0.64	0.63	0.60	0.59	0.58	0.58	0.59	0.59	0.59	0.58	0.59	0.60	
												Growth	-0.2%

Average Yearly Growth Calculated 0.8%
Yearly Growth Factor Used 1.0%

ITALICS = ESTIMATED DATA

MADT

Location Info	
Location ID	3991
Type	I-SECTION
Functional Class	3
Located On	ROUTE 146
Between	AND
Direction	2-WAY
Community	Worcester
MPO_ID	
HPMS ID	
Agency	Massachusetts Highway Department

Count Data Info	
Start Date	10/16/2018
End Date	10/17/2018
Start Time	12:00 AM
End Time	12:00 AM
Direction	2-WAY
Notes	
Count Source	
File Name	
Weather	
Study	
Owner	wjt
QC Status	Accepted

Interval: 60 mins	
Time	Hourly Count
00:00 - 01:00	319
01:00 - 02:00	179
02:00 - 03:00	183
03:00 - 04:00	221
04:00 - 05:00	547
05:00 - 06:00	1772
06:00 - 07:00	3419
07:00 - 08:00	4407
08:00 - 09:00	3958
09:00 - 10:00	3224
10:00 - 11:00	2731
11:00 - 12:00	2762
12:00 - 13:00	2964
13:00 - 14:00	3183
14:00 - 15:00	3628
15:00 - 16:00	4368
16:00 - 17:00	4650
17:00 - 18:00	4645
18:00 - 19:00	3554
19:00 - 20:00	2517
20:00 - 21:00	1860
21:00 - 22:00	1441
22:00 - 23:00	946
23:00 - 24:00	697
TOTAL	58175

Location Info	
Location ID	3991
Type	I-SECTION
Functional Class	3
Located On	ROUTE 146
Between	AND
Direction	2-WAY
Community	Worcester
MPO_ID	
HPMS ID	
Agency	Massachusetts Highway Department

Count Data Info	
Start Date	10/7/2020
End Date	10/8/2020
Start Time	12:00 AM
End Time	12:00 AM
Direction	
Notes	
Count Source	399102
File Name	
Weather	
Study	
Owner	MhdTelemetryAuto
QC Status	Accepted

Interval: 15 mins

Time	15 Min				Hourly Count
	1st	2nd	3rd	4th	
00:00 - 01:00	80	80	64	65	289
01:00 - 02:00	49	50	42	43	184
02:00 - 03:00	43	54	39	47	183
03:00 - 04:00	33	43	53	48	177
04:00 - 05:00	62	86	113	154	415
05:00 - 06:00	189	285	460	482	1416
06:00 - 07:00	518	671	814	805	2808
07:00 - 08:00	822	847	895	912	3476
08:00 - 09:00	774	777	730	696	2977
09:00 - 10:00	628	658	615	604	2505
10:00 - 11:00	577	576	594	641	2388
11:00 - 12:00	634	644	688	652	2618
12:00 - 13:00	681	723	706	692	2802
13:00 - 14:00	725	709	747	804	2985
14:00 - 15:00	879	911	896	928	3614
15:00 - 16:00	939	1056	997	946	3938
16:00 - 17:00	977	1016	1021	1001	4015
17:00 - 18:00	1065	1032	828	768	3693
18:00 - 19:00	768	672	613	583	2636
19:00 - 20:00	539	570	460	391	1960
20:00 - 21:00	390	362	346	321	1419
21:00 - 22:00	309	269	214	216	1008
22:00 - 23:00	212	192	181	148	733
23:00 - 24:00	133	147	123	96	499
TOTAL					48738

- Speed Data

MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Route 122A
At Proposed Site Driveway
Grafton, MA

Site Code: 527
Station ID:
527

Westbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent
09/30/20	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
01:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
02:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
09:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
12 PM	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
13:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
14:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
15:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
16:00	0	0	6	27	48	3	0	0	1	0	0	0	0	0	85	34
17:00	0	0	1	14	45	11	1	0	0	0	0	0	0	0	72	35
18:00	0	0	5	20	28	6	0	0	0	0	0	0	0	0	59	34
19:00	0	0	1	9	18	5	1	0	0	0	0	0	0	0	34	35
20:00	0	0	0	7	3	3	0	0	0	0	0	0	0	0	13	36
21:00	0	0	1	3	4	2	0	0	0	0	0	0	0	0	10	36
22:00	0	0	0	4	2	2	0	0	0	0	0	0	0	0	8	37
23:00	0	0	0	3	4	3	0	0	0	0	0	0	0	0	10	37

MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Route 122A
At Proposed Site Driveway
Grafton, MA

Site Code: 527
Station ID:
527

Westbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent
10/01/20	0	0	0	3	0	1	0	0	0	0	0	0	0	0	4	37
01:00	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2	38
02:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
09:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
12 PM	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
13:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
14:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
15:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
16:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
17:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
18:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
19:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
20:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
21:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
22:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
23:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

	15th Percentile :	26 MPH
	50th Percentile :	31 MPH
	85th Percentile :	34 MPH
	95th Percentile :	38 MPH
Statistics	10 MPH Pace Speed :	26-35 MPH
	Number in Pace :	243
	Percent in Pace :	81.8%
	Number of Vehicles > 35 MPH :	40
	Percent of Vehicles > 35 MPH :	13.5%
	Mean Speed(Average) :	32 MPH

MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Route 122A
At Proposed Site Driveway
Grafton, MA

Site Code: 527
Station ID:
527

Eastbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent
09/30/20	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
01:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
02:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
09:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
12 PM	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
13:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
14:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
15:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
16:00	1	2	17	72	96	40	9	0	0	0	0	0	0	0	237	36
17:00	0	2	5	50	119	60	10	0	0	0	0	0	0	0	246	37
18:00	0	0	6	50	80	41	8	0	0	0	0	0	0	0	185	37
19:00	0	0	10	27	42	19	3	1	0	0	0	0	0	0	102	37
20:00	0	0	2	31	32	9	5	1	0	0	0	0	0	0	80	36
21:00	0	0	3	19	25	11	3	0	0	0	0	0	0	0	61	37
22:00	0	0	0	8	16	2	3	0	0	0	0	0	0	0	29	36
23:00	0	0	0	10	11	7	1	0	0	0	0	0	0	0	29	37

MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Route 122A
At Proposed Site Driveway
Grafton, MA

Site Code: 527
Station ID:
527

Eastbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent
10/01/20	0	0	2	4	1	1	0	0	0	0	0	0	0	0	8	33
01:00	0	0	0	1	2	2	0	0	0	0	0	0	0	0	5	38
02:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
09:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
12 PM	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
13:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
14:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
15:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
16:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
17:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
18:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
19:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
20:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
21:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
22:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
23:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

	15th Percentile :	26 MPH
	50th Percentile :	31 MPH
	85th Percentile :	37 MPH
	95th Percentile :	39 MPH
Statistics	10 MPH Pace Speed :	26-35 MPH
	Number in Pace :	696
	Percent in Pace :	70.9%
	Number of Vehicles > 35 MPH :	236
	Percent of Vehicles > 35 MPH :	24.0%
	Mean Speed(Average) :	33 MPH

- Crash Data

Main Street at Providence Road

Crash Number	City Town	Crash Date	Crash Severity	Crash Time	Crash Year	Max Injury Severity Re	Number of Vehicles	Light Cond	Manner of Collision	Road Surface Condition	Total Fatalities	Total Non Fatal Injuries	Weather Conditions	X	Y	Street Number	Roadway	Near Intersection Roadway	Distance and Direction from Intersection
4050661	GRAFTON	05/01/2015	Non-fatal injury	7:37 AM	2015	Non-fatal injury - Non	1	Daylight	Single vehicle crash	Dry	0		2 Clear	185093	880682.5		MAIN STREET Rte 122A S / PROVIDENCE ROAD Rte 122 S		
4137735	GRAFTON	09/29/2015	Property damage only (no	2:23 PM	2015	No injury	2	Daylight	Rear-end	Dry	0		8 Cloudy/Clear	185093	880682.5		PROVIDENCE ROAD Rte 122 N / MAIN STREET Rte 122A N		
4204961	GRAFTON	06/29/2016	Non-fatal injury	2:24 PM	2016	Non-fatal injury - Fatal	2	Daylight	Head-on	Dry	0		1 Clear	185093	880682.5		MAIN STREET Rte 122A / PROVIDENCE ROAD Rte 122		
4339871	GRAFTON	11/31/2016	Non-fatal injury	4:02 PM	2016	Non-fatal injury - Non	2	Daylight	Angle	Dry	0		1 Cloudy	185066.7	880694.7	2	MAIN STREET Rte 122		
4403766	GRAFTON	05/21/2017	Non-fatal injury	12:11 PM	2017	Non-fatal injury - Non	1	Daylight	Single vehicle crash	Dry	0		1 Clear	185093	880682.5		PROVIDENCE RD Rte 122 N / MAIN ST Rte 122A		
4403843	GRAFTON	01/01/2017	Non-fatal injury	5:43 PM	2017	Non-fatal injury - Poss	1	Dark - light	Angle	Dry	0		1 Clear	185093	880682.5		MAIN ST / PROVIDENCE RD		
4413357	GRAFTON	07/31/2017	Property damage only (no	5:14 PM	2017	No injury	1	Daylight	Rear-end	Dry	0		8 Clear	185066.7	880694.7	2	MAIN ST	HENHILL RD	25 feet W of
4543325	GRAFTON	06/15/2018	Property damage only (no	6:50 PM	2018	No injury	1	Dark - light	Sideswipe, opposite di	Dry	0		8 Clear	185066.7	880694.7	2	MAIN ST Rte 122 S		
4577877	GRAFTON	07/04/2018	Property damage only (no	6:43 PM	2018	No injury	1	Daylight	Single vehicle crash	Dry	0		8 Clear	185067.6	880694.7	1	MAIN ST		

Main Street at Pleasant Street/Leland Hill Road

Crash Number	City Town	Crash Date	Crash Severity	Crash Time	Crash Year	Max Injury Severity Re	Number of Vehicles	Light Cond	Manner of Collision	Road Surface Condition	Total Fatalities	Total Non Fatal Injuries	Weather Conditions	X	Y	Street Number	Roadway	Near Intersection Roadway	Distance and Direction from Intersection
4181512	GRAFTON	08/06/2015	Non-fatal injury	2:01 PM	2015	Non-fatal injury - Poss	2	Daylight	Angle	Dry	0		2 Clear	182996.4	880826.9		LELAND HILL ROAD / MAIN STREET		
4187901	GRAFTON	03/02/2016	Property damage only (no	9:16 AM	2016	No injury	2	Daylight	Rear-end	Wet	0		8 Rain	182996.4	880826.9		MAIN STREET Rte 122 / PLEASANT STREET / LELAND HILL ROAD		
4189117	GRAFTON	03/17/2016	Property damage only (no	11:00 AM	2016	No injury	1	Daylight	Angle	Dry	0		4 Clear	182996.4	880826.9		MAIN STREET Rte 122A S / PLEASANT STREET		
4225417	GRAFTON	06/30/2016	Non-fatal injury	9:30 AM	2016	Non-fatal injury - Poss	2	Daylight	Angle	Dry	0		1 Clear	182996.4	880826.9		MAIN STREET Rte 122A / PLEASANT STREET / LELAND HILL ROAD		
4344510	GRAFTON	08/24/2016	Property damage only (no	3:58 PM	2016	No injury	2	Daylight	Rear-end	Dry	0		9 Clear/Unknown	182996.4	880826.9		MAIN STREET Rte 122A S / PLEASANT STREET		
4401755	GRAFTON	07/15/2017	Non-fatal injury	3:07 PM	2017	Non-fatal injury - Poss	2	Daylight	Angle	Dry	0		1 Clear	182996.4	880826.9		LELAND HILL RD / MAIN ST Rte 122A		
4403759	GRAFTON	01/30/2017	Property damage only (no	12:24 PM	2017	No injury	2	Daylight	Rear-end	Dry	0		0 Cloudy	182996.4	880826.9		MAIN ST / PLEASANT ST		
4504760	GRAFTON	02/07/2018	Property damage only (no	1:18 PM	2018	No injury	2	Daylight	Angle	Snow	0		0 Snow/Sleet, hail (freezi	182996.4	880826.9		PLEASANT ST / MAIN ST		
4565126	GRAFTON	06/14/2018	Non-fatal injury	8:34 AM	2018	Non-fatal injury - Non	2	Daylight	Angle	Dry	0		1 Clear	182996.4	880826.9		MAIN STREET / PLEASANT STREET		
4577884	GRAFTON	07/13/2018	Non-fatal injury	5:17 PM	2018	Non-fatal injury - Poss	2	Daylight	Angle	Dry	0		1 Clear	182996.4	880826.9		PLEASANT ST / MAIN ST		
4710955	GRAFTON	05/04/2019	Non-fatal injury	11:41 AM	2019	Possible Injury (C)	2	Daylight	Angle	Dry	0		0 Cloudy	182996.4	880826.9		MAIN ST / PLEASANT ST		

Main Street at Ferry Street

Crash Number	City Town	Crash Date	Crash Severity	Crash Time	Crash Year	Max Injury Severity Re	Number of Vehicles	Light Cond	Manner of Collision	Road Surface Condition	Total Fatalities	Total Non Fatal Injuries	Weather Conditions	X	Y	Street Number	Roadway	Near Intersection Roadway	Distance and Direction from Intersection
4725706	GRAFTON	06/29/2019	Property damage only (no	12:35 PM	2019	No Apparent Injury (C	2	Daylight	Rear-end		0		0 Clear	183879.7	880883.1		FERRY ST / MAIN ST		

Main Street at Cross Street

Crash Number	City Town	Crash Date	Crash Severity	Crash Time	Crash Year	Max Injury Severity Re	Number of Vehicles	Light Cond	Manner of Collision	Road Surface Condition	Total Fatalities	Total Non Fatal Injuries	Weather Conditions	X	Y	Street Number	Roadway	Near Intersection Roadway	Distance and Direction from Intersection
4403881	GRAFTON	05/21/2017	Non-fatal injury	6:10 PM	2017	Non-fatal injury - Poss	3	Daylight	Rear-end	Dry	0		1 Clear	184504.1	880761.3	46	MAIN ST	WATERVILLE ST	600 feet N of

MassHighway

CRASH RATE WORKSHEET

CITY/TOWN : Grafton, MA COUNT DATE : Oct-20 *MHD USE ONLY*

DISTRICT : 3 UNSIGNALIZED : x SIGNALIZED : Source #

~ INTERSECTION DATA ~

MAJOR STREET : Main Street (Route 122A) ST #

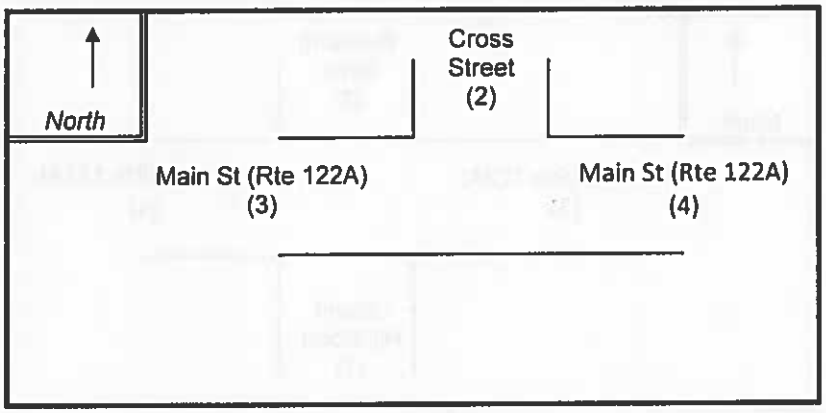
MINOR STREET(S) : Cross Street ST #

ST #

ST #

ST #

INTERSECTION DIAGRAM (Label Approaches)



INTERSECTION REF #

(1)

Peak Hour Volumes

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :		SB	EB	WB		
VOLUMES (PM) :		71	260	262		593

" K " FACTOR : 0.080 APPROACH ADT : 7,413 ADT = TOTAL VOL/"K" FACT.

TOTAL # OF ACCIDENTS : 1 # OF YEARS : 3 AVERAGE # OF ACCIDENTS (A) : 0.33

CRASH RATE CALCULATION : 0.12 RATE = $\frac{(A * 1{,}000{,}000)}{(ADT * 365)}$

Comments :

Project Title & Date: 527 - Grafton

MassHighway

CRASH RATE WORKSHEET

CITY/TOWN : Grafton, MA COUNT DATE : Oct-20 *MHD USE ONLY*

DISTRICT : 3 UNSIGNALIZED : x SIGNALIZED : Source #

~ INTERSECTION DATA ~

MAJOR STREET : Main Street (Route 122A) ST #

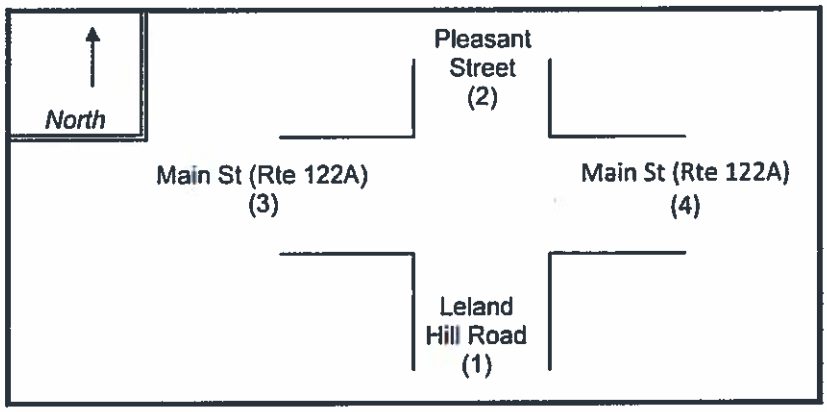
MINOR STREET(S) : Leland Hill Road / Pleasant Street ST #

ST #

ST #

ST #

INTERSECTION DIAGRAM (Label Approaches)



INTERSECTION REF #

(1)

Peak Hour Volumes

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :	NB	SB	EB	WB		
VOLUMES (PM) :	55	122	357	297		831

" K " FACTOR : 0.080 APPROACH ADT : 10,388 ADT = TOTAL VOL/"K" FACT.

TOTAL # OF ACCIDENTS : 11 # OF YEARS : 5 AVERAGE # OF ACCIDENTS (A) : 2.20

CRASH RATE CALCULATION : 0.58 RATE = $\frac{(A * 1{,}000{,}000)}{(ADT * 365)}$

Comments :

Project Title & Date: 527 - Grafton

MassHighway

CRASH RATE WORKSHEET

CITY/TOWN : Grafton, MA COUNT DATE : Oct-20 *MHD USE ONLY*

DISTRICT : 3 UNSIGNALIZED : x SIGNALIZED : Source #

~ INTERSECTION DATA ~

MAJOR STREET : Main Street (Route 122A) ST #

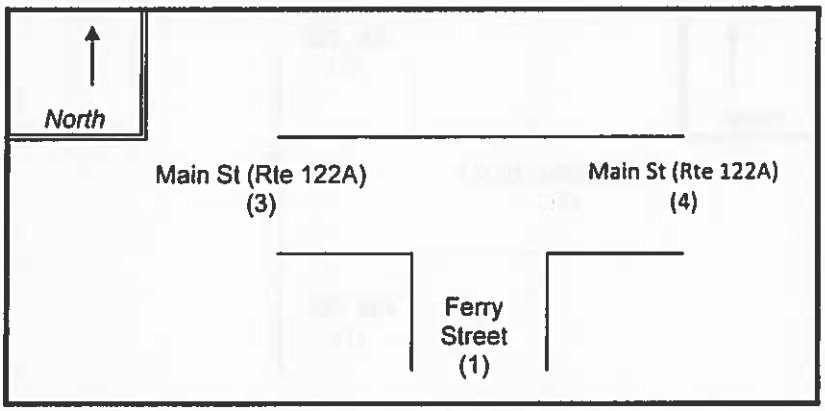
MINOR STREET(S) : Ferry Street ST #

ST #

ST #

ST #

INTERSECTION DIAGRAM
(Label Approaches)



INTERSECTION REF #

(1)

Peak Hour Volumes

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :	NB	SB	EB	WB		
VOLUMES (PM) :	77		345	289		711

" K " FACTOR : 0.080 APPROACH ADT : 8,888 ADT = TOTAL VOL/"K" FACT.

TOTAL # OF ACCIDENTS : 1 # OF YEARS : 5 AVERAGE # OF ACCIDENTS (A) : 0.20

CRASH RATE CALCULATION : 0.06 RATE = $\frac{(A * 1{,}000{,}000)}{(ADT * 365)}$

Comments :

Project Title & Date: 527 - Grafton

MassHighway

CRASH RATE WORKSHEET

CITY/TOWN : Grafton, MA COUNT DATE : Oct-20 *MHD USE ONLY*

DISTRICT : 3 UNSIGNALIZED : x SIGNALIZED : Source #

~ INTERSECTION DATA ~

MAJOR STREET : Providence Road (Route 122) ST #

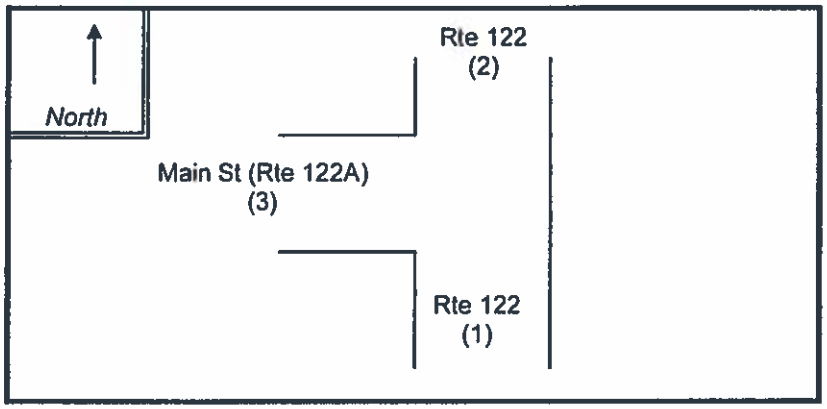
MINOR STREET(S) : Main Street (Route 122A) ST #

ST #

ST #

ST #

INTERSECTION DIAGRAM
(Label Approaches)



INTERSECTION REF #

(1)

Peak Hour Volumes

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :	NB	SB	EB			
VOLUMES (PM) :	572	537	247			1,356

" K " FACTOR : 0.080 APPROACH ADT : 16,950 ADT = TOTAL VOL/"K" FACT.

TOTAL # OF ACCIDENTS : 9 # OF YEARS : 5 AVERAGE # OF ACCIDENTS (A) : 1.80

CRASH RATE CALCULATION : 0.29 RATE = $\frac{(A * 1{,}000{,}000)}{(ADT * 365)}$

Comments :

Project Title & Date: 527 - Grafton

- Sight Line Calculations

Stopping Sight Distance

527 Grafton, MA - Site Driveway - Posted Travel Speed

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	EB	30	110.25	86.3	197
Direction 2	WB	30	110.25	86.3	197

INPUTS	Direction 1	Direction 2
Travel Direction	EB	WB
Speed	30	30
Grade	0	0
t	2.5	2.5
a	11.2	11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = 1.47 x t x V

Brake Distance = V^2 / (30 x ((a/32.2)+G))

Where:
t = reaction time (sec)
V = travel speed (mph)
G= roadway grade
a - deceleration rate (ft/sec^2)

Stopping Sight Distance

527 Grafton, MA - Site Driveway - 85th Percentile Observed Travel Speed

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	EB	37	135.975	131.2	267
Direction 2	WB	34	124.95	110.8	236

INPUTS	Direction 1	Direction 2
Travel Direction	EB	WB
Speed	37	34
Grade	0	0
t	2.5	2.5
a	11.2	11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = 1.47 x t x V

Brake Distance = V^2 / (30 x ((a/32.2)+G))

Where:
t = reaction time (sec)
V = travel speed (mph)
G= roadway grade
a - deceleration rate (ft/sec^2)

Intersection Sight Distance Calculations

Source: *A Policy on Geometric Design of Highways and Street, 6th Edition;* AASHTO; 2011.

ISD = 1.47 * V * t

V = speed
t = time gap

t = 7.5 s for a passenger car for Left Turn from a Stop
t = 6.5 s for a passenger car for Right Turn from a Stop

Canton Avenue

ISD = 1.47 * 30 * 7.5 = 331 ft **SAY 335 ft**
(left-turn from a stop)

ISD = 1.47 * 30 * 6.5 = 287 ft **SAY 290 ft**
(right-turn from a stop)

- Trip Generation

Institute of Transportation Engineers (ITE) 10th Edition
Land Use Code (LUC) 210 - Single-Family Detached Housing

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 100

AVERAGE WEEKDAY DAILY

Ln T = 0.920 Ln (X) + 2.71
Ln T = 0.920 Ln 100 + (2.71)
Ln T = 6.95
T = 1039.77
T = 1,040 vehicle trips
with 50% (520 vpd) entering and 50% (520 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.71 * (X) + 4.80
T = 0.71 * 100 + (4.80)
T = 75.80
T = 76 vehicle trips
with 25% (19 vph) entering and 75% (57 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

Ln T = 0.96 Ln (X) + 0.20
Ln T = 0.96 Ln 100 + (0.20)
Ln T = 4.62
T = 101.59
T = 102 vehicle trips
with 63% (64 vph) entering and 37% (38 vph) exiting.

SATURDAY DAILY

Ln T = 0.94 Ln (X) + 2.56
Ln T = 0.94 Ln 100 + (2.56)
Ln T = 6.89
T = 981.28
T = 982 vehicle trips
with 50% (491 vph) entering and 50% (491 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 0.84 * (X) + 17.99
T = 0.84 * 100 + (17.99)
T = 101.99
T = 102 vehicle trips
with 54% (55 vph) entering and 46% (47 vph) exiting.

- Trip Distribution

Journey-to-Work Distribution

US Census Journey-to-Work Data

Residence Town Name	Workplace Town Name	All Workers	% of Total Rounded
Grafton town	Grafton town	1,630	18%
Grafton town	Worcester city	1,201	13%
Grafton town	Westborough town	710	8%
Grafton town	Marlborough city	580	7%
Grafton town	Boston city	501	6%
Grafton town	Framingham town	370	4%
Grafton town	Shrewsbury town	226	3%
Grafton town	Natick town	217	2%
Grafton town	Millbury town	197	2%
Grafton town	Hopkinton town	196	2%
Grafton town	Milford town	160	2%
Grafton town	Ashland town	145	2%
Grafton town	Northborough town	140	2%
Grafton town	Waltham city	134	2%
Grafton town	Wellesley town	107	1%
Grafton town	Watertown Town city	97	1%
Grafton town	Cambridge city	93	1%
Grafton town	Northbridge town	93	1%
Grafton town	Southborough town	87	1%
Grafton town	Weston town	77	1%
Grafton town	Burlington town	64	1%
Grafton town	Auburn town	63	1%
Grafton town	Uxbridge town	50	1%
Grafton town	Hudson town	49	1%
Grafton town	Sudbury town	45	1%
Grafton town	Oxford town	45	1%
	Sub-Total	7,277	82%
	Other	1,632	18%
	Total	8,909	100%

Workplace	To/From Routes								
	Main Street (To/From West)		Pleasant Street (To/From North)		Cross Street/122* (To/From North)		Providence Road (To/From South)		Total
Grafton town	10%	1.8%	40%	7.3%	40%	7.3%	10%	1.8%	18.3%
Worcester city	100%	13.5%		0.0%		0.0%		0.0%	13.5%
Westborough town		0.0%	65%	5.2%	35%	2.8%		0.0%	8.0%
Marlborough city		0.0%	30%	2.0%	20%	1.3%	50%	3.3%	6.5%
Boston city		0.0%	30%	1.7%	20%	1.1%	50%	2.8%	5.6%
Framingham town		0.0%	30%	1.2%	20%	0.8%	50%	2.1%	4.2%
Shrewsbury town		0.0%	65%	1.6%	35%	0.9%		0.0%	2.5%
Natick town		0.0%	30%	0.7%	20%	0.5%	50%	1.2%	2.4%
Millbury town	100%	2.2%		0.0%		0.0%		0.0%	2.2%
Hopkinton town		0.0%		0.0%		0.0%	100%	2.2%	2.2%
Milford town		0.0%		0.0%		0.0%	100%	1.8%	1.8%
Ashland town		0.0%		0.0%		0.0%	100%	1.6%	1.6%
Northborough town		0.0%	65%	1.0%	35%	0.6%		0.0%	1.6%
Waltham city		0.0%	30%	0.5%	20%	0.3%	50%	0.8%	1.5%
Wellesley town		0.0%	30%	0.4%	20%	0.2%	50%	0.6%	1.2%
Watertown Town city		0.0%	30%	0.3%	20%	0.2%	50%	0.5%	1.1%
Cambridge city		0.0%	65%	0.7%	35%	0.4%		0.0%	1.0%
Northbridge town	50%	0.5%	30%	0.3%	20%	0.2%		0.0%	1.0%
Southborough town		0.0%	65%	0.6%	35%	0.3%		0.0%	1.0%
Weston town		0.0%	65%	0.6%	35%	0.3%		0.0%	0.9%
Burlington town		0.0%	30%	0.2%	20%	0.1%	50%	0.4%	0.7%
Auburn town	100%	0.7%		0.0%		0.0%		0.0%	0.7%
Uxbridge town	100%	0.6%		0.0%		0.0%		0.0%	0.6%
Hudson town	25%	0.1%	30%	0.2%	20%	0.1%	25%	0.1%	0.6%
Sudbury town		0.0%	30%	0.2%	20%	0.1%	50%	0.3%	0.5%
Oxford town	100%	0.5%	0%	0.0%		0.0%		0.0%	0.5%
Sub-Total		20.0%		24.6%		17.6%		19.5%	81.7%
Other		4.5%		5.5%		4.0%		4.4%	18.3%
Total		24.4%		30.2%		21.6%		23.8%	100.0%
	SAY	25%		30%		20%		25%	100%

- Delay Study

Providence Road at Main Street, Grafton, MA
Route 122 at Route 122A
Left Turn from Main St onto Providence Road Delay Study

Vehicle	Delay (s)
1	17
2	4
3	27
4	9
5	27
6	9
7	5
8	14
9	11
10	12
11	19
12	9
13	10
14	31
15	13
16	6
17	23
18	48
19	34
20	15
21	12
22	23
23	39
AVG	**18**

- Capacity Analysis

LEVEL OF SERVICE METHODOLOGY

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the 2010 Highway Capacity Manual (HCM). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements and (for signalized intersections) for the entire intersection. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements, and greater than 80 seconds for signalized movements).

Signalized Intersection Performance Measures

The six LOS designations for signalized intersections may be described as follows:

- *LOS A* describes operations with low control delay; most vehicles do not stop at all.
- *LOS B* describes operations with relatively low control delay. However, more vehicles stop than LOS A.
- *LOS C* describes operations with higher control delays. Individual cycle failures may begin to appear. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
- *LOS D* describes operations with control delay in the range where the influence of congestion becomes more noticeable. Many vehicles stop and individual cycle failures are noticeable.
- *LOS E* describes operations with high control delay values. Individual cycle failures are frequent occurrences.
- *LOS F* describes operations with high control delay values that often occur with over-saturation. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

The LOS for signalized intersections are calculated using the operational analysis methodology of the 2010 *Highway Capacity Manual*.[1] This method assesses the effects of signal type, timing, phasing, and progression; vehicle mix; and geometrics on delay. LOS designations are based on the criterion of control or signal delay per vehicle. Control or signal delay is a measure of driver discomfort, frustration, and fuel consumption, and includes initial deceleration delay approaching the traffic signal, queue move-up time, stopped delay and final acceleration delay. **Table A1** summarizes the relationship between LOS and control delay. The tabulated control delay criterion may be applied in assigning LOS designations to individual lane groups, to individual intersection approaches, or to entire intersections.

Table A1
LEVEL-OF-SERVICE CRITERIA
FOR SIGNALIZED INTERSECTIONS[1]

Control (Signal) Delay per Vehicle (seconds per vehicle)	Level of Service	
	v/c ≤ 1	v/c > 1
≤10.0	A	F
10.1 to 20.0	B	F
20.1 to 35.0	C	F
35.1 to 55.0	D	F
55.1 to 80.0	E	F
>80.0	F	F

[1]Source: *Highway Capacity Manual 2010*, Transportation Research Board; Washington, DC; 2010.

[1]*Highway Capacity Manual* 2010; Transportation Research Board; Washington, DC; 2010.

Unsignalized Intersection Performance Measures

The six LOS designations for unsignalized intersections may be described as follows:

- *LOS A* represents a condition with little or no control delay to minor street traffic.
- *LOS B* represents a condition with short control delays to minor street traffic.
- *LOS C* represents a condition with average control delays to minor street traffic.
- *LOS D* represents a condition with long control delays to minor street traffic.
- *LOS E* represents operating conditions at or near capacity level, with very long control delays to minor street traffic.
- *LOS F* represents a condition where minor street demand volume exceeds capacity of an approach lane, with extreme control delays resulting.

The LOS designations of unsignalized intersections are determined by application of a procedure described in the 2010 *Highway Capacity Manual.*[2] LOS is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay includes the effects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for LOS at unsignalized intersections are also given in the *Highway Capacity Manual 2010*. **Table A2** summarizes the relationship between LOS and average control delay.

Table A2
LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS[1]

Average Control Delay (seconds per vehicle)	Level of Service	
	$v/c \leq 1$	$v/c > 1$
≤ 10.0	A	F
10.1 to 15.0	B	F
15.1 to 25.0	C	F
25.1 to 35.0	D	F
35.1 to 50.0	E	F
>50.0	F	F

[1]Source: *Highway Capacity Manual 2010*, Transportation Research Board; Washington, DC; 2010.

[2] ibid

Intersection												
Int Delay, s/veh	4.2											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	57	207	7	0	239	7	10	58	27	9	12	39
Future Vol, veh/h	57	207	7	0	239	7	10	58	27	9	12	39
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	4	4	0	0	3	5	0	2	0	5	5	5
Mvmt Flow	65	235	8	0	272	8	11	66	31	10	14	44

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	280	0	0	243	0	0	674	649	239	694	649	276
Stage 1	-	-	-	-	-	-	369	369	-	276	276	-
Stage 2	-	-	-	-	-	-	305	280	-	418	373	-
Critical Hdwy	4.14	-	-	4.1	-	-	7.1	6.52	6.2	7.15	6.55	6.25
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.52	-	6.15	5.55	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.52	-	6.15	5.55	-
Follow-up Hdwy	2.236	-	-	2.2	-	-	3.5	4.018	3.3	3.545	4.045	3.345
Pot Cap-1 Maneuver	1271	-	-	1335	-	-	371	389	805	353	385	756
Stage 1	-	-	-	-	-	-	655	621	-	724	676	-
Stage 2	-	-	-	-	-	-	709	679	-	607	613	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1271	-	-	1335	-	-	324	366	805	280	362	756
Mov Cap-2 Maneuver	-	-	-	-	-	-	324	366	-	280	362	-
Stage 1	-	-	-	-	-	-	616	584	-	681	676	-
Stage 2	-	-	-	-	-	-	654	679	-	487	577	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.7	0	16.3	13.1
HCM LOS			C	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	426	1271	-	-	1335	-	-	513
HCM Lane V/C Ratio	0.253	0.051	-	-	-	-	-	0.133
HCM Control Delay (s)	16.3	8	0	-	0	-	-	13.1
HCM Lane LOS	C	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	1	0.2	-	-	0	-	-	0.5

Intersection						
Int Delay, s/veh	1.2					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	Y	
Traffic Vol, veh/h	202	43	6	231	38	10
Future Vol, veh/h	202	43	6	231	38	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	5	0	0	5	0	3
Mvmt Flow	217	46	6	248	41	11

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	263	0	500	240
Stage 1	-	-	-	-	240	-
Stage 2	-	-	-	-	260	-
Critical Hdwy	-	-	4.1	-	6.4	6.23
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.327
Pot Cap-1 Maneuver	-	-	1313	-	534	796
Stage 1	-	-	-	-	805	-
Stage 2	-	-	-	-	788	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1313	-	531	796
Mov Cap-2 Maneuver	-	-	-	-	531	-
Stage 1	-	-	-	-	805	-
Stage 2	-	-	-	-	784	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	11.9
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	571	-	-	1313	-
HCM Lane V/C Ratio	0.09	-	-	0.005	-
HCM Control Delay (s)	11.9	-	-	7.8	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.3	-	-	0	-

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↑		↱	
Traffic Vol, veh/h	27	194	194	7	10	32
Future Vol, veh/h	27	194	194	7	10	32
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	0	6	4	5	0	3
Mvmt Flow	31	220	220	8	11	36

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	228	0	-	0	506	224
Stage 1	-	-	-	-	224	-
Stage 2	-	-	-	-	282	-
Critical Hdwy	4.1	-	-	-	6.4	6.23
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.327
Pot Cap-1 Maneuver	1352	-	-	-	530	813
Stage 1	-	-	-	-	818	-
Stage 2	-	-	-	-	770	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1352	-	-	-	516	813
Mov Cap-2 Maneuver	-	-	-	-	516	-
Stage 1	-	-	-	-	797	-
Stage 2	-	-	-	-	770	-

Approach	EB	WB	SB
HCM Control Delay, s	0.9	0	10.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1352	-	-	-	715
HCM Lane V/C Ratio	0.023	-	-	-	0.067
HCM Control Delay (s)	7.7	0	-	-	10.4
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.2

Intersection						
Int Delay, s/veh	3.9					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	11	205	180	401	199	12
Future Vol, veh/h	11	205	180	401	199	12
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	100	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	0	7	6	4	10	10
Mvmt Flow	12	220	194	431	214	13

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1040	221	227	0	-	0
Stage 1	221	-	-	-	-	-
Stage 2	819	-	-	-	-	-
Critical Hdwy	6.4	6.27	4.16	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.363	2.254	-	-	-
Pot Cap-1 Maneuver	257	806	1318	-	-	-
Stage 1	821	-	-	-	-	-
Stage 2	437	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	207	806	1318	-	-	-
Mov Cap-2 Maneuver	207	-	-	-	-	-
Stage 1	662	-	-	-	-	-
Stage 2	437	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.7	2.5	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1318	-	207	806	-	-
HCM Lane V/C Ratio	0.147	-	0.057	0.273	-	-
HCM Control Delay (s)	8.2	0	23.4	11.1	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0.5	-	0.2	1.1	-	-

Intersection												
Int Delay, s/veh	4.4											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⬌			⬌			⬌			⬌	
Traffic Vol, veh/h	61	222	8	0	256	8	11	62	29	10	13	42
Future Vol, veh/h	61	222	8	0	256	8	11	62	29	10	13	42
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	4	4	0	0	3	5	0	2	0	5	5	5
Mvmt Flow	69	252	9	0	291	9	13	70	33	11	15	48

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	300	0	0	261	0	0	722	695	257	742	695	296
Stage 1	-	-	-	-	-	-	395	395	-	296	296	-
Stage 2	-	-	-	-	-	-	327	300	-	446	399	-
Critical Hdwy	4.14	-	-	4.1	-	-	7.1	6.52	6.2	7.15	6.55	6.25
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.52	-	6.15	5.55	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.52	-	6.15	5.55	-
Follow-up Hdwy	2.236	-	-	2.2	-	-	3.5	4.018	3.3	3.545	4.045	3.345
Pot Cap-1 Maneuver	1250	-	-	1315	-	-	345	366	787	328	362	736
Stage 1	-	-	-	-	-	-	634	605	-	706	663	-
Stage 2	-	-	-	-	-	-	690	666	-	586	597	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1250	-	-	1315	-	-	296	342	787	252	338	736
Mov Cap-2 Maneuver	-	-	-	-	-	-	296	342	-	252	338	-
Stage 1	-	-	-	-	-	-	593	566	-	660	663	-
Stage 2	-	-	-	-	-	-	631	666	-	460	558	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.7	0	17.6	13.8
HCM LOS			C	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	400	1250	-	-	1315	-	-	481
HCM Lane V/C Ratio	0.29	0.055	-	-	-	-	-	0.154
HCM Control Delay (s)	17.6	8	0	-	0	-	-	13.8
HCM Lane LOS	C	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	1.2	0.2	-	-	0	-	-	0.5

Intersection						
Int Delay, s/veh	1.2					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	Y	
Traffic Vol, veh/h	217	46	6	248	41	11
Future Vol, veh/h	217	46	6	248	41	11
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	5	0	0	5	0	3
Mvmt Flow	233	49	6	267	44	12

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	282	0	537	258
Stage 1	-	-	-	-	258	-
Stage 2	-	-	-	-	279	-
Critical Hdwy	-	-	4.1	-	6.4	6.23
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.327
Pot Cap-1 Maneuver	-	-	1292	-	508	778
Stage 1	-	-	-	-	790	-
Stage 2	-	-	-	-	773	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1292	-	505	778
Mov Cap-2 Maneuver	-	-	-	-	505	-
Stage 1	-	-	-	-	790	-
Stage 2	-	-	-	-	769	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	12.4
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	545	-	-	1292	-
HCM Lane V/C Ratio	0.103	-	-	0.005	-
HCM Control Delay (s)	12.4	-	-	7.8	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.3	-	-	0	-

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		⋔	
Traffic Vol, veh/h	29	208	208	8	11	34
Future Vol, veh/h	29	208	208	8	11	34
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	0	6	4	5	0	3
Mvmt Flow	33	236	236	9	13	39

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	245	0	-	0	543	241
Stage 1	-	-	-	-	241	-
Stage 2	-	-	-	-	302	-
Critical Hdwy	4.1	-	-	-	6.4	6.23
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.327
Pot Cap-1 Maneuver	1333	-	-	-	504	795
Stage 1	-	-	-	-	804	-
Stage 2	-	-	-	-	755	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1333	-	-	-	490	795
Mov Cap-2 Maneuver	-	-	-	-	490	-
Stage 1	-	-	-	-	781	-
Stage 2	-	-	-	-	755	-

Approach	EB	WB	SB
HCM Control Delay, s	1	0	10.6
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1333	-	-	-	690
HCM Lane V/C Ratio	0.025	-	-	-	0.074
HCM Control Delay (s)	7.8	0	-	-	10.6
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.2

Intersection						
Int Delay, s/veh	4.1					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰	↱	
Traffic Vol, veh/h	12	220	193	430	213	13
Future Vol, veh/h	12	220	193	430	213	13
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	100	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	0	7	6	4	10	10
Mvmt Flow	13	237	208	462	229	14

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1114	236	243	0	-	0
Stage 1	236	-	-	-	-	-
Stage 2	878	-	-	-	-	-
Critical Hdwy	6.4	6.27	4.16	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.363	2.254	-	-	-
Pot Cap-1 Maneuver	232	791	1300	-	-	-
Stage 1	808	-	-	-	-	-
Stage 2	410	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	182	791	1300	-	-	-
Mov Cap-2 Maneuver	182	-	-	-	-	-
Stage 1	634	-	-	-	-	-
Stage 2	410	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.3	2.6	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1300	-	182	791	-	-
HCM Lane V/C Ratio	0.16	-	0.071	0.299	-	-
HCM Control Delay (s)	8.3	0	26.3	11.5	-	-
HCM Lane LOS	A	A	D	B	-	-
HCM 95th %tile Q(veh)	0.6	-	0.2	1.3	-	-

Intersection												
Int Delay, s/veh	4.5											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	61	227	8	0	270	25	11	62	29	15	13	42
Future Vol, veh/h	61	227	8	0	270	25	11	62	29	15	13	42
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	4	4	0	0	3	5	0	2	0	5	5	5
Mvmt Flow	69	258	9	0	307	28	13	70	33	17	15	48

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	335	0	0	267	0	0	754	736	263	773	726	321
Stage 1	-	-	-	-	-	-	401	401	-	321	321	-
Stage 2	-	-	-	-	-	-	353	335	-	452	405	-
Critical Hdwy	4.14	-	-	4.1	-	-	7.1	6.52	6.2	7.15	6.55	6.25
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.52	-	6.15	5.55	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.52	-	6.15	5.55	-
Follow-up Hdwy	2.236	-	-	2.2	-	-	3.5	4.018	3.3	3.545	4.045	3.345
Pot Cap-1 Maneuver	1213	-	-	1308	-	-	328	346	781	312	347	713
Stage 1	-	-	-	-	-	-	630	601	-	684	646	-
Stage 2	-	-	-	-	-	-	668	643	-	581	593	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1213	-	-	1308	-	-	280	323	781	236	324	713
Mov Cap-2 Maneuver	-	-	-	-	-	-	280	323	-	236	324	-
Stage 1	-	-	-	-	-	-	588	561	-	638	646	-
Stage 2	-	-	-	-	-	-	609	643	-	454	553	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.7	0	18.6	15.2
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	380	1213	-	-	1308	-	-	431
HCM Lane V/C Ratio	0.305	0.057	-	-	-	-	-	0.185
HCM Control Delay (s)	18.6	8.1	0	-	0	-	-	15.2
HCM Lane LOS	C	A	A	-	A	-	-	C
HCM 95th %tile Q(veh)	1.3	0.2	-	-	0	-	-	0.7

Intersection	
Int Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	Y	
Traffic Vol, veh/h	243	46	6	257	41	11
Future Vol, veh/h	243	46	6	257	41	11
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	5	0	0	5	0	3
Mvmt Flow	261	49	6	276	44	12

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	310	0	574	286
Stage 1	-	-	-	-	286	-
Stage 2	-	-	-	-	288	-
Critical Hdwy	-	-	4.1	-	6.4	6.23
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.327
Pot Cap-1 Maneuver	-	-	1262	-	484	751
Stage 1	-	-	-	-	767	-
Stage 2	-	-	-	-	766	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1262	-	481	751
Mov Cap-2 Maneuver	-	-	-	-	481	-
Stage 1	-	-	-	-	767	-
Stage 2	-	-	-	-	761	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	12.7
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	521	-	-	1262	-
HCM Lane V/C Ratio	0.107	-	-	0.005	-
HCM Control Delay (s)	12.7	-	-	7.9	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.4	-	-	0	-

Intersection						
Int Delay, s/veh	1.5					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		⋔	
Traffic Vol, veh/h	38	225	214	8	11	37
Future Vol, veh/h	38	225	214	8	11	37
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	0	6	4	5	0	3
Mvmt Flow	43	256	243	9	13	42

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	252	0	-	0	590	248
Stage 1	-	-	-	-	248	-
Stage 2	-	-	-	-	342	-
Critical Hdwy	4.1	-	-	-	6.4	6.23
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.327
Pot Cap-1 Maneuver	1325	-	-	-	474	788
Stage 1	-	-	-	-	798	-
Stage 2	-	-	-	-	724	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1325	-	-	-	456	788
Mov Cap-2 Maneuver	-	-	-	-	456	-
Stage 1	-	-	-	-	768	-
Stage 2	-	-	-	-	724	-

Approach	EB	WB	SB
HCM Control Delay, s	1.1	0	10.8
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1325	-	-	-	675
HCM Lane V/C Ratio	0.033	-	-	-	0.081
HCM Control Delay (s)	7.8	0	-	-	10.8
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.3

Intersection						
Int Delay, s/veh	4.3					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	15	234	198	430	213	14
Future Vol, veh/h	15	234	198	430	213	14
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	100	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	0	7	6	4	10	10
Mvmt Flow	16	252	213	462	229	15

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1125	237	244	0	-	0
Stage 1	237	-	-	-	-	-
Stage 2	888	-	-	-	-	-
Critical Hdwy	6.4	6.27	4.16	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.363	2.254	-	-	-
Pot Cap-1 Maneuver	229	790	1299	-	-	-
Stage 1	807	-	-	-	-	-
Stage 2	405	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	178	790	1299	-	-	-
Mov Cap-2 Maneuver	178	-	-	-	-	-
Stage 1	629	-	-	-	-	-
Stage 2	405	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.6	2.6	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1299	-	178	790	-	-
HCM Lane V/C Ratio	0.164	-	0.091	0.318	-	-
HCM Control Delay (s)	8.3	0	27.2	11.7	-	-
HCM Lane LOS	A	A	D	B	-	-
HCM 95th %tile Q(veh)	0.6	-	0.3	1.4	-	-

Intersection	
Int Delay, s/veh	1.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	261	10	9	264	31	26
Future Vol, veh/h	261	10	9	264	31	26
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	284	11	10	287	34	28

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	295	0	597	290
Stage 1	-	-	-	-	290	-
Stage 2	-	-	-	-	307	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1266	-	466	749
Stage 1	-	-	-	-	759	-
Stage 2	-	-	-	-	746	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1266	-	462	749
Mov Cap-2 Maneuver	-	-	-	-	462	-
Stage 1	-	-	-	-	759	-
Stage 2	-	-	-	-	739	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	12.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	560	-	-	1266	-
HCM Lane V/C Ratio	0.111	-	-	0.008	-
HCM Control Delay (s)	12.2	-	-	7.9	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.4	-	-	0	-

Intersection												
Int Delay, s/veh	4.9											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	60	288	9	22	266	9	7	36	12	14	53	55
Future Vol, veh/h	60	288	9	22	266	9	7	36	12	14	53	55
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	1	0	5	3	0	0	3	5	5	0	0
Mvmt Flow	67	320	10	24	296	10	8	40	13	16	59	61

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	306	0	0	330	0	0	868	813	325	835	813	301
Stage 1	-	-	-	-	-	-	459	459	-	349	349	-
Stage 2	-	-	-	-	-	-	409	354	-	486	464	-
Critical Hdwy	4.1	-	-	4.15	-	-	7.1	6.53	6.25	7.15	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.53	-	6.15	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.53	-	6.15	5.5	-
Follow-up Hdwy	2.2	-	-	2.245	-	-	3.5	4.027	3.345	3.545	4	3.3
Pot Cap-1 Maneuver	1266	-	-	1213	-	-	275	312	709	284	315	743
Stage 1	-	-	-	-	-	-	586	565	-	661	637	-
Stage 2	-	-	-	-	-	-	623	629	-	557	567	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1266	-	-	1213	-	-	199	285	709	232	288	743
Mov Cap-2 Maneuver	-	-	-	-	-	-	199	285	-	232	288	-
Stage 1	-	-	-	-	-	-	548	528	-	618	622	-
Stage 2	-	-	-	-	-	-	505	614	-	472	530	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.3	0.6	19.6	19.5
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	308	1266	-	-	1213	-	-	383
HCM Lane V/C Ratio	0.198	0.053	-	-	0.02	-	-	0.354
HCM Control Delay (s)	19.6	8	0	-	8	0	-	19.5
HCM Lane LOS	C	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	0.7	0.2	-	-	0.1	-	-	1.6

Intersection	
Int Delay, s/veh	1.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	261	84	27	262	62	15
Future Vol, veh/h	261	84	27	262	62	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	1	1	4	2	3	0
Mvmt Flow	278	89	29	279	66	16

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	367	0	660	323
Stage 1	-	-	-	-	323	-
Stage 2	-	-	-	-	337	-
Critical Hdwy	-	-	4.14	-	6.43	6.2
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	-	-	2.236	-	3.527	3.3
Pot Cap-1 Maneuver	-	-	1181	-	426	723
Stage 1	-	-	-	-	732	-
Stage 2	-	-	-	-	721	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1181	-	414	723
Mov Cap-2 Maneuver	-	-	-	-	414	-
Stage 1	-	-	-	-	732	-
Stage 2	-	-	-	-	700	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	14.7
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	452	-	-	1181	-
HCM Lane V/C Ratio	0.181	-	-	0.024	-
HCM Control Delay (s)	14.7	-	-	8.1	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.7	-	-	0.1	-

Intersection						
Int Delay, s/veh	2					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		⋔	
Traffic Vol, veh/h	47	213	247	15	15	56
Future Vol, veh/h	47	213	247	15	15	56
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	3	2	2	0	0	2
Mvmt Flow	56	254	294	18	18	67

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	312	0	-	0	669	303
Stage 1	-	-	-	-	303	-
Stage 2	-	-	-	-	366	-
Critical Hdwy	4.13	-	-	-	6.4	6.22
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.227	-	-	-	3.5	3.318
Pot Cap-1 Maneuver	1243	-	-	-	426	737
Stage 1	-	-	-	-	754	-
Stage 2	-	-	-	-	706	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1243	-	-	-	404	737
Mov Cap-2 Maneuver	-	-	-	-	404	-
Stage 1	-	-	-	-	715	-
Stage 2	-	-	-	-	706	-

Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	11.6
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1243	-	-	-	628
HCM Lane V/C Ratio	0.045	-	-	-	0.135
HCM Control Delay (s)	8	0	-	-	11.6
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.5

Intersection						
Int Delay, s/veh	5.2					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	27	220	239	333	503	34
Future Vol, veh/h	27	220	239	333	503	34
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	100	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	97	97	97	97	97	97
Heavy Vehicles, %	0	1	2	4	1	0
Mvmt Flow	28	227	246	343	519	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1372	537	554	0	-	0
Stage 1	537	-	-	-	-	-
Stage 2	835	-	-	-	-	-
Critical Hdwy	6.4	6.21	4.12	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.309	2.218	-	-	-
Pot Cap-1 Maneuver	163	546	1016	-	-	-
Stage 1	590	-	-	-	-	-
Stage 2	429	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	114	546	1016	-	-	-
Mov Cap-2 Maneuver	114	-	-	-	-	-
Stage 1	414	-	-	-	-	-
Stage 2	429	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	19.5	4	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1016	-	114	546	-	-
HCM Lane V/C Ratio	0.243	-	0.244	0.415	-	-
HCM Control Delay (s)	9.7	0	46.5	16.2	-	-
HCM Lane LOS	A	A	E	C	-	-
HCM 95th %tile Q(veh)	1	-	0.9	2	-	-

Intersection												
Int Delay, s/veh	5.5											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	64	309	10	24	285	10	8	39	13	15	57	59
Future Vol, veh/h	64	309	10	24	285	10	8	39	13	15	57	59
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	1	0	5	3	0	0	3	5	5	0	0
Mvmt Flow	71	343	11	27	317	11	9	43	14	17	63	66

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	328	0	0	354	0	0	932	873	349	896	873	323
Stage 1	-	-	-	-	-	-	491	491	-	377	377	-
Stage 2	-	-	-	-	-	-	441	382	-	519	496	-
Critical Hdwy	4.1	-	-	4.15	-	-	7.1	6.53	6.25	7.15	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.53	-	6.15	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.53	-	6.15	5.5	-
Follow-up Hdwy	2.2	-	-	2.245	-	-	3.5	4.027	3.345	3.545	4	3.3
Pot Cap-1 Maneuver	1243	-	-	1188	-	-	249	287	688	258	291	723
Stage 1	-	-	-	-	-	-	563	546	-	638	619	-
Stage 2	-	-	-	-	-	-	599	611	-	534	549	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1243	-	-	1188	-	-	171	259	688	204	263	723
Mov Cap-2 Maneuver	-	-	-	-	-	-	171	259	-	204	263	-
Stage 1	-	-	-	-	-	-	523	507	-	593	602	-
Stage 2	-	-	-	-	-	-	474	594	-	444	510	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.3	0.6	22.1	22.3
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	277	1243	-	-	1188	-	-	352
HCM Lane V/C Ratio	0.241	0.057	-	-	0.022	-	-	0.414
HCM Control Delay (s)	22.1	8.1	0	-	8.1	0	-	22.3
HCM Lane LOS	C	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	0.9	0.2	-	-	0.1	-	-	2

Intersection	
Int Delay, s/veh	2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	280	90	29	281	66	16
Future Vol, veh/h	280	90	29	281	66	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	1	1	4	2	3	0
Mvmt Flow	298	96	31	299	70	17

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	394	0	707	346
Stage 1	-	-	-	-	346	-
Stage 2	-	-	-	-	361	-
Critical Hdwy	-	-	4.14	-	6.43	6.2
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	-	-	2.236	-	3.527	3.3
Pot Cap-1 Maneuver	-	-	1154	-	400	702
Stage 1	-	-	-	-	714	-
Stage 2	-	-	-	-	703	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1154	-	387	702
Mov Cap-2 Maneuver	-	-	-	-	387	-
Stage 1	-	-	-	-	714	-
Stage 2	-	-	-	-	681	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	15.7
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	424	-	-	1154	-
HCM Lane V/C Ratio	0.206	-	-	0.027	-
HCM Control Delay (s)	15.7	-	-	8.2	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	0.8	-	-	0.1	-

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	50	228	265	16	16	60
Future Vol, veh/h	50	228	265	16	16	60
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	3	2	2	0	0	2
Mvmt Flow	60	271	315	19	19	71

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	334	0	-	0	716	325
Stage 1	-	-	-	-	325	-
Stage 2	-	-	-	-	391	-
Critical Hdwy	4.13	-	-	-	6.4	6.22
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.227	-	-	-	3.5	3.318
Pot Cap-1 Maneuver	1220	-	-	-	400	716
Stage 1	-	-	-	-	737	-
Stage 2	-	-	-	-	688	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1220	-	-	-	377	716
Mov Cap-2 Maneuver	-	-	-	-	377	-
Stage 1	-	-	-	-	694	-
Stage 2	-	-	-	-	688	-

Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	12
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1220	-	-	-	602
HCM Lane V/C Ratio	0.049	-	-	-	0.15
HCM Control Delay (s)	8.1	0	-	-	12
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.5

Intersection	
Int Delay, s/veh	5.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	29	236	256	357	539	36
Future Vol, veh/h	29	236	256	357	539	36
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	100	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	97	97	97	97	97	97
Heavy Vehicles, %	0	1	2	4	1	0
Mvmt Flow	30	243	264	368	556	37

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1471	575	593	0	-	0
Stage 1	575	-	-	-	-	-
Stage 2	896	-	-	-	-	-
Critical Hdwy	6.4	6.21	4.12	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.309	2.218	-	-	-
Pot Cap-1 Maneuver	141	519	983	-	-	-
Stage 1	567	-	-	-	-	-
Stage 2	402	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	93	519	983	-	-	-
Mov Cap-2 Maneuver	93	-	-	-	-	-
Stage 1	375	-	-	-	-	-
Stage 2	402	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	22.6	4.2	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	983	-	93	519	-	-
HCM Lane V/C Ratio	0.268	-	0.321	0.469	-	-
HCM Control Delay (s)	10	0	61.1	17.9	-	-
HCM Lane LOS	B	A	F	C	-	-
HCM 95th %tile Q(veh)	1.1	-	1.2	2.5	-	-

Intersection												
Int Delay, s/veh	7											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	64	325	10	24	295	21	8	39	13	34	57	59
Future Vol, veh/h	64	325	10	24	295	21	8	39	13	34	57	59
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	1	0	5	3	0	0	3	5	5	0	0
Mvmt Flow	71	361	11	27	328	23	9	43	14	38	63	66

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	351	0	0	372	0	0	967	914	367	931	908	340
Stage 1	-	-	-	-	-	-	509	509	-	394	394	-
Stage 2	-	-	-	-	-	-	458	405	-	537	514	-
Critical Hdwy	4.1	-	-	4.15	-	-	7.1	6.53	6.25	7.15	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.53	-	6.15	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.53	-	6.15	5.5	-
Follow-up Hdwy	2.2	-	-	2.245	-	-	3.5	4.027	3.345	3.545	4	3.3
Pot Cap-1 Maneuver	1219	-	-	1170	-	-	236	272	672	244	277	707
Stage 1	-	-	-	-	-	-	550	536	-	625	609	-
Stage 2	-	-	-	-	-	-	587	597	-	522	539	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1219	-	-	1170	-	-	159	245	672	191	249	707
Mov Cap-2 Maneuver	-	-	-	-	-	-	159	245	-	191	249	-
Stage 1	-	-	-	-	-	-	509	496	-	579	591	-
Stage 2	-	-	-	-	-	-	462	580	-	432	499	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.3	0.6	23.4	30
HCM LOS			C	D

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	262	1219	-	-	1170	-	-	306
HCM Lane V/C Ratio	0.254	0.058	-	-	0.023	-	-	0.545
HCM Control Delay (s)	23.4	8.1	0	-	8.1	0	-	30
HCM Lane LOS	C	A	A	-	A	A	-	D
HCM 95th %tile Q(veh)	1	0.2	-	-	0.1	-	-	3.1

Intersection						
Int Delay, s/veh	2					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↱	
Traffic Vol, veh/h	297	90	29	310	66	16
Future Vol, veh/h	297	90	29	310	66	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	1	1	4	2	3	0
Mvmt Flow	316	96	31	330	70	17

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	412	0	756	364
Stage 1	-	-	-	-	364	-
Stage 2	-	-	-	-	392	-
Critical Hdwy	-	-	4.14	-	6.43	6.2
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	-	-	2.236	-	3.527	3.3
Pot Cap-1 Maneuver	-	-	1136	-	374	685
Stage 1	-	-	-	-	701	-
Stage 2	-	-	-	-	681	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1136	-	362	685
Mov Cap-2 Maneuver	-	-	-	-	362	-
Stage 1	-	-	-	-	701	-
Stage 2	-	-	-	-	659	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	16.5
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	399	-	-	1136	-
HCM Lane V/C Ratio	0.219	-	-	0.027	-
HCM Control Delay (s)	16.5	-	-	8.3	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	0.8	-	-	0.1	-

Intersection	
Int Delay, s/veh	2.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	56	239	284	16	16	70
Future Vol, veh/h	56	239	284	16	16	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	3	2	2	0	0	2
Mvmt Flow	67	285	338	19	19	83

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	357	0	-	0	767	348
Stage 1	-	-	-	-	348	-
Stage 2	-	-	-	-	419	-
Critical Hdwy	4.13	-	-	-	6.4	6.22
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.227	-	-	-	3.5	3.318
Pot Cap-1 Maneuver	1196	-	-	-	373	695
Stage 1	-	-	-	-	719	-
Stage 2	-	-	-	-	668	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1196	-	-	-	348	695
Mov Cap-2 Maneuver	-	-	-	-	348	-
Stage 1	-	-	-	-	671	-
Stage 2	-	-	-	-	668	-

Approach	EB	WB	SB
HCM Control Delay, s	1.6	0	12.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1196	-	-	-	586
HCM Lane V/C Ratio	0.056	-	-	-	0.175
HCM Control Delay (s)	8.2	0	-	-	12.4
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.6

Intersection	
Int Delay, s/veh	6.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	31	245	272	357	539	39
Future Vol, veh/h	31	245	272	357	539	39
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	100	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	97	97	97	97	97	97
Heavy Vehicles, %	0	1	2	4	1	0
Mvmt Flow	32	253	280	368	556	40

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1504	576	596	0	-	0
Stage 1	576	-	-	-	-	-
Stage 2	928	-	-	-	-	-
Critical Hdwy	6.4	6.21	4.12	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.309	2.218	-	-	-
Pot Cap-1 Maneuver	135	519	980	-	-	-
Stage 1	566	-	-	-	-	-
Stage 2	388	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	87	519	980	-	-	-
Mov Cap-2 Maneuver	87	-	-	-	-	-
Stage 1	363	-	-	-	-	-
Stage 2	388	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	24	4.4	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	980	-	87	519	-	-
HCM Lane V/C Ratio	0.286	-	0.367	0.487	-	-
HCM Control Delay (s)	10.1	0	68.7	18.3	-	-
HCM Lane LOS	B	A	F	C	-	-
HCM 95th %tile Q(veh)	1.2	-	1.4	2.6	-	-

Intersection						
Int Delay, s/veh	1					

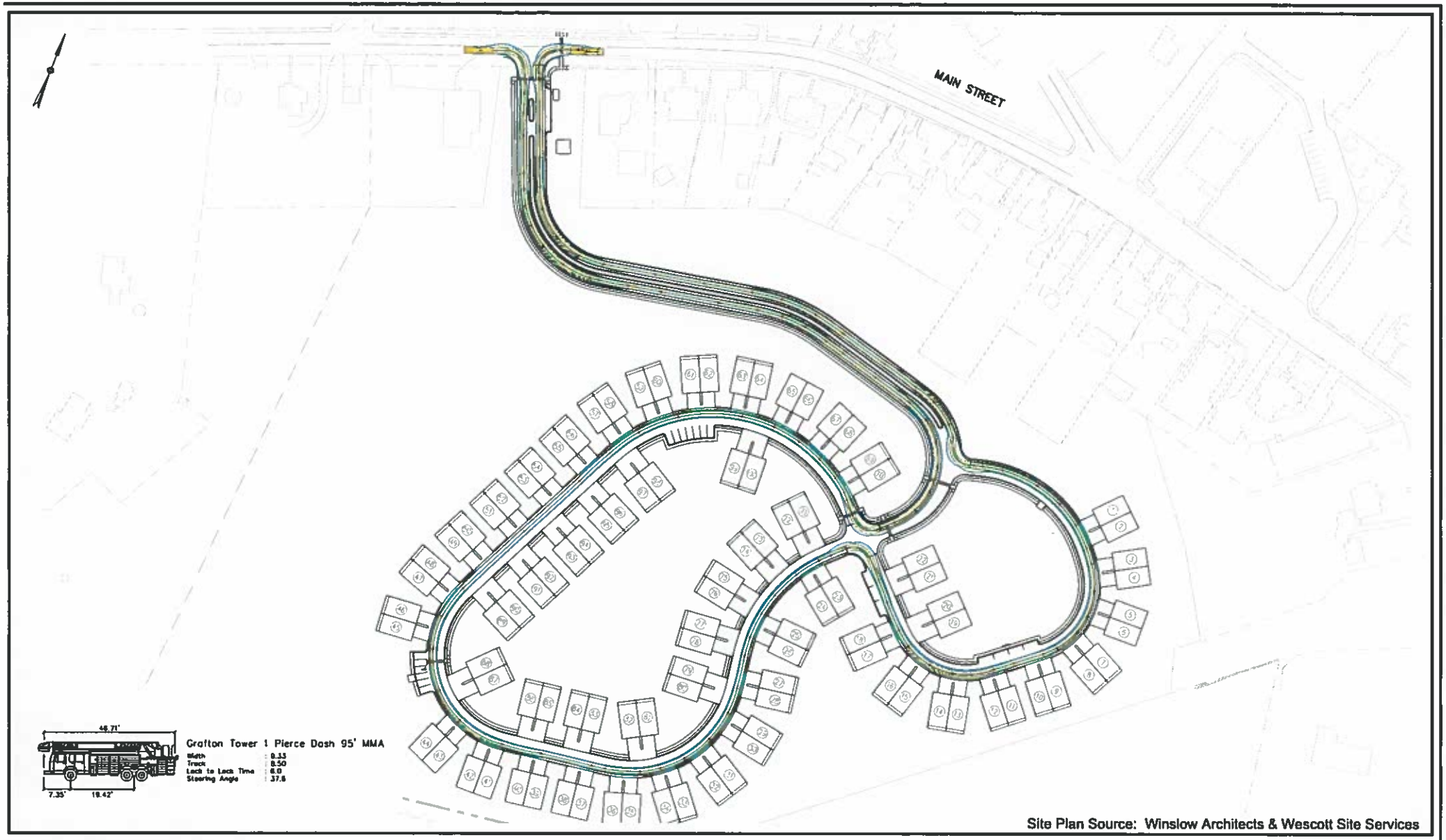
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	Y	
Traffic Vol, veh/h	337	35	29	319	21	17
Future Vol, veh/h	337	35	29	319	21	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	366	38	32	347	23	18

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	404	0	796	385
Stage 1	-	-	-	-	385	-
Stage 2	-	-	-	-	411	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1155	-	356	663
Stage 1	-	-	-	-	688	-
Stage 2	-	-	-	-	669	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1155	-	344	663
Mov Cap-2 Maneuver	-	-	-	-	344	-
Stage 1	-	-	-	-	688	-
Stage 2	-	-	-	-	646	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	14.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	438	-	-	1155	-
HCM Lane V/C Ratio	0.094	-	-	0.027	-
HCM Control Delay (s)	14.1	-	-	8.2	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.3	-	-	0.1	-

- AutoTURN® Analysis



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Scale: As Noted
DWG No. 527 Figure 2-Autoturn.dwg

Date: October 2020
Project No. 527

Proposed Development
Grafton, Massachusetts

SCALE
0 30 60 120 180 FEET

Exhibit 1
Autoturn Analysis
Grafton Tower 1