DRACUT APARTMENTS

Attachments to Application:

Traffic Impact and Access Study & Stormwater Report

Application for a Comprehensive Permit

Under M.G.L. Chapter 40B, Section 20-23

Submitted By:

The RENO Companies

Submitted To:

The Dracut Zoning Board of Appeals

Traffic Impact and Access Study

Proposed Residential Development
2041 Bridge Street

Dracut, MA

January 8, 2024

Prepared by:

BAYSIDE ENGINEERING

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Prepared for:

Marsh Hill Management, LLC

TRAFFIC IMPACT AND ACCESS STUDY

PROPOSED RESIDENTIAL DEVELOPMENT

2041 Bridge Street

DRACUT, MASSACHUSETTS

Prepared for:

Marsh Hill Properties LLC
Dracut, MA

January 8, 2024

Prepared by:

Bayside Engineering
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SECTION 1: EXECUTIVE SUMMARY

Bayside Engineering has prepared this Traffic Impact and Access Study (TIAS) for the proposed residential development (the "Project"), to be located on Bridge Street (Route 38) in Dracut, Massachusetts. The study has been prepared to conform with the March 2014 MassDOT/EOEEA *Transportation Impact Assessment (TIA) Guidelines*.

This report identifies existing traffic operating parameters on key roadways and intersections within the study area, evaluates the anticipated traffic volume increases as a result of the proposed project, analyzes the project's traffic-related impacts, determines the projects access/egress requirements and identifies appropriate mitigating measures designed to minimize the traffic-related impacts created by the project. The following provides a brief summary of the study findings.

Review of the Project and its access plan shows that in relation to roadway capacity, traffic safety, and traffic impacts upon the surrounding roadway network, the proposed project will have minimal impact on existing traffic conditions. With the proposed access, in conjunction with the mitigation measures described in this study, safe and efficient access can be provided to the clienteles of the Project and to the motoring public in the area.

PROJECT DESCRIPTION

The Project is to be located in the northeast corner of the intersection of Bridge Street and Marsh Hill Road. The site, containing approximately 5.3± acres (230,868± square feet) of land, consists of wooded land.

As currently proposed, the project will consist of the construction of forty (40) residential dwelling units. Parking would be provided for eighty-one (81) vehicles. Access would be provided by way of a driveway to Marsh Hill Road. Figure 1 shows the site location in relation to the surrounding area.

Figure 1
Site Location Map

STUDY AREA

Based on a review of the anticipated trip generation and trip distribution for the proposed development, a local study area was established. The study area includes the following intersections:

- Bridge Street, Cross Street and Marsh Hill Road
- Marsh Hill Road and Old Pasture Road

EXISTING CONDITIONS

Evaluation of existing conditions within the study area includes a description of roadway geometrics, traffic constraints, land uses at the intersections, and quantification of traffic volumes.

Existing Traffic Volumes

To establish base traffic conditions within the study area, manual turning movement and vehicle classification counts were obtained in November 2023. Peak-period manual turning movement counts were conducted during the weekday morning peak period (7:00 to 9:00 AM) and weekday evening period (4:00 to 6:30 PM) on Wednesday November 15, 2023. Daily traffic counts were conducted on Bridge Street and Marsh Hill Road from

November 14, 2023 through November 16, 2023 encompassing a two day period using automatic traffic recorders (ATR).

The traffic-volume data gathered as part of this study was collected during the month of November 2023. Data from the MassDOT was reviewed to determine the appropriate seasonal adjustments. Based on available Massachusetts Department of Transportation (MassDOT) data, November represents just below average month conditions. The November volumes were adjusted upward by a factor of 1.012 and used to represent average month conditions.

Due to the COVID-19 pandemic, traffic volumes from Spring 2019 through Winter 2021 were lower than normal. To account for this, data from the Massachusetts Department of Transportation's (MassDOT) Mobility Dashboard website and historical traffic volume data were used to adjust for the downturn in traffic volumes. However, effective March 1, 2022, MassDOT has indicated that overall, traffic volumes have established a 'new normal' and no adjustment for COVID-19 is required. The exception is in areas of high office development. Hence, no COVID-19 adjustment is necessary.

Bridge Street carries approximately 12,850 vehicles per day (vpd) in the site vicinity. During the weekday morning peak hour, Bridge Street carries approximately 765 vehicles per hour (vph). During the weekday evening peak hour, Bridge Street carries approximately 1,121 vph.

Marsh Hill Road carries approximately 6,550 vpd in the site vicinity. During the weekday morning peak hour, Marsh Hill Road carries approximately 551 vph. During the weekday evening peak hour, Marsh Hill Road carries approximately 609 vph.

Motor Vehicle Crash Data

Motor vehicle crash data for the study area intersections were obtained from the MassDOT Crash Portal for 2017 through the end of 2022. The motor vehicle crash data was reviewed to determine crash trends in the study area. Twenty-seven (27) crashes were reported at the study area intersections. All twenty-seven (27) crashes were reported at the intersection of Bridge Street, Cross Road, and Marsh Hill Road. No crashes were reported at the intersection of Marsh Hill Road and Old Pasture Road. No fatalities were reported. None of the study area intersections are currently on MassDOT's Highway Safety Improvement Program (HSIP) for 2018 to 2020.

Vehicle Speeds

Existing speed data for Bridge Street and Marsh Hill Road was also collected. The average speed of vehicles travelling northbound and southbound on Bridge Street, north of Marsh Hill Road was found to be 35.3 mph to 36.6 mph, respectively. The 85th percentile speed was found to be 41.0 mph for northbound vehicles and 42.0 mph for southbound vehicles.

The average speed of vehicles travelling eastbound and westbound on Marsh Hill Road,

east of Bridge Street was found to be 33.9 mph to 34.0 mph, respectively. The 85th percentile speed was found to be 38.0 mph for eastbound and 39.0 for westbound vehicles. The 85th percentile speed is the speed at which sight distances are evaluated.

Public Transportation

The Lowell Regional Transit Authority (LRTA) operates a bus route in the vicinity of the site. LRTA Bus Route 10 provides service from the Kennedy Transportation Center in Lowell to Ayotte's Market in Hudson, NH. The closest stop is located at the intersection of Bridge Street and Lafayette Street which is approximately 1.4 miles from the site. The bus route operates on weekdays from 6:30 AM to 6:09 PM and Saturdays from 7:20 AM to 6:56 PM.

Planned Roadway Improvements

Officials for MassDOT and the Town of Dracut were contacted regarding roadway improvements planned for the study area intersections. Discussions with MassDOT indicate that there are no roadway improvement plans that are being advanced at this time.

PROBABLE IMPACTS OF THE PROJECT

No-Build Traffic Volumes

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 the year 2030. Traffic volumes on the roadway network at that time, in the absence of the proposed project, would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific developments by others expected to be completed by 2030. Available data compiled by the Central Transportation Planning Staff (CTPS) indicate that a 0.17 percent (minor arterials) to 0.08 percent (interstate) compounded growth rate would be appropriate to develop future No-Build conditions. For this study, a one (1.0) percent compounded growth was used.

The Town of Dracut was contacted to identify specific planned developments in the vicinity of the study that could impact future traffic conditions. There is one potential project on Avis Avenue that could impact traffic flows in the surrounding area. The Avis Avenue project was approved for 19 single-family detached homes. Trips were obtained for the 19 dwelling units from the Traffic Assessment[1] prepared for the project and included in the future No-Build conditions. The trip generation worksheets are included in the Appendix.

[1] *Traffic Assessment, 52A Avis Avenue;* TEPP LLC; Salem, NH; June 11, 2020.

Build Traffic Volumes

Site generated traffic was based on trip-generation data published by the ITE *Trip Generation* manual[2]. The trip generation data for Land Use Code (LUC) 220 – Multifamily Housing (Low-rise) published by the ITE was evaluated to determine the expected trip generation for the proposed project.

On a typical weekday, the proposed project is expected to generate 270 vehicle trips (135 vehicles entering and 135 vehicles exiting). During the weekday morning peak hour, 16 vehicle trips (4 vehicles entering and 12 vehicles exiting) are expected. During the weekday evening peak hour, 20 vehicle trips (13 vehicles entering and 7 vehicles exiting) are expected.

TRAFFIC OPERATIONS ANALYSIS

The critical movements at all of the unsignalized intersections and the proposed site driveway within the study area all are expected to have v/c ratios well below 1.0, indicating capacity for the critical movement. At the signalized intersection of Bridge Street, Cross Street and Marsh Hill Road, the project will have a minimal impact on intersection operations, with little change in the overall v/c ratio.

RECOMMENDATIONS

A comprehensive transportation mitigation program has been developed that is designed to reduce automobile trips associated with the Project and accommodate the additional traffic expected to be generated by the Project in a safe and efficient manner. The elements of the transportation mitigation program have been separated into the following categories: Project Access, and Level-of Service/Congestion Mitigation and are described in the following sections.

Project Access

Access to the Project site will be provided by way of a full movement driveway to Marsh Hill Road. The following recommendations are offered with respect to the design and operation of the Project site driveways:

- The Project site driveway should be a minimum of 22 feet in width and designed to accommodate the turning and maneuvering requirements of the largest anticipated responding emergency vehicle. The site driveway should consist of one entering lane and one exiting lane.

[2] *Trip Generation,* Eleventh Edition; Institute of Transportation Engineers; Washington, DC; 2021.

- Vehicles exiting the Project site will be placed under STOP-sign control with a marked STOP line provided.

- The Project site driveway and internal circulating aisles should be designed to accommodate the turning and maneuvering requirements of service and delivery trucks and emergency vehicles.

- All signs and pavement markings to be installed within the Project site will conform to the applicable standards of the *Manual on Uniform Traffic Control Devices*[3] (MUTCD).

- Signs and landscaping to be installed as a part of the Project within the intersection sight triangle areas of the Project site driveway with Marsh Hill Road should be designed and maintained so as not to restrict lines of sight.

- Snow windrows within sight triangle areas of the Project site driveway with Marsh Hill Road will be promptly removed where such accumulations would impede sight lines.

Transportation Demand Management

The Project proponent has committed to the implementation of a comprehensive Transportation Demand Management (TDM) program as a part of the proposed operations at the proposed development. TDM plans are typically designed to promote transit, walking, bicycles, carpooling, vanpooling, and flexible work hours with the goal of reducing single occupancy vehicles (SOVs). The benefit of a TDM plan includes maximizing the efficiency of the existing transportation system, providing healthy commuter choices and by reducing vehicle trips which reduces greenhouse gas emissions. The Project proponent has committed to implementing a TDM program. The elements of the TDM program are described in the following paragraphs.

TDM Program Management

The project proponent will develop and implement a comprehensive TDM program that will be designed to minimize the number of SOVs by promoting alternative modes of transportation and monitoring and measuring the effectiveness of the program as the project is developed.

A Transportation Coordinator (TC) will serve as the single point of contact for tenants. Currently, there is not a Transportation Management Association (TMA) in the Town of Dracut. In neighboring Lowell and Tyngsborough, there is the Middlesex 3 TMA.

The TC will coordinate the TDM program and associated marketing and outreach activities with residents of the project. The TC, as part of the overall TDM program, will

[3] *Manual on Uniform Traffic Control Devices;* Federal Highway Administration; Washington D.C.; 2009.

develop and implement quality control procedures and performance measures to ensure a high level of service, appropriate implementation of alternative transportation incentive programs, and effectiveness of those programs. The email address and phone number of the TC will be posted in a central location within the project building and made available to all tenants. The TC will be responsible for a project website which will include a transportation section with up-to-date information with respect to the TDM program, commuter options, and incentive programs. Included on the website and posted at centralized locations in every building will be the following:

- Massachusetts Bay Transportation Authority (MBTA) maps, schedules and fare information,
- Join a TMA (when a TMA and if a TMA is established),
- Location of bicycle parking areas within the project,
- Map of local and regional bicycle and pedestrian routes,
- Commuter options available through MassDOT's Bay State Commute program which provides opportunities for individuals that choose to walk, bicycle, carpool, vanpool or that use public transportation to travel to and from work,
- Location and contact information for car sharing services,
- Information on ride matching services,

In order to reduce SOVs overall, and to encourage walking and the use of bicycles to commute to the project, the project proponent has committed to the following measures:

- Encourage bicycle and pedestrian commuting options that will be marketed to tenants by the TC. This will include the development of up-to-date pedestrian and bicycle maps for local and regional facilities, and the locations of bicycle parking within the project.
- Dedicated carpool spaces will be located on-site.
- Electric car charging spaces on-site will be provided.
- Provide air pumps and other bicycle tools such as fix-it at a centralized location.
- Sponsor annual employee transportation information events.

CONCLUSION

Based on this assessment, the following can be concluded with respect to the Project:

- On a typical weekday, the proposed project is expected to generate 270 vehicle trips (135 vehicles entering and 135 vehicles exiting). During the weekday morning peak hour, 16 vehicle trips (4 vehicles entering and 12 vehicles exiting) are expected. During the weekday evening peak hour, 20 vehicle trips (13 vehicles entering and 7 vehicles exiting) are expected.

- The Project will not have a significant impact (increase) on motorist delays or vehicle queuing over Existing or anticipated future conditions without the Project (No-Build conditions). Volume to capacity ratios (v/c) at the unsignalized intersections show very small increases overall. The v/c ratios for the critical movements at the unsignalized study area intersections are well below 1.0, indicating capacity for the movement.

- Lines of sight at the Project site driveway intersections with Marsh Hill Road were found to exceed the recommended minimum distances for safe and efficient operation based on the appropriate approach speed.

- A review of the Site Plan for the Project indicates that human-made objects, landscaping, and signs have been appropriately designed and located so as not to inhibit sight lines to and from the Project site driveways along Bridge Street.

SECTION 2: EXISTING TRAFFIC CONDITIONS

The evaluation of a proposed project's transportation impacts requires a complete understanding of the existing transportation system within the study area. Existing conditions include roadway geometrics, traffic control, daily and peak hour traffic flows, public transportation and vehicular crash data. Each of these are discussed below.

STUDY AREA

Based on a review of the anticipated trip generation and trip distribution for the proposed development, a local study area was established. The study area includes the following intersections:

- Bridge Street, Cross Street and Marsh Hill Road
- Marsh Hill Road and Old Pasture Road

FIELD SURVEY

A comprehensive field inventory of the proposed site was conducted in November 2023. The inventory included collection of existing roadway geometrics, traffic volumes, and safety data for the existing study area intersections and site access driveway locations. Traffic volumes were measured by means of automatic traffic recorder (ATR) counts and substantiated by manual turning movement counts (TMCs) conducted at the study area intersections.

GEOMETRICS

Primary study area roadways are described below. Figure 2 graphically summarizes the existing roadway and intersection characteristics within the study area.

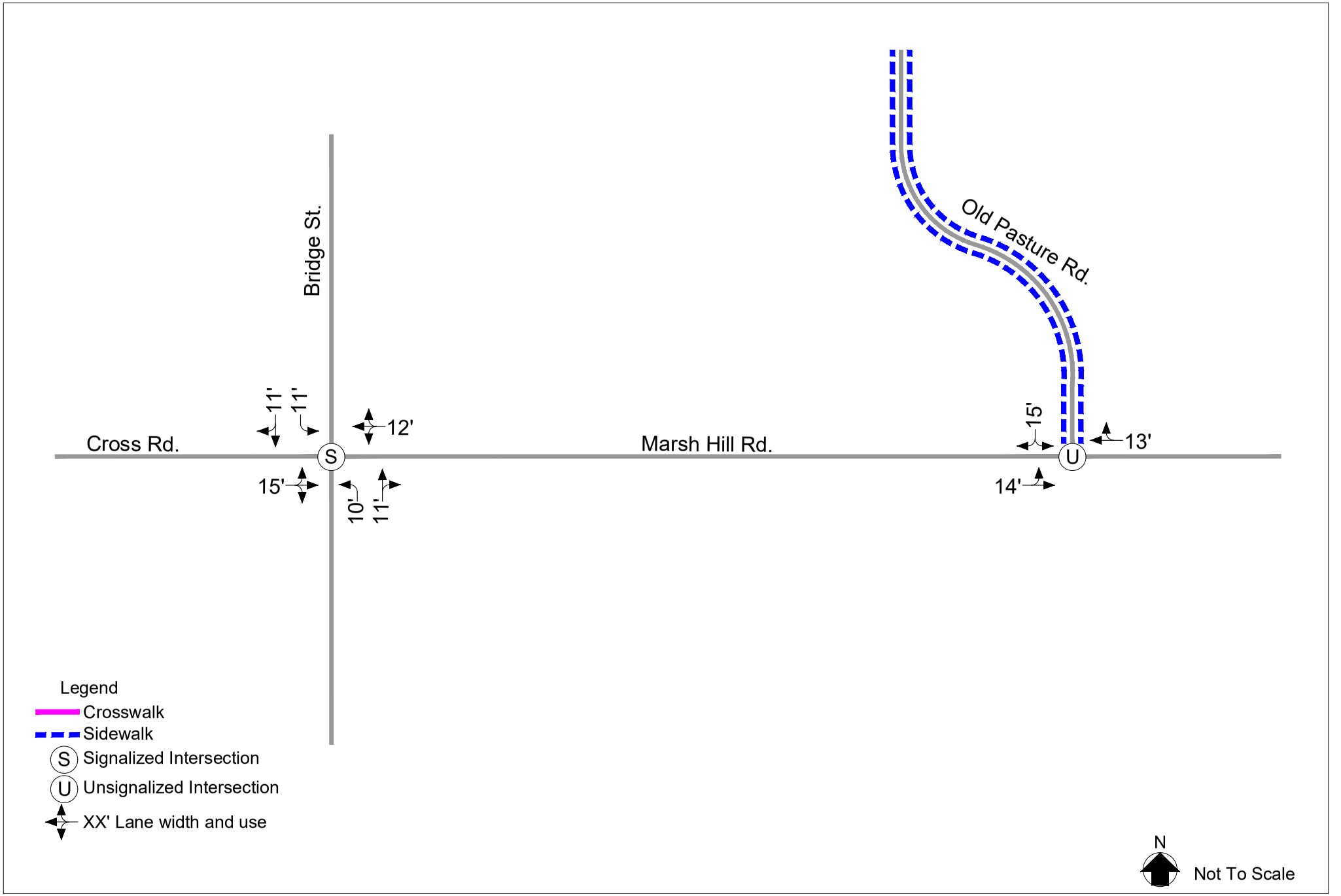

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Figure 2

Existing Lane Use,
Travel Lane Width and
Pedestrian/Bike Facilities
Peak Hour Traffic Volumes

Roadways

Bridge Street

Bridge Street is a two-lane, Rural Minor Arterial under the jurisdiction of the Town of Dracut. Bridge Street traverses the study area in a general north/south direction through the Town of Dracut. Travel lanes are generally separated by a double yellow centerline. Marked shoulders are also provided. The posted speed limit on Bridge Street in the vicinity of the site is 35 miles per hour (mph). Land use along Bridge Street in the study area consists of residential uses and commercial uses.

Marsh Hill Road

Marsh Hill Road is a two-lane, Rural Minor Collector under the jurisdiction of the Town of Dracut. Marsh Hill Road traverses the study area in a general east/west direction from Bridge Street easterly to Broadway Road (Route 113). The posted speed limit on Marsh Hill Road in the vicinity of the site is 30 mph. Land use along Marsh Hill Road in the site vicinity consists of residential uses.

Intersections

Bridge Street, Cross Street and Marsh Hill Road

Bridge Street forms the north and south legs of this four-legged intersection with Cross Street (west leg) and Marsh Hill Road (east leg). The Bridge Street approaches each consist of an exclusive left-turn lane and a shared through/right-turn lane. The Cross Street approach consists of a single lane and permits all movements. The Marsh Hill Road approach consists of a single lane and permits all movements. The intersection is controlled by a traffic signal. Land use in the vicinity consists of the site and residential and commercial properties.

Marsh Hill Road and Old Pasture Road

Marsh Hill Road forms the east and west legs of this three-legged intersection with Old Pasture road Lane (north leg). The Marsh Hill Road approaches each consist of a single lane permitting left or right turn movements, as well as through movements. The Old Pasture road approach consists of a single lane and permits both left and right turn movements. The Old Pasture road operates under STOP control. Land use in the vicinity consists of residential properties.

TRAFFIC VOLUMES

Existing Traffic Volumes

To establish base traffic conditions within the study area, manual turning movement and

vehicle classification counts were obtained in November 2023. Peak-period turning movement counts were conducted during the weekday morning peak period (7:00 to 9:00 AM) and weekday evening period (4:00 to 6:30 PM) on Wednesday November 15, 2023 at the following intersections:

- Bridge Street, Cross Street and Marsh Hill Road
- Marsh Hill Road and Old Pasture road

Daily traffic counts were conducted on Bridge Street and Marsh Hill Road in the site vicinity encompassing a two day period using automatic traffic recorders (ATR) from November 14, 2023 to November 16, 2023.

Analysis of the peak-period traffic counts indicated that the weekday morning commuter peak generally hour occurs between 7:15 AM and 8:15 AM and the weekday evening commuter peak hour generally occurs between 4:00 PM and 5:00 PM. The traffic count worksheets are provided in the Appendix.

Seasonal Adjustment

The traffic-volume data gathered as part of this study was collected during the month of November 2023. Available traffic volume data from the MassDOT was reviewed to determine the monthly variations of the traffic volumes. The traffic data showed November volumes to be slightly lower than average month conditions. Therefore, the November traffic volumes were adjusted upward by a factor of 1.012 and used to represent average month conditions.

Due to the COVID-19 pandemic, traffic volumes from Spring 2019 through Winter 2021 were lower than normal. To account for this, data from the Massachusetts Department of Transportation's (MassDOT) Mobility Dashboard website and historical traffic volume data were used to adjust for the downturn in traffic volumes. However, effective March 1, 2022, MassDOT has indicated that overall, traffic volumes have established a 'new normal' and no adjustment for COVID-19 is required. The exception is in the areas of high office development. Hence, no COVID-19 adjustment is necessary.

The 2023 existing weekday daily and peak-hour traffic volumes are summarized in Table 1. Figure 3 shows the 2023 Existing weekday morning and weekday evening peak hour traffic volumes. The seasonal worksheets are provided in the Appendix.

TABLE 1
EXISTING WEEKDAY TRAFFIC VOLUME SUMMARY[a]

Location	Weekday Traffic Volume[b]	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		Traffic Volume[c]	K Factor[d]	Directional Distribution[e]	Traffic Volume	K Factor	Directional Distribution
Bridge Street, north of Marsh Hill Road	12,850	765	6.0	57.3% SB	1,121	8.7	52.7% NB
Marsh Hill Road, east of Bridge Street	6,550	551	8.4	52.3% EB	609	9.3	57.1% WB

[a]Two-way traffic volume
[b]Daily traffic expressed in vehicles per day.
[c]Expressed in vehicles per hour.
[d]Percent of daily traffic volumes which occurs during the peak hour.
[e]Percent of peak-hour volume in the predominant direction of travel.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound.

Bridge Street carries approximately 12,850 vehicles per day (vpd) in the site vicinity. During the weekday morning peak hour, Bridge Street carries approximately 765 vehicles per hour (vph). During the weekday evening peak hour, Bridge Street carries approximately 1,121 vph.

Marsh Hill Road carries approximately 6,550 vpd in the site vicinity. During the weekday morning peak hour, Marsh Hill Road carries approximately 551 vph. During the weekday evening peak hour, Marsh Hill Road carries approximately 609 vph.

MOTOR VEHICLE CRASH DATA

Motor vehicle crash data for the study area intersections were obtained from the MassDOT Crash Portal for 2017 through the end of 2022. The motor vehicle crash data was reviewed to determine crash trends in the study area. Twenty-seven (27) crashes were reported at the study area intersections. All twenty-seven (27) crashes were reported at the intersection of Bridge Street, Cross Road, and Marsh Hill Road. No crashes were reported at the intersection of Marsh Hill Road and Old Pasture Road. No fatalities were reported. None of the study area intersections are currently on MassDOT's Highway Safety Improvement Program (HSIP) for 2018 to 2020. The crash data is summarized in Table 2 and included in the Appendix.

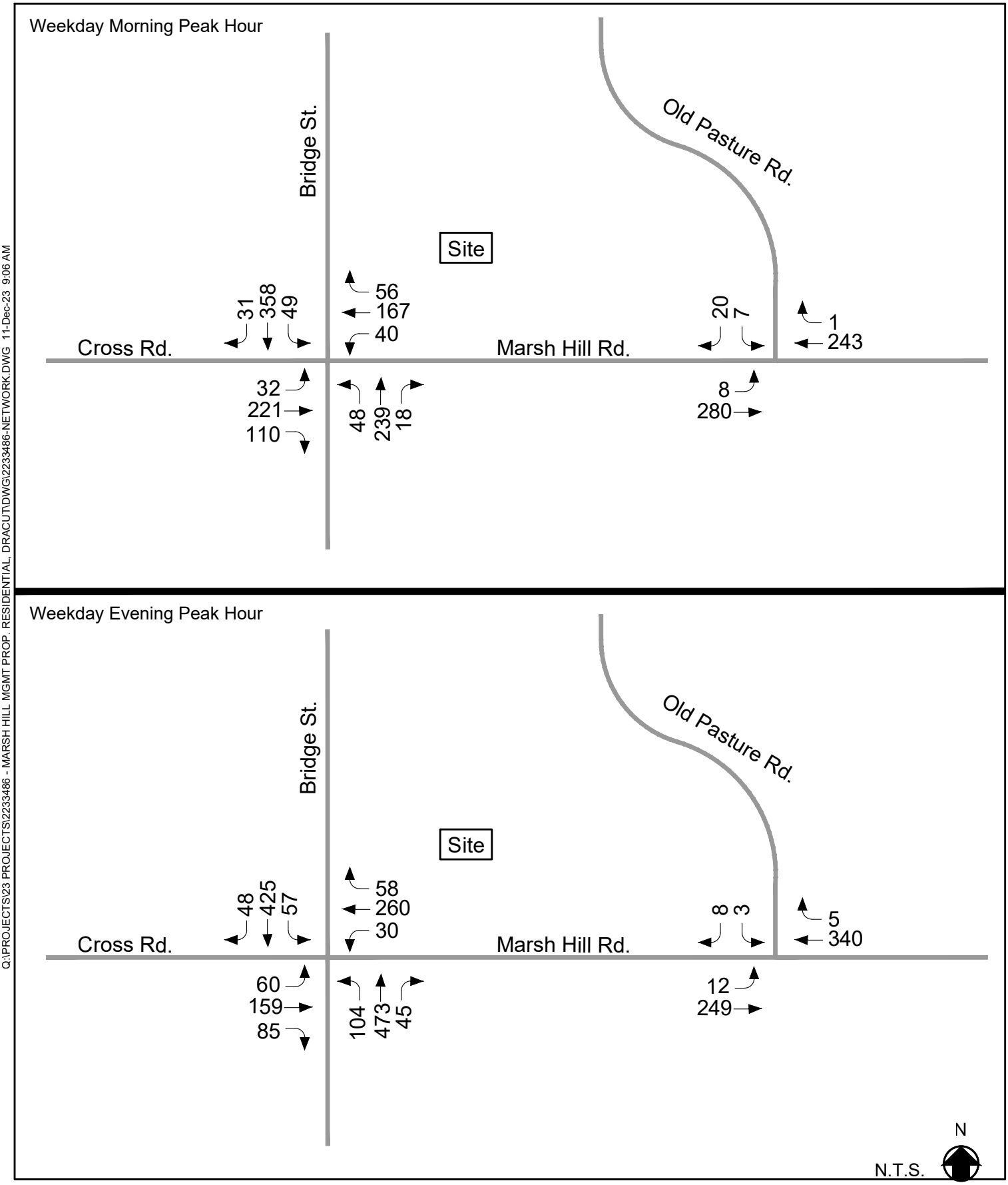

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Figure 3

2023 Existing Weekday Peak Hour Traffic Volumes

TABLE 2
MOTOR VEHICLE CRASH DATA SUMMARY[a]

Scenario	Bridge Street, Cross Street and Marsh Hill Road	Bridge Street and Old Pasture road
Year:		
2017	6	0
2018	3	0
2019	3	0
2020	4	0
2021	6	0
2022	5	0
Total	27	0
Average:	4.50	0.0
Crash Rate:	0.62	0.0
Significance:	No	No
Type:		
Angle	13	0
Rear-End	10	0
Front-To-Rear	1	0
Head-On	0	0
Sideswipe	0	0
Single Vehicle Crash	2	0
Unknown	1	0
Total	27	0
Time of Day:		
Weekday (7:00 to 9:00 AM)	6	0
Weekday (4:00 to 6:00 PM)	3	0
Remainder of Day	18	0
Total	27	0
Pavement Conditions:		
Dry	22	0
Wet	3	0
Snow/Ice	2	0
Other	0	0
Unknown	0	0
Total	27	0
Severity:		
Property Damage Only	21	0
Personal Injury	5	0
Fatal Accident	0	0
Unknown	1	0
Total	27	0

[a]Source: MassDOT Impact Crash Portal.
[b]Average crashes over analysis period.
[c]Crash rate per million entering vehicles (mev).
[d]Signalized intersections are significant if rate >0.73 crashes per million vehicles, and unsignalized intersections are significant if rate >0.57 crashes per million vehicles.

VEHICLE SPEEDS

Existing speed data for Bridge Street was also collected using the ATRs. The speed data is summarized in Table 3.

TABLE 3
OBSERVED VEHICLE SPEEDS

Location	Posted Speed Limit (mph)	Direction	Average Observed Speed[a] (mph)	85th Percentile Speed (mph)
Bridge Street, north of Marsh Hill Road	35	NB	35.3	41.0
	35	SB	36.6	42.0
Marsh Hill Road, east of Bridge Street	30	EB	33.9	38.0
	30	WB	34.0	39.0

[a]Based on speed data compiled on November 14 and 15, 2023.

As shown in Table 3, the average speed of vehicles travelling northbound and southbound on Bridge Street, north of Marsh Hill Road was found to be 35.3 mph to 36.6 mph, respectively. The 85th percentile speed was found to be 41.0 mph for northbound vehicles and 42.0 mph for southbound vehicles.

The average speed of vehicles travelling eastbound and westbound on Marsh Hill Road, east of Bridge Street was found to be 33.9 mph to 34.0 mph, respectively. The 85th percentile speed was found to be 38.0 mph for eastbound vehicles and 39.0 for westbound vehicles. The 85th percentile speed is the speed at which sight distances are evaluated.

PUBLIC TRANSPORTATION

The Lowell Regional Transit Authority (LRTA) operates a bus route in the vicinity of the site. LRTA Bus Route 10 provides service from the Kennedy Transportation Center in Lowell to Ayotte's Market in Hudson, NH. The closest stop is located at the intersection of Bridge Street and Lafayette Street which is approximately 1.4 miles from the site. The bus route operates on weekdays from 6:30 AM to 6:09 PM and Saturdays from 7:20 AM to 6:56 PM.

PLANNED ROADWAY IMPROVEMENTS

Officials for MassDOT and the Town of Dracut were contacted regarding roadway improvements planned for the study area intersections. Discussions with MassDOT indicate that there are no roadway improvement plans that are being advanced at this time.

SECTION 3:
2030 NO-BUILD AND BUILD TRAFFIC CONDITIONS

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 the year 2030. Traffic volumes on the roadway network at that time, in the absence of the proposed project, would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific developments by others expected to be completed by 2030. Consideration of these factors resulted in the development of 2030 No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic flow networks to develop 2030 Build conditions.

2030 NO-BUILD TRAFFIC VOLUMES

Traffic growth on area roadways is a function of the expected land development in the immediate area as well as the surrounding region. Several methods can be used to estimate this growth. A procedure frequently employed estimates an annual percentage increase in traffic growth and applies that percentage to all traffic volumes under study. The drawback to such a procedure is that some turning volumes actually grow at either a higher or a lower rate at particular intersections.

An alternative procedure identifies the location and type of planned development, estimates the traffic to be generated, and assigns it to the area roadway network. This produces a more realistic estimate of growth for local traffic. However, the drawback of this procedure is that the potential growth in population and development external to the study area would not be accounted for in the traffic projections.

To provide a conservative analysis framework, both procedures were used.

Background Traffic Growth

Research was performed to determine the historic growth rate for traffic in the study area as well as other planned developments that may affect traffic within the study area for the proposed project. The Central Transportation Planning Staff (CTPS)) was contacted to determine regional growth for Dracut and the surrounding area. Available data compiled by CTPS indicate that a 0.17 percent (minor arterials) to 0.08 percent (interstate) compounded growth rate would be appropriate to develop future No-Build conditions. To provide a conservative analysis, a background growth rate of 1.0 percent per year was used.

Specific Development by Others

The Town of Dracut was contacted to identify specific planned developments in the vicinity of the study that could impact future traffic conditions. There is one potential project on Avis Avenue that could impact traffic flows in the surrounding area. The Avis Avenue project was approved for 19 single-family detached homes. Trips were obtained for the 19 dwelling units from the Traffic Assessment[4] prepared for the project and included in the future No-Build conditions. The trip generation worksheets are included in the Appendix.

No-Build Condition Traffic Volumes

The 2030 No-Build weekday morning and evening peak-hour traffic volumes were developed by applying a compounded one (1.0) percent annual growth rate to the 2023 Existing peak-hour traffic volumes. Figure 4 shows the projected 2023 No-Build peak hour traffic volumes for the respective weekday morning and weekday evening peak-hours.

[4] *Traffic Assessment, 52A Avis Avenue;* TEPP LLC; Salem, NH; June 11, 2020.

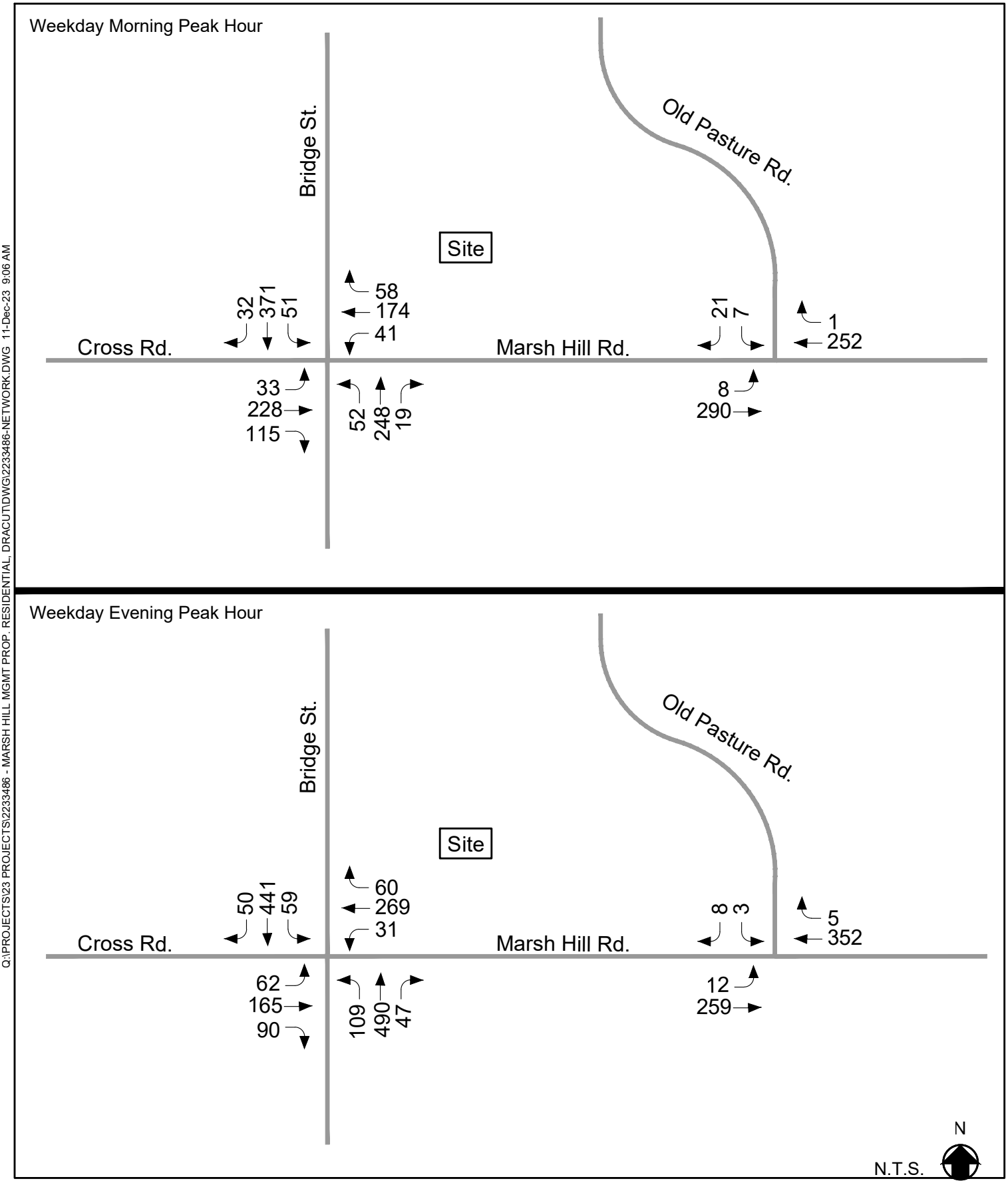

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Figure 4

2030 No-Build Weekday Peak Hour Traffic Volumes

FUTURE 2030 BUILD CONDITIONS

Project Description

the project will consist of the construction of forty (40) residential apartment units. Parking would be provided for eighty (80) vehicles. Access would be provided by way of a full movement driveway to Marsh Hill Road.

Traffic Generation

Site generated traffic was based on trip-generation data published by the ITE *Trip Generation* manual[5]. The trip generation data for Land Use Code (LUC) 220 – Multi-Family Housing (Low-Rise) published by the ITE was evaluated to determine the expected trip generation for the proposed project. The expected trip generation is summarized in Table 4 and the trip generation worksheets are included in the Appendix.

TABLE 4
TRIP-GENERATION SUMMARY

	Proposed Residential Trips[a]
Average Weekday Daily Traffic	270
Weekday Morning Peak Hour:	
Entering	4
Exiting	12
Total	16
Weekday Evening Peak Hour:	
Entering	13
Exiting	7
Total	20

[a]Based on ITE LUC 220, Single-Family Housing Attached; 40 dwelling units.

On a typical weekday, the proposed project is expected to generate 270 vehicle trips (135 vehicles entering and 135 vehicles exiting). During the weekday morning peak hour, 16 vehicle trips (4 vehicles entering and 12 vehicles exiting) are expected. During the weekday evening peak hour, 20 vehicle trips (13 vehicles entering and 7 vehicles exiting) are expected.

[5]*Trip Generation,* Eleventh Edition; Institute of Transportation Engineers; Washington, DC; 2021.

Trip Distribution

The directional distribution of the vehicular traffic approaching and departing the site is a function of existing travel patterns, similar uses, and the efficiency of the existing roadway system. A gravity model was developed based on Dracut Journey-to-Work data from the U.S. Census to determine the expected trip distribution. Table 5 summarizes the expected trip distribution. The trip distribution is shown graphically on Figure 5 and the gravity model is in the Appendix.

TABLE 5
PROPOSED TRIP DISTRIBUTION

Route	Direction	Percent of Trips
Bridge Street	North	5
Cross Street	West	13
Marsh Hill Road	East	28
Bridge Street	South	54
TOTAL		100

Future Traffic Volumes - Build Condition

The site-generated traffic was distributed within the study area according to the percentages summarized in Table 5. The site generated volumes for the project are shown on Figure 6 for the respective weekday morning and weekday evening peak hours. The Project's site traffic was then superimposed onto the 2030 No-Build traffic flow networks to reflect the proposed 2030 Build peak hour traffic volumes and are shown on Figure 7 for the respective weekday morning and weekday evening peak hours. These volumes were used as the basis for all analysis as well as to identify potential mitigation measures to ameliorate the project's impacts.

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N.T.S.

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Figure 5

Trip Distribution

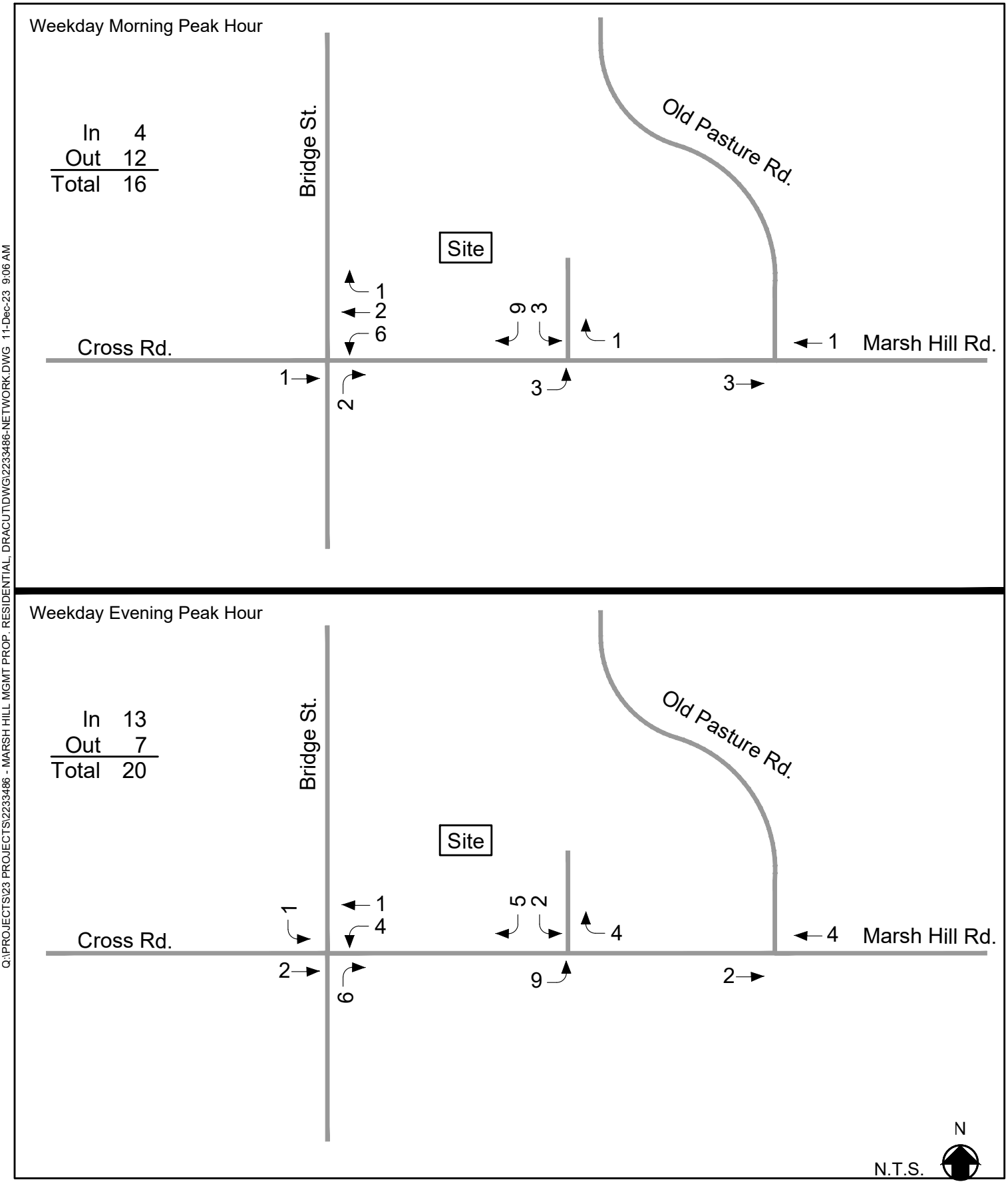

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Figure 6

Site Generated
Peak Hour Traffic Volumes

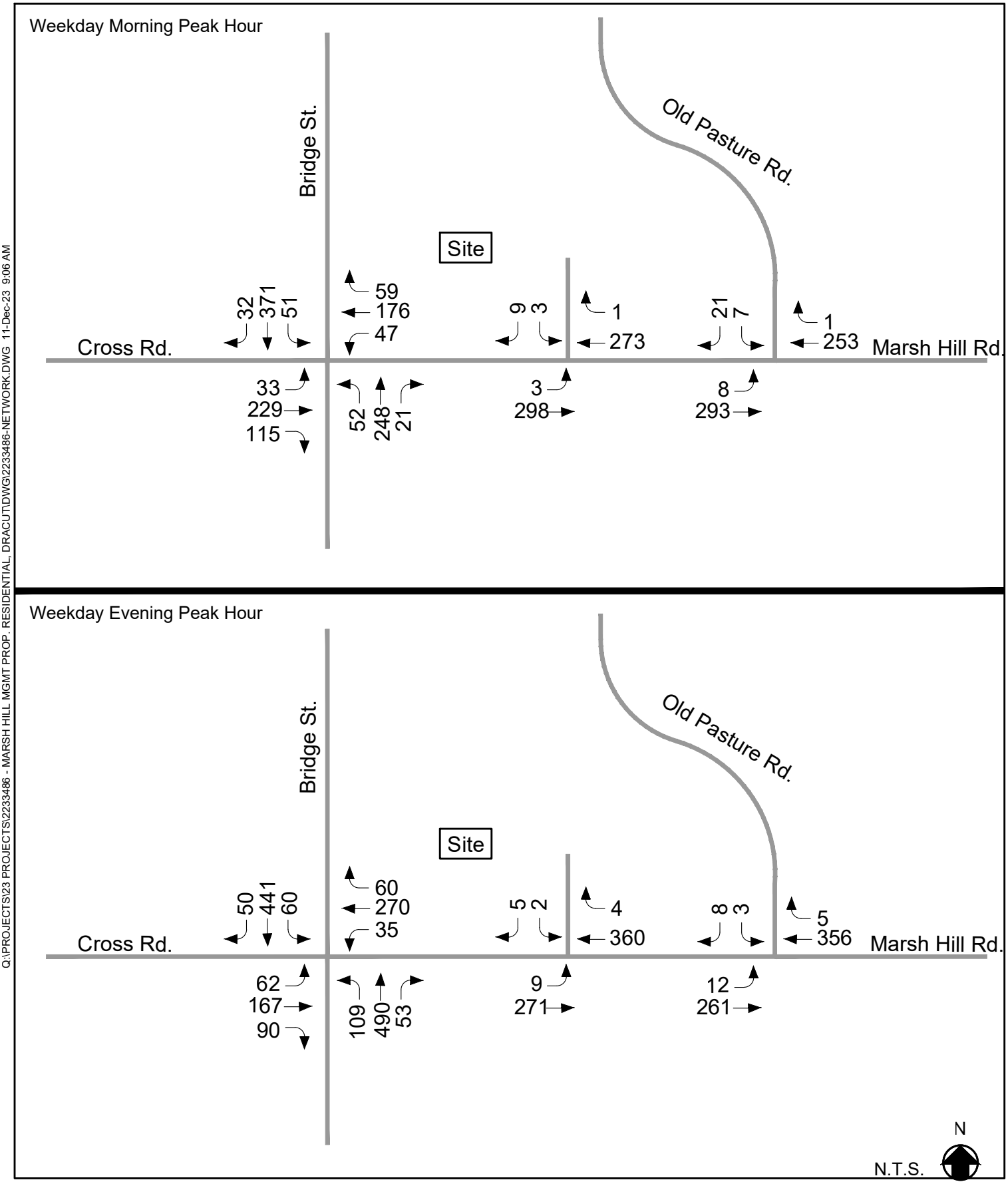

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Figure 7

2030 Build Weekday Peak Hour Traffic Volumes

A summary of peak-hour projected traffic-volume changes in the site vicinity are shown in Table 6. These volumes are based on the expected increases from the site traffic generation.

TABLE 6
TRAFFIC-VOLUME INCREASES[a]

Location/Peak Hour	2030 No-Build	2030 Build	Volume Increase over No-Build	Percent Increase over No-Build
Bridge Street, north of Marsh Hill Road				
Weekday Morning	793	794	1	0.1
Weekday Evening	1,162	1,163	1	0.1
Cross Street, west of Bridge Street				
Weekday Morning	634	637	3	0.5
Weekday Evening	745	748	3	0.4
Marsh Hill Road, east of Old Pasture Road				
Weekday Morning	550	554	4	0.7
Weekday Evening	619	625	6	1.0
Bridge Street, south of Marsh Hill Road				
Weekday Morning	846	854	8	1.0
Weekday Evening	1,208	1,218	10	0.8

[a]All volumes are vehicles per hour, total of both directions.

As shown in Table 6, project-related increases are in the range of 1 to 8 additional bi-directional vehicles during the weekday morning peak hour and 1 to 10 bi-directional vehicles during the weekday evening peak hour. This is approximately equivalent to one additional vehicle approximately every ten (10) minutes on average during the peak hours.

SECTION 4: ANALYSIS

To assess intersection operations, capacity analyses were conducted for Existing, No-Build, and Build traffic-volume conditions. Capacity analyses provide an indication of how well the study area intersections serve existing and projected traffic volumes. Vehicle queue analyses provide a secondary measure of the operational characteristics of an intersection or section of roadway under study in terms of lane use and demand.

METHODOLOGY

Levels of Service

Level-of-service (LOS) is a quantitative measure used to describe the operation of an intersection or roadway segment. The Level-of-Service definition is described by the quality of traffic flow and is primarily defined in terms of traffic delays. The primary result of capacity analyses[6] is the assignment of a level-of-service to traffic intersections or roadway segments under various traffic-flow conditions. Six levels of service are defined for traffic intersections and roadway segments. Levels-of-service criteria range from LOS A to LOS F. LOS A represents very good operating conditions while LOS F represents very poor operating conditions.

Signalized Intersections

Levels of service for signalized intersections are calculated using the methodology and procedures described in the 7th Edition *Highway Capacity Manual*[7] *(HCM7)*. The methodology assesses the intersection based on type of signal operation, signal timing and phasing, progression, vehicle mix, and intersection geometrics. Level-of-service designations are based on the delay per vehicle. Table 7 summarizes the relationship between Level-of-Service and delay for signalized intersections. The calculated delay values result

[6]The capacity analysis methodology is based on procedures presented in the *Highway Capacity Manual 7th Edition;* Transportation Research Board; Washington, DC; 2022.

[7]*Highway Capacity Manual 7th Edition*; Transportation Research Board; Washington, DC; 2022.

in levels-of-service designations which are applied to individual lane groups, to individual intersection approaches, and to the entire intersection. In the HCM7 methodology, the critical lane group volume to capacity ratio is reported.

TABLE 7
LEVEL-OF-SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS[a]

Delay per Vehicle (Seconds)	Defined Level-of-Service v/c[b] < 1.0	Defined Level-of-Service v/c[b] > 1.0
≤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

[a]*Highway Capacity Manual 7th Edition*; Transportation Research Board; Broad, DC; 2022; page 19-16.
[b]Volume to capacity ratio.

Unsignalized Intersections

The level-of-service (LOS) for an unsignalized intersection is determined by the methodology and procedures described in the HCM7. The level-of-service for unsignalized intersections is measured in terms of average delay for the critical movements (typically side street turning movements or mainline turning movements). The delay for the critical movements is a function of the available capacity for the movement and the degree of saturation of the lane group containing the critical movement. The delay calculation 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. The definitions for level-of-service at unsignalized intersections are also provided in the *Highway Capacity Manual 7th Edition*. Table 8 summarizes the relationship between level-of-service and average control delay for the critical movements at unsignalized intersections.

TABLE 8
LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS[a]

Average Delay (seconds per vehicle)	Defined Level-of-Service v/c[b] < 1.0	Defined Level-of-Service v/c > 1.0
≤ 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

[a]*Highway Capacity Manual 7th Edition*; Transportation Research Board; Broad, DC; page 20-6
[b]Volume to capacity ratio.

The analytical methodologies used for the analysis of unsignalized intersections use conservative analysis parameters, such as high critical gaps. The critical gap is defined as the minimum time between successive main line vehicles for a side street vehicle to execute the appropriate turning maneuver. Actual field observations indicate that drivers at the study area intersections accept smaller gaps in traffic than those used in the analysis procedures and therefore experience less delay than calculated by the HCM methodology. **The analysis results from the HCM model overstate the actual delays experienced in the field.** It should be noted that the unsignalized intersections along heavily trafficked roadways operate at constrained levels and the resulting calculated results of the unsignalized intersection analyses should be considered highly conservative.

CAPACITY ANALYSIS RESULTS

Level-of-service analyses were conducted for both average and peak month conditions for 2023 Existing, 2030 No-Build and 2030 Build conditions for the intersections within the study area. The results of the unsignalized capacity analyses are summarized in Table 9. The results of the signalized capacity analysis are summarized in Table 10. Detailed analysis sheets are presented in the Appendix.

TABLE 9
UNSIGNALIZED LEVEL-OF-SERVICE ANALYSIS SUMMARY

Critical Movement/ Peak Hour	2023 Existing					2030 No-Build					2030 Build				
	Demand[a]	V/C[b]	Delay[c]	LOS[d]	Queue[e]	Demand	V/C	Delay	LOS	Queue	Demand	V/C	Delay	LOS	Queue
Marsh Hill Road and Old Pasture Road															
All movements from Old Pasture Road (SB):															
Weekday Morning	27	0.05	10.8	B	5.0	28	0.05	10.9	B	5.0	28	0.05	10.9	B	5.0
Weekday Evening	11	0.03	11.9	B	2.5	11	0.03	12.1	B	2.5	11	0.03	12.2	B	2.5
Marsh Hill Road and Proposed Site Driveway															
All movements from site driveway (SB):															
Weekday Morning	--	--	--	--	--	--	--	--	--	--	12	0.02	10.7	B	2.5
Weekday Evening	--	--	--	--	--	--	--	--	--	--	7	0.01	11.6	B	0.0

[a]Demand of critical movements in vehicles per hour.
[b]Volume-to-capacity ratio.
[c]Delay in seconds per vehicle.
[d]Level of service.
[e]95th percentile queue in feet.

TABLE 10
SIGNALIZED LEVEL-OF-SERVICE SUMMARY
BRIDGE STREET, CROSS STREET AND MARSH HILL ROAD

Peak Hour/Lane Group	2023 Existing				2030 No-Build				2030 Build			
	V/C[a]	Delay[b]	LOS[c]	Queue[d]	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Weekday Morning												
Eastbound Lt/Th/Rt	0.67	24.5	C	142/246	0.70	25.5	C	149/274	0.70	25.6	C	150/275
Westbound Lt/Th/Rt	0.61	23.3	C	105/1866	0.64	24.2	C	111/202	0.68	26.0	C	117/232
Northbound Lt	0.13	8.4	A	9/20	0.15	8.5	A	10/21	0.15	8.5	A	10/21
Northbound Th/Rt	0.37	13.1	B	84/132	0.39	13.3	B	88/138	0.39	13.3	B	89/139
Southbound Lt	0.11	8.0	A	9/21	0.12	8.0	A	9/22	0.12	8.0	A	9/22
Southbound Th/Rt	0.52	15.3	B	133/216	0.54	15.6	B	139/226	0.54	15.6	B	139/226
Overall	**0.54**	**18.2**	**B**	**--**	**0.56**	**18.7**	**B**	**--**	**0.57**	**19.2**	**B**	**--**
Weekday Evening												
Eastbound Lt/Th/Rt	0.79	33.2	C	132/258	0.82	36.0	D	140/275	0.83	36.4	D	141/278
Westbound Lt/Th/Rt	0.84	36.7	D	170/281	0.87	38.8	D	178/296	0.89	42.6	D	183/307
Northbound Lt	0.31	9.4	A	19/37	0.34	10.2	B	20/39	0.34	10.2	B	20/39
Northbound Th/Rt	0.64	17.4	B	191/304	0.71	20.5	C	201/321	0.72	20.8	C	204/327
Southbound Lt	0.19	9.5	A	11/23	0.20	9.5	A	11/23	0.21	9.6	A	11/24
Southbound Th/Rt	0.68	19.5	B	191/272	0.71	20.8	C	202/286	0.71	20.8	C	202/286
Overall	**0.70**	**23.8**	**C**	**--**	**0.73**	**25.9**	**C**	**--**	**0.74**	**26.9**	**C**	**--**

[a]Maximum volume-to-capacity ratio.
[b]Delay in seconds per vehicle.
[c]Level of service.
[d]Average Queue (ft)/95th %tile Queue (ft)
Lt = Left; Th = Through; Rt = Right.

Bridge Street, Cross Street and Marsh Hill Road

Under 2023 existing conditions, this signalized intersection is modeled to operate at LOS B during the weekday morning peak hour and at LOS C during the weekday evening peak hour. Under future 2030 No-Build conditions, the intersection is projected to operate at LOS B during the weekday morning peak hour and at LOS C during the weekday evening peak hour. Under future 2030 Build conditions, the intersection is expected to continue to operate at LOS B during the weekday morning peak hour and at LOS C during the weekday evening peak hour.

Marsh Hill Road and Old Pasture Road

Under 2023 Existing conditions, the critical movements (all movements from Old Pasture Road) are modeled to operate at LOS B or better during the weekday morning and weekday evening peak hours. Under future 2030 No-Build conditions, the critical movements are expected to operate at LOS B or better during the weekday morning and weekday evening peak hours. Under future 2030 Build conditions, the critical movements are expected to continue to operate at LOS C or better during the weekday morning and weekday evening peak hours. The volume to capacity (v/c) ratio is projected to be well below 1.0 (theoretical capacity) indicating capacity for the left or right turn movement from Old Pasture Road.

Marsh Hill Road and Site Driveway

Under future 2030 Build conditions, the critical movements are expected to operate at LOS B or better during the weekday morning and weekday evening peak hours. The v/c is projected to be well below 1.0 (theoretical capacity) indicating capacity for the left or right turn movement.

SIGHT DISTANCE

Sight distance measurements were performed at the Marsh Hill Road intersection with the proposed site driveway in accordance with Massachusetts Department of Transportation (MassDOT) and American Association of State Highway and Transportation Officials (AASHTO) standards. Stopping sight distance (SSD) measurements were performed. In brief, SSD is the distance required by a vehicle traveling at the design speed of a roadway, on wet pavement, to stop prior to striking an object in its travel path. Table 11 presents the measured SSD at the site access intersections. The sight distance calculations are included in the Appendix.

TABLE 11
SIGHT DISTANCE SUMMARY

	Required Minimum (Feet)[a]	Measured (Feet)
Marsh Hill Road and Proposed Site Driveway		
Stopping Sight Distance:		
Marsh Hill Road approaching from the east	327	350
Marsh Hill Road approaching from the west	253	240[b]
Intersection Sight Distance:		
Site Driveway looking to the east	373[c]/430[d]	350
Site Driveway looking to the west	373[c]/430[d]	240 [b]

[a]Recommended minimum values obtained from *A Policy on Geometric Design of Highways and Streets*; American Association of State Highway and Transportation Officials (AASHTO); 2018 and based on 85th percentile speed, adjusted for grade.
[b]Distance to the center of Bridge Street.
[c]Recommended minimum value for vehicles turning right exiting a roadway under STOP-sign control.
[d]Recommended minimum value for vehicles turning left exiting a roadway under STOP-sign control.

As can be seen in Table 11, the SSD measurements performed at Marsh Hill Road and the proposed site driveway indicate that the intersection exceeds the recommended minimum requirements based on the 85th percentile speeds in the westbound direction. Approaching from the west, the site driveway is 240 feet from the center of Bridge Street. Speeds coming from the intersection are lower than those recorded and used in the analysis as the location of the speed measurements was closer to Old Pasture Road.

In accordance with the AASHTO manual, *"If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, this may require a major-road vehicle to stop or slow to accommodate the maneuver by a minor-road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road."* Accordingly, the ISD should be at least equal to the SSD, which would allow a driver approaching the minor road to safely stop. It is recommended that any landscaping or site signage be set-back from Marsh Hill Road to not impede sight lines.

SECTION 5: RECOMMENDATIONS AND CONCLUSION

RECOMMENDATIONS

A comprehensive transportation mitigation program has been developed that is designed to reduce automobile trips associated with the Project and accommodate the additional traffic expected to be generated by the Project in a safe and efficient manner. The elements of the transportation mitigation program have been separated into the following categories: Project Access, and Level-of Service/Congestion Mitigation and are described in the following sections.

Project Access

Access to the Project site will be provided by way of a full movement driveway to Marsh Hill Road. The following recommendations are offered with respect to the design and operation of the Project site driveways:

- The Project site driveway should be a minimum of 22 feet in width and designed to accommodate the turning and maneuvering requirements of the largest anticipated responding emergency vehicle. The site driveway should consist of one entering lane and one exiting lane.

- Vehicles exiting the Project site will be placed under STOP-sign control with a marked STOP line provided.

- The Project site driveway and internal circulating aisles should be designed to accommodate the turning and maneuvering requirements of service and delivery trucks and emergency vehicles.

- All signs and pavement markings to be installed within the Project site will conform to the applicable standards of the *Manual on Uniform Traffic Control Devices*[8] (MUTCD).

[8] *Manual on Uniform Traffic Control Devices;* Federal Highway Administration; Washington D.C.; 2009.

- Signs and landscaping to be installed as a part of the Project within the intersection sight triangle areas of the Project site driveway with Marsh Hill Road should be designed and maintained so as not to restrict lines of sight.

- Snow windrows within sight triangle areas of the Project site driveway with Marsh Hill Road will be promptly removed where such accumulations would impede sight lines.

Transportation Demand Management

The Project proponent has committed to the implementation of a comprehensive Transportation Demand Management (TDM) program as a part of the proposed operations at the proposed development. TDM plans are typically designed to promote transit, walking, bicycles, carpooling, vanpooling, and flexible work hours with the goal of reducing single occupancy vehicles (SOVs). The benefit of a TDM plan includes maximizing the efficiency of the existing transportation system, providing healthy commuter choices and by reducing vehicle trips which reduces greenhouse gas emissions. The Project proponent has committed to implementing a TDM program. The elements of the TDM program are described in the following paragraphs.

TDM Program Management

The project proponent will develop and implement a comprehensive TDM program that will be designed to minimize the number of SOVs by promoting alternative modes of transportation and monitoring and measuring the effectiveness of the program as the project is developed.

A Transportation Coordinator (TC) will serve as the single point of contact for tenants. Currently, there is not a Transportation Management Association (TMA) in the Town of Dracut. In neighboring Lowell and Tyngsborough, there is the Middlesex 3 TMA.

The TC will coordinate the TDM program and associated marketing and outreach activities with residents of the project. The TC, as part of the overall TDM program, will develop and implement quality control procedures and performance measures to ensure a high level of service, appropriate implementation of alternative transportation incentive programs, and effectiveness of those programs. The email address and phone number of the TC will be posted in a central location within the project building and made available to all tenants. The TC will be responsible for a project website which will include a transportation section with up-to-date information with respect to the TDM program, commuter options, and incentive programs. Included on the website and posted at centralized locations in every building will be the following:

- Massachusetts Bay Transportation Authority (MBTA) maps, schedules and fare information,

- Join a TMA (when a TMA and if a TMA is established),

- Location of bicycle parking areas within the project,

- Map of local and regional bicycle and pedestrian routes,

- Commuter options available through MassDOT's Bay State Commute program which provides opportunities for individuals that choose to walk, bicycle, carpool, vanpool or that use public transportation to travel to and from work,

- Location and contact information for car sharing services,

- Information on ride matching services,

In order to reduce SOVs overall, and to encourage walking and the use of bicycles to commute to the project, the project proponent has committed to the following measures:

- Encourage bicycle and pedestrian commuting options that will be marketed to tenants by the TC. This will include the development of up-to-date pedestrian and bicycle maps for local and regional facilities, and the locations of bicycle parking within the project.

- Dedicated carpool spaces will be located on-site.

- Electric car charging spaces on-site will be provided.

- Provide air pumps and other bicycle tools such as fix-it at a centralized location.

- Sponsor annual employee transportation information events.

CONCLUSION

Based on this assessment, the following can be concluded with respect to the Project:

- On a typical weekday, the proposed project is expected to generate 270 vehicle trips (135 vehicles entering and 135 vehicles exiting). During the weekday morning peak hour, 16 vehicle trips (4 vehicles entering and 12 vehicles exiting) are expected. During the weekday evening peak hour, 20 vehicle trips (13 vehicles entering and 7 vehicles exiting) are expected.

- The Project will not have a significant impact (increase) on motorist delays or vehicle queuing over Existing or anticipated future conditions without the Project (No-Build conditions). Volume to capacity ratios (v/c) at the unsignalized intersections show very small increases overall. The v/c ratios for the critical movements at the unsignalized study area intersections are well below 1.0, indicating capacity for the movement.

- Lines of sight at the Project site driveway intersections with Marsh Hill Road were found to exceed the recommended minimum distances for safe and efficient operation based on the appropriate approach speed.

- A review of the Site Plan for the Project indicates that human-made objects, landscaping, and signs have been appropriately designed and located so as not to inhibit sight lines to and from the Project site driveways along Bridge Street.