Transportation Impact Assessment

Proposed Residential Development
55 and 65 Farm Road
Sherborn, Massachusetts

Prepared for:

Fenix Parners Farm Road Development, LLC
Sherborn, Massachusetts

December 2022

Prepared by:

Vanasse & Associates inc
Transportation Engineers & Planners

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Dear Reviewer:

This letter shall certify that this *Transportation Impact Assessment* has been prepared under my direct supervision and responsible charge. I am a Registered Professional Engineer (P.E.) in the Commonwealth of Massachusetts (Massachusetts P.E. No. 38871, Civil) and hold Certification as a Professional Traffic Operations Engineer (PTOE) from the Transportation Professional Certification Board, Inc. (TPCB), an independent affiliate of the Institute of Transportation Engineers (ITE) (PTOE Certificate No. 993). I am also a Fellow of the Institute of Transportation Engineers (FITE).

Sincerely,

VANASSE & ASSOCIATES, INC.

Jeffrey S. Dirk

Jeffrey S. Dirk, P.E., PTOE, FITE
Managing Partner

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EXECUTIVE SUMMARY

Vanasse & Associates, Inc. (VAI) has conducted a Transportation Impact Assessment (TIA) in order to determine the potential impacts on the transportation infrastructure associated with the proposed construction of a residential development to be located at 55 and 65 Farm Road in Sherborn, Massachusetts (hereafter referred to as the "Project"). This assessment was prepared in consultation with the Massachusetts Department of Transportation (MassDOT) and the Town of Sherborn, and was performed in accordance with MassDOT's *Transportation Impact Assessment (TIA) Guidelines* and the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports.

Based on this assessment, we have concluded the following with respect to the Project:

1. Using trip-generation statistics published by the Institute of Transportation Engineers (ITE),[1] the Project is expected to generate approximately 264 vehicle trips on an average weekday (two-way, 24-hour volume), with 18 vehicle trips expected during the weekday morning peak-hour and 24 vehicle trips expected during the weekday evening peak-hour;

2. The Project will not result in a significant impact (increase) on motorist delays or vehicle queuing over anticipated future conditions without the Project (No-Build condition), with the majority of the movements at the study area intersections shown to operate at a level of service (LOS) of C or better, where an LOS of "D" or better is generally defined as "acceptable" operating conditions;

3. All movements at the Project site driveway intersection with Farm Road were shown to operate at LOS A during the peak hours with negligible vehicle queuing predicted;

4. No apparent safety deficiencies were noted with respect to the motor vehicle crash history at the study intersection; and

5. Lines of sight at the Project site driveway exceed, or could be made to exceed, the recommended minimum sight distance to function in a safe manner based on the appropriate approach speed.

[1] *Trip Generation,* 11th Edition; Institute of Transportation Engineers; Washington, DC; 2021.

In consideration of the above, we have concluded that the Project can be accommodated within the confines of the existing transportation infrastructure in a safe and efficient manner with implementation of the recommendations that follow.

RECOMMENDATIONS

A detailed transportation improvement program has been developed that is designed to provide safe and efficient access to the Project site and address any deficiencies identified at off-site locations evaluated in conjunction with this study. The following improvements have been recommended as a part of this evaluation and, where applicable, will be completed in conjunction with the Project subject to receipt of all necessary rights, permits, and approvals.

Project Access

Access to the Project site will be provided by way of a full-access driveway that will intersect the north side of Farm Road approximately 95 feet to the east of the existing gravel driveway that serves the Project site. The following recommendations are offered with respect to the design and operation of the Project site access and internal circulation:

- The Project site driveway and internal drives should be a minimum of 22 feet to the extent that parking along one or both sides of the drive will be prohibited and 24 feet otherwise, and designated to accommodate the turning and maneuvering requirements of the largest anticipated responding emergency vehicle.

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

- 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* (MUTCD).[2]

- A sidewalk should be provided along at least one side of the main driveway that should extend to Farm Road, where a school bus waiting area (widened sidewalk) should be provided.

- Driveways to the residential units should be a minimum of 21 feet long measured between the garage door and the far edge of the sidewalk (edge closest to the residence) where a sidewalk is provided, and 23 feet measured between the garage door and the edge of the traveled-way in locations without a sidewalk.

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

- Existing trees and vegetation located along the north side of Farm Road within the sight triangle area of the Project site driveway should be selectively trimmed or removed and maintained to provide the required line of sight.

[2]*Manual on Uniform Traffic Control Devices (MUTCD)*; Federal Highway Administration; Washington, D.C.; 2009.

- Snow accumulations (windrows) within the sight triangle areas of the Project site driveway will be promptly removed where such accumulations would impede sight lines.

Off-Site

Route 27/Farm Road

The addition of Project-related traffic to the Route 27/Farm Road intersection was not shown to result in a change in level-of-service for any movement over No-Build conditions, with Project-related impacts defined as an increase in average motorist delay of up to 3.9 seconds that resulted in a corresponding increase in vehicle queuing of up to one (1) vehicle. That being said and independent of the Project, it was noted that the Farm Road approach is predicted to operate at capacity (defined as LOS "E"). Given the limited impact of the Project at this intersection with no evidence of a specific safety deficiency based on a review of the MassDOT motor vehicle crash data, no improvements are recommended or appear to be required at this intersection to accommodate the Project

Transportation Demand Management

In an effort to encourage the use of alternative modes of transportation to single-occupant vehicles (SOVs), the following Transportation Demand Management (TDM) measures will be implemented as part of the Project:

- A transportation coordinator will be assigned for the Project to coordinate the TDM program;
- Information regarding public transportation services, maps, schedules, and fare information will be posted in a central location and/or otherwise made available to residents;
- A "welcome packet" will be provided to new residents detailing available public transportation services, bicycle and walking alternatives, and commuter options available;
- Pedestrian accommodations have been incorporated within the Project site and include a sidewalk that extends to Farm Road;
- A central maildrop should be provided; and
- Secure bicycle parking will be available to residents within the individual garages that are associated with each unit.

With implementation of the aforementioned recommendations, safe and efficient access will continue to be provided to the Project site and the Project can be accommodated within the confines of the existing and improved transportation system.

INTRODUCTION

Vanasse & Associates, Inc. (VAI) has conducted a Transportation Impact Assessment (TIA) in order to determine the potential impacts on the transportation infrastructure associated with the proposed construction of a residential development to be located at 55 and 65 Farm Road in Sherborn, Massachusetts (hereafter referred to as the "Project"). This study evaluates the following specific areas as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; and identifies and analyzes existing traffic conditions and future traffic conditions, both with and without the Project, along Farm Road and at the following specific intersections: South Main Street (Route 27) at Farm Road and Farm Road at Lake Street.

PROJECT DESCRIPTION

As proposed, the Project will entail the construction of a 32-unit residential development to be located at 55 and 65 Farm Road in Sherborn, Massachusetts. As proposed, the residential units will include 18 detached single-family homes and 7 attached duplex units (14 units total). The Project site encompasses approximately 13.06± acres of land that is bounded by areas of open and wooded space to the north; Farm Road, residential properties and areas of open and wooded space to the south; areas of open and wooded space to the east; and a residential property and areas of open and wooden space to the west. Figure 1 depicts the Project site location in relation to the existing roadway network. The Project site currently contains an existing single-family home located at 55 Farm Road that will be retained, and areas of open and wooded space, and low-lying wetland areas.

Access to the Project site will be provided by way of a full-access driveway that will intersect the north side of Farm Road approximately 95 feet to the east of the existing gravel driveway that serves the Project site.

Off-street parking will be provided in individual garages and driveways that will accommodate a minimum of two (2) vehicles per unit, with an additional eight (8) parking spaces provided in two (2) separate parking areas along the main driveway for visitors.

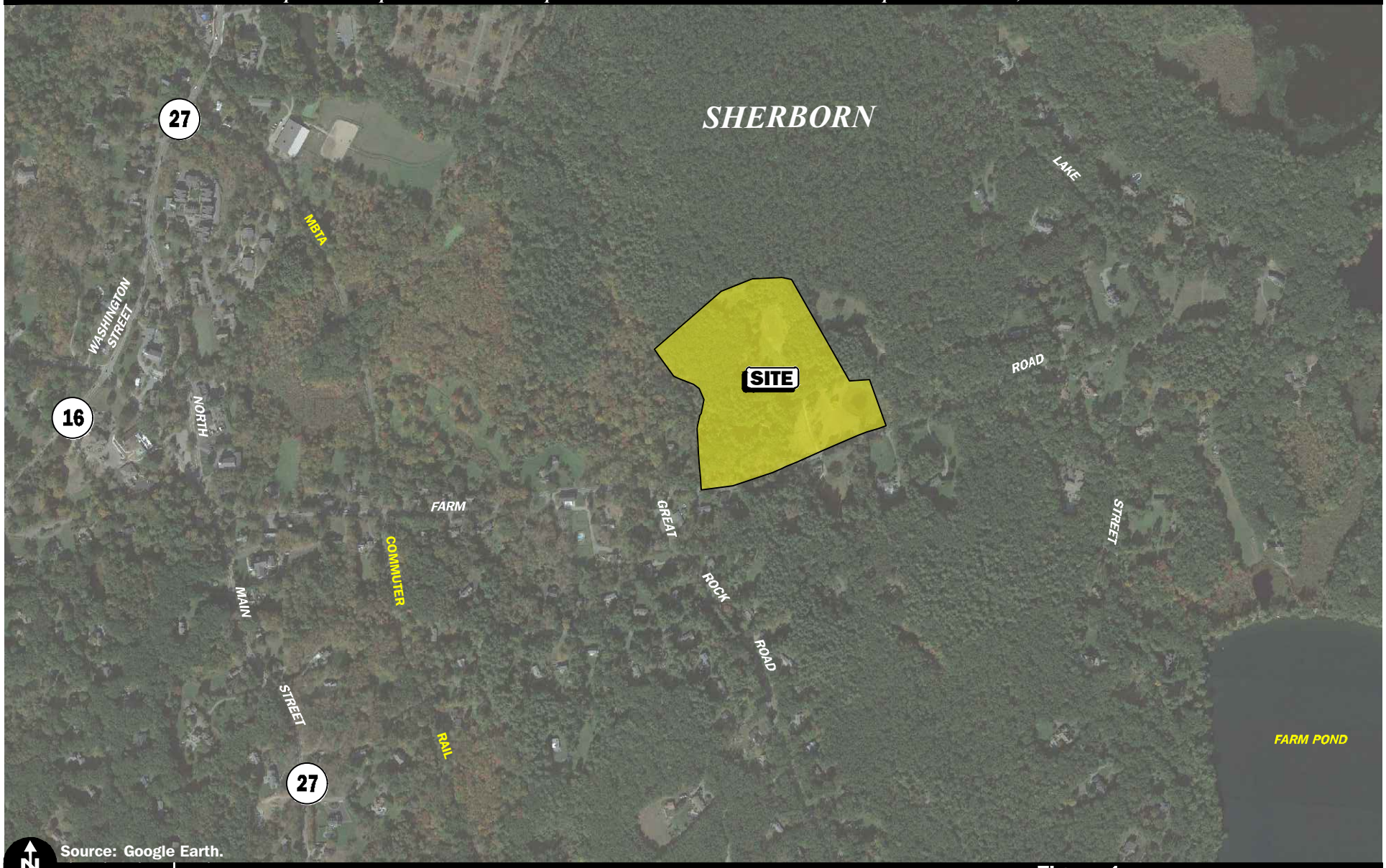

Figure 1

Site Location Map

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STUDY METHODOLOGY

This study was prepared in consultation with the Town of Sherborn and the Massachusetts Department of Transportation (MassDOT); was performed in accordance with MassDOT's *Transportation Impact Assessment (TIA) Guidelines* and the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports; and was conducted in three distinct stages.

The first stage involved an assessment of existing conditions in the study area and included an inventory of roadway geometrics; pedestrian and bicycle facilities; public transportation services; observations of traffic flow; and collection of daily and peak-period traffic counts.

In the second stage of the study, future traffic conditions were projected and analyzed. Specific travel demand forecasts for the Project were assessed along with future traffic demands due to expected traffic growth independent of the Project. A seven-year time horizon was selected for analyses consistent with MassDOT's *Transportation Impact Assessment (TIA) Guidelines*. The traffic analysis conducted in stage two identifies existing or projected future roadway capacity, traffic safety, and site access issues.

The third stage of the study presents and evaluates measures to address traffic and safety issues, if any, identified in stage two of the study.

EXISTING CONDITIONS

A comprehensive field inventory of existing conditions within the study area was conducted in September and August 2022. The field investigation consisted of an inventory of existing roadway geometrics; pedestrian and bicycle facilities; public transportation services; traffic volumes; and operating characteristics; as well as posted speed limits and land use information within the study area. The study area that was assessed for the Project consisted of Farm Road and the following intersections: Route 27 at Farm Road and Farm Road at Lake Street. The Lake Street north leg of the Farm Road/Lake Street intersection includes both an east and west leg which are separated by a raised island and operate independently. As such, this intersection has been described and evaluated as two (2) separate intersections: Farm Road/Lake Street East and Farm Road/Lake Street West.

The following describes the study area roadways and intersections.

ROADWAY

Farm Road

- Two-lane urban collector roadway under Town jurisdiction;
- Transverses study area in a general east-west direction;
- Provides two 10- to 11-foot wide travel lanes that are separated by a double-yellow centerline with 1- foot wide marked shoulders;
- The posted speed limit is 30 mph in the vicinity of the Project site and varies from 25 mph to 35 mph to the east;
- A sidewalk is provided on the north side of the roadway between Route 27 and the driveway to 25 Farm Road (approximately 1,100 feet east of Route 27);
- Illumination is not provided within the study area; and
- Land use within the study area consists of the Project site, residential properties, and areas of open and wooded space;

INTERSECTIONS

Table 1 and Figure 2 summarize existing lane use; traffic control, and pedestrian and bicycle accommodations at the study area intersection as observed in August 2022.

Table 1
STUDY AREA INTERSECTION DESCRIPTION

Intersection	Traffic Control Type[a]	No. of Travel Lanes Provided	Shoulder Provided? (Yes/No/Width)	Pedestrian Accommodations? (Yes/No/Description)	Bicycle Accommodations? (Yes/No/Description)
Rte. 27/Farm Rd.	S	1 general-purpose travel lane on all approaches	Yes; 1 foot on Rte. 27 and Farm Rd.	Yes; a sidewalk is provided along the north side of Farm Rd. between Route 27 and the dwy. to 25 Farm Rd., along the west side of Rte. 27 and along the east side Rte. 27 between the Pilgrim Church and Farm Rd.	No
Farm Rd./ Lake St. (West)	S	1 general-purpose travel lane on all approaches	Yes; 1 to 2 feet on all legs	No	No
Farm Rd./ Lake St. (East)	S	1 general-purpose travel lane on all approaches	Yes; 1 to 2 feet on all legs	No	No

[a]S = STOP-sign control.

TRAFFIC VOLUMES

In order to determine existing traffic-volume demands and flow patterns within the study area, automatic traffic recorder (ATR) counts, turning movement counts (TMCs), and vehicle classification counts were completed in September 2022. The ATR counts were conducted on September 14th through September 15th, 2022 (Wednesday through Thursday, inclusive) on Farm Road in the vicinity of the Project site in order to record weekday traffic conditions over an extended period, with weekday morning (7:00 to 9:00 AM) and evening (4:00 to 6:00 PM) peak-period TMCs performed at the study intersection on September 14th, 2022 (Wednesday). These time periods were selected for analysis purposes as they are representative of the peak traffic-volume hours for both the Project and the adjacent roadway network.

Traffic-Volume Adjustments

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, traffic-volume data from MassDOT Continuous Count Station No. AET09 located on Interstate 90 (I-90) in Framingham were reviewed.[3] Based on a review of this data it was determined that traffic volumes during the month of September are approximately 3.34 percent *above* average-month conditions. As such, no adjustment was made to the September traffic volumes as they are representative of above average conditions.

[3]MassDOT Traffic Volumes for the Commonwealth of Massachusetts; 2022.

Legend:

- Unsignalized Intersection
- Sidewalk
- XX' Lane Use and Travel Lane Width

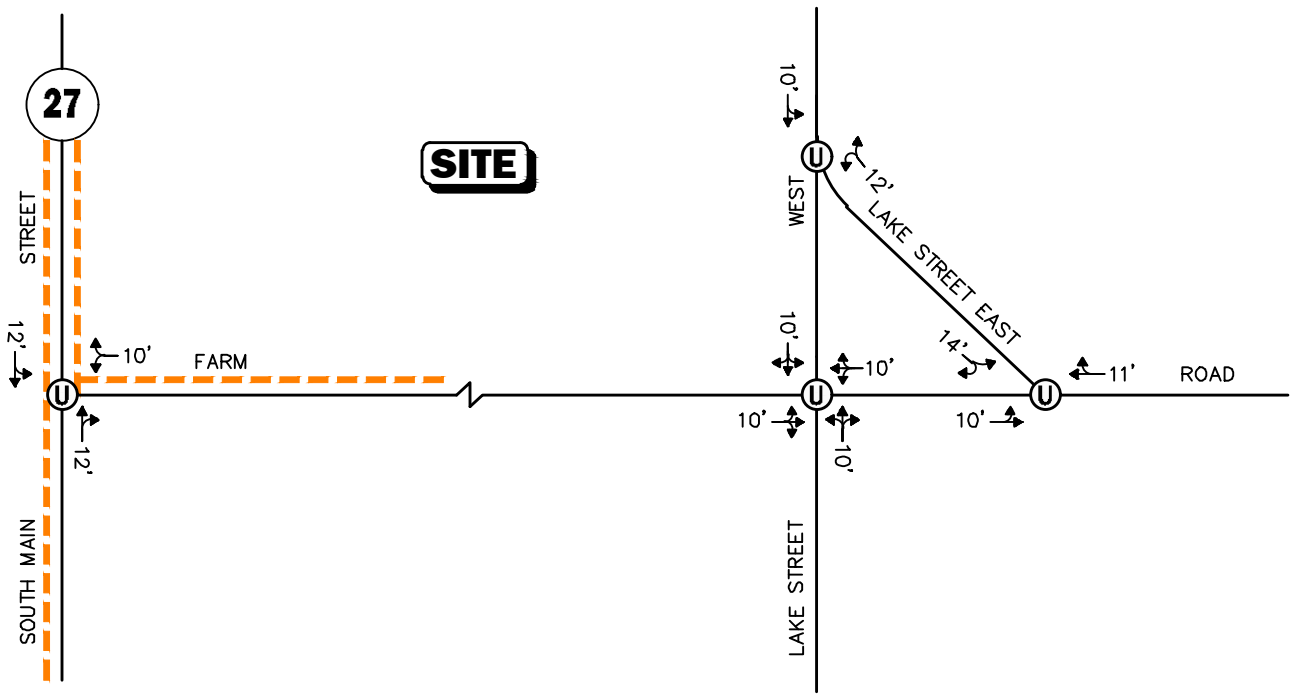

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Figure 2

Existing Intersection Lane Use, Travel Lane Width and Pedestrian Facilities

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In order to account for the impact on traffic volumes and trip patterns resulting from the COVID-19 pandemic, traffic-volume data collected at the MassDOT Continuous Count Station No. AET09 in September 2022 was compared to data collected at the same count station in September 2019. Based on this pre- and post-COVID-19 traffic-volume comparison, the traffic-volume data that was collected as part of this assessment was found to be approximately 5.9 percent *below* the conditions that existed prior to the COVID-19 pandemic. As such, the raw September traffic volumes were adjusted upward by 5.9 percent.

The 2022 Existing traffic volumes are summarized in Table 2, with the weekday morning and evening peak-hour traffic volumes graphically depicted on Figure 3. Note that the peak-hour traffic volumes that are presented in Table 2 were obtained from the aforementioned figure.

Table 2
2022 EXISTING TRAFFIC VOLUMES

Location/Peak Hour	AWT[a]	VPH[b]	K Factor[c]	Directional Distribution[d]
Farm Road, west of Lake Street West:	2,120	--	--	--
Weekday Morning (7:30 – 8:30 AM)	--	313	14.8	87.2% EB
Weekday Evening (5:00 – 6:00 PM)	--	243	11.5	69.1% WB

[a]Average weekday traffic in vehicles per day.
[b]Vehicles per hour.
[c]Percent of daily traffic occurring during the peak hour.
[d]Percent traveling in peak direction.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound.

As can be seen in Table 2, Farm Road in the vicinity of the Project site was found to accommodate approximately 2,120 vehicles on an average weekday (two-way, 24-hour volume), with approximately 313 vehicles per hour (vph) during the weekday morning peak-hour and 243 vph during the weekday evening peak-hour.

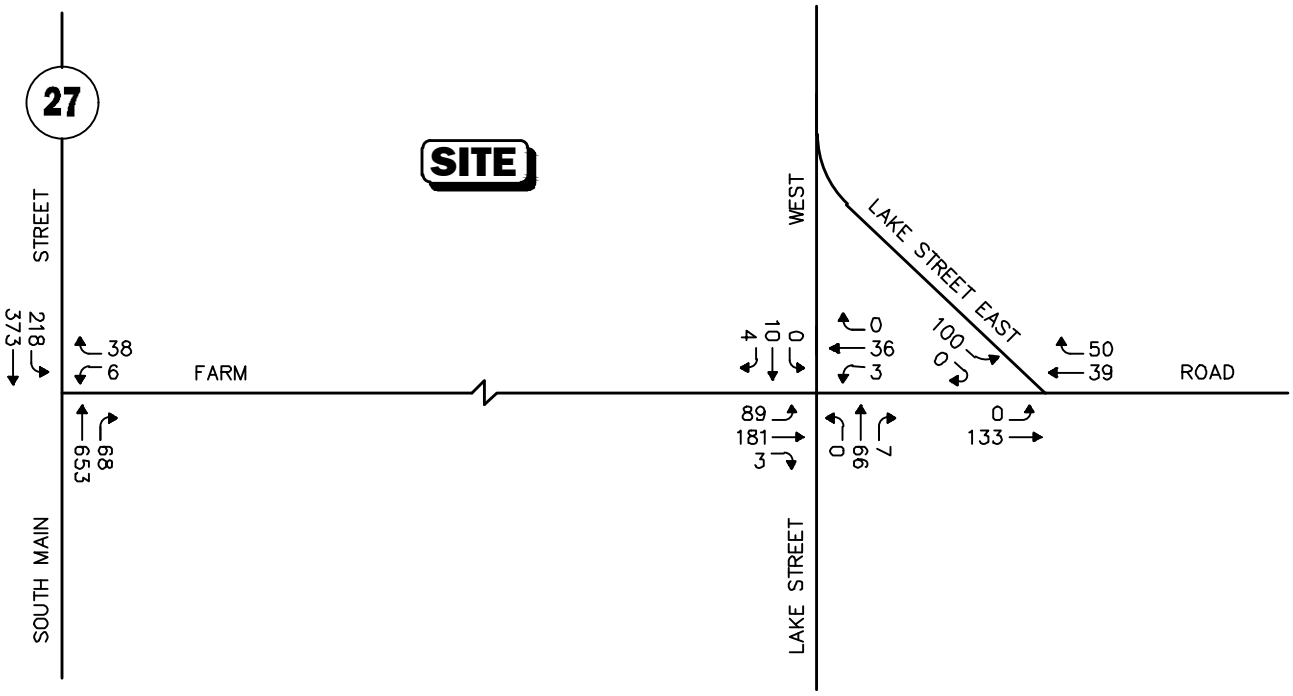
PEDESTRIAN AND BICYCLE FACILITIES

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in August 2022. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study area intersections, as well as the location of existing and planned future bicycle facilities. As detailed on Figure 2, sidewalks are provided along the west side of Route 27 and along the east side between the Pilgrim Church and Farm Road, and along the north side of Farm Road between Route 27 and the driveway to 25 Farm Road (approximately 1,100 feet east of Route 27).

Formal bicycle facilities are not provided within the study area and the study area roadways do not provide sufficient width (combined travel lane and shoulder) on a continuous basis to support bicycle travel in a shared traveled-way configuration.[4]

[4] Combined shoulder and travel lane width equal to or exceeding 14 feet.

WEEKDAY MORNING PEAK HOUR (7:30 - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (5:00 - 6:00 PM)

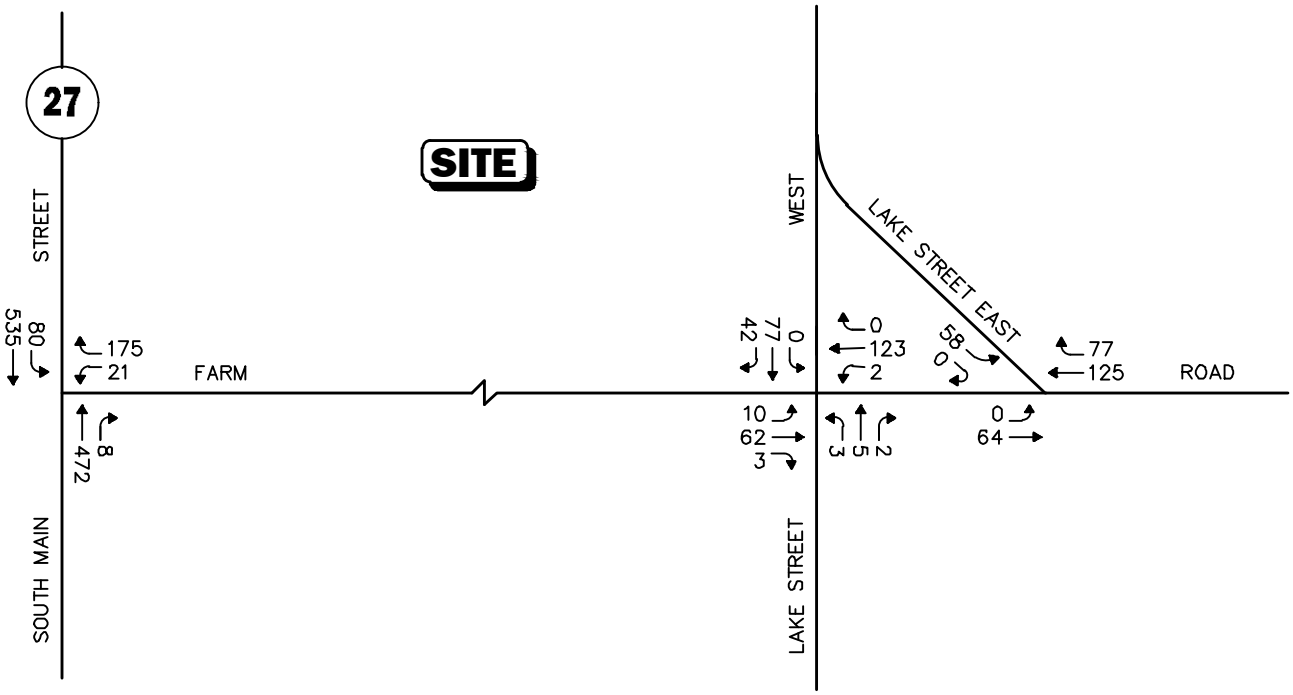


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Figure 3

2022 Existing
Peak-Hour Traffic Volumes

Vanasse & Associates inc

PUBLIC TRANSPORTATION

Regularly scheduled public transportation services are not currently provided within the Town of Sherborn or in the immediate vicinity of the Project site. The Sherborn Council on Aging (COA), with JFK Transportation in Natick, provides discounted taxi ride coupons. The cards cost $30.00 for a ten-ride coupon. JFK requires a 24-hour notice for local trips and a 48-hour notice for medical trips. The closest regularly scheduled public transportation services to the Project site are located in Natick (Massachusetts Bay Transportation Authority (MBTA) Commuter Rail service on the Framingham/Worcester Line from Natick Center Station).

SPOT SPEED MEASUREMENTS

Vehicle travel speed measurements were performed on Farm Road in the vicinity of the Project site in conjunction with the ATR counts. Table 3 summarizes the vehicle travel speed measurements.

Table 3
VEHICLE TRAVEL SPEED MEASUREMENTS

	Farm Road	
	Eastbound	Westbound
Mean Travel Speed (mph)	28	31
85th Percentile Speed (mph)	31	34
Posted Speed Limit (mph)	30	30

mph = miles per hour.

The mean vehicle travel speed along Farm Road in the vicinity of the Project site was found to be 28 mph in the eastbound direction and 31mph westbound, with the measured 85th percentile vehicle travel speed found to be 31 mph in the eastbound direction and 34 mph westbound, which is within a 5 mph pace of the posted speed limit in the vicinity of the Project site (30 mph). The 85th percentile speed is used as the basis of engineering design and in the evaluation of sight distances and is often used in establishing posted speed limits.

MOTOR VEHICLE CRASH DATA

Motor vehicle crash information for the study area intersection was provided by the MassDOT Highway Division Safety Management/Traffic Operations Unit for the most recent five-year period available (2015 through 2019, inclusive) in order to examine motor vehicle crash trends occurring within the study area. The data is summarized by intersection, type, severity, roadway and weather conditions, and day of occurrence, and presented in Table 4.

Table 4
MOTOR VEHICLE CRASH DATA SUMMARY[a]

	Route 27/ Farm Road	Farm Road/ Lake Street West	Farm Road/ Lake Street East
Traffic Control Type:[b]	U	U	U
Year:			
2015	1	0	1
2016	1	0	1
2017	1	0	1
2018	0	1	0
2019	0	0	0
Total	3	1	3
Average	0.60	0.20	0.60
Rate[c]	0.11	0.12	0.45
MassDOT Crash Rate:[d]	0.57/0.61	0.57/0.61	0.57/0.61
Significant?[e]	No	No	No
Type:			
Angle	1	1	0
Rear-End	0	0	0
Head-On	0	0	0
Sideswipe	0	0	0
Fixed Object	1	0	2
Pedestrian/Bicycle	0	0	0
Unknown/Other	1	0	1
Total	3	1	3
Conditions:			
Clear	3	1	1
Cloudy	0	0	1
Rain	0	0	1
Snow/Ice	0	0	0
Total	3	1	3
Lighting:			
Daylight	3	1	1
Dawn/Dusk	0	0	0
Dark (Road Lit)	0	0	1
Dark (Road Unlit)	0	0	1
Total	3	1	3
Day of Week:			
Monday through Friday	2	1	3
Saturday	1	0	0
Sunday	0	0	0
Total	3	1	3
Severity:			
Property Damage Only	1	1	2
Personal Injury	2	0	1
Fatality	0	0	0
Not Reported	0	0	0
Total	3	1	3

[a]Source: MassDOT Safety Management/Traffic Operations Unit records, 2015 through 2019.
[b]Traffic Control Type: U = unsignalized.
[c]Crash rate per million vehicles entering the intersection.
[d]Statewide/District crash rate.
[e]The intersection crash rate is significant if it is found to exceed the MassDOT crash rate for the MassDOT Highway Division District in which the Project is located (District 3).

As can be seen in Table 4, the study area intersections were found to have experienced an average of 0.6 or fewer reported motor vehicle crashes per year over the five-year review period and were found to have motor vehicle crash rates below the MassDOT statewide and District average crash rates for similar intersections for the MassDOT Highway Division District in which the intersections are located (District 3). The majority of the reported crashes occurred on a weekday; under clear weather conditions; during daylight; and involved collisions with a fixed object that resulted in property damage only.

A review of the MassDOT statewide High Crash Location List indicated that there are no locations within the study area or along Farm Road that are included on MassDOT's Highway Safety Improvement Program (HSIP) listing as a high crash location. In addition, no fatal motor vehicle crashes were reported to have occurred at the study area intersection over the five-year review period.

The detailed MassDOT Crash Rate Worksheet and High Crash Location mapping are provided in the Appendix.

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2029, which reflects a seven-year planning horizon consistent with MassDOT's *Transportation Impact Assessment (TIA) Guidelines*. Independent of the Project, traffic volumes on the roadway network in the year 2029 under No-Build conditions include all existing traffic and new traffic resulting from background traffic growth. Anticipated Project-generated traffic volumes superimposed upon the 2029 No-Build traffic volumes to reflect 2029 Build traffic-volume conditions with the Project.

FUTURE TRAFFIC GROWTH

Future traffic growth is a function of the expected land development in the immediate area and 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 may 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 procedure produces a more realistic estimate of growth for local traffic; however, potential population growth and development external to the study area would not be accounted for in the resulting traffic projections.

To provide a conservative analysis framework, both procedures were used, the salient components of which are described below.

Specific Development by Others

The Sherborn Town Planner was contacted in order to determine if there were any projects planned within the study area that would have an impact on future traffic volumes at the study intersections. Based on this discussion, the following developments were identified for review in conjunction with this assessment:

- ***Proposed Dunkin' with Drive-Through Window, Sherborn, Massachusetts.*** This project consists of the relocation of the existing Dunkin' restaurant located at 21 South Main Street (Route 27) and north of the Project to a new building just south of its current location that will include indoor seating and a drive through window.

- ***Greenwood Homes, Sherborn, Massachusetts.*** This project consists of the construction of four single-family homes to be located off Greenwood Street and southwest of the Project.

- ***Apple Hill Estates, Sherborn, Massachusetts.*** This project consists of the construction of 27 single-family homes to be located off Hunting Lane and north of the Project.

- ***Coolidge Crossing, Sherborn, Massachusetts.*** This project consists of the construction of 120 multi-family units to be located at 84 & 86 Coolidge Street and north of the Project.

- ***Meadowbrook Commons, Sherborn, Massachusetts.*** This project consists of the construction of 40 duplex units and 27 single-family homes to be located at 104 Coolidge Street and north of the Project.

- ***The Pines Residences, Sherborn, Massachusetts.*** This project consists of the construction of 60 multi-family units to be located at 41 North Main Street (Route 27) and north of the Project.

The traffic volumes associated with the aforementioned projects within the study area of this assessment are expected to be relatively minor and would be reflected in the general background traffic growth rate (discussion follows). No other developments were identified at this time that are expected to result in an increase in traffic within the study area beyond the general background traffic growth rate.

General Background Traffic Growth

Traffic-volume data compiled by MassDOT from permanent count stations located in the region were reviewed in order to determine general traffic growth trends in the area. This data indicates that traffic volumes have fluctuated over the 10-year period between 2009 and 2019, with an average traffic growth rate of 1.4 percent. In order to provide a prudent planning condition for the Project, a slightly higher 1.5 percent per year compounded annual background traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

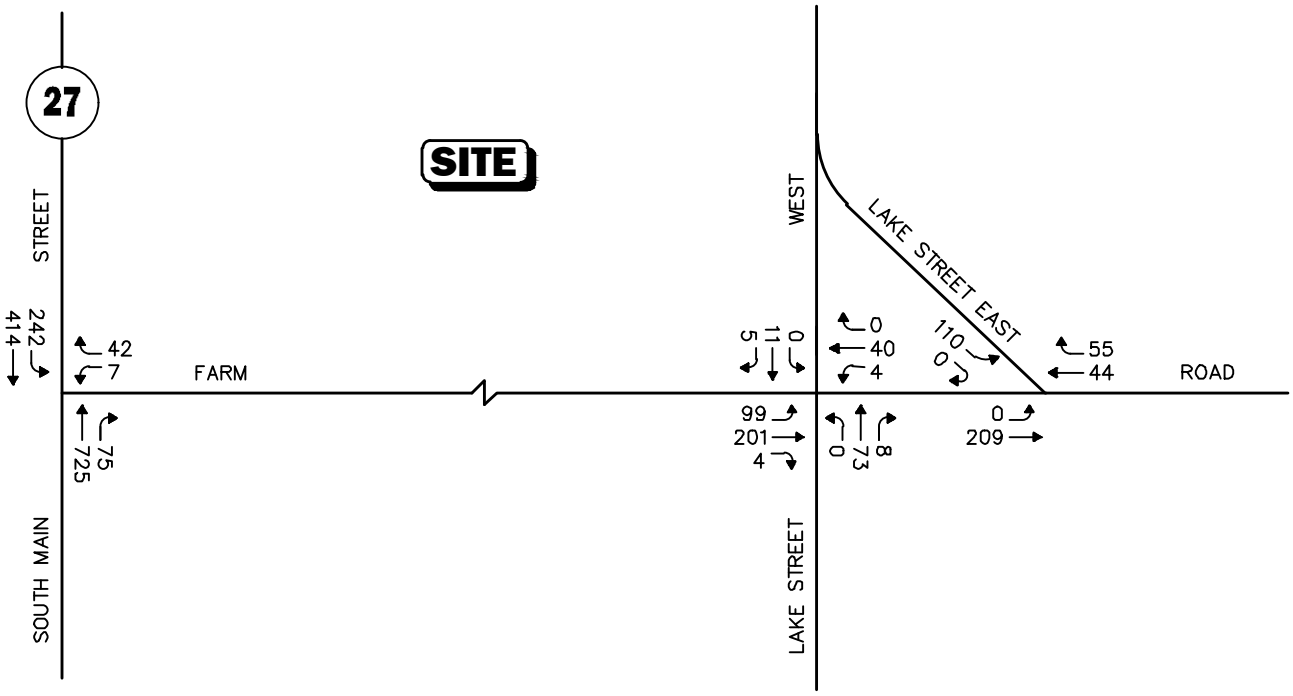
Roadway Improvement Projects

MassDOT and the Town of Sherborn were contacted in order to determine if there were any planned future roadway improvement projects expected to be completed by 2029 within the study area. Based on these discussions, no roadway improvement projects aside from routine maintenance activities were identified to be planned within the study area at this time.

No-Build Traffic Volumes

The 2029 No-Build condition peak-hour traffic volumes were developed by applying the 1.5 percent per year compounded annual background traffic growth rate to the 2022 Existing peak-hour traffic volumes. The resulting 2029 No-Build weekday morning and evening peak-hour traffic volumes are shown on Figure 4.

WEEKDAY MORNING PEAK HOUR (7:30 - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (5:00 - 6:00 PM)

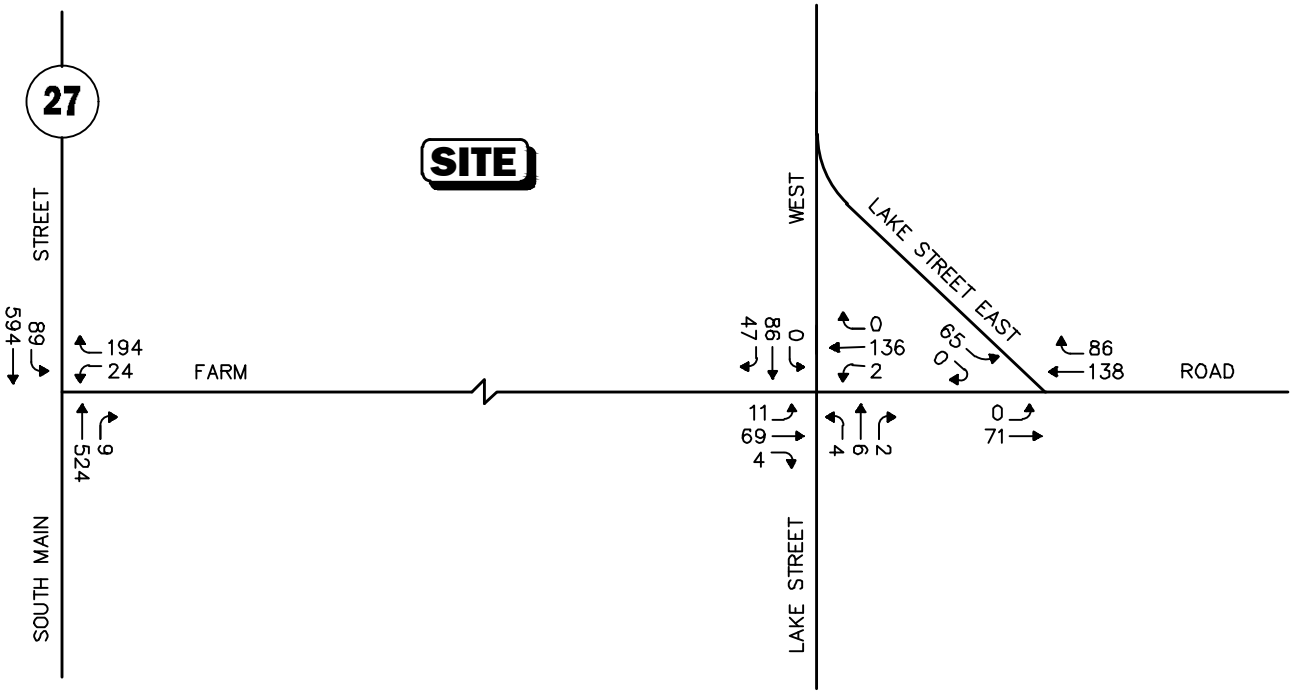


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Figure 4

2029 No-Build
Peak-Hour Traffic Volumes

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PROJECT-GENERATED TRAFFIC

Design year (2029 Build) traffic volumes for the study area roadways were determined by estimating Project-generated traffic volumes and assigning those volumes on the study roadways. The following sections describe the methodology used to develop the anticipated traffic characteristics of the Project.

As proposed, the Project will entail the construction of 32-unit residential development. As proposed, the residential units will include 18 detached single-family homes, and 7 attached duplex units (14 units total). In order to develop the traffic characteristics of the Project, trip-generation statistics published by the Institute of Transportation Engineers (ITE)[5] for similar land uses to those proposed were used. ITE Land Use Codes (LUCs) 210, *Single-Family Detached Housing*, and 215, *Single-Family Attached Housing*, were used to develop the trip-generation characteristics of the Project, the results of which are summarized in Table 5.

Table 5
TRIP-GENERATION SUMMARY

	Vehicle Trips		
Time Period/Direction	(A) Single-Family Detached Housing (18 units)[a]	(B) Single-Family Attached Housing (14 units)[b]	(A+B) Total Trips
Average Weekday Daily:			
Entering	104	28	132
Exiting	104	28	132
Total	208	56	264
Weekday Morning Peak-Hour:			
Entering	4	0	4
Exiting	12	2	14
Total	16	2	18
Weekday Evening Peak-Hour:			
Entering	12	3	15
Exiting	8	1	9
Total	20	4	24

[a]Based on ITE LUC 210, *Single-Family Detached Housing (18 units).*
[b]Based on ITE LUC 215, *Single-Family Attached Housing (14 units).*

Project-Generated Traffic-Volume Summary

As can be seen in Table 5, the Project is expected to generate approximately 264 vehicle trips on an average weekday (two-way, 24-hour volume, or 132 vehicles entering and 132 exiting), with 18 vehicle trips (4 vehicles entering and 14 exiting) expected during the weekday morning

[5]Ibid 1.

peak-hour and 24 vehicle trips (15 vehicles entering and 9 exiting) expected during the weekday evening peak-hour.

TRIP DISTRIBUTION AND ASSIGNMENT

The directional distribution of generated trips to and from the Project site was determined based on a review of Journey-to-Work data obtained from the U.S. Census for persons residing in the Town of Sherborn and then refined based on existing traffic patterns within the study area. The general trip distribution for the Project is graphically depicted on Figure 5. The additional traffic expected to be generated by the Project was assigned on the study area roadway network as shown on Figure 6 for the weekday morning and evening peak hours.

FUTURE TRAFFIC VOLUMES - BUILD CONDITION

The 2029 Build condition traffic volumes consist of the 2029 No-Build traffic volumes with the additional traffic expected to be generated by the Project added to them. The 2029 Build weekday morning and evening peak-hour traffic volumes are graphically depicted on Figure 7.

A summary of peak-hour projected traffic-volume changes outside of the study area that is the subject of this assessment is shown in Table 6. These changes are a result of the construction of the Project.

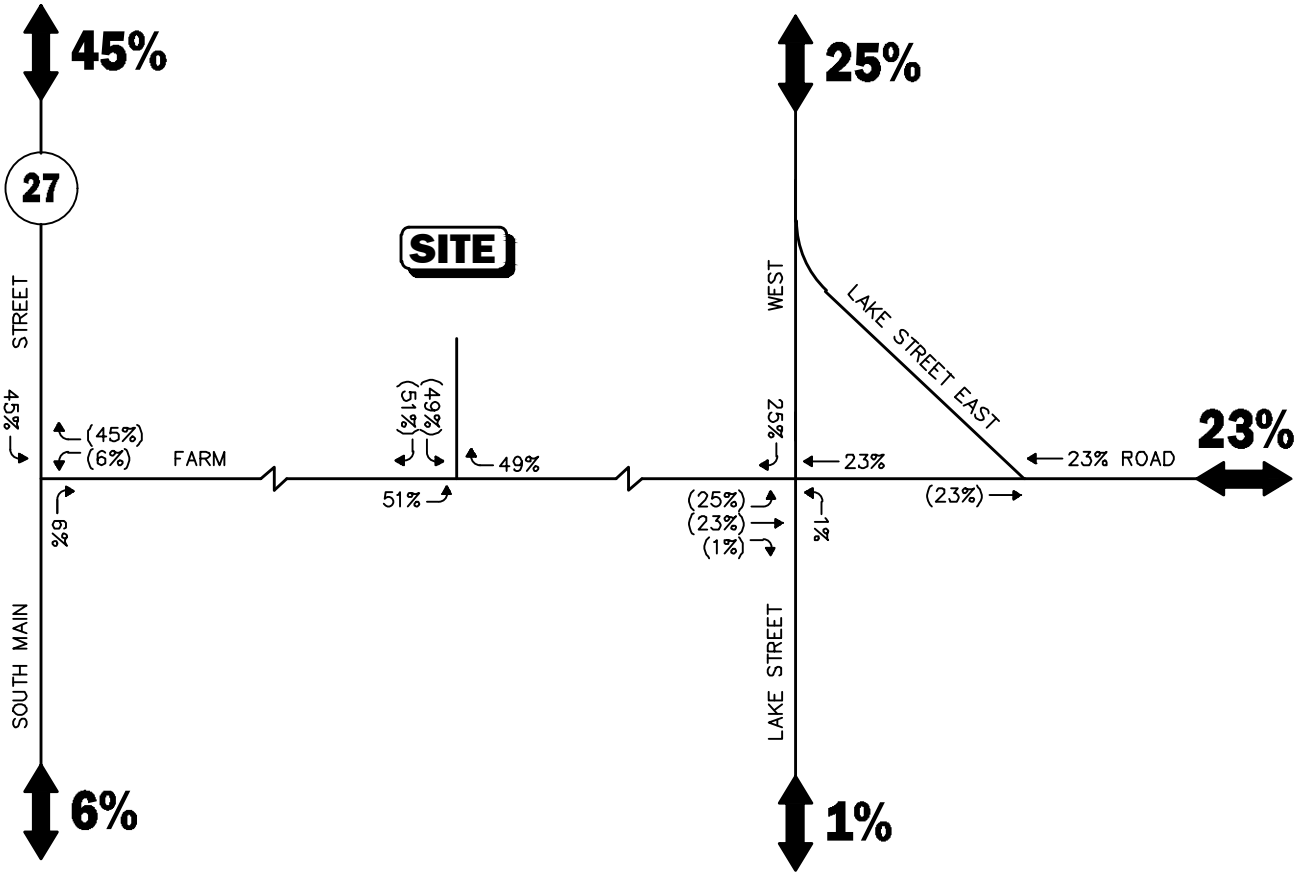
Table 6
PEAK-HOUR TRAFFIC-VOLUME INCREASES

Location/Peak-Hour	2022 Existing	2029 No-Build	2029 Build	Traffic-Volume Increase Over No-Build	Percent Increase Over No-Build
Route 27, north of Farm Road:					
Weekday Morning	1,282	1,423	1,431	8	0.6
Weekday Evening	1,262	1,401	1,412	11	0.8
Route 27, south of Farm Road:					
Weekday Morning	1,100	1,221	1,222	1	0.1
Weekday Evening	1,036	1,151	1,153	2	0.2
Farm Road, east of Lake Street:					
Weekday Morning	322	418	422	4	1.0
Weekday Evening	266	360	365	5	1.4
Lake Street, north of Farm Road:					
Weekday Morning	319	353	358	5	1.4
Weekday Evening	269	301	307	6	2.0
Lake Street, south of Farm Road					
Weekday Morning	89	100	100	0	0.0
Weekday Evening	92	104	104	0	0.0

Legend:

XX Entering Trips

(XX) Exiting Trips



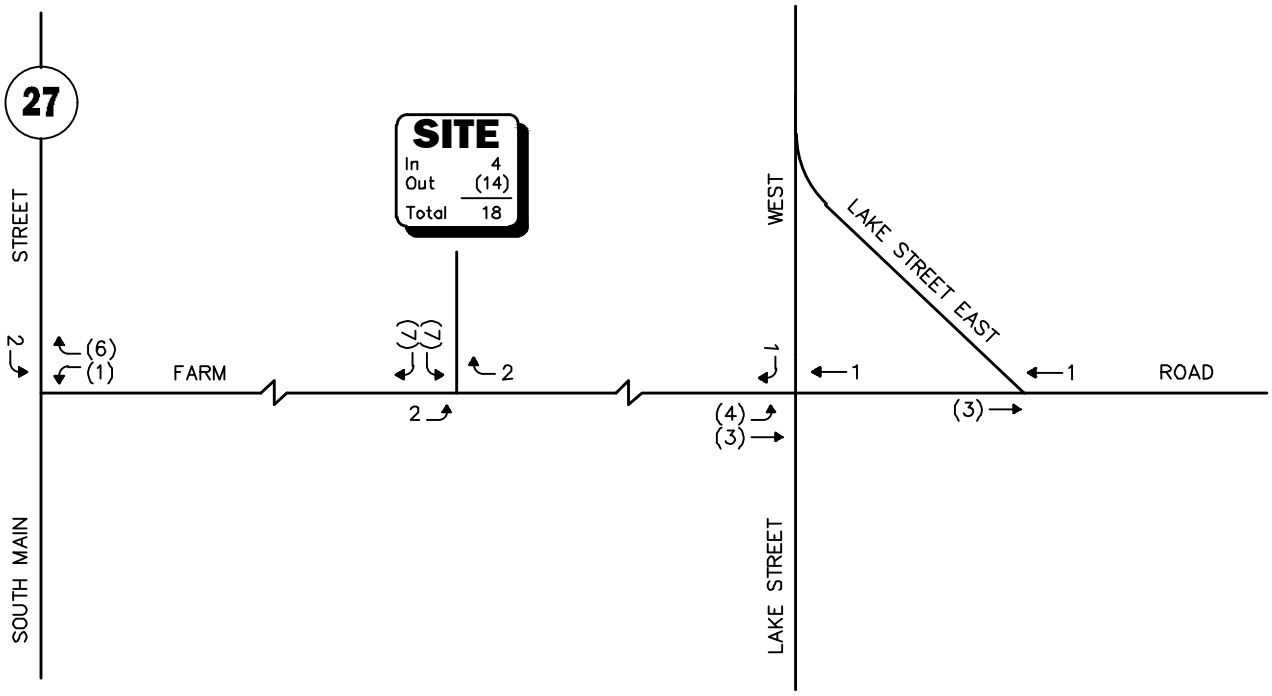
Not To Scale

Figure 5

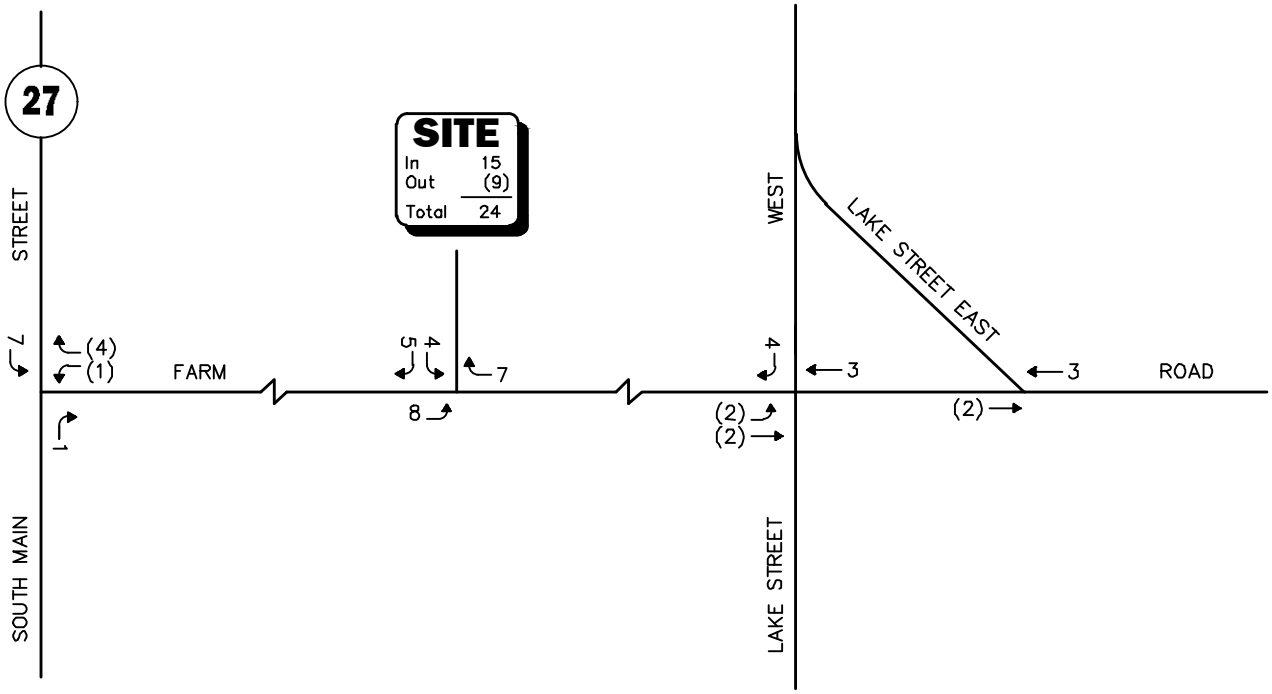
Trip Distribution Map

Vanasse & Associates inc

WEEKDAY MORNING PEAK HOUR (7:30 - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (5:00 - 6:00 PM)



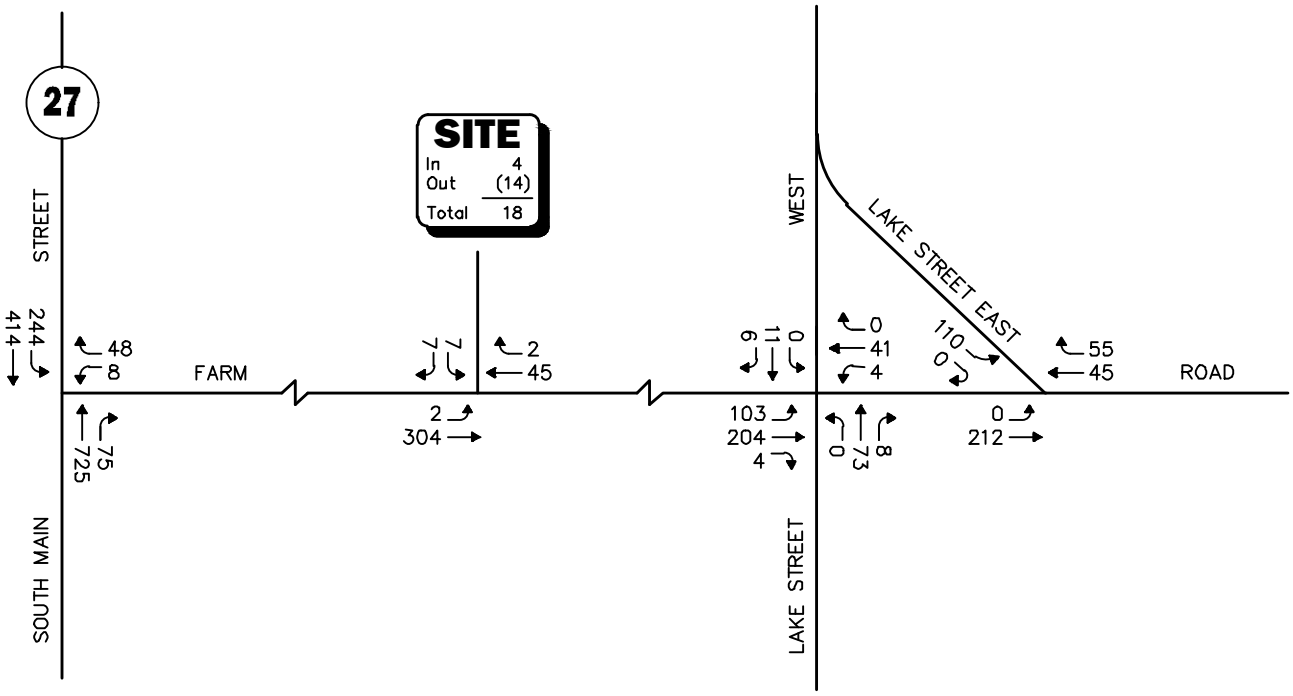
Not To Scale

Figure 6

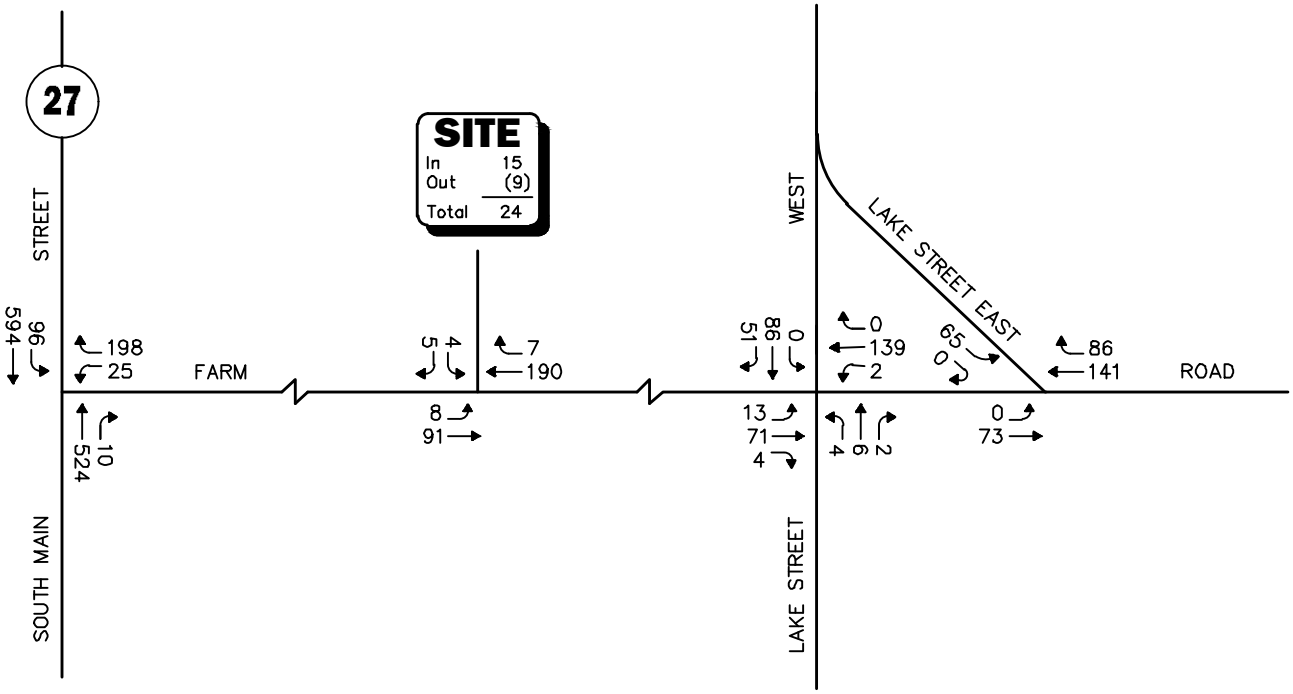
Project-Generated Peak-Hour Traffic Volumes

Vanasse & Associates inc

WEEKDAY MORNING PEAK HOUR (7:30 - 8:30 AM)



WEEKDAY EVENING PEAK HOUR (5:00 - 6:00 PM)



Not To Scale

Figure 7

2029 Build
Peak-Hour Traffic Volumes

Vanasse & Associates inc

As shown in Table 6, Project-related traffic-volume increases outside of the study area relative to 2029 No-Build conditions are anticipated to range from 0.1 to 1.3 percent during the peak periods, with vehicle increases shown to range from 1 to 11 vehicles. ***When distributed over the respective peak hours and to the roadway network that serves the Project site, the identified traffic-volume increases outside the immediate study area are not expected to result in a significant increase in motorist delays or vehicle queuing over anticipated future conditions without the Project (i.e., No-Build conditions).***

TRAFFIC OPERATIONS ANALYSIS

Measuring existing and future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity and vehicle queue analyses were conducted under Existing, No-Build, and Build traffic-volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

METHODOLOGY

Levels of Service

A primary result of capacity analyses is the assignment of level of service to traffic facilities under various traffic-flow conditions.[6] The concept of level of service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with level-of-service (LOS) A representing the best-operating conditions and LOS F representing congested or constrained operating conditions.

Since the level of service of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year.

[6]The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual;* Transportation Research Board; Washington, DC; 2010.

Unsignalized Intersections

The six levels of service 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 levels of service of unsignalized intersections are determined by application of a procedure described in the 2010 *Highway Capacity Manual.*[7] Level of service 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 level of service at unsignalized intersections are also given in the 2010 *Highway Capacity Manual*. Table 7 summarizes the relationship between level of service and average control delay for two-way STOP-controlled and all-way STOP-controlled intersections.

Table 7
LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS[a]

Level-Of-Service by Volume-to-Capacity Ratio		Average Control Delay (Seconds Per Vehicle)
v/c ≤ 1.0	v/c > 1.0	
A	F	≥ 10.0
B	F	10.1 to 15.0
C	F	15.1 to 25.0
D	F	25.1 to 35.0
E	F	35.1 to 50.0
F	F	> 50.0

[a]Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010; page 19-2.

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

Vehicle Queue Analysis

Vehicle queue analyses are a direct measurement of an intersection's ability to process vehicles under various traffic control and volume scenarios and lane use arrangements. The vehicle queue analysis was performed using the Synchro® intersection capacity analysis software which is based upon the methodology and procedures presented in the 2010 *Highway Capacity Manual*. The Synchro® vehicle queue analysis methodology is a simulation-based model which reports the number of vehicles that experience a delay of 6 seconds or more at an intersection. For signalized intersections, Synchro® reports both the average (50th percentile) and the 95th percentile vehicle queue. For unsignalized intersections, Synchro® reports the 95th percentile vehicle queue. Vehicle queue lengths are a function of the capacity of the movement under study and the volume of traffic being processed by the intersection during the analysis period. The 95th percentile vehicle queue is the vehicle queue length that will be exceeded only 5 percent of the time, or approximately 3 minutes out of 60 minutes during the peak one hour of the day (during the remaining 57 minutes, the vehicle queue length will be less than the 95th percentile queue length).

ANALYSIS RESULTS

Level-of-service and vehicle queue analyses were conducted for 2022 Existing, 2029 No-Build, and 2029 Build conditions for the intersections within the study area. The results of the intersection capacity and vehicle queue analyses are summarized in Table 8, with the detailed analysis results presented in the Appendix.

The following is a summary of the level-of-service and vehicle queue analyses for the intersections within the study area. For context, we note that an LOS of "D" or better is generally defined as "acceptable" operating conditions.

Unsignalized Intersections

Project-related impacts at the unsignalized study area intersections are shown in Table 8 and are defined as follows:

Route 27 at Farm Road

No change in level-of-service is predicted to occur for any movement over No-Build conditions, with Project-related impacts defined as an increase in average motorist delay of up to 3.9 seconds that resulted in a corresponding increase in vehicle queuing of up to one (1) vehicle. Independent of the Project, all movements from Farm Road are predicted to operate at capacity (i.e., LOS E) under No-Build conditions during both peak hours.

Farm Road at Lake Street West

No change in level-of-service is predicted to occur for any movement over No-Build conditions, with Project-related impacts defined as an increase in average motorist delay of up to 0.4 seconds that resulted in a corresponding increase in vehicle queuing of up to one (1) vehicle.

Farm Road at Lake Street East

No change in level-of-service or vehicle queuing is predicted to occur for any movement over No-Build conditions, with Project-related impacts generally defined as an increase in average motorist delay of up to 0.1 seconds.

Farm Road at Project Site Driveway

All movements at the Project site driveway intersection with Farm Road were shown to operate at LOS A during both peak hours with negligible vehicle queuing predicted.

Table 8
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Unsignalized Intersection/ Peak-Hour/Movement	2022 Existing				2029 No-Build				2029 Build			
	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Route 27 at Farm Road												
Weekday Morning:												
Farm Road WB LT/RT	44	25.9	D	1	49	39.0	E	2	56	42.9	E	2
Route 27 NB TH/RT	721	0.0	A	0	800	0.0	A	0	800	0.0	A	0
Route 27 SB LT/TH	591	4.2	A	1	656	4.6	A	2	658	4.7	A	2
Weekday Evening:												
Farm Road WB LT/RT	196	24.8	C	4	218	38.3	E	6	223	41.5	E	7
Route 27 NB TH/RT	480	0.0	A	0	533	0.0	A	0	534	0.0	A	0
Route 27 SB LT/TH	615	1.2	A	1	683	1.2	A	1	690	1.3	A	1
Farm Road at Lake Street West												
Weekday Morning:												
Farm Road EB LT/TH/RT	273	2.5	A	0	304	2.5	A	1	311	2.5	A	1
Farm Road WB LT/TH	39	0.6	A	0	44	0.7	A	0	45	0.7	A	0
Lake Street West NB LT/TH/RT	73	15.2	C	1	81	16.8	C	1	81	17.2	C	1
Lake Street West SB TH/RT	14	12.7	B	0	16	13.4	B	0	17	13.4	B	1
Weekday Evening:												
Farm Road EB LT/TH/RT	75	1.0	A	0	84	1.0	A	0	88	1.1	A	0
Farm Road WB LT/TH	125	0.1	A	0	138	0.1	A	0	141	0.1	A	0
Lake Street West NB LT/TH/RT	10	10.9	B	0	12	11.4	B	0	12	11.6	B	0
Lake Street West SB TH/RT	119	11.8	B	1	133	12.4	B	2	137	12.6	B	2
Farm Road at Lake Street East												
Weekday Morning:												
Farm Road EB TH	188	0.0	A	0	209	0.0	A	0	212	0.0	A	0
Farm Road WB TH/RT	89	0.0	A	0	99	0.0	A	0	100	0.0	A	0
Lake Street East SB LT	100	11.2	B	1	110	11.7	B	1	110	11.8	B	1
Weekday Evening:												
Farm Road EB TH	64	0.0	A	0	71	0.0	A	0	73	0.0	A	0
Farm Road WB TH/RT	202	0.0	A	0	224	0.0	A	0	227	0.0	A	0
Lake Street East SB LT	58	10.5	B	1	65	10.8	B	1	65	10.9	B	1

See notes at end of Table

Table 8 (continued)
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Unsignalized Intersection/ Peak-Hour/Movement	2022 Existing				2029 No-Build				2029 Build			
	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Farm Road at the Project Site Driveway												
Weekday Morning:												
Farm Road EB LT/TH	--	--	--	--	--	--	--	--	306	0.0	A	0
Farm Road WB TH/RT	--	--	--	--	--	--	--	--	44	0.0	A	0
Project Site Driveway SB LT/RT	--	--	--	--	--	--	--	--	15	9.8	A	0
Weekday Evening:												
Farm Road EB LT/TH	--	--	--	--	--	--	--	--	92	0.7	A	0
Farm Road WB TH/RT	--	--	--	--	--	--	--	--	194	0.0	A	0
Project Site Driveway SB LT/RT	--	--	--	--	--	--	--	--	9	9.8	A	0

[a]Demand in vehicles per hour.
[b]Average control delay per vehicle (in seconds).
[c]Level of service.
[d]Queue length in vehicles.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

SIGHT DISTANCE EVALUATION

Sight distance measurements were performed at the Project site driveway intersection with Farm Road in accordance with MassDOT and American Association of State Highway and Transportation Officials (AASHTO)[8] requirements. Both stopping sight distance (SSD) and intersection sight distance (ISD) 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. ISD or corner sight distance (CSD) is the sight distance required by a driver entering or crossing an intersecting roadway to perceive an on-coming vehicle and safely complete a turning or crossing maneuver with on-coming traffic. In accordance with AASHTO standards, if the measured ISD is at least equal to the required SSD value for the appropriate design speed, the intersection can operate in a safe manner. Table 9 presents the measured SSD and ISD at the subject intersection.

[8] *A Policy on Geometric Design of Highway and Streets,* 7th Edition; American Association of State Highway and Transportation Officials (AASHTO); Washington D.C.; 2018.

Table 9
SIGHT DISTANCE MEASUREMENTS[a]

Intersection/Sight Distance Measurement	Feet		
	Required Minimum (SSD)	Desirable (ISD)[b]	Measured
Farm Road at the Project Site Driveway			
Stopping Sight Distance:			
Farm Road approaching from the east	250	--	500+
Farm Road approaching from the west	250	--	500+
Intersection Sight Distance:			
Looking to the east from the Project Site Driveway	250	335	500+
Looking to the west from the Project Site Driveway	250	390	79/350[c]

[a]Recommended minimum values obtained from *A Policy on Geometric Design of Highways and Streets,* 7th Edition; American Association of State Highway and Transportation Officials (AASHTO); 2018; and based on an approach speed of 35 mph along Farm Road.

[b]Values shown are the intersection sight distance for a vehicle turning right or left exiting a roadway under STOP control such that motorists approaching the intersection on the major street should not need to adjust their travel speed to less than 70 percent of their initial approach speed.

[c]Available sight distance with the selective trimming/removal of trees and vegetation located within the sight triangle area of the Project site driveway.

As can be seen in Table 9, with the selective trimming/removal of trees and vegetation located within the sight triangle area of the Project site driveway along the north side of Farm Road and west of the driveway, the available lines of sight at the Project site driveway intersection will exceed the recommended minimum sight distance to function in a safe (SSD) manner based on a 35 mph approach speed, which is consistent the 85th percentile vehicle travel speeds measured along Farm Road (31/34 mph) and is 5 mph above with the posted speed limit in the vicinity of the Project site (30 mph).

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

VAI has conducted a TIA in order to determine the potential impacts on the transportation infrastructure associated with the proposed construction of a residential development to be located at 55 and 65 Farm Road in Sherborn, Massachusetts. The following specific areas have been evaluated as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; under existing and future conditions, both with and without the Project. Based on this assessment, we have concluded the following with respect to the Project:

1. Using trip-generation statistics published by the Institute of Transportation Engineers (ITE),[9] the Project is expected to generate approximately 264 vehicle trips on an average weekday (two-way, 24-hour volume), with 18 vehicle trips expected during the weekday morning peak-hour and 24 vehicle trips expected during the weekday evening peak-hour;

2. The Project will not result in a significant impact (increase) on motorist delays or vehicle queuing over anticipated future conditions without the Project (No-Build condition), with the majority of the movements at the study area intersections shown to operate at LOS C or better, where an LOS of "D" or better is generally defined as "acceptable" operating conditions;

3. All movements at the Project site driveway intersection with Farm Road were shown to operate at LOS A during the peak hours with negligible vehicle queuing predicted;

4. No apparent safety deficiencies were noted with respect to the motor vehicle crash history at the study intersection; and

5. Lines of sight at the Project site driveway exceed, or could be made to exceed, the recommended minimum sight distance to function in a safe manner based on the appropriate approach speed.

In consideration of the above, we have concluded that the Project can be accommodated within the confines of the existing transportation infrastructure in a safe and efficient manner with implementation of the recommendations that follow.

[9] Ibid 1.

RECOMMENDATIONS

A detailed transportation improvement program has been developed that is designed to provide safe and efficient access to the Project site and address any deficiencies identified at off-site locations evaluated in conjunction with this study. The following improvements have been recommended as a part of this evaluation and, where applicable, will be completed in conjunction with the Project subject to receipt of all necessary rights, permits, and approvals.

Project Access

Access to the Project site will be provided by way of a full-access driveway that will intersect the north side of Farm Road approximately 95 feet to the east of the existing gravel driveway that serves the Project site. The following recommendations are offered with respect to the design and operation of the Project site access and internal circulation:

- The Project site driveway and internal drives should be a minimum of 22 feet to the extent that parking along one or both sides of the drive will be prohibited and 24 feet otherwise, and designated to accommodate the turning and maneuvering requirements of the largest anticipated responding emergency vehicle.

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

- 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* (MUTCD).[10]

- A sidewalk should be provided along at least one side of the main driveway that should extend to Farm Road, where a school bus waiting area (widened sidewalk) should be provided.

- Driveways to the residential units should be a minimum of 21 feet long measured between the garage door and the far edge of the sidewalk (edge closest to the residence) where a sidewalk is provided, and 23 feet measured between the garage door and the edge of the traveled-way in locations without a sidewalk.

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

- Existing trees and vegetation located along the north side of Farm Road within the sight triangle area of the Project site driveway should be selectively trimmed or removed and maintained to provide the required line of sight.

- Snow accumulations (windrows) within the sight triangle areas of the Project site driveway will be promptly removed where such accumulations would impede sight lines.

[10]Ibid 2.

Off-Site

Route 27/Farm Road

The addition of Project-related traffic to the Route 27/Farm Road intersection was not shown to result in a change in level-of-service for any movement over No-Build conditions, with Project-related impacts defined as an increase in average motorist delay of up to 3.9 seconds that resulted in a corresponding increase in vehicle queuing of up to one (1) vehicle. That being said and independent of the Project, it was noted that the Farm Road approach is predicted to operate at capacity (defined as LOS "E"). Given the limited impact of the Project at this intersection with no evidence of a specific safety deficiency based on a review of the MassDOT motor vehicle crash data, no improvements are recommended or appear to be required at this intersection to accommodate the Project

Transportation Demand Management

In an effort to encourage the use of alternative modes of transportation to single-occupant vehicles (SOVs), the following Transportation Demand Management (TDM) measures will be implemented as part of the Project:

- A transportation coordinator will be assigned for the Project to coordinate the TDM program;
- Information regarding public transportation services, maps, schedules, and fare information will be posted in a central location and/or otherwise made available to residents;
- A "welcome packet" will be provided to new residents detailing available public transportation services, bicycle and walking alternatives, and commuter options available;
- Pedestrian accommodations have been incorporated within the Project site and include a sidewalk that extends to Farm Road;
- A central maildrop should be provided; and
- Secure bicycle parking will be available to residents within the individual garages that are associated with each unit.

With implementation of the aforementioned recommendations, safe and efficient access will continue to be provided to the Project site and the Project can be accommodated within the confines of the existing and improved transportation system.

APPENDIX

PROJECT SITE PLAN
AUTOMATIC TRAFFIC RECORDER COUNT DATA
TURNING MOVEMENT COUNT DATA
SEASONAL ADJUSTMENT DATA
COVID-19 ADJUSTMENT DATA
PUBLIC TRANSPORTATION SCHEDULES
VEHICLE TRAVEL SPEED DATA
MASSDOT CRASH RATE WORKSHEETS AND HIGH CRASH LOCATION MAP
GENERAL BACKGROUND TRAFFIC GROWTH
TRIP-GENERATION CALCULATIONS
TRIP DISTRIBUTION
CAPACITY ANALYSIS WORKSHEETS