

# Traffic Impact Study

## Active Senior Residential Development

### Willow Road (Route 133) Boxford, MA

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## INTRODUCTION

McMahon Associates has completed a review of the existing traffic operations and potential traffic impacts associated with the proposed active senior residential development located on the north side of Willow Road (Route 133) in Boxford, MA. The purpose of this traffic impact study is to evaluate existing and projected traffic operations and safety conditions associated with the proposed development within the study area.

The assessment documented in this traffic impact study is based on a review of existing traffic volumes, recent crash data, and the anticipated traffic generating characteristics of the proposed project. The study examines existing and projected traffic operations (both with and without the proposed development) at key intersections in the vicinity of the project site. The study area was selected based on a review of the surrounding roadway network and estimated trip generating characteristics of the proposed project. This study provides a detailed analysis of traffic operations during the weekday morning and weekday afternoon peak hours, when the combination of adjacent roadway volumes and project trips would be expected to be the greatest.

Based on the analysis presented in this study, the traffic projected to be generated by the proposed development would have a negligible effect on the area roadways and intersections. The following report documents these findings.

### *Project Description*

The project site, depicted in Figure 1, is located on the north side of Willow Road approximately 650 feet east of Deer Run Road, in Boxford, MA. The site is bounded by undeveloped land to the north and east, Willow Road to the south, and residential properties to the west. The existing project site has historically been a farm, but its current operation is unknown.

The proposed project includes the razing of existing on-site structures and the construction of 66 active senior living duplexes and a clubhouse/amenities area. Access to the site would be provided via one full-access driveway connecting to Willow Road, approximately 925 feet east of Deer Run Road. An emergency vehicle access driveway would be located approximately directly opposite Deer Run Road.







### ***Study Methodology***

This traffic impact study evaluates existing and projected traffic operations within the study area for the weekday morning and weekday afternoon peak hour traffic conditions, when the combination of the adjacent roadway volumes and estimated project trips would be expected to be the greatest.

The study was conducted in three steps. The first step consisted of an inventory of existing traffic conditions within the project study area. As part of this inventory, manual turning movement counts were collected at key intersections during the weekday morning and afternoon peak periods. A field visit was also completed to document intersection and roadway geometries and available sight distances at the site driveways. Crash data for the study area intersections was obtained from the Massachusetts Department of Transportation (MassDOT) to determine if the study area has any existing traffic safety deficiencies.

The second step of the study builds upon the data collected in the first step to establish the basis for evaluating potential transportation impacts associated with the projected future conditions. During this second step, the projected traffic demands associated with any planned future developments that could influence traffic volumes at the study area intersections were assessed. Consistent with MassDOT traffic study guidelines, 2020 Existing traffic volumes were forecasted to the future year 2027 to determine 2027 No Build (without project) conditions and 2027 Build (with project) conditions.

The third step of this study determined if measures are necessary to improve future traffic operations and safety, minimize potential traffic impacts, and provide safe and efficient access to the site with the proposed project in place.

### ***Study Area Intersections***

Based on a review of the anticipated traffic generating characteristics of the proposed project and a review of the adjacent roadways serving the project site, the following study area intersections were selected for analysis:

- Willow Road at Deer Run Road
- Willow Road at the proposed site driveway
- Willow Road at Spofford Road/Pine Plain Road

The traffic impact study presented in this report documents existing and future traffic conditions for the study area intersections noted above.

## EXISTING CONDITIONS

An accurate assessment of the potential traffic impacts associated with the proposed active senior residential development requires a comprehensive understanding of the existing traffic conditions within the project study area. The existing conditions assessment included in this study consists of an inventory of intersection and roadway geometries, an inventory of traffic control devices, the collection of peak period traffic volumes, and a review of recent crash data. The existing conditions in the vicinity of the project site are summarized below.

### *Roadway Network and Intersections*

A brief description of the principal roadways providing access to the project site is presented below.

#### Willow Road (Route 133)

Willow Road generally runs in the east-west direction through the Town of Boxford. Willow Road is classified as an urban minor arterial and is under Town jurisdiction. In the vicinity of the site, Willow Road serves primarily residential land uses. One approximately 12-foot travel lane and one-foot shoulder are provided in each direction, with no sidewalks provided on either side of the roadway. A speed limit of 40 miles per hour is posted in both directions along Willow Road.

#### Deer Run Road

Deer Run Road is a local road which runs in the north-south direction for approximately 1,300 feet to the south of Willow Road. Deer Run Road is approximately 25 feet wide and accommodates two-way traffic. No sidewalks are provided on either side of the roadway and no speed limits are posted.

#### Spofford Road

Spofford Road is a local road under Town of Boxford jurisdiction which runs in the north-south direction east of the project site. Spofford Road provides one approximately 10 foot travel lane in each direction. There are no sidewalks provided on Spofford Road, and a speed limit of 25 miles per hour is posted in both directions in the vicinity of Willow Road.

#### Pine Plain Road

Pine Plain Road is a local road which runs in the north-south direction approaching Willow Road and intersects Willow Road directly opposite Spofford Road. Pine Plain Road is under Town of Boxford jurisdiction. Pine Plain Road is approximately 20 feet wide and allows for two-way travel. A speed limit of 25 miles per hour is posted in both directions of travel and no sidewalks are provided along Pine Plain Road within the study area.

## ***Existing Traffic Volumes***

### **Existing Peak Hour Traffic Volumes**

To assess peak hour traffic conditions, manual turning movement counts were conducted at the study area intersections during the weekday morning and weekday afternoon peak periods.

Counts were conducted at the study area intersections on Wednesday, March 11, 2020 from 7:00 AM to 9:00 AM and from 4:00 PM to 6:00 PM. The results of the turning movement counts are tabulated by 15-minute periods and are provided in Appendix A of this report. The four highest consecutive 15-minute intervals during each of these count periods constitute the peak hours that are the basis of the traffic analysis provided in this report. Based on a review of the peak period traffic data, the weekday morning peak hour at the study area intersections occurs between 7:00 AM and 8:00 AM and the weekday afternoon peak hour occurs between 5:00 PM and 6:00 PM.

A 48-hour Automatic Traffic Recorder (ATR) count was conducted on Willow Road between Deer Run Road and Spofford Road/Pine Plain Road in the vicinity of the proposed site driveway from Wednesday, September 26 to Thursday, September 27, 2018. The results of the ATR count are provided in Appendix A of this report and are summarized in Table 1 below.

**Table 1: Willow Road ATR Data Summary**

<b>Direction</b>	<b>ADT<sup>1</sup></b>	<b>85<sup>th</sup> %<sup>2</sup></b>	
		<b>Speed</b>	<b>HV%<sup>3</sup></b>
Eastbound	3,630	43	6.9%
Westbound	3,600	43	5.7%
Combined	7,230	43	6.3%

1 Average daily traffic volume in vehicles per day

2 85th percentile speed in miles per hour

3 Heavy vehicle percentage

As shown in Table 1, the ATR count on Willow Road shows an Average Daily Traffic (ADT) volume of approximately 3,630 vehicles in the eastbound direction and approximately 3,600 vehicles in the westbound direction in September 2018. The 85<sup>th</sup> percentile speeds in both directions was measured to be 43 miles per hour.

### **COVID-19 Adjustment**

The COVID-19 pandemic and changes in travel patterns associated with the crisis have resulted in significant decreases in roadway traffic volumes relative to recent prior years. The turning movement counts conducted on March 11, 2020, occurred approximately four days before all public and private schools in the state were ordered to close and in-restaurant



dining and gatherings of more than 25 people were banned. In order to assess the potential impacts of the COVID-19 pandemic on the turning movement counts conducted, historical data from the MS2 Traffic Dashboard was reviewed. MS2 is a transportation software and database company which is utilized by MassDOT to maintain its Transportation Data Management System. The daily traffic volume trends contained within MS2's Traffic Dashboard are based on continuous traffic count data at MassDOT count stations across the commonwealth, and report the change in daily volume between 2019 and 2020 for the same day of the week in the same month. MS2 Traffic Dashboard data for Massachusetts from February 27 to March 26, 2020 is provided in Appendix B of this report. As shown in Appendix B, statewide vehicle volumes on March 11, 2020 are shown to be approximately 0.4% greater than the 2019 equivalent-day volume. For this reason, no specific COVID-19 adjustment was made to the 2020 Existing condition vehicle volumes.

#### Seasonal Variation

Beyond the effects of COVID-19, normal variation in traffic volumes are expected to occur throughout the year. In order to account for these seasonal variations, continuous count data from a MassDOT count station on I-95 in Boxford were reviewed. Based on the seasonal trends of the data, traffic counts collected during the month of March are shown to be approximately 9% lower than the average month. Therefore, in order to provide a more conservative analysis, the existing peak hour traffic volumes were adjusted upward by approximately 9%. The seasonal adjustment data from the continuous count station referenced is provided in Appendix C of this report.

The seasonally adjusted peak hourly traffic flows for the 2020 Existing conditions are depicted in Figure 2 for the weekday morning peak hour and Figure 3 for the weekday afternoon peak hour.

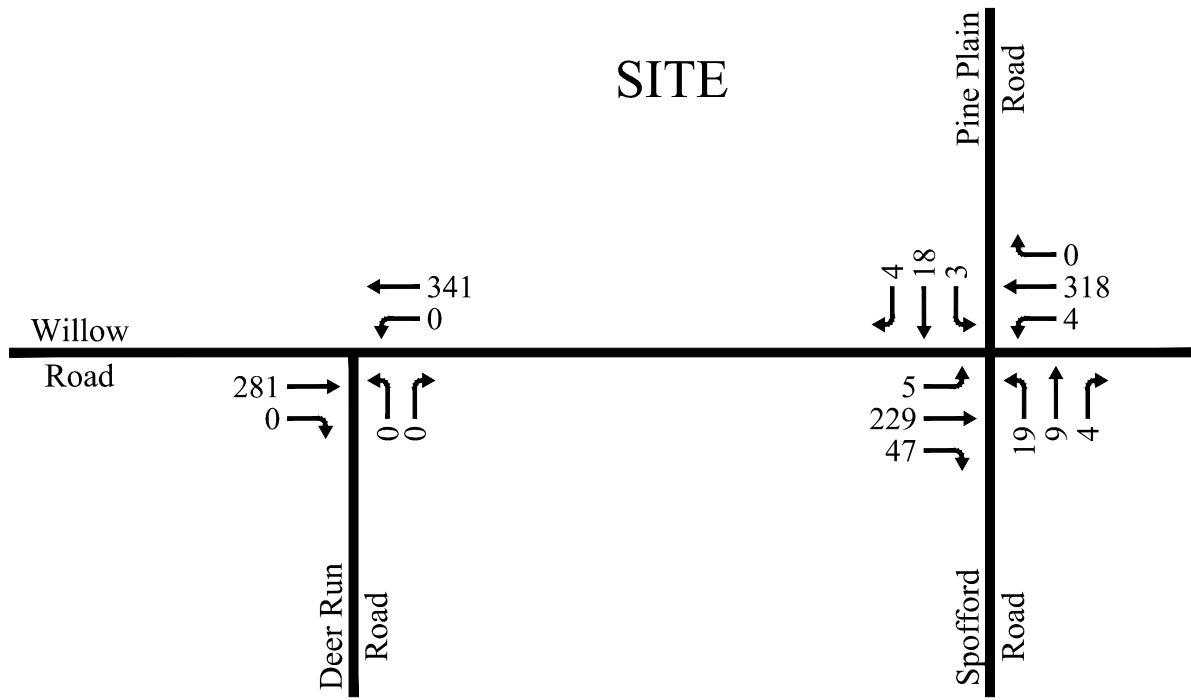


Figure 2  
2020 Existing Weekday Morning  
Peak Hour Traffic Volumes  
Active Senior Residential Development  
Boxford, Massachusetts

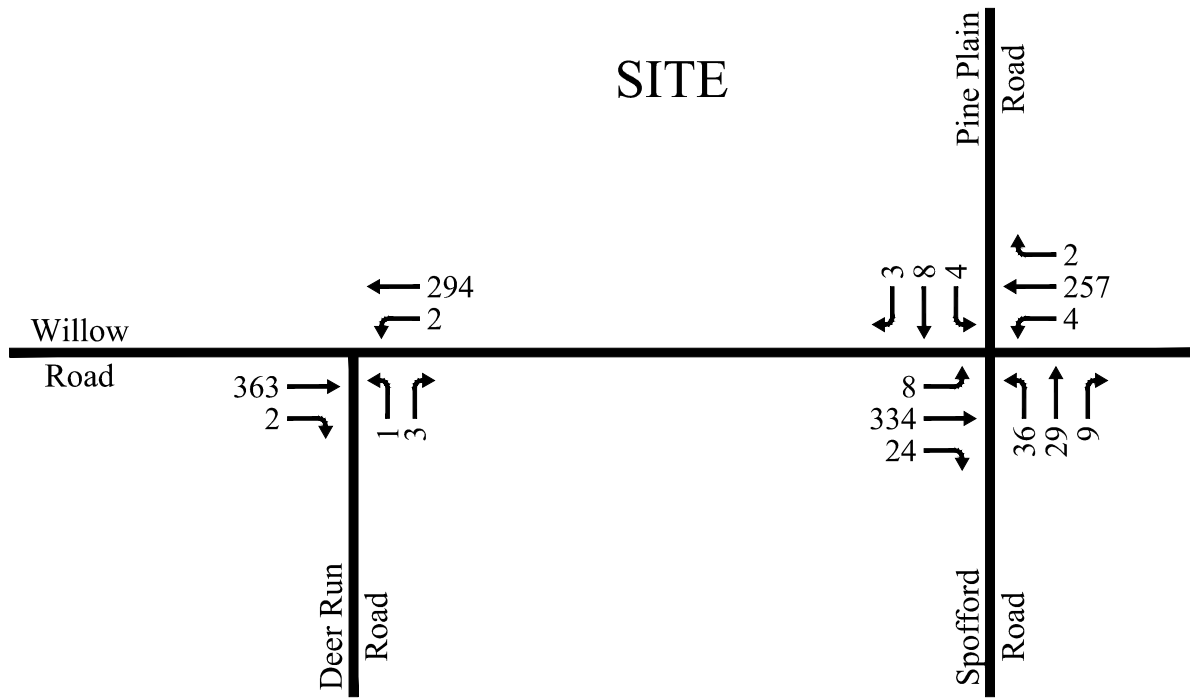


Figure 3  
2020 Existing Weekday Afternoon  
Peak Hour Traffic Volumes  
Active Senior Residential Development  
Boxford, Massachusetts

### *Crash Summary*

Crash data for the study area intersections was obtained from MassDOT for the most recently available five-year period from 2013 through 2017. A summary of the crash data is presented in Appendix D.

The MassDOT Crash Rate Worksheet calculations were used to determine whether the crash frequencies at the study area intersections were unusually high given the travel demands at each location. The MassDOT Crash Rate Worksheet calculates a crash rate expressed in crashes per million entering vehicles. The calculated rate is then compared to the average rate for signalized and unsignalized intersections statewide and within MassDOT District 4. For unsignalized intersections, the statewide and District 4 average crash rates are both 0.57 crashes per million entering vehicles.

The unsignalized intersection of Willow Road at Deer Run Road is reported to have experienced a total of two crashes in the five-year period analyzed, resulting in a crash rate of 0.17 crashes per million entering vehicles, which is well below the statewide and MassDOT District 4 average crash rate. Both reported crashes were single vehicle crashes, one of which resulted in personal injury and the other resulted in property damage only.

In the vicinity of the proposed site driveway location, two crashes were reported between 2013 and 2017 on Willow Road, resulting in a crash rate of 0.17 crashes per million entering vehicles. Both reported crashes were single vehicle crashes, one of which resulted in personal injury and the other resulted in property damage only.

Four crashes are reported in the MassDOT data during the five-year period analyzed at the unsignalized intersection of Willow Road at Spofford Road/Pine Plain Road. The resulting crash rate of 0.32 crashes per million entering vehicles is well below the statewide and MassDOT District 4 average crash rate. The manner of the collisions varied between the four crashes. One of the reported crashes resulted in personal injury, while the other three resulted in property damage only.



## **FUTURE CONDITIONS**

To determine future traffic demands on the study area roadways and intersections, the 2020 Existing traffic volumes were projected to the future-year 2027, in accordance with MassDOT guidelines. Traffic volumes on the study area roadways in 2027 are assumed to include all existing traffic, as well as new traffic resulting from general growth in the study area and from other planned development projects, independent of the proposed project. The potential background traffic growth, unrelated to the proposed project, was considered in the development of the 2027 No Build (without project) peak hour traffic volumes. The estimated traffic increases associated with the proposed project were then added to the 2027 No Build volumes to reflect the 2027 Build (with project) traffic conditions. A more detailed description of the development of the 2027 No Build and 2027 Build traffic volume networks is presented below.

### ***Future Roadway Improvements***

Planned roadway improvement projects can impact travel patterns and future traffic operations. MassDOT project information and the Town of Boxford were consulted to develop an understanding of future area roadway improvement projects. Based on these sources, no projects were identified which would be expected to directly affect conditions within the study area.

One potential roadway improvement project along Willow Road was identified via the MassDOT project database, a project which would include the reconstruction of Washington Street (Route 133) between the North Andover town line and its intersection with Main Street, approximately 1.5 miles west of the study area. The project would improve Washington Street (Route 133) to provide shared bicycle/pedestrian lanes on the roadway, and would also involve the realignment of several intersections and a number of other infrastructure improvements. This project is reported to have been in the 25% Design stage as of 2015, however the project would not be expected to significantly affect vehicle volumes or operations within the study area.

### ***Background Traffic Growth***

Traffic growth is generally a function of changes in motor vehicle use and expected land development within the area. In order to predict the rate at which traffic on the study area roadways can be expected to grow during the seven-year forecast period (2020 to 2027), both planned area developments and historic traffic growth were reviewed.

### **Site-Specific Growth**

Based on discussions with the Town of Boxford Planning Agent, no site-specific developments were identified which would be anticipated to impact traffic volumes within the study area. Additional construction related to fire-damaged houses and Approval Not

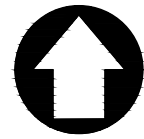
Required (ANR) projects was discussed, but the scale of these projects is expected to be minor and they are generally evenly distributed throughout the Town of Boxford. It is expected that additional vehicle trips associated with these minor developments would be captured within the general background growth rate discussed below.

#### Historic Traffic Growth

In order to establish an annual growth rate for the study area, the Merrimack Valley Planning Commission (MVPC) was contacted. Based on their analysis of historic traffic counts, the commission provided a growth rate of one percent per year for the study area. This one percent growth rate, compounded annually, was utilized to capture traffic growth associated with general changes in population, other small developments such as those discussed above, and developments that may not be known at this time.

#### ***2027 No Build Traffic Volumes***

The 2020 Existing peak hour traffic volumes were grown by one percent per year (compounded annually) over the seven-year study horizon (2020 to 2027) to establish the 2027 No Build weekday morning and afternoon peak hour traffic volumes, which are illustrated in Figure 4 and Figure 5, respectively, and are documented in the traffic projection model presented in Appendix E of this report.



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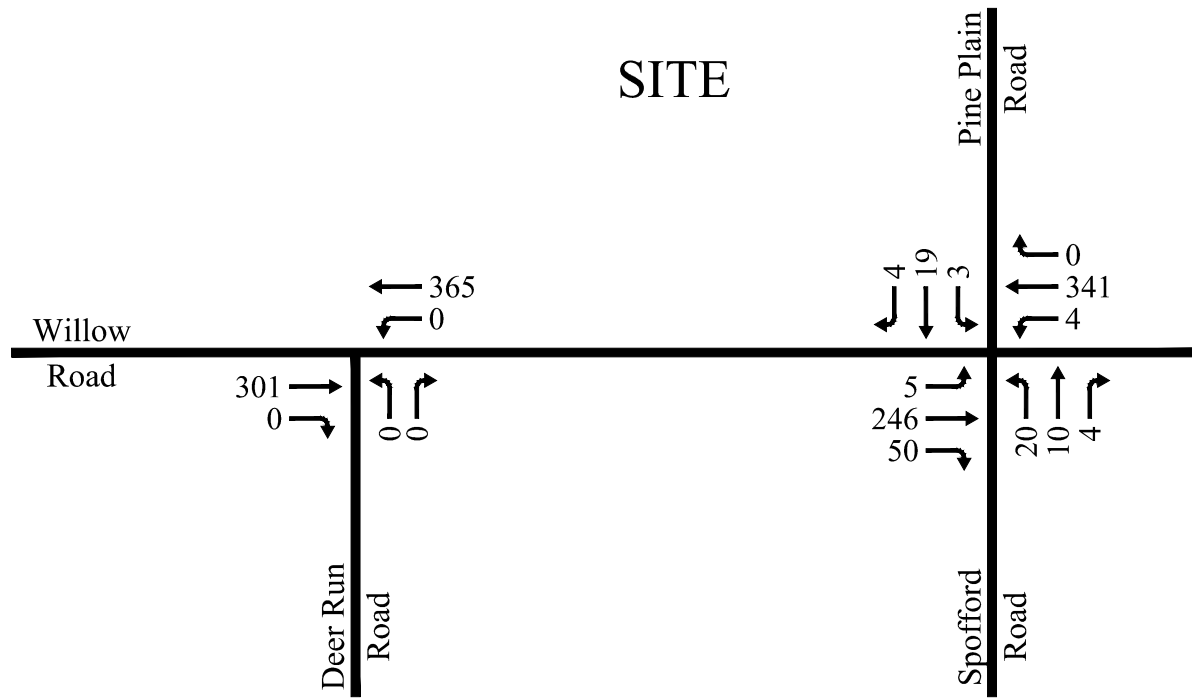
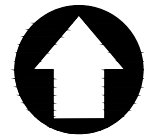


Figure 4  
2027 No Build Weekday Morning  
Peak Hour Traffic Volumes  
Active Senior Residential Development  
Boxford, Massachusetts



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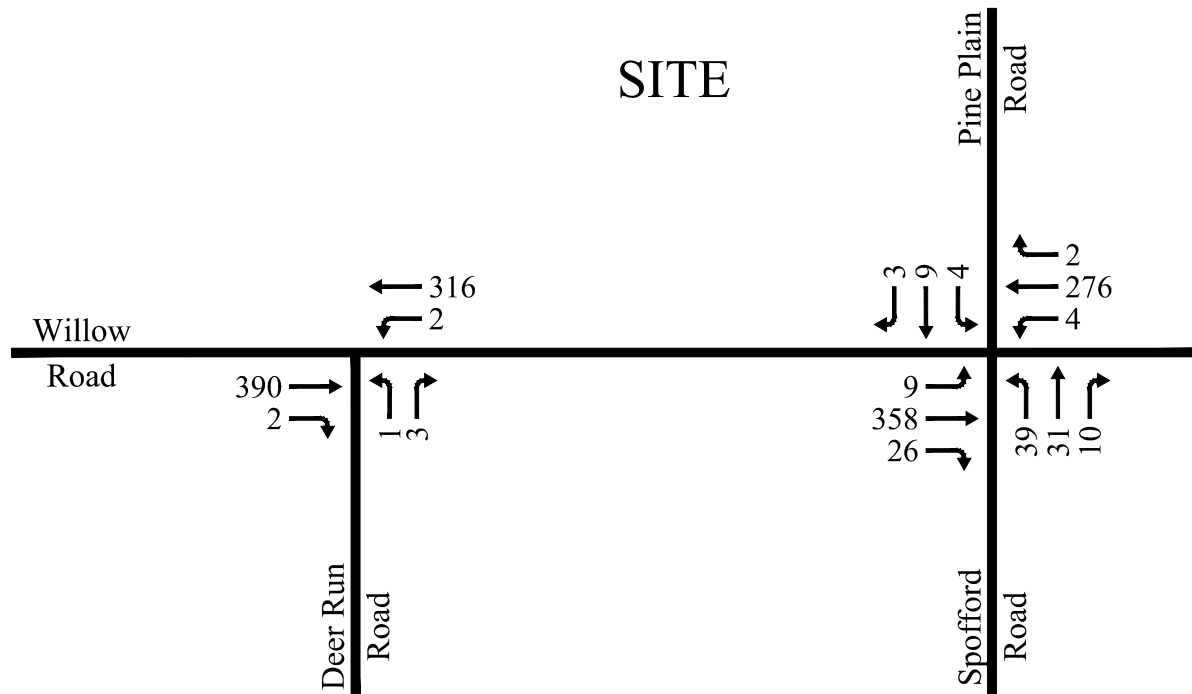


Figure 5  
2027 No Build Weekday Afternoon  
Peak Hour Traffic Volumes  
Active Senior Residential Development  
Boxford, Massachusetts



### ***Site-Generated Traffic***

In order to estimate the number of vehicle trips associated with the proposed senior living residential development, the Institute of Transportation Engineers' (ITE) publication, *Trip Generation Manual, 10<sup>th</sup> Edition*, was referenced. ITE is a national research organization of transportation professionals, and *Trip Generation Manual, 10<sup>th</sup> Edition* provides traffic generation information for various land uses compiled from studies conducted by members nationwide. For the proposed active senior residential development, two potential Land Use Codes (LUC) were identified: LUC 251 (Senior Adult Housing – Detached) and LUC 252 (Senior Adult Housing – Attached) both represent senior adult housing such as the proposed active senior development. Though the proposed duplexes would likely be considered attached housing, in order to present a more conservative analysis the vehicle trip estimates for the proposed development were developed based on LUC 251 (Senior Adult Housing – Detached). This reference establishes vehicle trip rates (in this case expressed in trips per number of dwelling units) based on actual traffic counts conducted at similar types of existing land uses.

The estimated vehicle trips associated with the proposed active senior residential development are presented in Table 2.

**Table 2: Proposed Project Trips**

Description	Size	Weekday AM			Weekday PM		
		Peak Hour			Peak Hour		
		In	Out	Total	In	Out	Total
Senior Residential <sup>1</sup>	66 dwelling units	10	20	30	21	14	35

1 ITE Land Use Code 251 (Senior Adult Housing - Detached), based on 66 dwelling units.

As shown in Table 2, the proposed active senior residential development is estimated to result in approximately 30 new vehicle trips (10 entering vehicles and 20 exiting vehicles) during the weekday morning peak hour and approximately 35 new vehicle trips (21 entering vehicles and 14 exiting vehicles) during the weekday afternoon peak hour. The number of estimated peak hour trips would result in approximately one additional vehicle trip on the adjacent roadways every two minutes during the weekday morning and afternoon peak hours.

### ***Project Trip Distribution and Assignment***

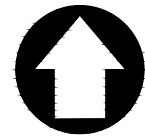
The additional traffic estimated to be generated by the proposed development was distributed onto the study area roadways and intersections based on the existing travel patterns of the adjacent roadways and on Census Journey-to-Work data for the Town of Boxford. A summary of the Journey-to-Work data and the existing travel patterns are provided in Appendix F of this report. The resulting arrival and departure patterns are

presented in Figure 6 and are documented in the traffic projection model found in Appendix E.

The project-related traffic was then assigned to the surrounding roadway network based on the project trip distribution patterns presented in Figure 6. The resulting distributed new project trips are shown in Figure 7 and Figure 8 for the weekday morning and weekday afternoon peak hours, respectively.

### ***2027 Build Traffic Volumes***

To establish the 2027 Build peak hour traffic volumes, the distributed new project trips were then added to the 2027 No Build peak hour traffic volumes to reflect the 2027 Build peak hour traffic volumes. The resulting 2027 Build weekday morning and afternoon peak hour traffic volumes are presented in Figure 9 and Figure 10, respectively, and are documented in the traffic projection model presented in Appendix E of this report.



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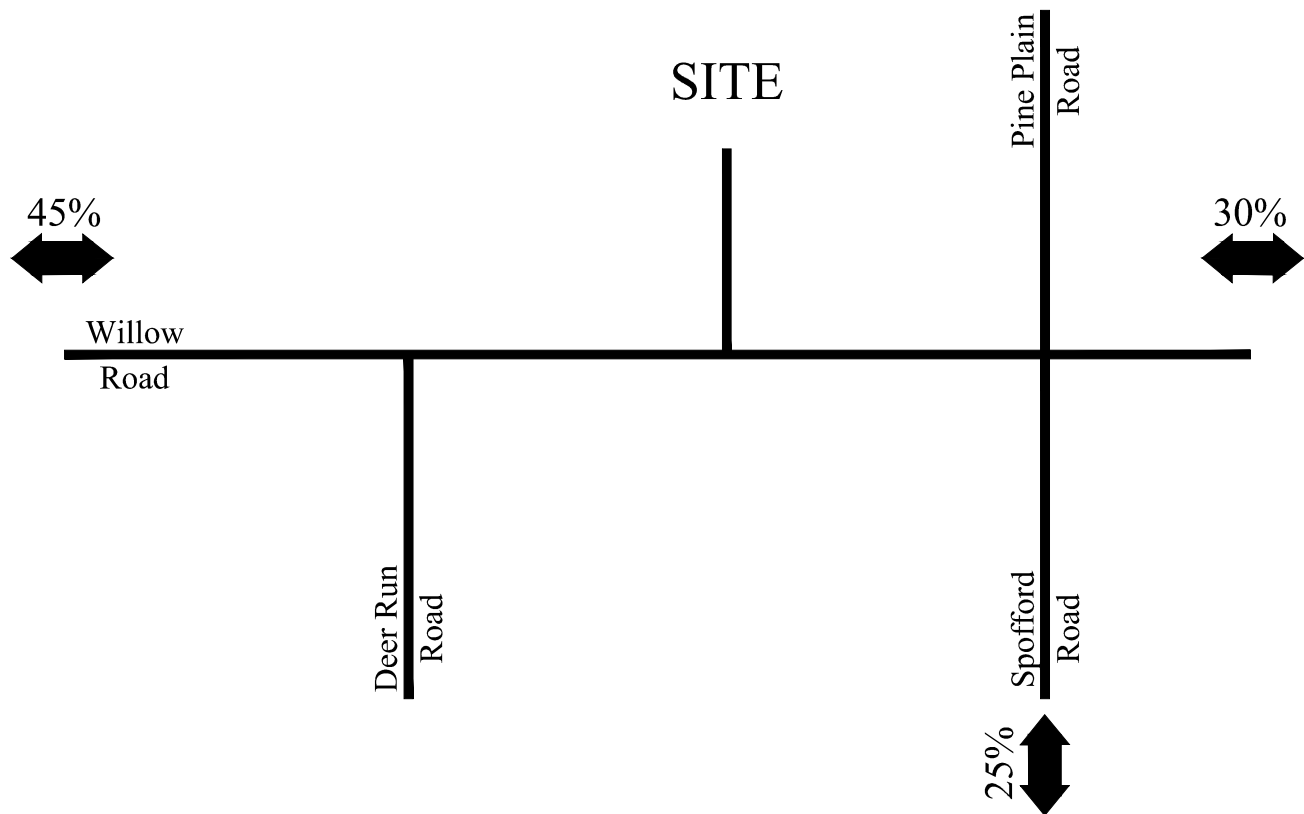
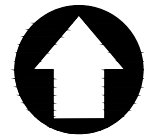
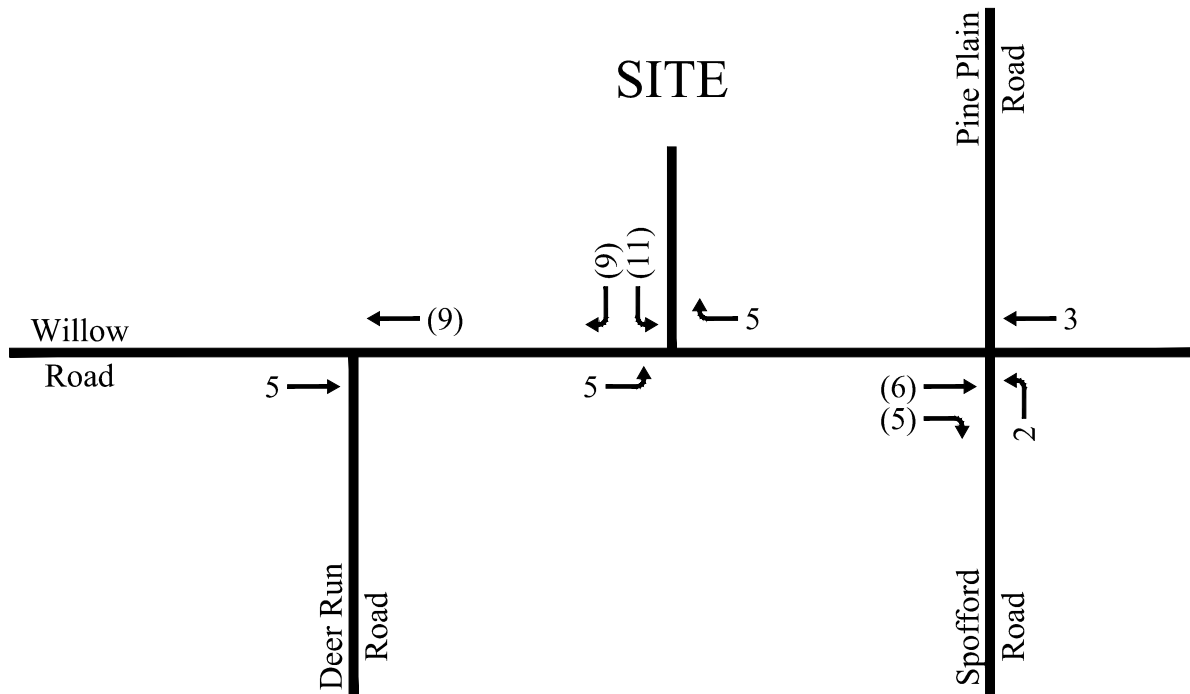


Figure 6  
Directions of Arrival and Departure  
Peak Hour Traffic Volumes  
Active Senior Residential Development  
Boxford, Massachusetts



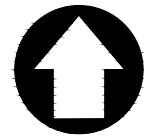
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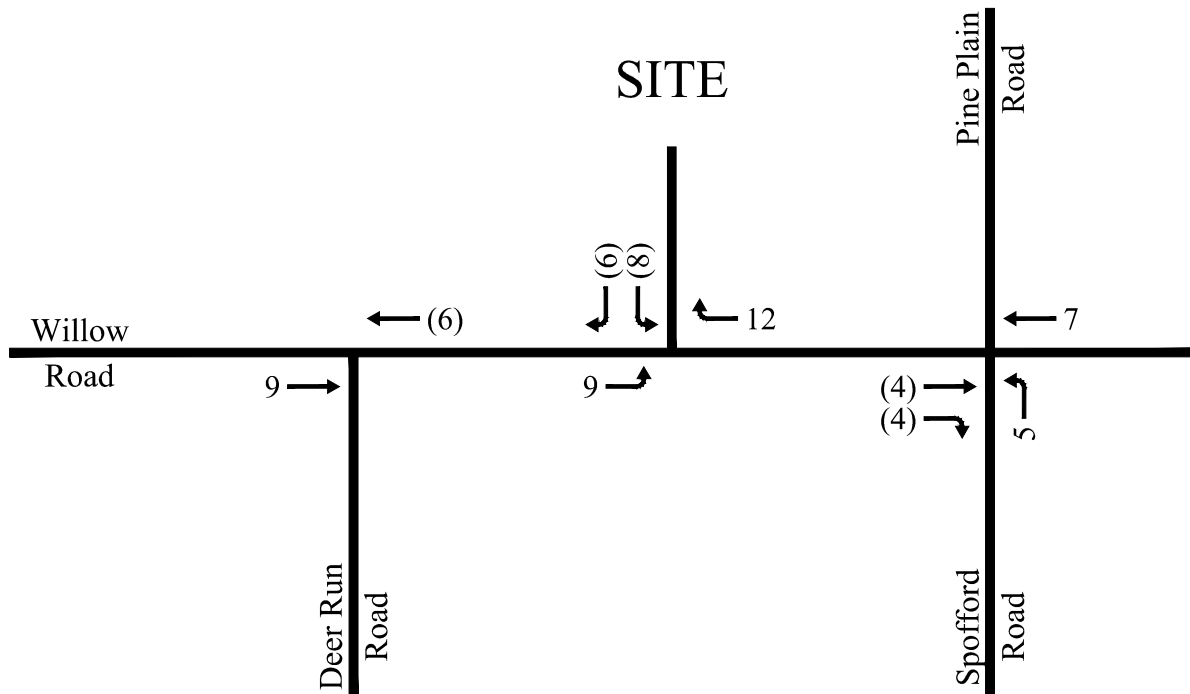
Legend  
Entering (Exiting)

Figure 7  
Weekday Morning Peak Hour  
New Project Trips  
Active Senior Residential Development  
Boxford, Massachusetts





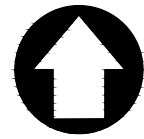
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Legend

Entering (Exiting)

Figure 8  
Weekday Afternoon Peak Hour  
New Project Trips  
Active Senior Residential Development  
Boxford, Massachusetts



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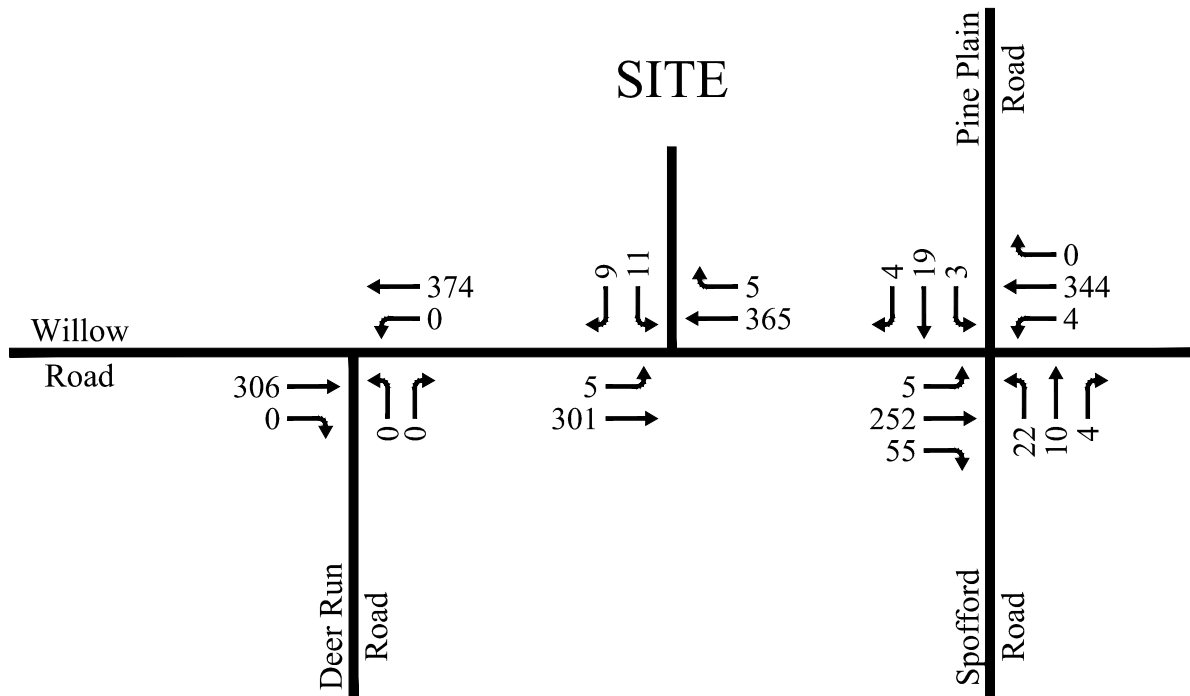
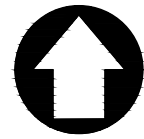


Figure 9  
2027 Build Weekday Morning  
Peak Hour Traffic Volumes  
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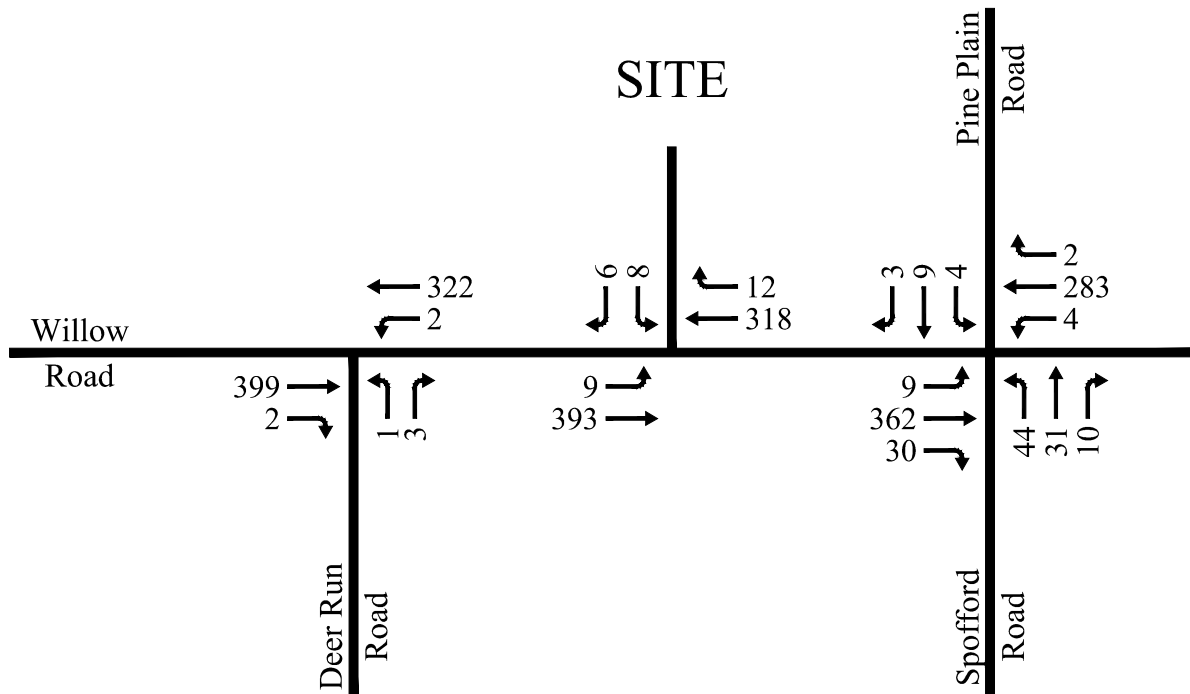


Figure 10  
2027 Build Weekday Afternoon  
Peak Hour Traffic Volumes  
Active Senior Residential Development  
Boxford, Massachusetts

## TRAFFIC OPERATIONS ANALYSIS

In previous sections of this report, the quantity of traffic at the study area intersections has been discussed. This section describes the overall quality of the traffic flow at the study area intersections during the weekday morning and weekday afternoon peak hours. As a basis for this assessment, intersection capacity analysis was conducted using the Synchro capacity analysis software at the study area intersections under the 2020 Existing, 2027 No Build and 2027 Build peak hour traffic conditions. The analysis is based on Synchro capacity analysis methodologies and procedures contained in the *Highway Capacity Manual, 6<sup>th</sup> Edition* (HCM), which is summarized in Appendix G. A discussion of the evaluation criteria and a summary of the results of the capacity analysis are presented below.

### *Level-of-Service Criteria*

Average total vehicle delay is reported as level-of-service (LOS) on a scale of A to F. LOS A represents delays of 10 seconds or less and LOS F represents delays in excess of 50 seconds for unsignalized intersections and greater than 80 seconds for signalized intersections. A more detailed description of the LOS criteria is provided in Appendix G.

### *Capacity Analysis Results*

Intersection capacity analysis was conducted using Synchro capacity analysis software for the study area intersections to evaluate the 2020 Existing, 2027 No Build, and 2027 Build traffic conditions during the weekday morning and weekday afternoon peak hours. As mentioned previously, the peak hour traffic volumes utilized as part of this analysis are provided in the traffic projection model, attached in Appendix E of this report.

The Synchro capacity analysis results for the 2020 Existing, 2027 No Build, and 2027 Build traffic conditions are presented in Appendix H, Appendix I, and Appendix J, respectively. The capacity analysis results for the critical stop-controlled approaches at each of the study area intersections are presented in Table 3. A more detailed summary of the capacity analysis for each study area intersection is provided in Appendix K. The results of the specific capacity analysis at the study area intersections are discussed below.

**Table 3: Unsignalized Intersection Capacity Analysis**

Intersection	Movement	Peak Period	2020 Existing			2027 No Build			2027 Build		
			LOS <sup>1</sup>	Delay <sup>2</sup>	V/C <sup>3</sup>	LOS	Delay	V/C	LOS	Delay	V/C
Willow Road (Route 133) at Deer Run Road	NB LR	AM	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00
		PM	B	11.9	0.01	B	12.3	0.01	B	12.4	0.01
Willow Road (Route 133) at Spofford Road/ Pine Plain Road	NB LTR	AM	C	17.6	0.15	C	19.0	0.17	C	19.6	0.18
		PM	C	18.6	0.25	C	20.2	0.31	C	21.7	0.32
	SB LTR	AM	C	16.5	0.10	C	17.5	0.11	C	17.8	0.11
		PM	C	15.7	0.08	C	16.9	0.10	C	17.1	0.10
Willow Road (Route 133) at Site Driveway	SB LR	AM	n/a	n/a	n/a	n/a	n/a	n/a	B	13.7	0.05
		PM	n/a	n/a	n/a	n/a	n/a	n/a	B	14.2	0.04

1 Level-of-Service

2 Average vehicle delay in seconds

3 Volume to capacity ratio

n/a Not applicable

During the weekday morning peak hour zero vehicles are shown making a turn from the northbound Deer Run Road approach under current or future conditions at the intersection of Willow Road at Deer Run Road. As such, during the weekday morning peak hour this approach is shown to operate with no delay. During the weekday afternoon peak hour, the stop-controlled Deer Run Road approach is shown to currently operate at LOS B. Under future conditions, without and with the proposed project in place, the approach is projected to continue to operate at LOS B, with negligible additional delay from 2027 No Build to 2027 Build conditions.

At the intersection of Willow Road at Spofford Road/Pine Plain Road, the stop-controlled northbound Spofford Road and southbound Pine Plain Road approaches are both shown to currently operate at LOS C during the weekday morning and afternoon peak hours. Under future conditions, without and with the proposed project in place, both approaches are projected to continue to operate at LOS C during both peak hours studied. With the proposed project in place, the Spofford Road approach is projected to operate with 1.5 seconds or less of additional average vehicle delay during both peak hours and the Pine Plain Road approach is projected to operate with approximately 0.5 seconds or less of additional average vehicle delay.

The site driveway approach to Willow Road is projected to operate at LOS B during both the weekday morning and weekday afternoon peak hour under 2027 Build conditions.

All movements along Willow Road at the study area intersections are projected to operate with negligible delay under 2020 Existing, 2027 No Build, and 2027 Build conditions.

### *Site Access and Circulation*

Access to the project site is proposed to be provided primarily by a full-access driveway on Willow Road, located approximately 925 feet east of an existing unpaved driveway on the site. A secondary site driveway to be used for emergency access only is proposed to be constructed on Willow Road directly opposite Deer Run Road. The proposed site driveways are expected to provide safe and efficient access to the site.

### *Sight Distance*

A field review of the available sight distance was conducted at the location of the proposed site driveway on Willow Road. The American Association of State Highway and Transportation Officials (AASHTO) publication, *A Policy on Geometric Design, 2018 Edition*, defines minimum and recommended sight distances at intersections. The minimum sight distance is based on the required stopping sight distance (SSD) for vehicles traveling along the main road. The recommended sight distance allows vehicles to enter the main street traffic flow without requiring the mainline traffic to slow to less than 70% of their speed and is referred to as intersection sight distance (ISD). According to AASHTO, "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 time to anticipate and avoid collisions."

In order to accurately assess required sight distance on Willow Road, the 85<sup>th</sup> percentile speeds of 43 mph in both directions measured from the ATR on Willow Road were utilized. Table 4 summarizes the AASHTO sight distance standards for the 85<sup>th</sup> percentile speeds on Willow Road and the available sight distance measured at each driveway.

**Table 4: Sight Distance Requirements**

Location	Looking	Speed 85th %		SSD <sup>1</sup> Required	ISD <sup>2</sup> Recommended	Sight Distance Measured	Meets Required SSD?
		Limit (mph)	Speed (mph)				
Site Driveway	Left (East)	40	43	325	415	500+	Yes
	Right (West)	40	43	340	475	500+	Yes

1 AASHTO stopping sight distance (see AASHTO equations 3-2 and 3-3) for the 85th percentile speed.

2 AASHTO intersection sight distance (see AASHTO equations 9-1 and 9-2) for the 85th percentile speed.

As shown in Table 4, the available sight distance for vehicles exiting the site onto Willow Road looking either direction was measured to be greater than 500 feet, which exceeds the required and recommended AASHTO sight distances for the 85<sup>th</sup> percentile speed.

Sight distance at the proposed emergency access driveway also exceeds the required sight distances for the 85<sup>th</sup> percentile speed, allowing for safe access and egress of emergency vehicles.

## CONCLUSION

The proposed project includes the construction of a 66-unit active senior living residential development on Willow Road (Route 133), approximately 650 feet east of Deer Run Road in Boxford, MA. Access to the site would be provided via a proposed full-access driveway located approximately 925 feet east of Deer Run Road. An additional driveway would be located on Willow Road directly opposite Deer Run Road provided for emergency access only.

Based on the analysis presented in this traffic impact study, the proposed project is estimated to generate approximately 30 new vehicle trips (10 entering vehicles and 20 exiting vehicles) during the weekday morning peak hour and approximately 35 new vehicle trips (21 entering vehicles and 14 exiting vehicles) during the weekday afternoon peak hour. The number of estimated peak hour trips would result in approximately one additional vehicle trip on the adjacent roadways every two minutes during the weekday morning and afternoon peak hours.

The capacity analysis indicates that the proposed active senior residential development is projected to have a negligible impact on the operations of the intersections of Willow Road at Deer Run Road and Willow Road at Spofford Road/Pine Plain Road, with all approaches at the intersections projected to operate at the same level-of-service under future conditions, without and with the proposed project in place. The driveway exiting the site is projected to operate at LOS B during the weekday morning and weekday afternoon peak hours.

Available sight distances at the primary site driveway on Willow Road exceed required and recommended sight distances for the 85<sup>th</sup> percentile of operating speeds on Willow Road, allowing for safe and efficient access and egress for vehicles entering and exiting the proposed development.

Based on a review of the analysis contained within this traffic impact study, the proposed active senior residential development is not shown to have a significant impact on the overall traffic operations of the study area intersections and roadways.